KNOWLEDGE

AN ILLUSTRATED MAGAZINE OF SCIENCE

PLAINLY WORDED - EXACTLY DESCRIBED

CONDUCTED BY RICHARD A. PROCTOR.

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

VOLUME V.

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LONDON: FRIDAY, JULY 4, 1884.

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THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

XXXVII.—COUNT RUMFORD AND THE BAVARIAN BEGGARS.

I MUST not leave the subject of vegetable cookery without describing Count Rumford's achievements in feeding the paupers, rogues, and vagabonds of Munich. An account of this is the more desirable from the fact that the "soup" which formed the basis of his dietary is still misunderstood in this country, for reasons that I shall presently state.

After reorganising the Bavarian army, not only as regards military discipline, but in the feeding, clothing, education, and useful employment of the men, in order to make them good citizens as well as good soldiers, he attacked a still more difficult problem—that of removing from Bavaria the scandal and burden of the hordes of beggars and thieves which had become intolerable. He tells us that "the number of itinerant beggars of both sexes, and all ages, as well foreigners as natives, who strolled about the country in all directions, levying contributions from the industrious inhabitants, stealing and robbing, and leading a life of indolence and most shameless debauchery, was quite incredible," and, further, that "these detestable vermin swarmed everywhere, and not only their impudence and clamorous importunity were without any bounds, but they had recourse to the most diabolical acts, and most horrid crimes, in the prosecution of their infamous trade. Young children were stolen from their parents by these wretches, and their eyes put out, or their tender limbs broken and distorted, in order, by exposing them thus maimed, to excite the pity and commiseration of the public." He gives further particulars of their trading upon the misery of their own children, and their organisation to obtain alms by systematic intimidation. Previous attempts to cure the evil had failed, and the public had lost all faith in further projects, and therefore no support was to be expected for Rumford's scheme. "Aware of this," he says, "I took my measures accordingly. To convince the public that the scheme was feasible, I determined first, by a great exertion, to carry it into complete execution, and *then* to ask them to support it."

He describes the military organisation by which he distributed the army throughout the country districts to capture all the strolling provincial beggars, and how, on Jan. 1, 1790, he bagged all the beggars of Munich in less than an hour by means of a well-organised civil and military *battue*, the New Year's Day being the great festival when all the beggars went abroad to enforce their customary black-mail upon the industrious section of the population. Though very interesting, I must not enter upon these details, but cannot help stepping a little aside from my proper subject to quote his weighty words on the ethical principles upon which he proceeded. He says that "with persons of this description, it is easy to be conceived that precepts, admonitions, and punishments would be of little avail. But where precepts fail, *habits* may sometimes be successful. To make vicious and abandoned people happy, it has generally been supposed necessary, *first*, to make them virtuous. But why not reverse this order? Why not make them first *happy* and then virtuous? If happiness and virtue be *inseparable*, the end will as certainly be attained by one method as by the other; and it is most undoubtedly much easier to contribute to the happiness and comfort of persons in a state of poverty and misery than, by admonitions and punishments, to improve their morals."

He applied these principles to his miserable material with complete success, and referring to the result exclaims, "Would to God that my success might encourage others to follow my example!" Further examination of his proceedings shows that in order to follow such example, a knowledge of first principles and a determination to carry them out in bold defiance of vulgar ignorance, general prejudice, and polite sneering, is necessary.

Having captured the beggars thus cleverly, he proceeded to carry out the above stated principle, by taking them to a large building already prepared, and where "everything was done that could be devised to make them *really comfortable*." The first condition of such comfort, he maintains, is cleanliness, and his dissertation on this, though written so long ago, might be inscribed in letters of gold over the portals of our Health Exhibition of to-day.

Describing how he carried out his principles, he says of the prisoners thus captured:—"Most of them had been used to living in the most miserable hovels, in the midst of vermin and every kind of filthiness, or to sleep in the streets, and under the hedges, half naked and exposed to all the inclemencies of the seasons. A large and commodious building, fitted up in the neatest and most comfortable manner, was now provided for their reception. In this agreeable retreat they found spacious and elegant apartments, kept with the most scrupulous neatness; well warmed in winter, and well lighted; a good, warm dinner every day, *gratis*, cooked and served up with all possible attention to order and cleanliness; materials and utensils for those that were able to work; masters *gratis* for those who required instruction; the most generous pay, *in money*, for all the labour performed; and the kindest usage from every person, from the highest to the lowest, belonging to the establishment. Here in this asylum for the indigent and unfortunate no ill-usage, no harsh language is permitted. During five years that the establishment has existed, not a blow has been given to any one, not even to a child by his instructor."

This appears like the very expensive scheme of a benevolent utopian; but, to set my readers at rest on this point, I will anticipate a little by stating that, although at first some expense was incurred, all this was finally repaid, and, at the end of six years, there remained a nett profit of 100,000 florins "after expenses of every kind, salaries, wages, repairs, &c., had been deducted."

I must not dwell upon his devices for gradually inveigling the lazy creatures into habits of industry, for he understood human nature too well to adopt the gaoler's theory, which assumes that every able-bodied man can do a day's work daily, in spite of previous habits. Rumford's patients became industrious ultimately, but were not made so at once.

This development of industry was one of the elements of financial and moral success, and the next in importance was the economy of the commissariat, which depended on Rumford's skilful cookery of the cheapest viands, rendering them digestible, nutritious, and palatable. Had he adopted the dietary of an English workhouse or an English prison, his financial success would have been impossible, and his patients would have been no better fed, nor better able to work.

The staple food was what he calls a "soup," but I find, on following out his instructions for making it, that I obtain a porridge rather than a soup. He made many experiments, and says: "I constantly found that the richness or quality of a soup depended more upon a proper choice of the ingredients, and a proper management of the fire in the combination of these ingredients, than upon the quantity of solid nutritious matter employed;—much more upon the art and skill of the cook than upon the sum laid out in the market."

Our vegetarian friends will be interested in learning that at first he used meat in the soup provided for the beggars, but gradually omitted it, and the change was unnoticed by those who ate, and no difference was observable as regards its nutritive value.

In 1790 little, or rather nothing, was known of the chemistry of food. Oxygen had been discovered only sixteen years before, and chemical analysis, as now understood, was an unknown art. In spite of this, Rumford selected as the basis of his soup just that proximate element which we now know to contain, bulk for bulk, more nutritive matter than any other that exists either in the animal or vegetable kingdom, viz., *casein*. He not only selected this, but he combined it with those other constituents of food which our highest refinements of modern practical, chemistry, and physiology have proved to be exactly what are required to supplement the casein and constitute a complete dietary. By selecting the cheapest form of casein and the cheapest sources of the other constituents, he succeeded in supplying the beggars with good hot dinners daily at the cost of one halfpenny each. The cost of the mess for the Bavarian soldiers under his command was rather more, viz., twopence daily, three farthings of this being devoted to pure luxuries, such as beer, &c. The details of the means by which he achieved these notable results will be stated in my next.

Apropos of the great enthusiasm at present existing on the subject of photography, and the number of distinguished amateurs who practise the art, it may interest our readers to know that among them may be included H.R.H. Duc de Chartres, who has just favoured Messrs. Watson & Sons, of 313, High Holborn, with an order for complete outfits to take pictures up to 18 by 16 inches.

The members of the Harleian Society have received during the week the "Visitation of London, 1633–4," Vol. II., edited by Dr. J. J. Howard. The "Registers of St. Antholin, Budge Row," had previously been issued to subscribers by Messrs. Mitchell & Hughes. The "Visitation of Gloucestershire in 1623," edited by Sir John Maclean and W. C. Heane, Esq., will also be ready for members this year; likewise Vol. I. of the "Registers of St. James, Clerkenwell," edited by Robert Hovenden, Esq.

NOTES ON FLYING AND FLYING-MACHINES.

By Richard A. Proctor.

(*Continued from page 472.*)

We come next to a much more important point, namely, extent of supporting surface. We are to consider the air now, not with regard to its density, the quality which enables a balloon, filled with rarer gas, to float in air, but with reference to its power of resisting downward motion through it; that is, of resisting the effects of gravity. We have to inquire what extent of surface, spread either in the form of wings or as in parachutes, will suffice to support a man or a flying-machine. It is here that the researches recently made seem to bear most significantly upon the question of the possibility of flight.

The history of the parachute affords some insight into the supporting power of the air—some, but not much. The parachute has been commonly suffered to fall from beneath the car of a balloon. Suspended thus, in the lee, so to speak, of the balloon's mass, and with its supporting surface unexpanded, the parachute descends under highly unfavourable conditions. A great velocity of descent is acquired before the parachute is fully expanded, and thus the parachute has to resist a greater down-drawing force than would be the case if the machine were open, and surrounded on all sides by free air, at starting. The consequence is a great and sudden strain upon all parts of the parachute, as well as a degree of oscillation which seriously risks its structure, besides impairing its supporting power—since this power would obviously act most effectively if the span of the parachute remained horizontal throughout the descent. The following account of Garnerin's descent, in 1797, illustrates the foregoing remarks:—"In 1797," says Mr. Manley Hopkins, "Garnerin constructed a parachute, by which he descended from a balloon, at an elevation of 2,000 feet. The descent was perilous, for the parachute failed, for a time, to expand; and after it had opened, and the immediate fears of the immense concourse which had assembled in Paris to witness the attempt had been removed, the oscillations of the car, in which Garnerin was seated, were so violent as to threaten either to throw him out, or, on arriving at the ground, to dash him out with violence. He escaped, however!" We notice the same circumstances in the narrative of poor Cocking's disastrous attempt in 1837. "When the cords which sustained the parachute were cut, it descended with dangerous rapidity, oscillating fearfully, and at last the car broke away from the parachute, and Mr. Cocking was precipitated to the ground, from a height of about one hundred feet."

But apart from these considerations, the parachute affords no evidence whatever of the increased sustaining power of the air on bodies which traverse it rapidly in a more or less horizontal direction. The parachute descends, and descends quickly: we have to inquire whether the air may not resist descent so strongly that with comparatively small effort a horizontal or even ascending motion may be effected.

A familiar illustration of this supporting power of the atmosphere is given in the flight of an oyster-shell or piece of thin slate, deftly thrown from a schoolboy's practised hand. Such a missile, instead of following the parabolic path traversed by an ordinary projectile, is seen to skim along almost like a bird on resting pinions. It will sometimes even ascend (after the projectile force has ceased to act in raising it), as though in utter disobedience to the laws of gravitation.

The fact appears to be that when a horizontal plane traverses the air in a horizontal direction, the supporting power of the air is increased in proportion as the plane moves more quickly, or in proportion to the actual quantity of air it glides over, so to speak. Indeed, we have clear evidence to this effect in the behaviour of the common toy-kite, the supporting power of which is increased in proportion to the force of the wind. For a kite held by a string in a strong horizontal current of air, corresponds exactly to an inclined plane surface drawn swiftly in a horizontal direction during a calm. The same supporting power which results from the rapid passage of the air under the kite will be obtained during the rapid passage of the kite over still air.

When we study the flight of birds we are confirmed in the opinion that velocity of horizontal motion is a point of extreme importance as respects the power of flying. For though there are some birds which seem to rise almost straight from the ground, yet nearly all, and especially the larger and heavier birds, have to acquire a considerable horizontal velocity before they can take long flights. Even many of those birds which seem, when taking flight, to trust rather to the upward and downward motion of their wings than to swift horizontal motion, will be found, when carefully observed, to move their wings up and down in such sort as to secure a rapid forward motion. I have been much struck by the singularly rapid forward motion which pigeons acquire by what appears like a simple beating of their wings. A pigeon which is about to fly from level ground may be seen to beat its wings quickly and with great power; and yet instead of rising with each downward stroke, the bird is seen to move quite horizontally,—as though the wings acted like screw-propellers. I believe, in fact, that the wings during this action do really act, both in the upward and downward motion, in a manner resembling either screw-propulsion or the action by which seamen urge a boat forward by means of a single oar over the stern.* The action of a fish's tail is not dissimilar; and as the fish, by what seems like a simple beating of its tail from side to side, is able to dart swiftly forwards, so the bird, by what seems like a beating of its wings up and down, is able—when occasion requires—to acquire a swift forward motion. At the same time it must be understood that I am not questioning the undoubted fact that the downward beat of a bird's wing is also capable of giving an upward motion to the bird's body. The point to be specially noticed is that when a bird is taking flight from level ground, the wings are so used that the downward stroke gives no perceptible upward motion.

But since a horizontal velocity is thus effective, we might be led to infer that the larger flying creatures, which, *cæteris paribus*, travel more swiftly through the air than the smaller, would require a smaller relative extent of supporting surface. We are thus led to the consideration of that point which has always been regarded as the great, or rather the insuperable difficulty, in the way of man's attempts at flight,—his capacity or incapacity to carry the requisite extent of supporting surface. We are led to inquire whether a smaller extent of supporting surface than has hitherto been deemed necessary may not suffice in the case of a man, and *à fortiori* in the case of a large and powerful flying-machine.

The inference to which we have thus been led, is found to accord perfectly with the observations which have been made upon flying creatures of different dimensions. It has been found that the supporting surface of these creatures,—whether insects, birds, or bats,—by no means varies in proportion to their weight. This is one of the most important results to which the recent inquiries into the problem of flight have led; and I believe that my readers cannot fail to be interested by an account of the relations which have been observed to hold between the weight and the supporting surface of different winged creatures.

We owe to M. de Lucy, of Paris, the results of the first actual experiments carried out in this direction. The following account of his observations (made in the years 1868, 1869) is taken from a paper by Mr. Brearey, the Honorary Secretary to the Aëronautical Society. "M. de Lucy asserts," says Mr. Brearey, "that there is an unchangeable law, to which he has never found any exception, amongst the considerable number of birds and insects whose weights and measurements he has taken, viz., that the smaller and lighter the winged animal is, the greater is the comparative extent of supporting surface. Thus in comparing insects with one another—the gnat, which weighs 460 times less than the stag-beetle, has fourteen times greater relative surface. The ladybird, which weighs 150 times less than the stag-beetle, possesses five times more relative surface, &c. It is the same with birds. The sparrow, which weighs about ten times less than the pigeon, has twice as much relative surface. The pigeon, which weighs about eight times less than the stork, has twice as much relative surface. The sparrow, which weighs 339 times less than the Australian crane, possesses seven times more relative surface, &c. If we now compare the insects and the birds, the gradation will become even more striking. The gnat, for example, which weighs 97,000 times less than the pigeon, has forty times more relative surface; it weighs 3,000,000 times less than the crane of Australia, and possesses relatively 140 times more surface than this latter, which is the heaviest bird M. de Lucy had weighed, and was that also which had the smallest amount of surface, the weight being nearly 21 lb.; and the supporting surface 139 inches per kilogramme (2 lb. $3\frac{1}{4}$ oz). Yet of all travelling birds the Australian cranes undertake the longest and most remote journeys, and, with the exception of the eagles, elevate themselves the highest, and maintain flight the longest."

M. de Lucy does not seem to have noticed the law to which these numbers point. It is exceedingly simple, and amounts in fact merely to this, that instead of the wing-surface of a flying creature being proportioned to the weight, it should be proportioned to the surface of the body (or technically, that instead of being proportioned to the cube, it should be proportioned to the square of the linear dimensions). Thus, suppose that of two flying creatures one is 7 times as tall as the other, the proportions of their bodies being similar, then the body surface of the larger will be 49 times (or 7 times 7) that of the other, and the weight 343 times (or 7 times 7 times 7) that of the other. But instead of the extent of wing-surface being 343 times as great, it is but 49 times as great. In other words, relatively to its weight the smaller will have a wing-surface 7 times greater than that of the larger. How closely this agrees with what is observed in nature, will be seen, by the case of the sparrow as compared with the Australian crane; for M. de Lucy's experiments show that the sparrow weighs 339 times less than the Australian crane, but has a relative wing-surface 7 times greater.

It follows, in fact, from M. de Lucy's experiments, that, as we see in nature, birds of similar shape should have wings similarly proportioned, and not wings corresponding to the

* Sailors call this *sculling*, a term more commonly applied to the propulsion of a boat by a single oarsman using a pair of oars, or sculls.

relative weight of the birds. The same remark applies to insects; and we see, in fact, that the bee, the bluebottle, and the common fly—insects not unlike in their proportions—have wings proportioned to their surface dimensions; the same holding amongst long-bodied insects, like the gnat and the dragon-fly, and the same also among the different orders of flying beetles.

So that, setting apart differences of muscular capacity and adaptation, a man, in order to fly, would need wings bearing the same proportions to his body as we observe in the wings of the sparrow or the pigeon. In fact, the wings commonly assigned to angels by sculptors and painters would not be so disproportioned to the requirements of flight as has been commonly supposed, if only the muscular power of the human frame were well adapted to act upon wings so placed and shaped, and there were no actual inferiority in the power of human muscles (cross-section for cross-section) as compared with those of birds.

So far as the practicability of actual flight on man's part is concerned, these two points are, indeed, among the most important we have to consider. It was to Borelli's remarks on these points, in his famous treatise, *De motu Animatium*, that the opinion so long entertained respecting the impracticability of flight must be referred. He compared the relative dimensions of the breast muscles of birds with those of the corresponding muscles in man, and thence argued that man's frame is altogether unadapted to the use of wings. He compared also the relative muscular energy of birds and men, that is, the power of muscles of equal size in the bird and the man; and yet was further confirmed in the opinion that man can never be a flying animal.

(To be continued.)

ELECTRO-PLATING.

VII.

By W. SLINGO.

THE copy, on being released from the mould, is generally more or less brittle. It is, therefore, made red-hot in a clear fire or by means of a blow-pipe. When cool it is placed in a weak sulphuric acid solution to remove any scale or superficial impurities which may be present. After a few minutes' exposure it is removed into a vessel containing clean water, and subsequently taken out and dried. Any superfluous metal that still remains is now chipped off and the copy cut to form. The surface next requires polishing, which is accomplished with rotten-stone and oil, applied with a stiff brush. The particles of metal, &c., adhering to the copy are washed off with soap and boiling water, and the surface again polished, using this time moistened rouge and a soft brush. The finger, at this stage, becomes a very useful tool for brightening the smoother portions of the surface. When the copy is required to possess considerable substance, that is to say, when it is to be able to withstand rough or hard usage, as in the case of electrotypes of wood engravings, &c., a backing of foreign and more easily fusible metal is and must be provided. It would be false economy, and, indeed, almost a practical impossibility, to take copies sufficiently stout to answer such purposes as above indicated. The process of "backing" should present no serious difficulties to the amateur. The copy should be laid face downwards and the back or inner surface moistened with killed spirits of salts, that is to say, hydrochloric acid which has been neutralised or killed by dropping in it small pieces of zinc. A small piece of pewter solder is then placed on the back of the copy and made to cover that surface. This is easily accomplished with a soldering iron or (holding the copy in the jaws of a pair of pliers, so as to be able to move it about) a blowpipe flame.* For want of better means, a good flame may be obtained from a gas-jet, and sometimes from a spirit-lamp, with the aid of a piece of non-combustible tubing, such as the stem of a clay tobacco-pipe. Care must be taken that the surface of the copper is fairly coated with solder. This is ensured by an efficient application of the chloride of zinc solution. The coating of solder being obtained, lead is next poured in till the required thickness is obtained. The lead combines or adheres to the solder readily, but would not so adhere to the bare copper, hence the necessity for using the solder. Apart from the scientific or experimental interest pertaining to the various operations described, there are a vast number of practical applications fraught with the greatest importance. Not the least of these is the adaptation of the electrotyping process to printing on a large scale. Where a large number of impressions are required, more particularly of diagrams, pictorial illustrations, newspaper headings, &c., the process is almost invariably resorted to. The *Illustrated London News* and such-like papers not only treat their illustrations in this way, but apply the process to their type as well. The process is a simple one. A ball of gutta-percha is place on the centre of the type and worked outwards gradually so as to exclude every possible particle of air, and obtain a perfect negative copy of the type. A weight is placed on the percha, and left there until the latter has cooled down When cool, the percha is well coated with plumbago, and immersed in the electrolytic bath for a few hours, when, a sufficiently thick deposit having been obtained, it is taken from the bath, the percha separated from the copper, and a substantial backing supplied. The backing being made level, it is screwed on to a wooden block, of a thickness sufficient to raise the electrotype to the same level or thickness as ordinary lead type. The advantage of such a process is evident. More especially is this so in the case of an engraving, which would manifestly suffer very considerably were it used extensively. The durability of a wood engraving is not extraordinarily great, and once damaged the cost of replacing it is almost, if not quite, as great as the original cost; whereas, by the adoption of the electrotyping process, additional equally good copies may be procured at only a trifling expense. The advantages offered by the process for the preservation of valuable and artistic engravings are too apparent to be further discussed. Some papers, it may be furthermore remarked, are very hard and unyielding, and in consequence they considerably injure the type or block, speedily rendering the impressions blurred and more or less trying to decipher. It is recorded that as many as 20,000,000 impressions have been taken from a single mould. Some typers use plaster of Paris instead of gutta-percha; but although it is cheaper and sets more rapidly, it does not yield so perfect a copy, there being a want of clearness. There is, however, one great drawback to the adoption of the electrotyping process for books, viz., that in second or subsequent editions, errors, small, it may be, in the amount of type involved, but great in importance, cannot be rectified without sacrificing a page or so of the electrotype. On the other hand, there is

* A soldering-iron in the hands of the amateur is often a dangerous weapon. He is apt to use it too heavily, and there is a possibility of his pushing it through the electrotype. A spirit flame is, therefore, safer and equally effectual.

to be considered the fact that were it not for the comparatively small expense involved in taking and warehousing electrotypes, many valuable but little saleable works could not bear the cost of a second edition.

The amateur who aspires to produce good work eventually is advised to be particular in every detail, and not to rest satisfied until every mould immersed in the bath is efficiently copied. In experimenting in electro metallurgy there is nothing to be apprehended of an unduly difficult or impracticable nature. Cleanliness is essential. Having satisfied himself with his proficiency in copying coins and such-like simple surfaces, the experimentalist may next proceed to more elaborate and more intricate work. To obtain a silvered or gilded copy of the skeleton of a leaf should not be too great a task for him ultimately, and what kind of work is there that is prettier or more interesting?

Supposing that, with the aid of the elastic mould, copies have been obtained of medals, &c., more or less undercut, let us next direct our attention to plaster casts and other similar works of art. Small and simple busts, &c., should be attempted first. An interesting experiment is to coat a small bust with copper. This is easily effected by first saturating the plaster with bee's-wax or linseed oil—the former by preference—and then applying a good coating of plumbago. Some unimportant portion of the bust has then attached to it the wire connected with the zinc pole of the battery. It is not difficult to imagine that any mould which is in deep relief, or considerably undercut, will, under ordinary circumstances, receive a very uneven deposit, that portion which lies in the immediate neighbourhood of the connecting wire receiving the lion's share. To obviate this, a few short pieces of fine wire are firmly attached to the wire from the zinc pole of the battery, and their free ends placed in the hollow and more remote parts of the mould. By this means a more equable deposit is ensured. In the present experiment of copper-plating a bust, only a very thin deposit may be permitted, otherwise there will be a considerable want of definition, the finer lines, which are essential to the character of any work of art, being lost. I have had comparatively thick deposits in which the design is somewhat faithfully depicted on both sides of the copy, but such a result can only be looked for after considerable practice. As a rule, the thinner the film, the truer will be the design.

COMET FAMILIES OF THE GIANT PLANETS.

By Richard A. Proctor.

There is a family of comets every member of which travels in an orbit passing near the orbit of Jupiter; another family every member of which can be similarly associated with Saturn; others depending in the same way on Uranus; others on Neptune: and in fact, so fully has this sort of relation been recognised, that the idea has even been thrown out that a planet travelling outside the orbit of Neptune but as yet unknown might be detected by the movements of a comet intersecting the great plane of planetary movement far beyond Neptune's orbit. It may be mentioned, indeed, in passing, that the comet of 1862, which has been associated with the meteors of Aug. 10 and 11, intersects the plane of planetary movements at a place about as far beyond the orbit of Neptune as that orbit is beyond that of Uranus, and that it has been held probable that at that distance an as yet undiscovered giant planet may travel.

This remarkable relation among the orbits of the comets which travel periodically around the sun has been interpreted by supposing that all such comets were drawn in from outer space by the sun's attraction, and prevented from returning to outer space by the disturbing influence of one or other of the giant planets. If we suppose a comet, drawn sunwards past the orbit of Jupiter, to be so perturbed by the action of that planet as to lose a considerable portion of its velocity, then that comet would travel thereafter on an orbit passing close to the point on Jupiter's orbit where it had been thus perturbed in such sort as to become an attendant on the sun. But in the first place the explanation requires that the original orbit of the comet should have passed near to the orbit of Jupiter, and a little consideration will show that there should be millions of comets for each thus travelling,—a numerical relation not found to exist among the cometic systems. And secondly, while the explanation would be valid enough were a comet a solid globe or very small, it fails utterly when we recognise that a comet is a flight of bodies occupying a very large extent of space. It can be shown that supposing a comet's head to be but 10,000 miles in diameter, and formed of discrete meteoric masses, then if the comet came near enough to Jupiter for its centre to be disturbed in the way the theory requires, those meteoric masses nearest to Jupiter would be so much more disturbed as to be sent on very different orbits, while the new orbits of those masses farthest from Jupiter would be so much less disturbed that their orbits would also be entirely different. The theory that such comets have been introduced from without fails utterly in the presence of observed facts, and would never indeed have obtained acceptance for an instant but for the carelessness with which such theories are too often dealt with, being presented as abstract ideas instead of being tested in measure and quantity.

The existence of the comet families of the giant planets can scarcely be explained without assuming, what we have already in another way been led to recognise,—the ejection from the giant planets of masses of matter in eruptions akin to those which take place in the sun. Whether such eruptions take place now in the giant planets or not would be difficult to prove, for although we have evidence of tremendous disturbances, we have nothing to show conclusively that these would suffice to eject matter for ever from within these planets' globes. Whether a careful study of the region outside the discs of Jupiter and Saturn would reveal aught throwing light on this matter, I am not prepared to say; but I am certain the edges of the discs of the giant planets are worth much more careful study than they have yet received. Undoubtedly many of the comets of Jupiter's family must have been added to the solar cometic system hundreds of thousands, if not millions, of years ago. But quite possibly both Jupiter and Saturn still eject matter from time to time with such velocities from their interior that it passes away never to return to them. In this as in many other features Jupiter and Saturn resemble the sun. They may be regarded as telling us in some degree what was the past of our own earth, when she was full of the fiery vigour of planetary youth. But they tell us more clearly what will be the future of our sun when the glowing vapourising masses now surrounding him have lost their intense lustre, and ceasing to possess his present life-giving qualities he is approaching the condition of dark suns which exist already in immense numbers within our stellar system.

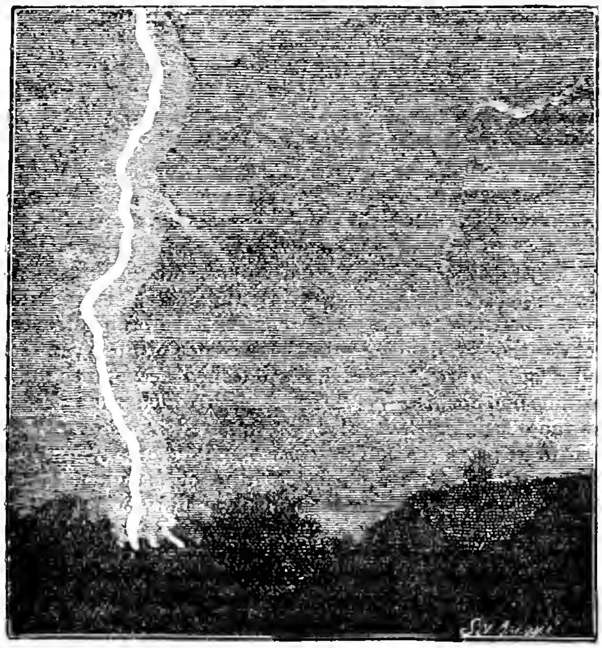
Erratum.—In the third line from the bottom of the paragraph on Legacy Law Reform, on p. 479 of Vol. V., "insure" should be "immune."

PHOTOGRAPHING A FLASH OF LIGHTNING.

THE accompanying engraving was made directly from a photograph sent to us by Mr. W. C. Gurley, of Marietta Observatory, who writes as follows:—

"The reproduction of a flash of lightning by photography would, a few years since, have been deemed quite an impossibility, but the introduction of the rapid bromo-gelatine process has rendered it not only possible but comparatively easy of accomplishment.

"The accompanying photograph is from a negative taken by myself during a thunderstorm which passed several miles south of the observatory on the evening of May 4.



"Wheatstone has demonstrated by direct experiment that the duration of a single flash of lightning cannot possibly exceed a millionth of a second. That a photograph showing the detail of the one mentioned could be taken in this inappreciably short time seems quite wonderful, not to say incredible. The plate employed was one of Cramer's extra rapid, and developed with strong pyrogallic developer.

"It will be observed that the flash is not of the usually depicted zigzag form, and that it seems to be alternately contracted and expanded in its passage through the atmosphere.

"Taking the interval between the flash and the report, I estimated its distance from the camera to have been about five miles."—*Scientific American.*

THE report on the composition and quality of daily samples of the water supplied to London, for the month ending May 31st, 1884, by William Crookes, F.R.S., William Odling, M.B., F.R.S., F.R.C.P., and C. Meymott Tidy, M.B., F.C.S., says:—"Of these 189 samples of water, the whole were, without exception, clear, bright, and well filtered. The quality of the water supplied to the metropolis during the past month, as indicated by its state of aëration, and high degree of freedom from colour and excess of organic matter, was excellent. Its perfect filtration was shown by the absence of even a trace of suspended matter in any one of the numerous samples submitted to examination."

THE ANTARCTIC REGIONS.

By Richard A. Proctor.

THERE are parts of our earth of which we know less than of the moon, or even of some of the planets. The eyes of the astronomer have looked upon the unattainable summits of the lunar mountains; he has studied the arid wastes which lie within the lunar craters; he has measured the light which these regions reflect—nay, even to the degree to which they are warmed under the blazing sun of the long lunar day. Passing beyond the moon, the astronomer has studied the lands and seas of a world which has justly been termed a miniature of our earth: he has watched the clouds which form over the continents and oceans of the planet Mars, and are dissipated even like our own by the solar rays; he has determined the very constituents of that planet's atmosphere. But more than this, the astronomer has actually studied the condition of parts of Mars, where (if analogy can be trusted) the very inhabitants of that world are unable to penetrate. The ruddy orb which during the spring months was now conspicuous in our skies presents to the astronomer its Arctic and Antarctic wastes. He is able to watch the gradual increase of either region as winter prevails alternately over the northern and southern hemisphere of Mars: he can measure their gradual reduction with the progress of the Martial summer; and he can infer from their aspect that even in the height of summer there still remain ice-covered regions so wide in their range as doubtless to defy the efforts of the Martialists to penetrate to the poles of the globe on which they live. So that where most probably no living creature on Mars has ever penetrated, the astronomer can direct his survey; and questions which no Martial geographer can pretend to answer the terrestrial astronomer can discuss with a considerable degree of confidence. It is the same even with the more distant planets Jupiter and Saturn. Despite the vast spaces which separate us from these orbs, we yet know much respecting their physical habitudes; and whereas our knowledge of our own earth is limited by certain barriers as yet unpassed, and probably impassable, there is no part of the surface of either of the giant planets which has not come under the astronomer's scrutiny.

These considerations suggest in turn the strange thought that possibly the unattained places of our earth have been viewed by beings which are not of this world. I say *possibly*, but I might almost say *probably*. It seems in no degree unreasonable to suppose not merely that the earth's sister-planet Venus is inhabited, but that some creatures on Venus possess the reasoning powers and the insight into the secrets of Nature which have enabled the inhabitants of Earth to study the orbs which circle like herself around the sun. If this be the case—if there are telescopists in Venus as skilful as those inhabiting our earth—they are able to answer questions which hitherto have baffled our geographers. They may not, indeed, have the means of ascertaining details respecting the structure of our continents and oceans. They cannot know, for instance, whether the region to which Livingstone has penetrated is, as he supposes, the head of the river we terrestrials call the Nile, or, as others suppose, is in reality the head of the Congo. For certainly no telescopic powers possessed by our astronomers could give us information on such points, if our position were interchanged with that of the inhabitants of Venus. But astronomers in Venus can, without excessive telescopic power, inform themselves whether our polar regions are like the corresponding regions in Mars—or whether, as many geographers suppose, the Arctic regions are occupied in summer by an open ocean, while in the Antarctic regions there is a large continent.

A new interest was given to inquiries respecting the condition of Arctic and Antarctic regions by the circumstance that the expedition of the *Challenger* is expected to bring us information respecting the latter regions, while application has been made for Government assistance towards an Arctic expedition. I propose to consider, now, some of the questions which are connected with Antarctic research, and in particular to discuss the probability of the existence of great continental lands within the Antarctic circle.

Before proceeding to consider these points, however, I have a few remarks to make on the question of Government aid to this branch of geographical research.

It should be remembered by those who discuss this subject that the first exploration of the polar regions of our earth had a commercial origin. It was supposed that by finding a passage round the northern shores of the American continent communication with China and the East Indies would be facilitated. A way had been found round Cape Horn, but the way was long, and the storms which rage in Antarctic seas rendered the route uninviting to the contemporaries of Magellan. The natural supposition in those days was, that voyagers from the great maritime northern countries—from England, from Spain and Portugal, or from the Netherlands—would find their advantage in sailing northwards rather than southwards. Hence the long and persistent efforts made to discover a north-western passage. Nor were the more directly Arctic voyages of Hudson and Richardson conducted with any other primary purpose. It is indeed manifest, as any one will perceive on examining a terrestrial globe, that a north-eastern course would avail nearly as well as a north-western for reaching eastern countries from Europe, and that a directly polar course would be better than either, if only (as Hudson hoped) a safe passage might be found through the Arctic seas.

Gradually, as the hope of finding a north-western passage available for commerce died out, other circumstances encouraged persistence in the efforts which had been made to penetrate the regions lying to the north of the American continent. There was much, indeed, in the desire to accomplish what had foiled so many; and it may be questioned whether this desire had not a good deal to do with the appeals which were made for Government assistance, as also with the ready response of Government to those appeals. Nevertheless, a real scientific interest had become associated with the search after a north-west passage. The magnetic pole of the earth was known to lie somewhere amid the dreary archipelago, with its ice-bound inlets and glacier-laden shores, through which our Arctic seamen had so long attempted to penetrate. There, also, lies one of the northern poles of cold; while the configuration of the isothermal lines (or lines of equal temperature) in the neighbourhood, shows how some influence is at work carrying relative warmth from the Atlantic towards the North Pole, and leaving the regions on the west of that course exposed to a degree of cold greatly more intense. To these considerations others connected with the whaling trade were added, though I am not prepared to say that (so far as the question of Government assistance was concerned) these considerations had very great weight.

It cannot be denied, however, that at a certain stage in the history of Arctic voyaging, the mere barren ambition to attain or approach the North Pole of the earth, was set in advance of more practical considerations. We find, for instance, that in the case of Parry's "boat and sledge" expedition from Spitzbergen polewards, certain sums of money were set as a reward for reaching such and such northern latitudes, the sum of ten thousand pounds being the prize for attaining the North Pole itself.

It would not be easy, perhaps, to assign any sufficient reason for the renewal, by a scientific expedition, of those arduous explorations in which Wilkes, d'Urville, and (especially) the younger Ross, discovered all that is known about the Antarctic ice-barrier. There was much, indeed, in the results obtained by Ross to invite curiosity on the one hand, and on the other to show that the Antarctic regions can be penetrated successfully in certain directions. It seems far from unlikely that other openings exist by which the southern pole may be approached, than that great bay, girt round by steep and lofty rocks, where Ross made his nearest approach to the southern magnetic pole. I shall presently indicate reasons for believing that the Antarctic as well as the Arctic regions are occupied by an archipelago — ice-bound, indeed, during the greater part of the year—but nevertheless not altogether impenetrable during the Antarctic summer. Yet there is little to encourage any attempts to explore this region otherwise than in ships specially constructed to encounter its dangers.

(To be continued.)

THE INTERNATIONAL HEALTH EXHIBITION.

VI.—WATER AND WATER SUPPLIES.

A PRELIMINARY inquiry into the nature of water would more become a treatise on chemistry than the present pages; yet, nevertheless, some definition must be given of this all-important matter to enable our readers to understand exactly what we have to deal with, and how intimately the subject is interwoven with all that concerns our healthy being.

Pure water, as such, does not come within the scope of our ordinary life; it only occupies a legitimate place in the laboratory of the experimental chemist, who defines it to be a combination of the elements hydrogen and oxygen in the proportions of two volumes of the former to one of the latter, or graphically, $H-O-H$. For further information on the physical properties of pure water, and of its elemental components, we must refer the reader to the numerous text-books on chemistry now in circulation. A popular lucid account of the subject may be derived from a perusal of the excellent little handbook entitled "Water and Water Supplies," by Professor Attfield, and published under the direction of the Executive Council by Messrs. Clowes & Sons, in the Exhibition buildings. Chemically, pure water, then, does not come within the field of our observations as inquirers into the usefulness of that medium. What, then, have we to deal with?

The water with which we are familiar may be defined as a compound of very variable character. Each sample would have to be analysed before we could pronounce with decision its distinctive attribute. In general, however, the term pure water may be taken to signify water which contains in solution and admixture various solids and gases, which, for domestic purposes, are not only harmless, but useful. It thus resolves itself into a question of relative utility; we say *relative*, because we speak of ourselves as human beings. Certain waters which are eminently suited to the propagation and nutrition of other living things, would be absolutely poisonous to *Homo sapiens*; indeed, such deleterious waters are often so constantly associated with certain forms of life, both animal and vegetable, that their presence is always sufficient to determine the character of the liquid as unsuitable to man. The question may here be raised that it is the ingestion of the living things which produces the evil effects, and that is very true to a large extent; but besides the growth and multiplication within our bodies of disease-producing germs, the waters which they inhabit are chemically contaminated; the fermentative action which they set up therein results in the elimination of non-living substances, which, apart from the organisms themselves, are highly poisonous. And we would here suggest that the first rapid, and in some cases almost instantaneous, phase in zymotic diseases may not be so much due to the growth and development of the germs themselves, as to the poisonous ferments which they create, and which are imbibed along with them.

As instances of what we would here imply, we may point to the fermentative action of the yeast-plant (*Saccharomyces cerevisia*)*, which produces alcohol, and which, even after death through the administration of ether,† gives rise to a non-living soluble ferment, which transforms cane into grape-sugar. The alcohol and the glucogenic ferment retain their properties after the yeast-plant itself has ceased to exist. The butyric acid remains as butyric acid after the bacterium (*Bacillum subtile*) has passed away. Foul gases and putrefactive fluids remain after the death of *Bacterium termo*; and may we not with reason expect to find that the greater part of the mischief which ends in splenic disease, pulmonary tubercles, and leprous deformations, is the immediate cause of the ferments produced by their respective bacteria (*Bacillum anthracis*, *B. tuberculosus*, and *B. lepræ*); and that our physicians in their ætiological studies might direct some of their experiments towards finding antidotes for these poisons? Cannot a specific be found to neutralise the ferment of *B. tuberculosus*, and be applied so as to result in the reduction of tubercle in this way? We trust that the time has arrived when experimental inquiry shall partially turn from the inoculation of guinea-pigs and the preparation of microscopical slides from the tissues of the poor innocent victims, to the chemical side of the question, where the disease germs only shall be sacrificed at the altar of Æsculapius.‡

We are not digressing; we are only trying to show by living examples how very much this aspect of the water question has been neglected. Pages of matter have been devoted by various authors to the consideration of the purifying processes of Nature, such as the open flows of water in rivers, aqueducts, down cataracts, and gullies, and its percolation through the soil, subsoil, and rock to wells of great depth, all the arguments for which are based upon the theory that, through oxidation of organic remains, the harmful azotised and carbonaceous matters are converted into useful nitrates and carbon dioxide, and the water thus fitted for domestic purposes. Now, all this is very true about dead forms of life, but what about the living? And, still more, what about the nascent living or germ condition?

All *Bacteria*, but more particularly the forms termed *Bacilli*, are excessively minute bodies, chiefly of rod-like* shapes in their adult condition; they are assigned to the group of *Schizomycetes* amongst the lower *Fungi*. *Micrococcus* is a rounded form, and averages about $\frac{1}{25000}$ in. in diameter, or only 1 μ.† *Bacterium termo*, the active agent in putrefaction, is about 1 μ in breadth by 1·5 μ in length. The majority of *Bacilli* are infinitesimal in size; in fact, in a specimen of the *Bacillum* of Oriental leprosy which recently came under our notice, it was difficult to detect any signs of the germs with a magnifying power of even 500 diameters; but with 1,000 diameters we were able to distinguish certain nests (stained methyl violet), in the substance of the fine connective tissue of the papillæ of the skin, which latter was tinged with Bismarck brown. On careful examination, these nests were seen to be composed of congeries of little rods, or *Bacilli*. So much, then, in proof of the minuteness of these disease-germs. The presence of oxygen and carbon dioxide given to the water can scarcely be held as destructive to such forms of life; they would rather tend to an opposite result. However that may be, bacteria are most tenacious of their existence; otherwise, how could they have survived the ill-treatment received at the hand of Dr. Bastian and other observers? According to Eidam‡ they are killed by a fourteen hours' exposure to a temperature of 40° C., or a three hours' exposure to 45° C. Their *germs* when *dry* can resist 110° C., but succumb when 120° C. is reached§. Tyndall|| also has shown that infusions with bacteria are not sterilised unless they are subjected to prolonged boiling—about *four hours.* When moist, however, they are more easily destroyed; and here is the bearing of the germ question upon the water supply:—

The activity of the germs seems to be manifested only in the presence of moisture. Recent researches, especially those communicated to the Parisian Academy of Sciences, have shown that the air teems with these primitive forms; they have been actually strained therefrom, and an approximate estimation of their numbers in a given volume of the atmosphere at different seasons, places, and under specified conditions has been formulated. It has been shown that after a shower of rain the air is considerably purified of these organisms; they are carried down by the water into the soil, and there they increase and multiply under favourable conditions to vitiate the air once more with their countless descendants.

Their methods of reproduction have been ascertained through microscopical investigation; and, so far as we are aware, they are propagated (α) by *fission*, or division of an adult into two individuals by constriction, and subsequent separation of the parts; (β) by a process closely allied to fission called the *zooglœa* stage, in which division seems to be carried on in a passive state, embedded in a jelly-like surrounding; and (γ), as first shown by Koch,¶ and verified by Ewart,** through elongation of the rods into filaments, the internal portion of which becomes subdivided into small, highly refractive particles or germs, which are liberated through the bursting of the parent envelope.

* In reply to an inquiry as to the average size of the yeast cell, we may state that *our own* measurements were taken from the larger variety of the plant known as "German," "dry," or "baker's" yeast, viz., 12 micromillimètres, or about 1-2000 inch. Ordinary brewer's "barm," however, usually furnishes cells which measure only 8μ, or 1-3200 inch approximately.

† Hoppe-Seyler, in "Watts' Dictionary of Chemistry," second Supplement, London, 1875, p. 522.

‡ The prevention of zymotic diseases by a prior removal of the germs from food substances does not so much concern our medical brethren, as our purely chemical *confrères*, naturalists, and practical workers. We may leave the *Æsclepiadæ* to cope with Archæus and his emissaries *after* the mischief has been done.

* *Bacterium*, from the Gr. βάκτρον, a rod or staff. *Bacillum*, dim. of Lat. *baculum*, a little rod.

† Here, as elsewhere, we shall denote the *micromillimètre* by the Greek letter μ. 1 μ = 0·0000397 inch.

‡ "Beiträge zur Biologie der Pflanzen," by Cohn. Vol. I., p. 223.

§ Sanderson and Ewart in "Proc. Roy. Soc.," Vol. 28, p. 477.

|| "Trans. Roy. Soc.," Vol. clxvii., pp. 149 et 177.

¶ "Beitr. zur Biol. d. Pflanzen," by Cohn, Vol. ii., p. 3.

** "Proc. Roy. Soc.," Vol. xxvii., p. 474.

This last process has been termed *multiplication by endogonidia*; and we cannot but fancy that it is to its potent agency that we are indebted for the myriads of germ forms which pollute the atmosphere. The inhalation of these germs, however, does not seem to be all-powerful in the spread of infections, as they are to a large measure intercepted by the natural filter, commonly known as the nostrils, and are further checked in their growth by the unfavourable secretions and gases given off by the glandular organs of our bodies; so that in the struggle for existence they are compelled to succumb, and their harmful action is thus arrested, or reduced to a minimum. The "nervous" or other pathological condition of the individual, of course, opens the gates even to these *dry* germs; but it is averred that persons in a normal state of health are able, at most times, to withstand their ravages.

When, however, they gain access to their hotbed of water, their activity is so stimulated that the poor unfortunate who gives them a reception must inevitably become a prey to these poisonous parasites. It thus becomes incumbent on all those to whom the welfare of their fellow-beings is entrusted, to the heads of families, as much as to water-supply companies, to learn something about these matters, and to seek for remedies, such as may lie in their power, which shall effectually prevent the spread of disease and the increase of mortality.

In this paper it has been our endeavour to show how seemingly insignificant yet subtle an influence,—an influence which can baffle the chemical or even the practised microscopical detective,—is at work undermining the constitutions of thousands of healthy lives. We shall in continuation of this subject show how those evils might be remedied, and what has already been done by practical workers in this field of inquiry. Our next communication will deal with the physiographical aspect of the water-supply question, suitably illustrated.

ON PECULIARITIES OF SIGHT, AND OPTICAL ILLUSIONS.*

By Nath. E Green.

A MOST interesting and instructive paper might be written on the subject of optical illusions in connection with astronomical observation. How many minute companions to stars, how many extra satellites of planets, how many strange appearances, have been seen by certain observers, and by them only. Yet those observers believed in their own sight, and were fully convinced of the actuality of the appearances reported. May not an explanation be found in the eccentricities of optics or in personalities of vision?

The object of this paper is to draw attention to the subject, and by a few confessions to induce others to take it up, being assured that, although the individual may feel depressed, the great cause of truth will be advanced by the discussion.

And first, with regard to minute points of light. The writer has experienced a difficulty when searching for faint comites, or the inner satellites of Saturn, in determining which are real and which spurious points. The eye having a tendency to produce these where they do not exist, and the real things being only seen by glimpses, it requires great patience, and frequent repetition of a point in the same position to be assured of its existence. A friend once remarked when searching for the satellites of Saturn, "How many do you want me to see, for I can see as many as you like." Surely this optical illusion will account for the appearance of many minute objects, that others have been unable to confirm. Another illusion is the persistence of an object on the retina after the eye has been withdrawn from the telescope. This has occurred after long observation of Jupiter with an 18-in. reflector. On removing the eye from the instrument, to make a drawing of what has been observed, a clear, bright disc has so interfered between the eye and the pencil-point, that an effort was required to remove the illusion before the drawing could be made. May not this retention of an object on which the eye has long been fixed account for the appearance of a satellite *through* the limb of Jupiter, the image of the satellite being continued on the retina after it had passed behind the planet?*

But what shall we say of the reported visibility of the unilluminated portion of Venus? This phenomenon has been reported so frequently that it seems like heresy to doubt the fact. We are not referring to the fine ring of light that surrounds the disc just before immersion at a transit, or when Venus is very near the sun at inferior conjunction, but to those reported appearances, in full daylight, when the planet is at greatest elongation. The writer had a friend who could always see the dark side, even in the finder; he has shown Venus to another unaccustomed to astronomical observation, when the planet was on the meridian and about half full. "How is it," said he, "that I see the whole of the round?" And very recently, when friends were in the observatory, and viewing Venus, on putting the question, "Can you see the unillumined portion?" the answer has been, "Now you mention it, I think I can." In all these cases, and many others, the writer has been unable to perceive that which others have seen.

One more illusion, and we have done. When observing the ring of Saturn, and especially the outer ring, for evidences of division, a very distinct shadow of Saturn has appeared on the following portion of the sky—this is, of course, a simple optical defect, arising possibly from the same cause as the dark forms that are seen after looking at the sun. It is just possible that a similar effect follows Venus, and to some eyes appears like the dark portion of the planet against the sky.†

There is a fine opportunity before us of testing some of these appearances, and the readers of this journal may be induced to record their experiences.

* From the *Astronomical Register*.

* This is, however, inconsistent with the accounts given by Mr. Todd, of Adelaide, and his assistants.—R. P.

† This seems to me just *impossible*. The dark shade seen in this way is of the same shape as the luminous object, and similarly situated: the "terminator" of Venus is not of the same shape as the outline of the unillumined part of the disc.—R. P.

During the year 1883, Professor Simon Newcomb, U.S.N., visited Europe by order of the United States Government, for the purpose of collecting information respecting the most recent improvements in astronomical instruments. His report to the Secretary of the Navy contains a good deal of valuable information for the practical astronomer. He speaks highly of the definition of the enormous refractor at Vienna. He also commends the method of supporting mirrors devised by the MM. Henry of Paris, adding, however, that it has, so far, not been employed with reflectors exceeding 12 in. in aperture. He by no means speaks with unmixed admiration of the much bepuffed "Equatorial circle"; while he has little but praise for the Strasburg circle under construction by the Messrs. Repsold. One of the most interesting things described by Professor Newcomb is the extremely shallow form of mercury basin employed for reflection-observations at Strasburg, Leyden, &c.

THE EVOLUTION OF FLOWERS.

By Grant Allen.

SOME HIGHER LILIES.

ALL the true lilies with which we have dealt so far have had bulbs to grow from, and have been, on the whole, very succulent and herbaceous in character. They have also persisted in the primitive lily habit of producing dry capsules, each of the three cells in which contained numerous seeds.

There are, however, some higher types of lily, not very largely represented in our British flora, which differ considerably from the tulip, the fritillary, and the tiger-lilies in one or other of these central characteristics. I propose briefly glancing at two of these to-day, the common asparagus (*Asparagus officinalis*) and the butcher's broom (*Ruscus aculeatus*). They are our two English representatives of the sub-order of Liliaceæ known as Asparageæ.

Dismiss from your mind entirely the ordinary garden notion of asparagus, as a thick, stumpy, succulent shoot, and try to realise the life of the wild plant itself as it grows by the sandy, tideless levels of the Mediterranean, or far more sparingly on a few isolated rocky headlands of our own Cornish or Irish coast. Essentially a maritime weed, the wild asparagus has, instead of a bulb, a deep creeping root-stock, buried far out of harm's reach in the sand or the crannies; and from this stock it sends up every spring a few soft, scaly, annual shoots, thin and wiry, which branch out afterwards into tufted feathery heads of minute foliage. In our gardens, we trench and manure the selected and cultivated variety, so that each year the annual stems grow very large, high, and bushy, and collect abundant material for the next spring's growth, which they conceal during the winter in the buried root-stock. Hence the young shoots in the garden kind have become unnaturally large, thick, and luscious. But in the wild state, asparagus seldom attains more than one quarter the height of the big, luxuriant, cultivated variety, and its spring shoots are far thinner, stringier, and more woody in texture.

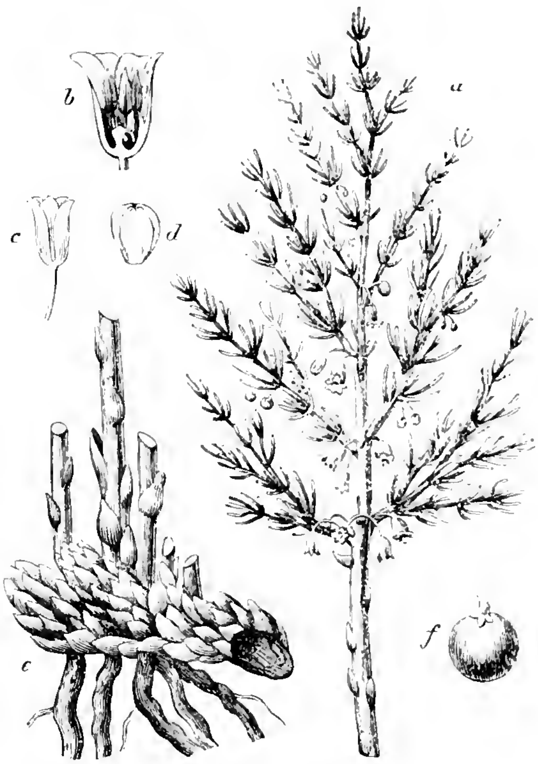


Fig. 1.—Asparagus Officinalis.

On the edible young stems of the garden asparagus, everybody must have noticed a few short, stumpy scales, generally of a faint mauve colour; and these are almost the only true leaves the plant ever produces. When it grows older, the place of foliage is fulfilled by the fine clustered hair-like green points, which are, in fact, very small branches, or, if you like to be extremely scientific, abortive pedicels (that is to say, flower-stalks whose buds and blossoms have never developed). Look very closely at the base of each such cluster—the full-grown garden asparagus will do quite as well for this purpose as its wild ancestor—and you will see that it is enclosed by very tiny dry scales, each of which is really a bract or leaf, similar to those on the spring shoots. From the axils or angles made by these bracts with the stem, the cluster of abortive pedicels springs, just as each separate blossom in a wild hyacinth or a common spotted orchis, springs from a small bract of a far more conspicuous character. One may say, in fact, that each cluster of so-called leaves in the asparagus answers to a whole head of flowers in the bluebell or orchis, only that the actual blossoms themselves are in this case never developed.

Why the asparagus has thus taken to producing these innumerable pedicels instead of true leaves would be a long and difficult question to answer fully. It must suffice here to say briefly that in many plants of dry places (for example, in the stonecrops) the stem and branches as well as the leaves are filled with chlorophyll, and help to perform the foliar functions. In others (for example, in the cactuses) the true leaves have dwindled away absolutely to nothing, because the succulent stem performs their functions better under its own peculiar circumstances. In asparagus, the true leaves remain only as protective scales, but the work of foliage has been taken on by the stem and pedicels, simply because they could do the work more conveniently.

The flowers of the asparagus are small and greenish, and at first sight very inconspicuous. On looking closer, however, you will see that they are perfect little lilies, each with six distinct perianth-pieces—that is to say, three sepals and three petals, the distinction being here well marked—and the usual six stamens and three-celled ovary. Many of the flowers, however, have stamens only; others have pistils with abortive stamens: the plant is just beginning to separate the sexes in distinct blossoms. But the separation has not yet gone far; none of the female flowers have as yet quite lost their stamens, though they are reduced to useless filaments bearing abortive anthers. Indeed, a few blossoms on each plant usually still retain both stamens and pistil. Unattractive as they are in colour, the asparagus flowers have a delicate perfume, and secrete abundant honey; hence they are visited and fertilised by hive bees and a few other insects.

But the most marked peculiarity about the asparagus, as distinguished from the other lilies we have hitherto examined, is certainly the fact that it produces red berries, instead of dry green or brown capsules. This berry has, of course, been produced, like all others, by the intervention of birds, which thus distribute the seeds in the best possible situations. Accordingly, the plant is able to lessen the number of seeds in each cell to one only. To be sure, the flower has two ovules or young seeds in each cell of the ovary; but as the fruit ripens, one of these usually becomes abortive. This is just the exact reversal of what we saw happen in an earlier stage of evolution; and yet it is only a further step in the same direction, under a slight disguise. We noticed that the earliest monocotyledons, such as the alismas, had many carpels in every flower, each containing one seed. In the simpler lilies, such as the tulip and fritillary, the number of carpels was reduced to three (united in a single capsule), while, by way of compensation, the seeds in each cell were increased to several. But in the asparagus, the improved mode of dispersion by the aid of birds enables the plant still further to simplify its plan by reducing the number of seeds in each cell to one. It thus effects the greatest possible saving both in fertilisation and in dispersion of seeds.

The butcher's broom is a still more singular modification of the lily type, in which the foliar functions are performed by flattened, leaf-like branches, exactly simulating true leaves. It stands alone among British monocotyledons in attaining a shrubby, woody, tree-like habit. The branches are so extremely like leaves in outward appearance that their true nature can only be discovered by reasoning and analogy. Most of them bear on their under surface (or rather on the upper side, which is so twisted as to turn

Fig. 2.—Ruscus Aculeatus.

downward) a single small, whitish lily flower, having six distinct perianth pieces, and either three stamens or a three-celled ovary, for the division of the sexes is here almost complete, though a few hermaphrodite blossoms occasionally occur. If you look very closely, however, you will see that each flower is borne on a small pedicel, united along its whole length with the leaf-like branch (well shown at *b* in the accompanying woodcut), and that a very tiny scale or bract lies under every blossom. Similar very small scales, the last relics of the true leaves, now abortive, are found beneath the leaf-like branches. The flowers and fruit seem accordingly to grow out of the middle of a leaf, a peculiarity which gives butcher's broom a very strange and uncanny appearance. In the immature ovary, there are two ovules in each cell, but, as the fruit ripens, one in each cell always becomes abortive, so that at most there are but three seeds in the berry. More often, however, only two perfect seeds are developed, and it is not uncommon to find berries with only one ; so that butcher's broom, in fact, carries all the tendencies of the asparagus just one stage further. The berries are bright red, and very attractive to birds, but the seeds are excessively hard and indigestible. Butcher's broom is a glossy evergreen, and the leaf-like branches are stiff and prickly, effectually deterring cattle from browzing off its tempting foliage.

CONCEIT (FOR SELF AND FAMILY).

By Richard A. Proctor.

My friend Mr. Foster has touched on the thought—a sound and suggestive one — that what is called patriotism is often only a wider development of selfishness. The least cultured among men are personally selfish, family selfishness is less contemptible but yet contemptible enough, and the selfishness of so-called patriotism is by comparison, but by comparison only, almost respectable. (I say so-called patriotism, for real patriotism is as distinct from the quality in question as just self-regard is from pure selfishness.)

But may we not in like manner recognise in false patriotism something akin rather to self-conceit, and conceit of family, than to selfishness of the personal or of the family kind? And may we not also distinguish between self-conceit and self-knowledge, precisely as we distinguish between selfishness and due self-regard?

Self-conceit is so obviously a fault of the uncultured and ill-developed mind that it is hardly necessary to dwell on the evidence of inferiority which it affords. This is curiously shown by the way in which this quality is manifested in children. Almost all children are more or less conceited,—generally more,—and grow out of their conceit (if it is in them to develope higher things) as they get older, just as they grow out of the monkeyhood of early infancy (often a very pretty monkeyhood) and the savagery of later childhood. Of course, many remain self-conceited to youth and manhood, or through life. Our less-developed classes are as inherently self-conceited through life as all or nearly all men are in early childhood. That supreme self-conceit presented in Tennyson's fine picture of the Northern Farmer, will be found, by any one who takes the trouble to search for it, in ninety-nine out of a hundred of our peasantry and men of purely agricultural life, even when the age supposed to be full of wisdom and experience has been reached. It seems incredible, but talk to men of the class to which Tennyson's "Northern Farmer" belonged and you will find many who doubt (at the bottom of their minds) whether Godamoighty quite knows their full value in the world. "Does Godamoighty knaw what a's doing a taakin o' me?" asks the old pagan, and we smile at his amazing self-conceit ; yet it is common enough, and even outside those classes whose pursuits involve little calculated to raise the mind's level or to widen the ideas.

Family conceit is less obviously a sign of incomplete development ; yet there can be little mistake about its real meaning when we rightly apprehend its nature. The child shows family conceit a little later than self-conceit, but the quality is essentially one belonging to childhood either of the individual or of the race. The Northern Farmer, though he had not passed much beyond the stage of self-conceit ("See how quolity smoiles when they sees me a passin' by"), had some family conceit too, if we fully understand his reference to "Jones, as never mended a fence," and "Robinson, as arn't a haporth o' sense." Doubtless the Joneses and the Robinsons seemed to him to belong to an inferior race, besides being individually and personally contemptible. But family conceit is more widely spread (as well as a wider form of conceit) than conceit of self. We find it in races a grade higher than those which supply the chief developments of personal conceit. It yields more slowly before culture and knowledge. We see it in families which have every means of recognising the inherent absurdity of the feeling, who have before them as clearly the evidence of the insignificance of particular families as they have before them the evidence of the personal insignificance of the individual man. It is indeed true that, among the worst developed races, family conceit is more prevalent than in races which have had better advantages. The Flanagans and Dohertys are naturally full of pride of family, and prepared by breaking heads after due coat-tail-treading to show the superiority of the race which may be has not produced in all time a single person above or even quite up to the average; and in like manner in our own country we find a steady though dull form of family pride in the Noakeses and Styleses of remote and undeveloped country districts. But the failing is found outside such races as these. It can not only be recognised in families called noble and royal (it comes out amusingly for instance, so far as I can judge from extracts, in some royal books which have recently been published in this country) but it can be recognised also in those whose opportunities of culture and study should have taught them better. Nay, sometimes even that special study of biological laws which should show that each individual represents scores of families and has qualities which can no more be assigned to one family than the qualities of a river can be assigned to one out of its hundred sources, fails to correct this foolish feeling, which like others of our lower qualities is innate and scarce to be corrected by culture, reasoning, or acquired knowledge.

What however can be much more absurd in reality than to find a family claiming for its members—or quietly assuming without claiming openly—superior qualities? We know that the very existence of family conceit is a mark of want of sense, a sign of inferior culture. But apart from this we know that every person born into the world shares multitudinous faculties and qualities inherited from hundreds, thousands, nay tens and hundreds of thousands of foregoers. When a man boasts "I am a Snillum or a Snobbig" he can really only mean that a thousandth part of his blood comes from some remote Snobbig or a Snillum, of presumably better qualities than they recognise in themselves—so that their family history has—by their own account—been one of descent. It is sad for them, but they ought to know best. Still the idea of a family strain is absurd on the face of it, and family conceit is only less contemptible than personal vanity.

In a description of the mowing and reaping machine works of Mr. W. A. Wood the following occurs:—"Statement of materials we consumed in the manufacture of 45,032 machines, our production in 1883. We give only the principal materials used. Pig-iron, 10,500 tons; steel, 1,000 tons; wrought and cold rolled iron, 4,500 tons; malleable iron, 1,600 tons; coal, 7,000 tons; coke, 1,000 tons; moulding sand, 4,000 tons; grinding stones, 225 tons; painting material, 490,000 lb.; spring wire, 60,000 lb.; tacks and rivets, 120,000 lb.; brass and composition, 120,000 lb.; screws, 10,000 gross; lubricating oils, 10,000 gallons; lumber, 10,000,000 ft.; cotton duck, 90,000 yards; carriage and plough bolts, 3,000,000. As evidence of the magnitude that the use of self-binding machinery in harvesting grain has attained, we will state that we furnished our customers in 1883, 2,500 tons of twine."

Reviews.

SOME BOOKS ON OUR TABLE.

What is Art? By James Stanley Little. (London: W. Swan, Sonnenschein & Co. 1884.)—If we may judge from internal evidence, Mr. Little is an artist who, like the unfortunate Haydon, believes that Society is wilfully blind to his genius; and in whose mind the rejection of his works by the Royal Academicians has induced a feeling the reverse of friendly towards that body. We may be mistaken, and Mr. Little may be speaking in parables; but we can put no other interpretation upon certain passages in his book. Be his object, however, what it may, he sets down many things (in somewhat too inflated language) which may well be laid to heart by all who are concerned for Art progress in England. His claim for the pre-eminent dignity of Landscape Art is not, in the present condition of popular taste, likely to be conceded; albeit the study of his utterances on this point might not be without profit to the devotees of the empty-perambulator and kitten-playing-with-string school of painting. His protest against shoddy is none too vigorous.

A Short Text-Book of Inorganic Chemistry. By Dr. Hermann Kolbe. Translated and Edited by T. S. Humpidge, Ph.D. (London: Longmans, Green & Co. 1884.)—"This short text-book," says its author in his preface, "has been written to recall to the memory of students who have attended a course of lectures on Experimental Chemistry what they have seen and heard, and to clear up any points which may not have been properly understood." Assuredly both Dr. Kolbe and his translator may be congratulated on the success with which they have fulfilled their self-imposed task; for in the 606 closely-printed pages before us will be found the means of obtaining the most thorough grounding in Inorganic Chemistry. Dr. Humpidge has added to his lucid translation short accounts of Gay Lussac's law, the law of Avogadro, and the manufacture of coal-gas; and has further supplemented the descriptions of various elements and compounds in the text. He has also contributed an appendix containing an account of the methods used for determining atomic and molecular weights, of Prout's law and of the Periodic law, as well as a series of useful tables. A beautifully lithographed table of spectra forms the frontispiece; numerous woodcuts are inserted in the text, and there is a good and exhaustive index to the whole book. It forms no unworthy addition to the Messrs. Longmans' admirable series of Text-books of Science.

Rock History: a Note-book of Geology. By C. L. Barnes, M.A. (London: Edward Stanford. 1884.) It is long since we have come across an introductory work on geology at once so practical and attractive as this of Mr. Barnes. While admitting his obligation to Lyell's "Student's Elements of Geology," our author must be credited with having employed his materials in about as convenient and instructive a form for the student as he could well have adopted. He commences with an enunciation of the general principles of geology, and then proceeds to treat of the physical structure, composition, stratification, and ages of the various rocks. Having thus familiarised the beginner with the structure of the earth's crust as a whole, Mr. Barnes goes on to apply and illustrate the knowledge thus acquired in a way which has much, beyond its novelty, to recommend it. He deals with the various formations *seriatim*, commencing with a succinct account of each. This is followed by a table giving in the first column the divisions of the formation described; in the second column, the places of its occurrence in England and Wales; in the third the localities of its occurrence abroad; in the fourth its lithological or petrological character; in the fifth the climate prevailing when it was deposited; in the sixth the leading fossils which characterise it; in the seventh its thickness in the British Isles; while the eighth is occupied with general elucidative remarks. Finally comes a map of England and Wales, in which the formation treated of only is coloured (this strikes us as an excellent idea); while opposite each map is a well-executed chart containing drawings of the fossils most characteristic of the rocks described. Then follows a chapter on the igneous rocks, a table of the classification of the animal kingdom—together with the more important fossil examples of each division; while the work concludes with a glossary of the geological and palæontological terms employed in the body of it. No one about to make a tour in his own country this summer should omit Mr. Barnes's capital little book from his outfit.

Handbooks: International Health Exhibition (London: William Clowes & Son. 1884).—This eminently practical series of handbooks is worthy of the large circulation which it will undoubtedly command. In it Mr. Paget deals with "Healthy Schools;" Mr. Acland, C.B., F.R.S., with "Health in the Village;" Dr. Attfield, F.R.S., with "Water, Water Supplies, and Unfermented Beverages;" Mr. Berdmore on "The Principles of Cooking;" Miss C. T. Wood on "Food and Cookery for Infants and Invalids" (with an introduction by Dr. Cheadle); Surgeon-Major Evatt on "Ambulance Organisation, Equipment, and Transport;" and Capt. Shaw, C.B., on "Fires and Fire Brigades." Of these capital little volumes, the second, fifth, and sixth are illustrated, Mr. Acland's and Dr. Evatt's profusely, while Capt. Shaw gives a series of engravings depicting the appliances for extinguishing fire in 1667, 1707, and 1884. The reader interested in either of the subjects discussed in this series may select his volume by its title, with the certainty that he will find the matter treated of at once pleasantly, intelligently, and (for practical purposes) exhaustively.

A Practical Introduction to Medical Electricity. By A. de Watteville, M.A., M.D., B.Sc., &c. Second Edition. (London: H. K. Lewis. 1884.)—Dr. de Watteville's book furnishes a species of Thesaurus for the medical electrician, so thoroughly is every branch of its subject treated on. There is, unhappily, so much advertising quackery in connection with medical—or pseudo-medical—electricity nowadays, that a real and appreciable service is rendered to therapeutics by a physician of our author's professional standing offering such an exposition as that whose title heads this notice, based upon purely scientific principles. In it he discusses the leading theorems of electro-physics, describes in detail the various forms of apparatus employed, and treats in succeeding chapters of electro-physiology, electro-diagnosis, and electro-therapeutics. His volume should be on the shelves of the consulting-room of every one whose name appears in the Medical Register.

Treatise on Consumption: A Work for the Million. By William Dale, M.D. (London: Francis Hodgson. 1884.)—In a country in which the fell disease Phthisis annually claims so many victims as it does in our own, Dr. Dale's pamphlet must possess a painful interest. In it, after an introductory chapter, he successively deals with the causes of consumption, infection and phthisis, and lastly of its treatment. His style is readable and agreeable, and his book may be studied, not without profit, by all who have or imagine they have what is popularly known as "a delicate chest."

Health Assurance. By Wm. Fleming Phillips. (London: Wyman & Sons. 1884.)—This little pamphlet developes an idea which strikes us as being an eminently common-sense and feasible one. Put as shortly as possible, it is that the well-to-do classes should pay a certain sum per head, ill or well, annually to their medical attendants, much as is already done in medical clubs by those in a lower rank of life. For the details of Dr. Phillips's scheme we must refer the reader to his pamphlet itself. It only costs sixpence, and will repay perusal.

The Laundry Guide, by W. J. Menzies, contains useful recipes for softening water, making laundry soap, &c.

We have also before us *Naturen*, published in Christiania; *The Bulletin de l'Agence Générale de l'Electricité*, Paris; *The Railway Review*, Chicago; *Bradstreets*, New York; *The Dyer, Calico-Printer, and Colour Trades Review*, London; *The Tricyclist*, London; *Ciel et Terre*, Brussels; and *Society*, each addressing its own extensive and influential section of the public.

The Practical Telegraphist. By W. Lynd, A.S.T.E. (London: Wyman & Sons, 1884.)—This is a work which will doubtless prove useful to those interested in telegraphy. In the main it is a miscellaneous compilation from several reliable authorities. Details are given of the system of working and of the principles and construction of several instruments adopted in the Postal Telegraph Service. The volume concludes with interesting, and, we may say, valuable statistics, pourtraying the marvellous development of telegraphy at home and abroad. The work is got up in a style highly creditable to the publishers.

Telegraphy. By W. H. Preece, F.R.S., M.I.C.E., and J. Sivewright, M.A., C.M.G. Third Edition. (London: Longmans, Green, & Co., 1884.)—This work, which is responsible for a very large proportion of the volume previously noticed, occupies the position of being without a rival in its particular sphere. It is, for its size, very comprehensive, while the language is simple and clear. These reasons, combined with a moderate price, have so far secured for it immunity from competition. The new edition embraces chapters on the telephone, fast repeaters, and quadruplex telegraphy, additions of great value. Notwithstanding one or two little slips, the book is to be highly commended, and will take a lot of beating.

Editorial Gossip.

I regret to say that Mr. Thomas Foster has been recommended by his medical advisers a transatlantic journey. The promised concluding paper of his series cannot appear this week; but as he has somewhat wilfully determined to continue his literary work during the journey, it may be expected to appear very shortly, as it will probably be posted for England immediately on his arrival in New York.

Many correspondents ask me if any photographic portrait of my editorial countenance is extant. Messrs. Elliott & Fry have recently requested me to sit for some new photographs. The pictures, which I regard as very satisfactory, are, I believe, now ready for issue.

One of the letters last week unfortunately escaped correction, and the result is that some rather remarkable new Greek words appear.

"A lady" has received many letters relating to the rational dress in that form which cannot be distinguished from ordinary dress, but is as light, or almost as light, as the more obtrusive divided skirt. We believe that patterns will before long be provided for those who care to obtain them; when ready they will be advertised in these columns.

THE FACE OF THE SKY.

From July 4 to July 18.

By F.R.A.S.

The sun continues to provide daily work for the observer, and should be examined with the telescope whenever the sky is clear. The aspect of the night sky will be found delineated in Map VII. of "The Stars in their Seasons," twilight, however, still persisting all night long. Mercury is a morning star to-day, but comes into superior conjunction with the sun at 5 a.m. on the 13th, upon which, of course, he becomes an evening star. Venus will be in inferior conjunction with the sun at 2 a.m. on the 12th. Every effort should be made by the student to observe her in the telescope at and about this time, as she presents one of the most exquisite and all-repaying spectacles that it is possible to conceive, shining as a hair-like semi-circular thread of silver in the glare of sunlight. Moreover, under really favourable atmospheric circumstances, and a sufficiently-constricted telescopic field, the observer may hope to see the dark body of the planet embraced by this wonderful silver hair of light, like "the old moon in the new moon's arms." At noon on July 11th Venus will be approximately 4° 51′, or about 10 diameters of the sun, south or below his centre. This may help the beginner to fish her up with a telescope not mounted equatorially. No other planets are visible at present. Three occultations of stars by the moon occur during the fourteen days covered by these notes. The first happens on the night of the 11th, and is one of the fourth mag. star θ Aquarii, which will disappear at the moon's bright limb at 11h. 18m., at an angle of 67° from her vertex. It will re-appear at her dark limb at 12h. 29m. p.m. at a vertical angle of 279°. On July 15, the fourth mag. star o Piscium will disappear at the bright limb of the moon at 12h. 53m. p.m., at an angle from the vertex of 60°. It will re-appear at 51m. after 1 the next morning, at an angle of 264° from her vertex. Lastly, on the 16th, rather more than half-an-hour before the moon rises, she will have occulted 31 Arietis, a star of the sixth magnitude. Later, at 11h. 55m. p.m., this star will re-appear at the moon's dark limb at a vertical angle of 246°. When our notes begin, the moon is in Libra; but at two o'clock this afternoon she leaves it for the narrow northern strip of Scorpio. She takes until one o'clock to-morrow morning to cross this, and then enters Ophiuchus. This she quits at 10 p.m., on the 6th, for Sagittarius. Her passage through Sagittarius occupies until 11 a.m. on the 9th, at which hour she passes into Capricornus, the boundary between which and Aquarius she crosses at 5 a.m. on the 10th. About 3 a.m. on the 13th, she leaves Aquarius for Pisces, and continues to travel through that large and straggling constellation until she enters Aries, at 5 a.m., on the 16th. At 8 p.m., on the 17th, she moves into Taurus, which she is still traversing when these notes terminate.

The "Researches on Astronomical Spectrum Photography" of the late lamented Professor Henry Draper have just been republished, with an introduction and description of the apparatus by Professor C. A. Young, and measurements and description of the plates by Professor E. C. Pickering, together with reprints of Dr. Draper's various papers on the subject. Apart from its enduring importance as a record of a mass of valuable physical facts, and as containing a history of the infancy and youth of Stellar spectral research, this posthumous volume of the great American physicist possesses a high degree of interest, as showing what an enormous amount of scientific work of the highest value could be performed by an absolutely unsubsidised observer. Professor Draper would have felt that he was inflicting as much degradation on science as he would have brought upon himself personally had he gone whining to Congress for "endowment." Like our own Faraday, though, he "had no time to get rich;" and his name will assuredly live in honour when those of the men whose idea of science is narrowed to that of their own pecuniary advancement will have long sunk into oblivion.

"Let Knowledge grow from more to more."—Alfred Tennyson.

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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No communications are answered by post, even though stamped and directed envelope be enclosed.

LARGE CELLS FOR ELECTRO DEPOSITION.

[1322]—Mr. Slingo's last paper on "Electro-plating," in which he refers to the expense of rectangular baths made of pottery, reminds me of my own experience in the early days of electrotyping (about 1845–6). I made two large tanks for depositing copper 4 ft. long, 2½ ft. wide, and 2¼ ft. deep. They were of common deal, put together in the usual way, by dove-tailing; but were double. The outer tank was about 1 in. thick; the inner tank was made of ½ in. wood, with outside dimensions ¼ in. less all round than the inside dimensions of the outer trough. On the bottom of the outside tank were a few small blocks about 1 in. square and ¼ in. thick. Thus, when the inner or lining tank was put in its place, resting on these blocks there was a space on all sides and the bottom of ¼ in. thickness between the inner and outer tank. To keep the lining accurately in the middle, I put temporary strips ¼ in. thick down each side.

This being arranged, I poured melted pitch into the ¼-inch space, only in sufficient quantity, *at first*, to flow over the bottom and rise a few inches above the sides, as I anticipated a floating up of the whole of the inner case if all the liquid were added at once. On the following day, after this first pouring had cooled and solidified, I poured more, sufficient to fill the ¼-inch space completely, and then left the whole to solidify. Then followed a curious illustration of the viscosity of the apparently solid pitch. The inner case gradually rose day by day, threatening to wreck the whole arrangement. I filled it with water, and it gradually sunk until it rested on the check blocks, where it remained when subsequently filled with the copper solution.

The second compound trough was similarly treated, and both were used by myself for two years without leakage, and long afterwards by my successor. The copper solution soaks through the porous wood of the inner lining, but is effectually resisted by the surrounding wall of pitch. I do not recommend this for *silver* solutions; the cyanides are alkaline, and will act upon the pitch, and thus, in course of time, the solution will become polluted by a solution of the pitch. This does not happen to the acid copper solution. Now that paraffin wax is obtainable for 6d. per pound, I recommend it as a substitute for the pitch, and have no doubt that cells thus constructed will be found available for all kinds of solutions that are used cold.

W. Mattieu Williams.

COLOUR-LANGUAGE.

[1323]—The construction which Mr. Titchener (question 1320) puts on my sentence is justified by the wording, but so general a statement must be interpreted by the spirit and context, rather than solely by the letter.

For it is not pretended that uncivilised folk can so discriminate between the subtle gradations of colour as to have words for every shade, but it is none the less certain that where terms are invented for colours, the concrete precedes the abstract.

Mr. Titchener's question gives me the desired occasion to call attention to my friend Mr. Grant Allen's delightful book on the "Colour Sense" (Trübner & Co.), and especially to the last chapter "On the Growth of the Colour-Vocabulary," from which the following is quoted:—

"The earliest names must be names of things, or of visible and audible actions. . . . When we wish to express a hitherto unnamed colour, the simplest way of doing it is to take an object which possesses that colour and apply its title as an adjective to the thing which we wish to describe. A particular shade of very light yellow has no distinctive name, but we must call it something for some special purpose, and so we think of its nearest common representative, a *primrose*. Thenceforward the new name becomes an adjective, and we ask naturally for a yard of primrose ribbon. Now, what we see civilised men doing to-day under our own eyes, primitive men did centuries ago, when they framed the earliest colour names. It would seem at present as though the various terms for colours might be divided into two classes—the truly abstract, such as *blue*, *green*, *yellow*, and the concrete used abstractly, such as *lilac*, *orange*, *pink*. The former class appears to have no other meaning than that of pure colour; while the latter class are clearly derived from the names of concrete objects. But in reality the difference between them is merely one of time. Abstract colour-terms are the names of concretes, whose original signification has been forgotten" (pp. 252, 253). Edward Clodd.

DIVISIBILITY BY SEVEN.

[1324]—Mr. Askew, in 1274, May 30, asks for a proof of a method for ascertaining the divisibility of a number by 7, which he states to have been discovered by Mr. Rickard, of Birmingham. Probably many have discovered it: my father did, for one, and taught it to me some thirty years ago. The test-number is equally useful for 7, 11, and 13. The method, as worked by my father, gives, in the case of a number divisible by all three factors, the other factor as well, without further labour: and in this respect it has an advantage over that of Mr. Rickard.

If a number, N, be marked off from the right-hand end in periods of three digits; and if a, b, c, &c., be the periods; and if M be the difference between the sums of the alternate periods; we have, writing r for 1000,

$$N = a + b\,r + c\,r^2 + d\,r^3 + \&c.$$
$$M = a - b + c - d + \&c.$$
$$\therefore N - M = b\,(r+1) + c(r^2-1) + d(r^3+1) + \&c.$$

and is divisible by $(r+1)$; hence, if M be divisible by $(r+1)$ or any factor of it, so also is N. And in this case $r+1 = 1001 = 7 \times 11 \times 13$.

My father's rule was to set the right-hand period under the next, and subtract, setting the remainder under the next, and so on. In the last period, the subtraction is *downwards* if the lower number be the larger. In this instance, since we have 1 to carry into the last period, the 931 must be read as 932. The ultimate remainder, 924, is the test-number; and, since this is divisible by 7 and 11, so also is the whole number.

8	026	518	423
931	095	423	
924			

If the test-number chanced to be zero, the second line would be the quotient produced by dividing the given number by 1001; *i.e.*, it is the factor remaining after dividing out 7, 11, and 13. For let us call the second line "V;" writing three ciphers at the end, we get 1000V; and we know that, if this be deducted from the upper line, the remainder = V. Hence N = 1001V = $7 \times 11 \times 13 \times$ V. In the above example, if the left-hand period were 932 instead of 8, the test-number would be zero.

If the periods be *single* digits, *i.e.*, if $r = 10$, we get a test for divisibility by 11, and at the same time the quotient after dividing out 11. The rule is to set the last digit under the next, and subtract, setting the remainder under the next, and so on.

6 4 3 7 2 5 8 3
0 5 8 5 2 0 5 3

In this instance the test-number $= 0$; hence the given number $= 11 \times 5852053$.

With periods of two digits, we get a test for divisibility by 101; and so for four or more digits. C. L. Dodgson.

Ch. Ch., Oxford.

P.S.—The sum of *all* the periods gives us, for periods of 1, 2, 3, &c., digits, a test for divisibility by 9, 99, 999 $(=27 \times 37)$, &c., or for any factors of these numbers. This method may also be worked by a rule analogous to that given above; *e.g.*, to test for 999, mark off in periods of three, write 000 over the right-hand period, and subtract, writing the remainder over the next, and so on. Hence, also, if the test-number chanced to be zero, the upper line (omitting the 000) would be the quotient produced by dividing the given number by 999.

Probably similar rules may be made for most primes. I have myself made fairly simple rules for 17 and for 19; but such processes are rather curious than useful.

[1325]—Mr. Askew's rule is applicable not only, as he says, to the division 7 and 13, but also to 91. The reason is that both $(1000+1)$ and (1000^2-1) happen to be exactly multiples of these three numbers.

Any number of over six figures may be expressed in the form

$$a + 1000b + 1000^2c + 1000^3d + \quad \ldots \qquad [A]$$

where the letters a, b, &c., stand for the numbers expressed by the successive triplets of figures, beginning at the right hand.

Now the quantity

$$(1000+1)b + (1000^2-1)c + (1000^3-1)d + \ldots\ldots \qquad [B]$$

must be a multiple of 7, 13, and 91. If therefore the quantity [A] be divisible by one of these numbers, so also will the difference between [A] and [B]—viz, $a - b + c - d + \ldots$. Henry Bradley.

[A number which is divisible by two prime numbers must necessarily be divisible by their product.—R.P.].

(Answer to Letter 1274, page 399.)

[1326]—"Point off the given number into periods of three figures. Add separately alternate periods, and find the difference of the sums thus obtained. If this difference is divisible by seven, the original number is so, and if not, not."

The reason is as follows:—Adding the figures alternately, and taking the difference, gives the criterion of divisibility by eleven, since the successive powers of ten (1, 10, 100, 1,000, &c.) divided by eleven give remainders 1, 10, 1, 10, &c.; similarly, adding them alternately in sets of two gives the criterion of divisibility by 101, since 1, 100, 10,000, 1,000,000, &c., divided by 101, give as remainders 1, 100, 1, 100, &c., and adding alternately in sets of three gives the criterion of divisibility by 1001, since 1, 10^3, 10^6, 10^9, &c., give the remainders 1, 10^3, 1, 10^3, &c., when divided by 1001, and since 1001 is divisible by 7 and 13, the same method gives a criterion of divisibility for each of those numbers.

This is only a special case of the law of divisibility in any scale of notation—viz., that adding the figures gives the criterion of divisibility by one *less* than the radix of the scale, adding them alternately and finding the difference gives the criterion for one *more* than the radix. The radix in this case is 1,000. The number taken by Mr. Askew is 220,971,901.

220,000,000 =	a multiple of 1,001		+ 220
971,000 =	,,	,,	− 974
961 =	,,	,,	+ 901
∴ 220,974,901 =	,,	,,	+ 147

and since 1,001 is divisible by 7 and 147 is divisible by 7, a multiple of 1,001 + 147 is divible by 7. Also since 1,001 is divisible by 13 and 147 divided by 13 leaves remainder 4, a multiple of 1,001 + 147 must leave remainder 4. H. A. Nesbitt.

PROPERTY OF NUMBERS.

[1327]—The problem proposed in article No. 1295 of your issue of 6th inst. presents no great difficulty. The actual working-out, which is rather lengthy, I forward separately.

The result may be given as follows:—

Let a, b, c, and d be the remainders when a number N is divided by 3, 5, 7, and 11 respectively.

Then $N = 1155r + 385a + 231b + 330c + 210d$.

The value of r must be taken to suit the conditions of the problem, viz., N is to be a number of three digits.

If this problem is to be given as a mode of figure-conjuring, the conjurer will find the figures involved rather long for mental calculation. It would be better in that case to limit the problem thus:—

Tell a person to take any number not exceeding 100 (to say 105 might give a clue to the puzzle), to mentally divide the number by 3, by 5, and by 7, and to announce the remainders. The would-be conjurer should then be able to announce the number thought of in a few seconds.

The key to the conjuring is as follows—

$$N = 105r + 70a + 21b - 15c$$

r being taken as zero or a negative quantity to suit conditions of problem. A. H. R. E.

P.S.—If another divisor, 13, be introduced and e be the remainder, then it can similarly be found that

$$N = 15015r + 5005a + 6006b + 10725c + 1365d + 6930e.$$

PROBLEM IN NUMBERS.

[1328]—The following problem was given by a Moor at Gibraltar to a friend of mine:—

Divide any number by 3, 5, and 7; the remainders are a, b, and c, and the number of 100 is d. With these data what is the number?

Answer.—$70a + 21b + 15c \pm n \times 105$, n being such a number as will bring the result into the given number of 100.

E.g. 421.

Remainders.

$$
\begin{array}{l}
3)421 \\
\overline{140 + 1 \times 70 = \ 70} \\
5)421 \\
\overline{84 + 1 \times 21 = \ 21} \\
7)421 \\
\overline{60 + 1 \times 15 = \ 15} \\
\qquad\qquad\qquad \overline{106} \\
\qquad\quad + 105 \times 3 = 315 \\
\qquad\qquad\qquad \overline{421}
\end{array}
$$

It may interest your readers to discover the rule and prove it. How the Moor discovered it may be an interesting subject to speculate on.

G. H. Bolland.

A SHEETED GHOST.

[1329]—I once saw a ghost—that is to say, as much of a ghost as I believe anyone ever saw (notwithstanding all one may read and hear) excepting, of course, nervous illusions. About the year 1861, when I was eighteen, and serving my articles, I was in bed with the window-blind up, and the moon shining into the room and on to my bed. I half awoke and, to my surprise, saw standing on me and reaching beyond the ceiling, a tall figure, like that of a man or woman draped in white. I continued to look at the figure, and then not feeling comfortable, resolved to ascertain what it all meant. At this time I was still only half awake, as only a few seconds had elapsed.

I raised myself, and lo! my ghost vanished. But not quite; for in a moment the optical illusion was apparent to me.

Just in front of and close to my eyes had been a pointed fold of the upper sheet of the bedclothes, and upon this the moon shone. In my half-awake condition the effect was perfect, and apparently the figure stood there in all its height: but when I moved I became more awake, and saw the ghost disappear into the pointed fold of the sheet.

J. B. Williams.

TRUE AND FALSE PERSPECTIVE.

[1330]—Neither "Ros. Vansittart" [1276] nor "An Old Draughtsman" [1288] appears to me to have touched the difficulty felt by "R. Jones" [1214], which is one that I (as a teacher of drawing) have found very puzzling to learners, especially to those who like to know exactly the "why and wherefore" of the rules they are taught. The fact is that the usual method, illustrated by "An Old Draughtsman," is a compromise between the impossibility of drawing a picture with a movable centre of vision and impractibility of drawing one on the inner surface of a sphere. The point of view for each picture must be rigidly fixed, and this necessitates the limiting of the field of view to a circle forming the base of a cone whose sides meet at the eye at an angle of not more than about 45° (some artists say not more than 30°). As soon as the eye is directed towards any other point than the centre of the base of this cone, the point to which it is directed becomes at once the centre of the base of a new cone, and a new picture must be drawn upon that point as centre. This is the difficulty experienced by "R. Jones," and over which so many students stumble. As long as the face of a cube is square to the direction of the observer's eye, it must be drawn square, although it may be on one side of the line of direction, for, as soon as he looks directly at it, he changes the position of the centre of vision, which then falls upon the cube itself, and the line of direction is no longer square to the same face of the cube.

The only exact way of representing objects as they actually appear to the eye is by drawing them on the inner surface of a hollow sphere to be viewed with the eye at the centre. This, of course, is impracticable, and indeed is unnecessary, as the same *effect* is got in the usual way if the visual angle is not made too large. Each picture may be then considered as a circular segment of a sphere of which the line of direction is a radius, and if the segment be taken small enough it will be so nearly a plane as to be represented on a flat surface without undue distortion, and *when viewed at the centre* will give the exact effect of the real object.

Wm. Field.

LETTERS RECEIVED AND SHORT ANSWERS.

John A. R. Newlands. You will find a short review of your book on page 370 of our fifth volume.—H. A. Nesbitt. Letters by the Rev. C. L. Dodgson and another correspondent were marked for insertion a fortnight ago.—Ignorant. Your question is more difficult to answer than it looks. I know of good books whence you may learn the various wild flowers, and cheap books having the same end; but none rigidly answering both descriptions. "Familiar Wild Flowers," published by Cassell & Co., and Ann Pratt's "Wild Flowers," published by the Society for Promoting Christian Knowledge come under the former category. Of the lower-priced works Bettany's "First Lessons in Practical Botany," published by MacMillan for a shilling, is as good as any.—George Hill wants to know how many feet of air can be compressed into an iron vessel one foot square? Obviously this must depend upon the strength of the vessel; 250 ft. if it is strong enough. Perhaps some aëronautical reader will answer your question, How long it takes to fill an ordinary balloon.—Frederick Elgar. My personal experience with reference to strawberries differs widely from yours. I have eaten unnumbered gallons of them without developing either rheumatism or gout; albeit both my father and grandfather suffered from the last-named complaint. Should this meet the eye of Mr. Mattieu Williams he may, perhaps, give you the benefit of his opinion.—John Channon. While persistently declining to advertise trade articles in the Health Exhibition now open at South Kensington, I willingly call attention to your exhibit of a Brick Finial in Class 50, representative as it is of the style and quality of instruction imparted at the Technical College, Finsbury, where all the *real* work of the City and Guilds of London Institute will be done in the future, as it has been in the past.—The Ynyscedwyn Company send me a pamphlet to prove that London might be rendered practically smokeless by the use of anthracite, as is the case in New York.—John E. Syms defends the usual method of drawing a cube against "R. Jones" and "C. E. Bell" (letters 1,214 and 1,307). Perhaps I may suggest that each of the disputants should place a cube behind, and with one face parallel to, a sheet of plate-glass, and, keeping the eye rigidly fixed (say by applying it to a pin-hole in a fixed card) trace the outline he sees accurately on the glass, and communicate the result in as short a form as possible. It will be time enough to theorise when we are agreed as to our facts.—A. L. M. sends an account of an odd coincidence. He is resident in the house of an old gentleman who is a keen flower-gardener. On the 19th ult., my correspondent was watching his landlord smarten up his beds, and after a little badinage, threatened to get up in the night and ride a donkey over them! As a matter of fact, a donkey did wander from its house that very night, get into the garden, and make an utter wreck of it; and on seeing its hoof-marks the next morning, the unfortunate proprietor of the ruined flowers could at first scarcely be convinced that his lodger had not carried his curiously improbable jocular threat into execution. "Now," says my correspondent, "I ask, suppose that I had threatened to kill him instead, and he had been found dead in the morning, could I have escaped hanging?"—A. P. Sinnett. Premising that reviews in this journal are not written by its editor unless specially signed by him, but are penned by contributors supposed to possess special knowledge of the subjects of the books to which they relate, I regret that the writer of the notice to which you take exception should have employed a phrase in the slightest degree calculated to hurt your feelings; but having myself read your book when it first appeared, I can only conceive that he said—with perhaps rather needless brusqueness—what every impartial reader of it must have thought. Your cutting from *Light* is not worth the paper it is printed on, inasmuch as the citation of many of the names it contains as those of Spiritualists is *dishonest*. Thackeray, for example, repudiated, both editorially and in his private capacity, the slightest belief in the cock-and-bull stories told by Robert Bell in Vol. II. of the *Cornhill Magazine* (vide Vol. VII. of that magazine, p. 706). Lord Brougham, again, publicly denied any belief in Spiritualism, and so on. Professor Hare was insane, and died, I believe, in an asylum. Nay, will you write to the very first man whose name heads your list, the Earl of Crawford and Balcarres, asking him whether he does or does not believe that so-called "Spiritual" phenomena are supernatural — and publish his reply? Mr. Crookes's "Phenomena of Spiritualism" lies on the table before me as I write. Finding, as I do, in it its author's testimony to the probity and the reality of the phenomena exhibited by Miss Florrie Cook (whom he took such elaborate pains *not* to find out), and knowing how this same Miss Cook's imposture was at once detected on Jan. 9, 1880, by Sir George Sitwell and Herr von Buch, what possible value can I attach to anything that Mr. Crookes may testify or say on the subject of spiritualism? It is idle to talk of "the frauds sometimes perpetrated" by media. Can you give the name of one single well-known medium who has not been ultimately detected? I refuse to suffer the precious space in these columns to be wasted in connection with an imposture which can only be legitimately met by proceeding against media under 5th Geo. IV., c. 83, s. 4, and by placing their dupes in safe confinement.—MISS F. H. WOOD. I have received your historical chart, and your description of your new adjustable geometrical ruler with which it was executed. The latter seems an ingenious instrument, but as I have not the smallest idea when I shall be in town, I regret my inability to make an appointment to inspect it.—MISS MARGARET B. ALDER opines that if "the abysmal depths of the oceans were laid bare . . . . the red clay, with its incipient zeolites, feldspars, and iron oxides, and superfluous silica, would harden into basalt, granite, whinstone, trachyte, and other rocks said to be produced by former volcanic action"—in which I regret to differ from her.—CRAS. I know nothing about the books read for the London degree. The Hamiltonian system of interlinear translation will enable you to construe, but you will infallibly be tripped up in your examination if you do not study the grammatical structure of the sentences as well.—GEORGE CHAPMAN. Our satisfaction is mutual.—A. N. Professor Hughes was the real inventor of the microphone. I cannot spare the column which a description of its construction would occupy. So far as I know it has not been used by any maker of ear trumpets.—J. MURRAY. Send your communication to some other journal, with the offer of a handsome reward to any one who can make head or tail of it.—W. COMMON. Your "puzzle" is as old as the hills. Everything depends upon the direction in which you sail round the world. A ship going from west to east gains a day, on going from east to west loses one, so that if they started simultaneously on their respective voyages, and met again at their conclusion, it might be Tuesday on board of one ship and Thursday on the other. The difficulty is insuperable. There is no such a thing as a hora mundi.—C. E. MARRIOTT sends a letter to the Editor (for Mr. Pillinger) stating that he encloses fifteen stamps—which he does not—for a timepiece! My dear young friend, you must find out where Mr. P. lives, and write straight to him yourself. I am not his agent, and don't keep his timepieces here.—THE NATIONAL HEALTH SOCIETY sends me an excellent little tract on vaccination, which can hardly be too widely circulated.—SIR DANIEL COOPER and E. HOWELL. Thanks for cards of invitations, which overwhelming pre-occupation only has prevented me from accepting.—N. HOPKEN, AN OLD DRAUGHTSMAN, ROSALIE VANSITTART, and ARTHUR A. WEST. See reply to "John E. Syms," above.—W. W. S. It is utterly beyond the province of KNOWLEDGE to recommend individual tradesmen, but of the names you give the third is undoubtedly that of the most scientific artist.—A SUBSCRIBER asks for the composition of some transparent medium for the crystoleum process, which will not spot. Can any of our photographic readers oblige him?—R. RUSSELL. Neither the names nor addresses of correspondents can be given without their special permission.—GANGA RAM. Your pamphlet, when received, will be read by an expert in the matter to which it relates.—ERNEST (*sic*) ENQUIRER. As your facts are wrong, and your conclusions from them erroneous, I feel that I shall best comply with your request to "deal gently with" you by simply acknowledging the receipt of your letter.—W. CAVE THOMAS. Your original letter was already in type when the one you wished to be substituted for it arrived.—M. E. SIMPSON. Your communication shall be forwarded to the proper quarter.—J. The subject is being treated of from a *scientific* point of view, and from that alone; but science is dumb in the presence of such considerations as those which you advance.—T. COMMON. It seems probable, as you say, that Mr. A. McD. has misunderstood the passage you quote. I entirely agree with you that "Mr. Garbett would probably get as much information with regard to the flood from the 'Homo diluvii testis' among the Salamanders in the British Museum as from Mount Ararat and Noah's rainbow."—WATSON & SONS. Received.

THE eighteen principal English railways have earned almost exactly a million a week for the twenty-four weeks of the present year.

A SHIP STRUCK BY LIGHTNING.—A despatch from Derry, dated 22nd ult., says:—"Captain M'Cann, master of the Derry barque *Village Bell*, arrived in port this evening from Baltimore. He reports having eight sailors on board belonging to the Spanish ship *Angeleta*, from New Orleans to Barcelona, which was struck by lightning and set on fire." The message states that the whole of the crew were rescued, and makes no mention of any casualty amongst them. The ship appears to have been burnt to the water's edge.

Our Paradox Column.

THE foolish fellow who mischievously threatened a universal storm some time since, publishes the following curious illustration of paradoxical absurdity. We give it, heading and all, as it appeared in the *New York Tribune*:—

WIGGINS'S DARK MOON.

IS THE EARTH ACCOMPANIED BY TWO SATELLITES?

THE CANADIAN WEATHER-SEER SAYS IT IS AND TELLS THE REASON WHY.

To the Editor of the Tribune.

SIR,—For many years it has been my belief that our planet is accompanied by two satellites, a visible and a dark one, the distance of the latter from the earth being probably double that of the former. The librations of the moon, the irregularity of her motions in her orbit, and the fact that her perigee seldom takes place immediately on the orbit of our earth in advance of the earth's course, are strong evidence of the disturbing influence of a sister satellite. The variation in the time and height of the tides, occasional tides of excessive height without apparent cause, and the frequent occurrence of double tides, cannot be explained on the hypothesis that the earth is attended by only one secondary. Earthquakes which are caused by unusual planetary attraction frequently occur when it would appear that the force which produced them had not yet reached its climax, and could not till after the moon's conjunction with the sun. The recent earthquake in England occurred two days before the moon was in conjunction with the solar orb, and before she was in perigee, showing that her attractive power must have joined with another and very nearly equal force before she reached the line of her solar conjunction. This earthquake I predicted would return with increased violence on May 20. It did so, causing the destruction of many villages and the death of hundreds of people. On the same day occurred the disastrous cyclone in British Burmah. The earthquake, however, did not appear in England, and I am convinced it was moved eastward by the influence of this dark planet. The recent cold wave which passed over America must have been due to this source, and as nearly the same conditions will exist on the 26th and 27th of the present month, the same cold wave would appear were it not for the changed position of this dark horse of the heavens.

All great storms should occur after certain planetary conjunctions, whereas they frequently precede them, and it is for this reason that many meteorologists—among them Sir William Thompson (*sic*)—have denied that the moon has any influence whatever in producing storms on the surface of our globe. Years before I published predictions I found that some of my storms would be delayed for several days, others would appear ahead of time, and frequently the heaviest would be annihilated altogether. There were no known planets which could possibly produce this effect, and I was at length forced to the conclusion, as I have said, that our earth is accompanied by a dark satellite. It would further appear that the "dark days" of which frequent mention is made in history—so called because they could not be traced to an ordinary solar eclipse—were of such a character as to justify the belief that they were caused by an opaque body intervening between our globe and the sun, for the suddenness and brevity of the darkness could not be interpreted as due to smoke or vapour in the earth's atmosphere.

I am confident that the moon and this dark satellite were in conjunction with the sun, or nearly so on March 9, 1883, which produced the eruption of the great Java volcano, and caused the storm which I predicted would be—and the London *Times* says it was the greatest storm of the present century. On March 26, 1884, this planet was somewhere in the neighbourhood of her inferior or superior conjunction, and heightened the storm of the 28th of that month. Strange to add, I have just received letters from Michigan saying that a solar eclipse was visible in that State on May 16, 1884, at 7 o'clock in the evening, when fully one-third of the solar disc was in darkness. As the moon at that moment was twelve degrees south of the celestial equator, and the sun was as many degrees north of it, this phenomenon could not have been caused by our visible satellite. Doubtless it was the passing of this dark planet across the sun's disc.

I have little sympathy with Professor Proctor and others, who, with the prejudice of the old schoolmen, persist in declaring that our moon is a dead planet, and is not possessed of an atmosphere. Any one who will take the trouble to look when she is in quadrature, will see with the naked eye on a clear night the whole luminous annulus or ring of light that surrounds her orb, which is proof positive and complete that she is enveloped in an atmosphere similar to our own. The same arguments were used long ago by Dr. Dick and others to prove that Jupiter and other primaries are destitute of an atmosphere, while the very fact that they are visible, is evidence that they are endowed with atmospheres like that of our own globe, for surely no one is now antiquated enough to believe that light exists throughout space but only in the atmosphere of the planets. The non-existence of a second satellite to the earth is therefore not proved by reason of its invisibility. Its position can only be ascertained by noticing the sudden quenching of stars, and I trust that astronomers both in America and Europe will aid in obtaining the magnitude and motions of this lonely wanderer in the sidereal heavens. E. STONE WIGGINS.

Ottawa, June 3, 1884.

To all which nonsense the *New York Tribune* is at the pains somewhat gravely to reply. The closing words of the leader devoted to this precious rubbish are neat however:—"Unfortunately," says the *Tribune*, "there is one view of Mr. Wiggins's discovery which he has failed to take, to wit, the view that it may not be at all necessary. For between accepting a dark moon (save as an exercise of pure faith) and believing that the meteorological theories of Mr. Wiggins are nonsensical, the great majority of mankind will, we fear, be very apt to find the second conclusion the easier and simpler of the two."

THERE is a series of illustrated notes on the Pons-Brooks Comet of 1883, by H. C. Wilson, in the *Sidereal Messenger* for June, which students of cometary physics will read with interest.

MANGANESE IN ANIMALS AND PLANTS.—Recent researches by M. Maumené have, says *Engineering*, shown that the metal manganese exists in wheat, rice, and a great variety of vegetables. Wheat contains from $\frac{1}{3000}$ to $\frac{1}{15000}$ of its weight of the metal, which exists chiefly as a salt of an organic acid. It is also found in potatoes, beetroot, carrots, beans, peas, asparagus, apples, grapes, and so on. The leaves of the young vine are very rich in it; so are the stones of apricots. The proportion in cacao is very great, as it is in coffee, tobacco, and especially in tea. In the 50 grammes of ashes left by a kilogramme of tea, there was found 5 grammes of metallic manganese. There are vegetables, however, in which no manganese can be found, as, for example, oranges, lemons, onions, &c. Many medicinal plants contain it, as for example, cinchona, white mustard, and the lichen (*Roccella tinctoria*). Animal blood does not always contain it, but it is found in milk, bones, and even hair. M. Maumené regards its presence in the human body as an accident, and not of vital importance. He also suggests that doctors should cease to employ manganese as a succedaneum with iron, for while the latter is useful to the blood, the former is an intruder which is only tolerated in small traces, and rejected in larger quantities. Tea, coffee, and other vegetables require abundance of manganese in the soil for their proper cultivation, and the absence of it may account for the failure of many plantations.

IN connection with the series of lectures now and for some time past in course of delivery by some of our best-known scientific men, at the Royal Victoria Coffee Hall, a lecture was given on Tuesday week by Mr. Arthur Nicols, F.G.S., F.R.G.S., on "The Dog as the Friend of Man," illustrated by numerous large coloured pictures of the heads of the principal breeds, prepared specially from drawings by distinguished artists. The lecturer treated his subject from the point of view of the lover of dogs, rather than of the dog-fancier. He first gave a sketch of the origin of domestic dogs, which all competent naturalists are now agreed in considering as having been derived from some three or four wild species; and proceeded to consider in detail the senses—sight, hearing, and smell—by instances mainly derived from his own experiences at home and abroad, giving many illustrative examples and anecdotes of the utility of dogs. In more than one instance the lecturer showed how his life had been saved by the viligance of these faithful animals. He next described the characteristics of the principal breeds, commented on dog-shows, canine madness, &c., and gave instances in evidence of the intellect and moral character of dogs, concluding with remarks on the influence which association with the dog has exerted on man himself. The lecture was listened to throughout with great attention by a very considerable proportion of the audience, the conduct of the occupants of the gallery, however, leaving much to be desired. A hand-bill was previously distributed in the hall of notes, drawn up by Mr. Nicols, on "Mad Dogs: How to Know Them, and What to Do," with the object of diffusing useful information on this important subject.

Our Mathematical Column.

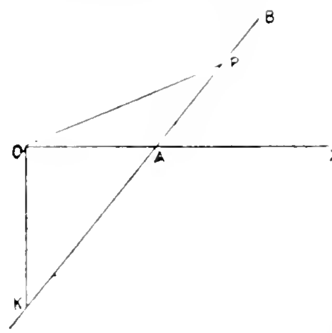
EASY LESSONS IN CO-ORDINATE GEOMETRY.

BY RICHARD A. PROCTOR.

(*Continued from p. 467.*)

POLAR CO-ORDINATES.

45. PROP.—*To find the polar equation to a straight line in terms of the angle at which it is inclined to the initial line, and the intercept on the initial line.*



Let A B be a line meeting the initial line O X in A. Let O A $=a$, and $\angle$ B A X $=\alpha$. Take P any point on A B, and let the co-ordinates of P be r, θ. Join O P, then

$$\text{O P} = \text{OA}\,\frac{\sin \text{O A P}}{\sin \text{O P A}}$$

that is $r = a\,\dfrac{\sin \alpha}{\sin (\alpha-\theta)}$

the required equation, which may be written in the form

$$r \sin (\theta-\alpha) + a \sin \alpha = 0 \qquad (1.)$$

We might have obtained (1) from the equation to A B in rectangular co-ordinates (O X the axis of X). For draw O K perpendicular to O X to meet A B in K, then O K $= a \tan \alpha$. Thus the equation to B K is

$$\frac{x}{a} - \frac{y}{a \tan \alpha} = 1$$

that is, since $x = r \cos \theta$, and $y = r \sin \theta$

$$\frac{r \cos \theta}{a} - \frac{r \sin \theta \cos \alpha}{a \sin \alpha} - 1 = 0$$

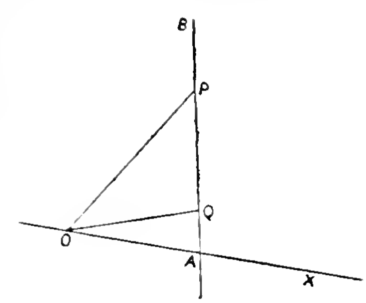
or

$$r \sin (\theta-\alpha) + a \sin \alpha = 0 \qquad (1)$$

as before.

We can obtain the polar equation in a more convenient form by determining the line in a different manner.

47. PROP.—*To find the polar equation to a line in terms of the perpendicular on the line, and the angle at which this perpendicular is inclined to the initial line.*



Let A B be a straight line. Draw O Q perpendicular to A P, and suppose O Q $=p$ and $\angle$ Q O A $=\alpha$; let r, θ be the co-ordinates of any point P in A B; then

$$\text{O P} \cos \text{P O Q} = \text{O Q}$$

that is

$$r \cos (\theta-\alpha) = p$$

the required equation.

47. If in (1) $a=0$, the equation becomes

$$r \sin (\theta-\alpha) = 0$$

i.e., $\sin (\theta-\alpha) = 0$

Hence $\theta=\alpha$ or else $\theta-\alpha=\pi$; that is $\theta=\alpha$ or $\alpha+\pi$; and it is obvious that either form expresses the same line. Hence the equation to a line through the pole inclined at an angle α to the initial line is

$$\theta = \alpha.$$

48. And, *vice versâ*, an equation of the form $\theta =$ a constant, represents a straight line through the pole; for it is clear that such a line is the only curve for every point of which θ is constant.

49. The polar equation of the straight line is of the form

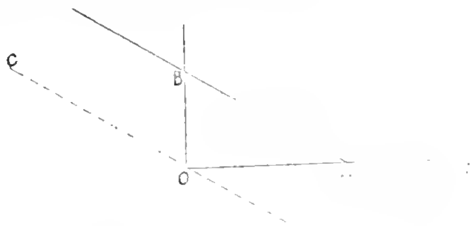
$$\text{A}\, r \cos \theta + \text{B}\, r \sin \theta + \text{C} = 0 \qquad (1)$$

and we might easily prove, conversely, by an independent process that an equation of this form always represents a straight line. This is not necessary, however, since transforming to rectangular co-ordinates making the pole the origin and the initial line the axis of , (1) becomes

$$\text{A}\, x + \text{B}\, y + \text{C} = 0$$

an equation which, as we have already seen, represents a straight line whose intercept on the axis of x (that is, on the initial line of our polar equation) is $-\dfrac{\text{C}}{\text{B}}$, and which is inclined to the same axis or initial line at an angle whose tangent is $-\dfrac{\text{B}}{\text{A}}$.

50. The following examples illustrate the method of drawing the lines represented by given polar equations.



Take first the equation

$$2r\cos\theta+3r\sin\theta-6=0 \qquad \text{(i)}$$

Put $\theta=0$, giving $2r-6=0$

That is $r=3$

Again put $\theta=\frac{\pi}{2}$, giving $3r-6=0$

That is $r=2$

Thus the given equation represents the line A B in the figure, in which O A = 3, and O B = 2, O B being drawn at right angles to the initial lino O X.

51. The following method is often more conveniently applicable. In (i) put as before $\theta=0$, giving $r=3$; that is, determining the point A in which the given line cuts the initial line. Now since

$$r=\frac{-6}{2\cos\theta+3\sin\theta}$$

it is clear that if such a value be given to θ that

$$2\cos\theta+3\sin\theta=0.$$

In other words, if we take

$$\tan\theta=-\frac{2}{3}$$

r becomes infinitely great. Hence if O C be drawn from O inclined to O X at an angle whose trigonometrical tangent $=-\frac{2}{3}$, then O C must be parallel to the line represented by (i). Thus we must take O A = 3 and then draw through A the line D A B parallel to O C.

Take as another illustration the equation

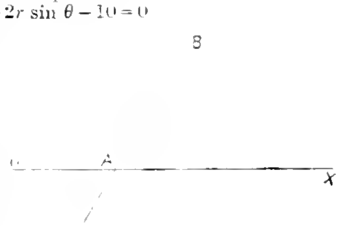
$$5r\cos\theta-2r\sin\theta-10=0$$

Here $\theta=0$ gives $r=2$, and to make r infinite we must take

$$5\cos\theta-2\sin\theta=0$$

that is, $\tan\theta=\frac{5}{2}$

Thus if we take O A = 2 and draw A B inclined to O X at an angle B A X whose tangent is $\frac{5}{2}$, A B is the line represented by the given equation.



(*To be continued.*)

EASY RIDERS ON EUCLID'S FIRST BOOK.

WITH SUGGESTIONS.

PROP. 33.

142. Two straight lines A B and A C are drawn from a point A; and two other straight lines D E and D F from a point D. A B is equal and parallel to D E, and A C is equal and parallel to D F. Show that B E is equal and parallel to C F.

143. If a quadrilateral have two of its sides parallel, and the other two equal but not parallel, any two of its opposite angles are equal to two right angles.

144. Two equal but not parallel lines make equal angles on the same side of a third line which joins their extremities. Show that the straight line which joins their other extremities shall make equal angles with the two first lines and be parallel to the third.

145. In the figure to Euc. I. 5, G L drawn perpendicular as to B C produced, is produced to M so that L M is equal to L G. Show that B L is equal and parallel to F C.

PROP. 34.

146. The diagonals of a parallelogram bisect each other.

147. If two straight lines bisect each other, the straight lines joining their extremities form a parallelogram.

148. No two straight lines drawn from the extremity of the base of a triangle to the opposite sides can possibly bisect each other.

(*To be continued.*)

Our Whist Column.

BY FIVE OF CLUBS.

THE HANDS.

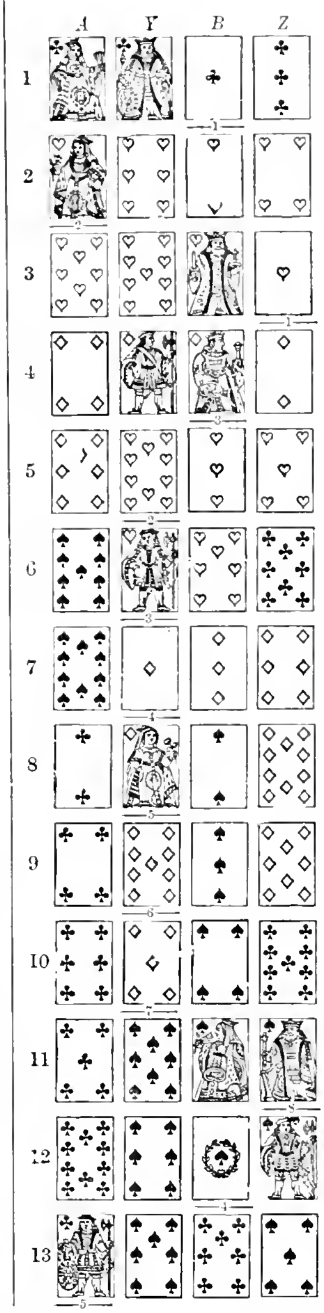
B { *H.* K, 7, 3, 2. S. A, Q, 4, 3, 2.
C. A, 7. D. K, 3. }

Y { *H.* Kn, 10, 9, 6.
C. K.
D. A, Q, Kn, 9, 5
S. 8, 7, 6. }

A-B, 0. **B**
Y *Tr. H4* **Z**
Y-Z, 3.
A leads.

4, 5, A. *H.*
3, 8, 9. C.
2, 6, 8, 10 D.
5, Kn, K. S. } *Z*

A { *H.* Q, 8. S. 10, 9.
C. Q, Kn, 10, 6, 5, 4, 2. D. 7, 4. }



THE GAME.

1. *A* leads from his long suit, and properly leads Queen from Q, Kn, 10, &c. The suit is established first round.

2. *B* seeing his partner's suit cleared (of course it is not known to *B* that *A*'s suit is *established*), and having commanding strength in Spades and a King guarded in Diamonds, properly leads trumps.

3. After this round *Y* remains with command in trumps; *B* cannot hold more than two, or he would have led Heart three originally—*the penultimate*.

4. *Z* properly leads from length rather than from strength.

5. *A* properly discards from his weakest suit.

6. *Y* clears out trumps before leading from his long suit.

7. So far as this round shows, *Y* may not have length and strength in the suit originally led by *Z*, but may be simply playing to clear *Z*'s suit.

8. *B* renouncing shows *Z* how the Diamonds lie. *Y* holds Queen, nine, and five. If *Z* plays the lowest he will have to take the next round in Diamonds, and either to lead *A*'s established suit or the suit in which *B* is presumably strong. But playing out the ten, *Z* clears his partner's Diamonds, gaining one trick in that suit.

9. *B* plays very badly here. The other three tricks are in *A B*'s hands, and all wanted if game is to be saved. But the weakness so many players have for making tricks themselves rather than let their partner make them, causes *B* to finesse the Queen, instead of taking the trick with the Ace and leading Club to his partner's commanding sequence.

The above hand is from Cavendish (Notes by Five of Clubs). It illustrates a point which inexperienced players constantly overlook,—the necessity of getting rid of command of partner's suit when that suit has been established and can be brought in.

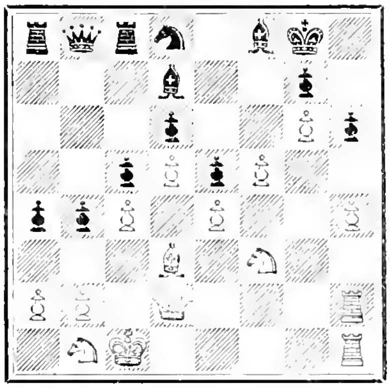
Our Chess Column.

By Mephisto.

THE following remarkable position occurred in the game between Messrs. Hirsch and Blackburn, the latter player yielding Pawn and move to his opponent, in the Handicap Tournament now in progress at the Divan.

Mr. Blackburn.

Black.



White.

Mr. Hirsch.

White has a very strong game, and, with a few well-directed moves, he ought soon to obtain a winning advantage. Amongst other moves he may play Kt to Kt5 as the P dare not take, to be followed by Kt to R7, and P to B 6 &c. Black is almost powerless, and could not have offered much resistance. In this position White played the most remarkable move of

Q to Kt5.

and the game continued as follows:—

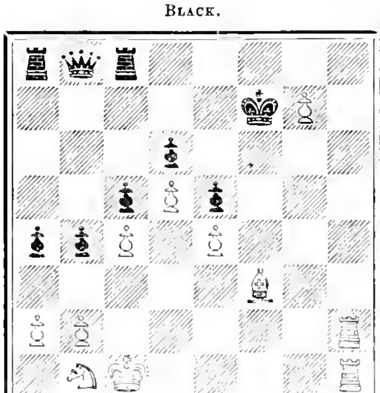
	P × Q
P × P	Kt to B2
P to B6	B to Kt5
B to K2 (threatening to win by Kt × P).	
	B × Kt
B × B	P × P
P × P	B to Kt 2.

Here White missed the right reply, and thus failed to reap the benefit of his brilliant play. White played P × B, to which Black replied with Kt to Kt4, and ultimately won the game. We think, however, that the issue would have been different had Black followed the obvious line of play and taken the two pieces; in which case the following might have occurred:—

P × Kt (ch)	K × P
P × B	

Mr. Blackburn.

Black.



White.

Mr. Hirsch.

Now we really do not see a satisfactory continuation for Black. Our informant, Mr. Frankenstein, is of opinion that White ought to win. We give a few possible variations, leaving to our readers to determine whether Black had any valid defence. If, for example:—

K takes P		R to Kt sq	
R to Kt sq (ch)		B to R5 (ch)	
K to B3	K to B sq	K takes P	K to K2 !
R to R6 (ch)	R to R8 (ch)	R to Kt sq (ch)	R to Kt sq
K to K2	K to K2	K moves	K to Q2
R to R7 (ch)	R to R7 (ch)	R to B2 (ch)	B to B7
K to B sq	K to B sq (*b*)	K to K2	Q to Kt3 (*c*)
B to Kt		R to B7 (ch)	R to B2 (*d*)
and wins (*a*).		and wins.	

(*a*) Black has no satisfactory move, as White threatens B to K6, if Black now plays R to Ksq, then B to R5, R to K2. R to R8 (ch) and wins, or, if instead of R to Ksq, Black plays R to B2, White ought to win by winning the Queen by R to R8 (ch), and remaining with two minor pieces against a Rook. This, we think, is the best result that Black may hope to attain.

(*b*) And the position is the same as before. If, instead of K to Bsq, Black now plays K to B3, then B to R5 wins.

(*c*) Instead of this, Black may play R takes P. R takes R, K to B2. B to K6(ch), K to Kt3. R to R7, Q to Qsq. Kt to Q2, Q to B3. B to B4, and White must win by bringing his Kt well into play. The black Rook dare not move, and if either P advances, White pushes on.

(*d*) Again, it is difficult to see what to do for Black, as White threatens either B takes R, followed by R to B8 or B to K6, followed by R to B7. If now Q to Qsq, B to K6(ch), K to B2. R to B7(ch), K to Kt3. R to Q7, Q to B3. Kt to Q2 (threatening R to Bsq, followed by R takes P(ch) &c.), Q to R3, R takes P(ch), K to Kt2. R to Q7(ch), followed by B to B5, and White ought to win.

We do not presume to have exhausted Black's chances of defence, at almost every move a variation of play may occur; the above analysis is only intended to serve as a general indication of what might be attempted in this remarkable position.

SOLUTION OF PROBLEM, p. 467.

1. R to Kt3, and mates accordingly.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions received of A. W. Overton—George Gouge—Q. T. V.

Senex wishes to find an opponent for correspondence games.

E. Ridgeway.—If 1. B to K6, Kt takes P, and there is no mate. This problem has deceived a good many solvers.

Contents of No. 139.

SPECIAL NOTICE.

KNOWLEDGE
AN ILLUSTRATED MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, JULY 11, 1884.

CONTENTS OF NO. 141.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

[I have received many inquiries in regard to the earliest history of the study of life in other worlds, and am surprised to find how little is known of the work of Huyghens, Fontenelle, and others, in that direction. It has occurred to me, in particular, that the bright and graceful little treatise of Fontenelle, published early in the eighteenth century, (written as it was at a time when the Vortices of Descartes were in full vogue in his own country, though beginning to be discredited in the country of the great Newton) would be interesting and new to thousands of our readers. I propose, therefore, to give an English version of the little book here, with such notes of my own as may seem necessary and desirable. The quaint old illustrations are given; those illustrating the vortices are indeed necessary to give an idea of the old notions respecting these celestial whirlpools.—RICHARD A. PROCTOR.]

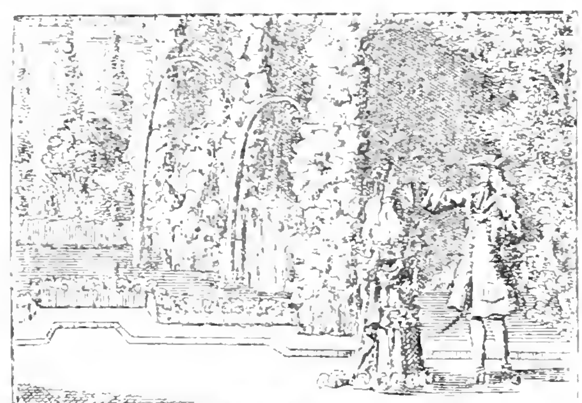
FONTENELLE'S PREFACE.

I AM pretty much in the same case with Cicero, when he undertook to write of philosophical matters in the Latin tongue, there being, then, no books upon that subject but what were in Greek. He was told that such an attempt would be useless, because those who were lovers of philosophy would rather take the pains to search for it in Greek writers than make use of Latin ones, which treated of it, but at second hand; and that those who had no relish for this science would never trouble their heads with either Greek or Latin. To these objectors, he answered, it would happen quite otherwise; for, says he, the great ease people will find in reading Latin books will tempt those to be philosophers who are none, and they who already are philosophers by reading Greek books will be very glad to see how the subject is handled in Latin.

Cicero might with good reason answer as he did, because the excellency of his genius and the great reputation he had acquired warranted the success of all he wrote; but in a design not much unlike his I am far from having those grounds of confidence which he had. My purpose is to discourse of philosophy, but not directly in a philosophical manner, and to raise it to such a pitch that it shall not be too dry and insipid a subject to please gentlemen, nor too mean and trifling to entertain scholars. Should I be told (as Cicero was) that such a discourse as this would not please the learned, because it cannot teach them anything, nor the illiterate, because they will have no mind to learn; I will not answer as he did. It may be endeavouring to please everybody; I have pleased nobody. Now, to keep a medium betwixt two extreams is so very difficult that I believe I shall never desire to put myself a second time to the like trouble.

If I should acquaint those who are to read this book, and have any knowledge of natural philosophy, that I do not pretend to instruct, but only to divert them; by presenting to their view, in a gay and pleasing dress, what they have already seen in a more grave and solid habit. Not but they to whom the subject is new may be both diverted and instructed. The first will act contrary to my intention if they look for profit, and the last if they seek for nothing but pleasure.

I have chosen that part of philosophy which is most likely to excite curiosity; for I think nothing concerns us more than to enquire how this world which we inhabit is made; and whether there be any other worlds like it which are also inhabited as this is. But, after all, it is at everybody's discretion how far they will run their disquisitions. Those who have any thoughts to lose may throw them away upon such subjects as these, but I suppose such as can employ their time better will not be at so vain and fruitless an expense.



Great Fontenelle the Heavens did Descry, And taught the Ladies his Philosophy.

In these discourses I have introduced a lady, to be instructed in things of which she never heard; and I have made use of this fiction to render the book the more exceptable, and to give encouragement to gentlewomen by the example of one of their own sex, who, without any supernatural parts or tincture of learning, understands what is said to her; and, without any confusion, rightly apprehends what vortexes and other worlds are. And why may not there be a woman like this imaginary Marchioness, since her conceptions are no other than such as she could not chuse but have?

To penetrate into things either obscure in themselves, or but darkly expressed, requires deep meditation, and an earnest application of the mind! but here, nothing more is requisite than to read and imprint an idea of what is read in the fancy, which will certainly be clear enough. I shall desire no more of the fair sex, than that they will peruse this system of philosophy, with the same application that they do a romance or novel, when they would retain the plot, or find out all its beauties. It is true, that the ideas of this are less familiar to most ladies than those of romances, but they are not more obscure; for at most, twice or thrice thinking, will render them very perspicuous.

I have not composed an airy system, which has no foundation at all: I have made use of some true philosophical arguments, and of as many as I thought necessary; but it falls out very luckily in this subject, that the physical ideas are in themselves very diverting; and as they convince and satisfy reason, so at the same time they present to the imagination a prospect which looks as if it were made on purpose to please it.

When I meet with any fragments which are not of this kind, I put them into some pretty strange dress: Virgil has done the like in his "Georgicks;" when his subject is very dry, he adorns it with pleasant digressions: Ovid has done the same in his "Art of Love;" and though his subject be of itself very pleasing, yet he thought it tedious to talk of nothing but love. My subject has more need of digressions than his, yet I have made use of them very sparingly, and of such only, as the natural liberty of conversation allows: I have placed them only where I thought my readers would be pleased to meet with them; the greatest part of them are in the beginning of the book, because the mind cannot at first be so well acquainted with the principal ideas which are presented to it; and, in a word, they are taken from the subject itself, or as near to it as is possible.

I have related nothing concerning the inhabitants of the several worlds which may seem fabulous or chimerical; but have said whatever may be reasonably thought of them; and the visions which I have added have some real foundation; what is true and what is false are mingled together, but so as to be easily distinguished. I will not undertake to justify so fantastical and odd a composition, which is the principal point of the work, and yet for which I can give no very good reason.

There remains no more to be said in this place to a sort of people who, perhaps, will not be easily satisfied, though I have good reasons to give them; but that the best which can be given will not satisfy them. These are the scrupulous persons who imagine that the placing inhabitants anywhere but upon the earth will prove dangerous to religion. I know how excessively tender some are in religious matters, and therefore I am very unwilling to give any offence, in what I publish, to people whose opinion is contrary to that I maintain. But religion can receive no prejudice by my system, which fills an infinity of worlds with inhabitants, if a little error of the imagination be but rectified. When it is said the moon is inhabited, some presently fancy that there are such men there as ourselves; and priests, without any more ado, think him an Atheist who is of that opinion. None of Adam's posterity, cry they, ever travelled so far as the moon; nor were any colonies ever planted in that region. I grant it. The men in the moon are not the sons of Adam. And here again theology would be puzzled if there should be men anywhere who never descended from him. To say no more, this is the great difficulty to which all others may be reduced; to clear it by a larger explanation, I must make use of terms which deserve greater respect than to put into a treatise, so far from being serious as this is. But perhaps there is no need of answering the objection, for it concerns nobody but the men in the moon; and I never yet affirmed there are men there. If any ask what the inhabitants are, if they be not men? all I can say is that I never saw them; and it is not because I have seen them that I speak of them. Let none, however, think that I say there are no men in the moon purposely to avoid the objection made against me, for it appears it is impossible there should be any men there, according to the idea I have framed of that infinite diversity and variety, which is to be observed in the works of nature. This idea runs through the whole book, and cannot be contradicted by any philosopher. Nay, I believe I shall only hear this objection started by such as shall speak of these discourses without having read them. But is this a point to be depended on? No, on the contrary, I should more probably fear that the objection might be made to me from many passages.

FONTENELLE.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS

By Edward Clodd.

IV.

THE artificial divisions which man in his pride of birth made between the several classes of phenomena in the inorganic world, and also between the inorganic and the organic, are being swept away before the larger knowledge and insight of our time. Indeed, it would seem that the surest test we can apply to the worth of any kind of knowledge is whether it adds to or takes from our growing conception of unity. If it does the former, we cannot overthrow it; if it does the latter, then is it science "falsely so called."

That notable doctrine known as the correlation of physical forces, or the convertibility into one another of heat, light, electricity, chemical affinity, &c., each being a mode of manifestation of an unknown energy which "lives through all life, extends through all extent," has its counterpart in the correlation of spiritual forces. Varied as are the modes of expression of these, that variety is on the surface only. Deep down lies the one source that feeds them, the one heart to whose existence their pulsations witness. All primitive philosophies, all religions "that man did ever find," are but as the refractions of the same light dispersed through different media; are the result of the speculations of the same subject, allowances being made for what the astronomers call personal equation, upon like objects. And, therefore, in treating of the nature and limitations of man's early thought concerning his surroundings, whether these be the broad earth bathed in the sunshine, or swathed in the darkness, or the sounds that come from unseen agents, the sight of spectral visitants of whom he cannot have touch, and out of which are built up his theories of the invisible world: the reader may find reference to the same conditions which were shown in former papers to give birth and sustenance to primitive myth. The same fantastic conclusions, drawn from rude analysis and associations, and from seeming connections of cause and effect; the same bewildering entanglement between things which we know can have nothing in common, meet us; and the same scientific method by which is determined the necessary place of each in the advance of man to truth through illusion is applied.

The illustrations of the vital connection which the savage assumes between himself and his name show how easy is the passage from belief in life inhering in everything, to belief in it as capable of power for good or evil. This can be shown by illustrations from more tangible things than names. The savage who is afraid to utter these, shrinks from having his likeness taken, in the feeling that some part of him is transferred, and at the mercy of the sorcerer and enemy. The Malemutes of North America refused to risk their lives before a photographic apparatus. They said that those who had their likenesses, had their spirit, and they would not let these pass into the keeping of those who might use them as instruments of torment. The Yanktons accused Catlin of causing a scarcity of buffaloes by putting a great many of them in his book, and refused to let him take their portraits. So with the Araucanians, who ran away if any attempt was made to sketch them. Among such races, we find great care exercised lest cuttings of hair, parings of nails, saliva, refuse of food, water in which they had washed, &c., should fall into unfriendly or mistrusted hands. The South Sea Island chiefs had servants following them with spittoons, that the saliva might be buried in some hidden place. Among the Polynesians any one who fell ill attributed it to some sorcerer, who had got hold of refuse from the sick and was burning it, and the quiet of the night was often broken by the blowing of shell-trumpets, as signals for the sorcerer to stop until the gifts on their way to appease him could arrive. As with the name or the portrait, whoever possessed a part of the material substance possessed a part of the spiritual, and in this world-wide belief in a sympathetic connection between things living and not living lies the whole philosophy of sorcery, of charms, amulets, spells, and the general doctrine of luck surviving through the successive stages of culture to this day. And he who would prevent anything from his person getting into hostile hands, naturally sought after things in which coveted qualities were believed to dwell, and avoided those of a reverse nature. So we find tiger's flesh eaten to give courage, and the eyes of owls swallowed to give good sight in the dark. The Kaffirs prepare a powder made of the dried flesh of various wild beasts, the leopard, tiger, elephant, snake, &c., so as to absorb the several virtues of these creatures. The Tyrolese hunter wears his tuft of eagle's down to gain long sight and daring, and the Red Indian strings bears' claws round his neck to get Bruin's savage courage. The customs of scalping and, in some measure, of cannibalism, may be referred to the same notion, for the Red man will risk his life to prevent a tribesman's scalp being captured by the foe, and the New Zealander will swallow the eyes of his slain enemy to improve his sight. When a whaler died, the Eskimos distributed portions of his dried body among his friends, and rubbed the points of their lances with them, it being held that a weapon thus charmed would pierce a vital part in a whale, where another would fail. Sometimes the body was laid in a cave, and, before starting for the chase, the whalers would assemble, and, carrying it to a stream, plunge it in, and then drink the water. When the heroic Jesuit, Brébeuf, was tortured by the Iroquois, they were so astonished at his endurance, that they laid open his breast and came in a crowd to drink the blood of so valiant a foe, thinking to imbibe with it some portion of his courage. A chief tore out his heart and devoured it.

Cannibalism, it may be remarked, *en passant*, is also found to have a religious significance, on the supposition, which has unsuspected survival among advanced races, that eating the body and drinking the blood communicates the spirit of the victim to the consumer. It is not always the most savage races who practise it; for example, the Australians, despite the scarcity of large animals for food supply, rarely eat the flesh of man, whilst the New Zealanders, who rank far above them, and had not the like excuse, were systematic feeders on human flesh.

As examples of a reverse kind, but witnessing to the play of like beliefs in qualities passing from brutes and lifeless things, we find some races avoiding oil, lest the game slip through their fingers, and abstaining from the flesh of deer, lest it engenders timidity, and of pigs and of tortoises, lest the eater has very small eyes. Dr. Tylor gives an apposite illustration of a kindred superstition in the Hessian lad who thinks that he may escape the conscription by carrying a baby-girl's cap in his pocket, as a symbolical way of repudiating manhood. Among ourselves there was an old medical saw, "Hare-flesh engendereth melancholy bloude," and in Swift's "Polite Conversation" we have this reason assigned by Lady Answerall when asked to eat it; whilst faith is not yet extinct in the "Doctrine of Signatures," or the notion that the appearance of a plant indicates the disease for which it is a remedy, as the "eyebright," the black-purple spot on the corolla of which was said to show that it was good for weak eyes.

Brand remarks* that the custom of giving infants coral to help in cutting the teeth, is said to be a survival of an old belief in it as an amulet; and in English, Sicilian, and West Indian folk-lore, we find the belief that it changes colour in sympathy with the pale or healthy look of the wearer. An old Latin author says: "It putteth of lightenynge, whirlewynde, tempeste, and stormes fro shyppes and houses that it is in."

We are each of us hundreds of thousands of years old, and although our customs and beliefs have a far less venerable antiquity, their sources lie not less in primitive thought. Like the survival of the "casula" or "little house" or "shelter" in the chasuble of the priest; like the use of stone knives in circumcision long after the discovery of metals; the general tends to become special; the common, its primitive need or service forgotten, to become sacred. Sometimes the early idea abides; the Crees, who carry about the bones of the dead carefully wrapped up as a fetish; the Caribs, who think such relics can answer questions; the Xomanes, who drink the powdered bones in water, that they may receive the spirit; the Iroquois cited above; represent the barbarous ancestry of higher races, whether of the Bacchanalians described by Arnobius, who thought that the fulness of the divine majesty was imparted to them when they tore and ate the struggling rams with mouths dripping with gore, or of the faithful who receive nutriment through the symbols of the Cross. And the prayers of savage and civilised have this in common, that some advantage is thereby sought by the utterer; their sacrifices are alike the giving up of one's goods or one's self to a deity who may be appeased or bribed thereby; their fastings are cultivated as inducing the abnormal states in which their old men dream dreams and their young men see visions, spirits appearing as angels ascending and descending between earth and the abode of the blest; their baptisms are the ancient lustrations, which water, as the cleansing element, suggested; and their eastward position, over which jurists and ecclesiastics have fought, the undoubted relic of worship of the rising sun.

In short, there is no rite or ceremony yet practised and revered amongst us which is not the lineal descendant of barbaric thought and usage, expressing a need which, were men less the slaves of creation and indolence, would long since have found loftier form than in genuflexion before shrine and reliquary. By an exercise of imagination not possible but for these being a felicitous "gesture language" of the cries of human souls, a mass of heathen and pagan rites have been transformed into those of the Christian

* "Pop. Ant.," II., 85.

faith. That they have come to be mistaken for the ideas symbolised; that with the loftiest spiritual teaching there should remain commingled belief in miraculous power in fragments (mostly spurious) of dead men and their clothes; only shows the persistency of that notion of a vital connection between the lifeless and the living which this paper has sought to illustrate.

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE MIDDLE DEPTHS (*continued*).

THE larvæ of these two great water-beetles are elongate, six-footed creatures, with powerful jaws (Fig. 1), presenting no sort of resemblance to the beetles themselves; both are carnivorous and extremely voracious, dealing destruction to great numbers of their companions in pond-life. The ordinary spiracles being aborted, their respiration is conducted through certain projections at the tip of the tail, which are thrust above the surface to imbibe air. Having passed a comparatively short life in the larval condition, the insect quits the water, and, forming a cell in the damp margins of the pond, there effects its change to the pupal state. In due time the beetle is produced from this,

Fig. 1.—Larva of Hydrophilus piceus.

at first soft and pale, but acquiring, after a few days' exposure to the air, its normal colour and consistency. The female Hydrophilus forms a marvellous sac for the reception of her eggs. It is composed of a gummy substance, the secretion of which is effected not in or near the mouth, but at the other end of the alimentary canal. A tough, papery bag is formed, which carries a long spike, and is attached to subaqueous plants. The eggs, about fifty in number, are regularly placed side by side within this, and are thus protected from the attacks of such aquatic creatures as might feel disposed to try the taste of beetles' eggs.

Another of the Philhydrida, a much smaller insect, of yellowish-brown colour, called *Spercheus emarginatus* (Fig. 2), which used to be found at Whittlesea Mere, and was supposed by many to have become extinct as a British species until recently rediscovered by Mr. T. R. Billups at a certain spot in the neighbourhood of South London, forms

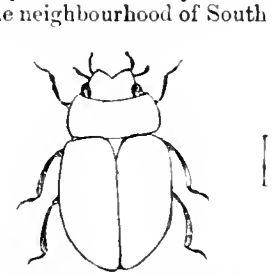


Fig. 2.—Spercheus emarginatus.

a bag which the mother carries about on the under surface of her body. This insect, both in the larval and perfect state, is described by the Rev. W. W. Fowler, who has kept and watched the species, as having the peculiar habit of walking on the under-side of the surface of the water with its back downwards, after the fashion of a fly on a ceiling, a thin film of air contained between the body and the edges of the elytra seeming to act as a float; the larva, too, is so completely permeated with air by means of its large tracheæ as to be rendered quite buoyant, and to find, apparently, as much difficulty in sinking as a man with a cork jacket on; so it needs no effort to maintain itself in its inverted position just below the surface.

Water-beetles, as we have already said, are not confined to the water, but at night frequently leave their native ponds and enjoy themselves in the air, or migrate to other quarters. No collection of water is so small as not to prove attractive to them; even cart-ruts that have been converted into so many miniature canals by a heavy rain may soon become tenanted. They cannot boast of any great brilliance of colouring. Yellows of no very conspicuous hue, browns, greys and blacks, singly or intermixed, are the prevailing tints. Some few of the brighter yellow species are spotted with black, and so become rather pretty, and some of the Philhydrida are slightly adorned with spots and patches of a metallic tint something like that of "peacock copper ore," but with these few exceptions they are a sombre set of insects, and their chief interest certainly lies in the remarkable modifications which fit them for aquatic life.

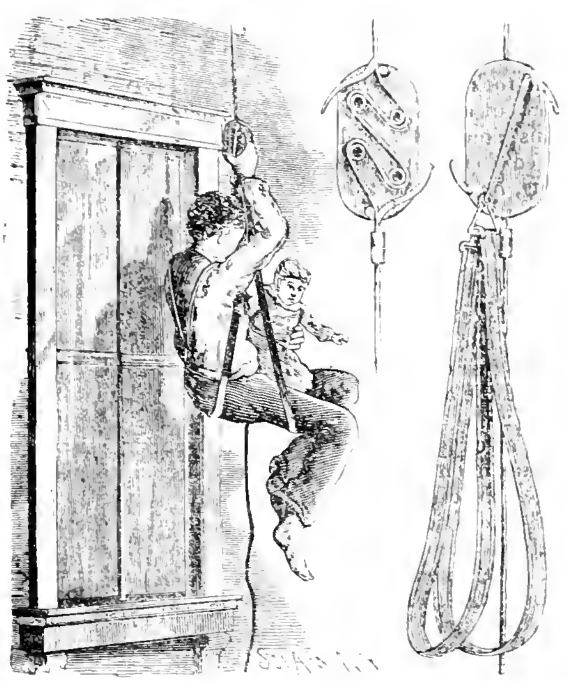
We now pass to the Dipterous fauna of the middle depths. The Diptera, it will be remembered, are the two-winged flies, and none of these in the perfect state inhabit water; some, however, are aquatic during their two earlier stages. Omitting a few very aberrant forms, there may be considered to be two very distinct types of flies, one slender, with abnormally long and fragile legs, and with antennæ of moderate length, and frequently tufted or fringed with hairs; the other stouter and more substantial, with much shorter legs, and antennæ so inconspicuous as often to be unnoticed. It is to the former of these groups that most of the species whose larvæ are aquatic belong. They consist of certain kinds of gnats, midges, and daddy-longlegs, insects whose *names* are as familiar as household words, though no very exact signification appears to be popularly attached—at any rate to the two former of these, which are often vaguely used for any minute and delicate flying insect, of whatever nature. Very varied are the habits of the long-legged, long-horned flies; some of them are the causes of certain gall-like excrescences that occasionally disfigure plants, and inside which their larvæ live; the larvæ of others, again, live in the earth, especially in damp places, and it is only a few members of the group that are aquatic, and that we have now to deal with.

It may seem difficult to conceive of a method by which so fragile a creature as a gnat, which would be irretrievably damaged by contact with the water, can manage safely to convey its eggs into such a position as will permit the larvæ hatched from them at once to get into their proper element. Most wonderful, indeed, is the plan adopted. Finding some floating shred of straw, stick, grass, or other such support, the expectant mother rests her two fore-legs on this, allows the next pair gently to touch the water, and crosses the third pair behind to form a sort of vice in which to hold the eggs as they are deposited. Then a long oval egg is lodged in the angle formed by the crossed legs, with its longer diameter vertical; another, following it, is glued on to the side of the first in a similar position, and so on till some 200 or 300 are fastened into a sort of raft, or rather life-boat, as the mass is curved upwards at each end. Then the little vessel is abandoned to the mercy of winds and wavelets, and so floats about for a few days, benefiting by sun and air, till the growing embryos, finding their quarters too close, push open a kind of trap-door in the floor of the egg and take a dive at once into their watery home. They are quaint-looking creatures, with a big head and thorax and long, tapering body, and they swim about head downwards. Near the tail, a straight branch, carrying a number of hairs at its tip, projects at an angle with the body. This is a respiratory tube, and communicates both with the outer air at its tip, and with the tracheal system at its base. All that is necessary for breathing, therefore, is that the tip of this tube should be above the surface. Accordingly, when at rest, the larva takes up this position, while at other times it goes wriggling about through the water, being of sufficient buoyancy to rise without effort to the surface when occasion demands. After several changes of skin the pupal stage is reached, and the last moult is accompanied by a remarkable alteration in the appearance of the insect. The head and thorax now appear as if thrown into one large mass, from which the body tapers away. But the most astonishing change of all is that which takes place in the respiratory system; the entrance to this is now transferred to the opposite end of the body, and appears as two small twisted horns projecting from the gigantic head. If now the insect were to retain its inverted position, there would obviously be no possibility of bringing these breathing horns nearer the air than a whole body's length; therefore, it turns a somersault in the water, and henceforth goes about head uppermost, an attitude which, when it is at the surface, brings the organs in question just above the water. Though the creature is now a pupa, and can take no nourishment, it is possessed of almost as much freedom of motion as before, and jerks itself about by vigorous wrigglings of its awkward form.

(*To be continued.*)

A NOVEL FIRE-ESCAPE.

THE sides of the block are united by four friction pins, arranged on two diagonal lines, and over which the rope or wire is passed (as clearly shown in the engraving).



The rope is also passed over pins at the top and bottom of the block. At each end of the block is pivoted a brake lever, the inner ends of which press the rope against the pins. On a rod secured to one of the outer side surfaces of the block runs a traveller, to which one end of a belt of leather or webbing is secured, the other end of the belt being provided with a hook to be passed over the rod.

To use the escape, one end of the rope is hooked in the window-sill, and the other end thrown out of the window. The belt is passed round the body, and the hook clasped over the side rod. Then the person steps out of the window and slides slowly down the rope, the friction pins in the block preventing a rapid descent. By means of the brake levers the apparatus can be stopped at any time. When the block arrives at the ground, the person unfastens the belt, and the block is pulled up again to be used by another person, who throws the end of the rope that had been fastened in the room out of the window, and secures the opposite end. The device is portable, takes up a small space in a gripsack, and weighs but little.

This invention has been patented by Messrs. David Ware and C. W. Richman, of Philadelphia, Pa.—*Scientific American.*

NOTES ON FLYING AND FLYING-MACHINES.

BY RICHARD A. PROCTOR.

(*Continued from page 4.*)

BUT although the reasoning of Borelli suffices perfectly well to show that man can never fly by attaching pinions to his arms, and flapping these in imitation (however close) of a bird's action in flying, it by no means follows that man must be unable to fly when the most powerful muscles of his body are called into action to move suitably-devised pinions. M. Besnier made a step in this direction (towards the close of the last century) when he employed, in his attempts to fly, those powerful muscles of the arm which are used in supporting a weight over the shoulder (as when a bricklayer carries a hod, or when a countryman carries a load of hay with a pitchfork). But the way in which he employed the muscles of the leg was less satisfactory. In his method, a long rod passed over each shoulder, folding pinions being attached to both ends of each rod. When either end of a rod was drawn down, the descending pinion opened, the ascending pinion at the other end closing; and the two rods were worked by alternate downward pulls with the arms and legs. The downward pull with the arms was exceedingly effective; but the downward pull with the legs was altogether feeble. For the body lying horizontally, the muscles used in the downward pull with the legs were those by which the leg is carried forward in walking, and these muscles have very little strength, as any one will see who, standing upright on one leg, tries, without bending the knee of the other, to push forward any considerable weight with the front of this leg.

Yet even with this imperfect contrivance Besnier achieved a partial success. His pinions did not, indeed, serve to raise him in the air; but when, by a sharp run forward, he had brought that aerial supporting power into action of which we have spoken above, the pinions, sharply worked, so far sustained him as to allow him to cross a river of considerable width. It is not unlikely that, had Besnier provided fixed sustaining surfaces, in addition to the movable pinions, he might have increased the distance he could traverse. But, as regards flight, there was a further and much more serious defect in his apparatus. No means whatever were provided for propulsion. The wings tended to raise the body (this tendency only availing, however, to sustain it); but they could give no forward motion. With a slight modification, it is probable that Besnier's method would enable an active man to travel over ground with extreme rapidity, clearing impediments of considerable height, and taking tolerably wide rivers almost "in his stride"; but I believe that the method could never enable men actually to fly.

It may be remarked, indeed, that the art of flying, if it is ever attained, will probably be arrived at by means of attempts directed, in the first place, towards rapid passage along *terra firma*. As the trapeze gymnast avails himself of the supporting power of ropes, so the supporting power of the air may be called into action to aid men in traversing the ground. The following passage from Turnor's *Astra Castra* shows that our velocipedists might soon be outvied by half-flying pedestrians: "Soon after Bacon's time," he tells us, "projects were instituted to train up children from their infancy in the exercise of flying with artificial wings, which seemed to be the favourite plan of the artists and philosophers of that day." If we credit the accounts of some of these experiments, it would seem that considerable progress was made that way. The individuals who used the wings could skim over the surface of the earth with a great deal of ease and celerity. This was accomplished by the combined faculties of running and flying. It is stated that, by an alternate continued motion of the wings against the air, and the feet against the ground, they were enabled to move along with a striding motion, and with incredible speed.

A gymnast of our own day, Mr. Charles Spencer ("one of the best teachers of gymnastics in this country," says Mr. Brearey), has met with even more marked success, for he has been able to raise himself by the action of wings attached to his arms. The material of which these wings were made was too fragile for actual flight; and Mr. Spencer was prevented from making strong efforts because the wickerwork to which the apparatus was attached, fitting tightly round his body, caused pain, and obstructed his movements. Yet he tells us that, running down a small incline in the open air, and jumping from the ground, he has been able, by the action of the wings, to sustain flight for a distance of 120 feet; and when the apparatus was suspended in the transept of the Crystal Palace (in the spring of 1868), he was able, as we have said, to raise himself, though only to a slight extent, by the action of the wings. It should be remarked, however, that his apparatus seems very little adapted for its purpose, since the wings are attached to the arms in such sort that the weak breast-muscles are chiefly called into play. Borelli's main objection applies in full to such a contrivance; and the wonder is that Mr. Spencer met with even a partial success. One would have expected rather that the prediction of a writer in the *Times* (calling himself Apteryx, or the Wingless) would have been fulfilled, and that the "aëronaut, if he flapped at all, would come to grief, like the sage in 'Rasselas,' and all others who have tried flying with artificial wings."

The objection founded on the relative weakness of the muscles of man as compared with those of birds (without reference to the question of adaptation), seems at first sight more serious. Although there can be little question that the superior strength of the muscles of birds has been in general enormously exaggerated, yet such a superiority undoubtedly exists to some degree. This gives the bird a clear advantage over man, insomuch that man can never hope by his unaided exertions to rival the bird in its own element. It by no means follows, however, that because man may never be able to rival the flight of the eagle or the condor, of the pigeon or the swallow, he must therefore needs be unable to fly at all.

It should be remembered, also, that men can avail themselves of contrivances by which a considerable velocity may be acquired at starting; and that when the aëronaut is once launched with adequate velocity, a comparatively moderate exertion of force may probably enable him to maintain that velocity, or even to increase it. In this case, a moderate exertion of force would also suffice to enable him to rise to a higher level. To show that this is so, we need only return to the illustration drawn from the kite. If a weight be attached to a kite's tail, the kite, which will maintain a certain height when the wind is blowing with a certain degree of force, will rise to a greater height when the force of the wind is but slightly increased.

Kites afford, indeed, the most striking evidence of the elevating power resulting from the swift motion of an inclined plane through the air, the fact being remembered always that, whatever supporting and elevating power is obtained when air moves horizontally with a certain velocity against an inclined plane, precisely the same supporting and elevating power will be obtained when the inclined plane is drawn or propelled horizontally with equal velocity through still air. Now the following passages from the "History of the Char-volant," or kite-carriage, bear significantly upon the subject we are now upon. The kite employed in the first experiments (made early in the present century) had a surface of fifty-five square feet. "Nor was less progress made in the experimental department when large weights were required to be raised or transposed. While on this subject, we must not omit to observe that the first person who soared aloft in the air by this invention was a lady, whose courage would not be denied this test of its strength. An arm-chair was brought on the ground, then, lowering the cordage of the kite by slackening the lower brace, the chair was firmly lashed to the main-line, and the lady took her seat. The main-brace being hauled taut, the huge buoyant sail rose aloft with its fair burden, continuing to ascend to the height of a hundred yards. On descending, she expressed herself much pleased with the easy motion of the kite and the delightful prospect she had enjoyed. Soon after this another experiment of a similar nature took place, when the inventor's son successfully carried out a design not less safe than bold—that of scaling by this powerful aerial machine the brow of a cliff two hundred feet in perpendicular height. Here, after safely landing, he again took his seat in a chair expressly prepared for the purpose, and, detaching the swivel-line which kept it at its elevation, glided gently down the cordage to the hand of the director. The buoyant sail employed on this occasion was thirty feet in height, and had a proportionate spread of canvas. The rise of the machine was most majestic, and nothing could surpass the steadiness with which it was manœuvred, the certainty with which it answered the action of the braces, and the ease with which its power was lessened or increased. . . . . Subsequently to this, an experiment of a very bold and novel character was made upon an extensive down, where a waggon with a considerable load was drawn along, while this huge machine at the same time carried an observer aloft in the air, realising almost the romance of flying."

We have here abundant evidence of the supporting and elevating power of the air. This power is, however, in a sense, dormant. It requires to be called into action by suitable contrivances. In the kite, advantage is taken of the motion of the air. In flight, advantage must be taken of motion athwart the air, this motion being, in the first place, communicated while the aëronaut or flying-machine is on the ground. Given a sufficient extent of supporting surface, and an adequate velocity, any body, however heavy, may be made to rise from the ground: and there can be no question that mechanicians can devise the means of obtaining at least a sufficient velocity of motion to raise either a man or a flying machine, provided with no greater extent of supporting surface than would be manageable in either case. It is not the difficulty of obtaining from the air *at starting* the requisite supporting power that need deter the aëronaut. The real difficulties are those which follow. The velocity of motion must be maintained, and should admit of being increased. There must be the means of increasing the elevation, however slowly. There must be the means of guiding the aeronaut's flight. And lastly, the aëronaut or the flying-machine must fly with well-preserved balance—the supporting power of the air depending entirely on the steadiness with which the supporting surfaces traverse it.

I believe that these difficulties are not insuperable; and not only so, but that none of the failures recorded during the long history of aëronautical experiments need discourage us from hoping for eventual success. Nearly all those failures have resulted from the neglect of conditions which have now been shown to be essential to the solution of the problem. Nothing but failure could be looked for from the attempts hitherto made; and, indeed, the only wonder is that failure has not been always as disastrous as in the case of Cocking's ill-judged descent. If a man who has made no previous experiments will insist on jumping from a summit of a steeple, with untried wings attached to his arms, it cannot greatly be wondered at that he falls to the ground and breaks his limbs, as Allard and others have done. If, notwithstanding the well-known weakness of the human breast-muscles, the aeronaut tries to rise by flapping wings like a bird's, we cannot be surprised that he should fail in his purpose. Nor, again, can we wonder if his attempts to direct balloons from the car should fail, when we know the car could not even be drawn with ropes against a steady breeze without injury to the supporting balloon. And we need look no further for the cause of the repeated failures of all the flying-machines yet constructed, than to the fact that no adequate provision has yet been made to balance such machines, so that they may travel steadily through the air. It seems to have been supposed that if propelling and elevating power were supplied the flying-machine would balance itself; and, accordingly, if we examine the proposed constructions, we find that in nine cases out of ten (if not in all) the machine would be as likely to travel bottom-upwards as on an even keel. The common parachute (which, however, is not a flying-machine) is the only instance I can think of in which a non-buoyant machine for aërial locomotion has possessed what is called a "position of rest."

Perhaps the gravest mistake of all is that of supposing that, on a first trial, a man could balance himself in the air by means of wings. Placed, for the first time, in deep water, man is utterly unable to swim, and if left to himself will inevitably drown; although a very slight and very easily-acquired knowledge of the requisite motions will enable him to preserve his balance. And yet it seems to have been conceived by most of those who have attempted flight, that when first left to himself in open air, with a more or less ingeniously-contrived apparatus attached to him, a man would not only be able to balance himself in that unstable medium, but also to resist the down-drawing action of gravity (which scarcely acts at all on the swimmer), and wing his way through the air by a series of new and untried movements!

It encourages confidence in the attempts now being made to solve the problem of aërial locomotion, that they are tentative—founded on observation and experiment, and not on vague notions respecting the manner in which birds fly. Fresh experiments are to be made, more particularly on the supporting power of the air upon bodies of different form, moving with different degrees of velocity. These experiments are under the charge of Messrs. Browning and Wenham, of the Aeronautical Society, whose skill in experimental research, and more particularly in inquiries depending on mechanical considerations, will give a high value to their deductions. The question of securing the equipoise of flying-machines has also received attention; and it is probable that the principle of the instrument called the gyroscope will be called into action to secure steadiness of motion, at least in the experimental flights. What this principle is need not here be scientifically discussed; but it may be described as the tendency of a rotating body to preserve unchanged the direction of the axis about which the body is rotating. The spinning-top and the quoit (well thrown) afford illustrations of this principle. The peculiar flight of a flat missile, already referred to, depends on the same principle; for the flight only exhibits the peculiarities mentioned when the missile is caused to whirl in its own plane. But the most striking evidence yet given of the steadying property of rotation is that afforded by the experiments of Professor Piazzi Smyth, the Astronomer Royal for Scotland. During the voyage to Teneriffe (where, it will be remembered, his well-known Astronomer's Experiment was carried out), he tested the power of the gyroscope in giving steadiness, by causing a telescope to be so mounted, that the stand could not shift in position without changing the axial pose of a heavy rotating disc. The disc was set in rapid rotation by the sailors, and then the Professor directed the telescope towards a ship on the horizon. A fresh wind was blowing, so that everything on deck was swayed in lively sort by the tossing vessel; nor did the telescope *seem* a whit steadier—the motion of objects round it giving to the instrument an appearance of equal instability. But the officers were invited to look through the tube, and to their amazement, the distant ship was seen as steady in the middle of the telescopic field as though, instead of being set up on a tossing and rolling ship, the telescope had been mounted in an observatory on *terra firma*. The principle of the gyroscope has also been used for the purpose of so steadying the stand of a photographic camera placed in the car of a balloon, that photographs might be taken despite the tendency of the balloon to rotate. As applied to flying-machines, the gyroscope would require to be so modified in form that its weight would not prove an overload for the machine. This is practicable, because a flat horizontal disc, rotating rapidly, will support itself in the air if travelling horizontally forward with adequate swiftness. In other words, since travelling-machines *must* travel swiftly, the gyroscopic portion of the machine may be made to support itself.

It is this property of enforced rapidity of motion which renders the probable results of the mastery of our problem so important. It has been well remarked that two problems will be solved at once, when the first really successful flying-machine has been made—not only the problem of flight, but the problem of travelling more swiftly than by any contrivances yet devised. In the motion of a flying-machine, as distinguished from the flight of man by his own exertions, the swiftness of the bird's flight may be more than matched. It is a mere mechanical problem which has to be solved; and few mechanicians will deny that when once the true principles of flight have been recognised, the ingenuity of man is capable of constructing machines in which these principles shall be carried out. Iron and steam have given man the power of surpassing the speed of the swiftest of four-footed creatures—the horse, the greyhound, and the antelope. We have full confidence that the same useful servants place it in man's power to outvie in like manner the swiftest of winged creatures—the swallow, the pigeon, and the hawk.

THE TRICYCLES OF TO-DAY.

THE "CHEYLESMORE CLUB."

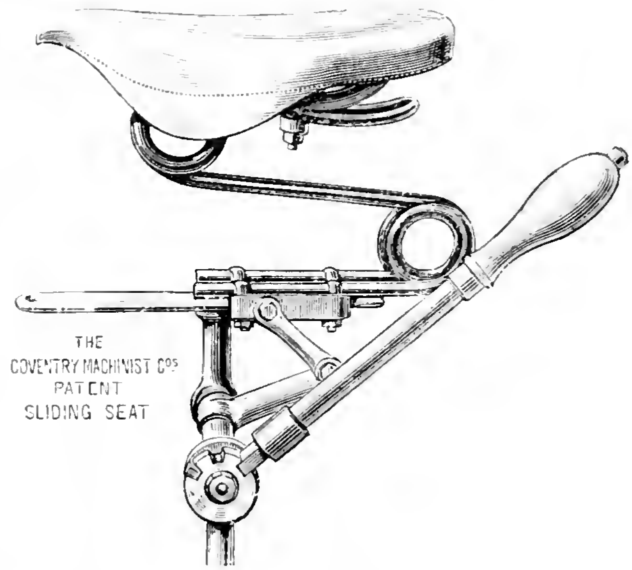
THE "Cheylesmore Club" is a very well-known type of a double-driving, rear-steering tricycle, and was, a season or two back, the general favourite of the London and large provincial clubs. It has, moreover, been largely supplied by the makers to many distinguished members of society. The frame is made of light steel tubing, and ball bearings are fitted to the driving and steering wheels, as well as the crank shaft, while the reputation of the Coventry Machinists' Company is a sufficient guarantee of the workmanship and high finish of the machine. The swan-like curved backbone, with little steering-wheel behind, gives it a very graceful appearance when in motion, causing it to contrast favourably with many front-steerers, which often put one so much in mind of perambulators and bath-chairs.

The machine, however, of late has lost some of its original prestige, which is traceable to two principal causes. The first reason may be readily accounted for by the great love of cycling novelty which is the inherent, ruling spirit of so many wheelmen, who are never satisfied unless they possess the "latest out," fancying, because there has recently been such a superabundance of animated discussion in numerous journals relating to improvements in tricycles, that the latest types of machines must of necessity possess great additional advantages over the older ones. The other reason, which has militated to a very great extent against its continued popularity, has been the frequent warning raised on all hands— "Don't, my dear fellow, have a rear-steering tricycle unless you wish to break your neck!"

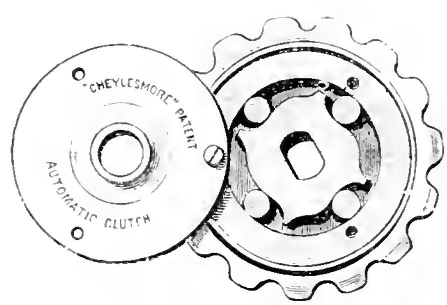
Now, undoubtedly the great majority of rear-steerers in the hands of careless or inexperienced riders are highly dangerous in descending hills, but the "Cheylesmore" is by no means to be classed in the same category. Not but what also there are other important exceptions of equally well-know rear-steerers which are in every way as safe as the "Cheylesmore," and with which I hope to deal in future papers. I may here state that I have ridden the "Cheylesmore" down exceedingly steep, stony, and rutty hills in Derbyshire, and on no single occasion have I come to grief. I remember quite well when first I rode the machine several friends of mine who ride front-steerers warned me to be very careful in descending hills, since the little wheel of rear-steerers was very apt to tip up, somewhat after the fashion the rear-wheel serves bicycle learners. But my machine has never served me so, although its backbone is several inches shorter than they are made this season, which alteration should certainly make them still steadier.

The makers now attach when specially ordered a patent sliding-seat to the machine (see illustration), the position of which the rider can alter backwards or forwards at pleasure, thus giving him the twofold advantage of being able to place his saddle directly over his pedals for hill climbing, or far back on the backbone when going down bank, in this manner preventing more than ever any slight tendency on the part of the machine either to swerve or tip up.

To my mind, one of the most pleasureable features of the machine is the patent automatic clutch action. The clutch gear, which is exceedingly simple, and never liable to get out of order, is fitted to the pedal-cranks, being connected by cogs and chains to the driving-wheels. It consists of a small toothed box, through which the crank-end passes without even coming into contact with it. The box, through which the crank passes, contains a small metal disc, which



has four hollows cut in its circumference, round at one end and angular at the other. In each of these cavities rides a small steel roller, which, on pedalling the crank forward, is jammed in the angular portion of the cavity, and thus pressed against the box, causing the wheel to rotate; but on pedalling backwards the ball is released, and runs round freely in the circular portion of the cavity. Its action, however, will be clearly seen by a reference to the accompanying illustration. By means, therefore,



of this simple contrivance the pedals remain perfectly stationary in descending hills, thus forming excellent foot-rests. It is decidedly advantageous to be able to use the pedals as foot-rests, since it enables the rider to cease pedalling on the smallest incline, his feet being ready for action when required, and no fear, as on other machines, of getting his ankles severally rapped in trying to replace his feet on swiftly-revolving pedals. It also empowers him to obtain a full leverage of the crank at any time he requires it, which proves very useful in climbing steep hills, by taking half-strokes. Some cyclists consider it a disadvantage, I know, at times not to be able to back pedal; but I have never found it so.

The machine is supplied with an excellent spoon break, which is sufficiently powerful to bring the machine to a dead stop on almost any incline, while the steering arrangement is everything that can be desired. On a good level road there are but few machines which can pass it, and it is by no means a slow or bad hill-climber. In fact, take the

"Cheylesmore" for all in all, I consider it a cheap, safe, pretty, comfortable, and, in the hands of a good rider, a fairly swift machine. F.

THE ELECTRO-MAGNET.

By W. Slingo.

PRESUMABLY most readers are acquainted with the general features of an electro-magnet. It is, however, an instrument or tool capable of performing such wonderful dexterities, and of affording such a valuable insight into the principles of electricity, that a few brief remarks upon its structure and its uses may, it is thought, be welcome. Electricity is not such a young science but that most people know the electro-magnet to consist primarily of a coil or helix of insulated wire and a piece of soft iron, and that a current of electricity, in traversing the wire, renders the iron a magnet. For the benefit of the uninitiated, and in order to present a more continuous series of experiments and illustrations, a few lines may be advantageously devoted to the simpler fundamental features pertaining to the subject prior to venturing upon that portion of it which will be kept more prominently in view—viz., the best form to be adopted for a particular purpose, supplemented by directions for easily making and using the instrument. The two extremities of an ordinary steel magnet exhibit a difference in their behaviour, and are therefore in themselves different. Either end of a magnet attracts equally the same piece of unmagnetised iron, the difference being observable in the action of the ends or poles upon each other. Two magnetised sewing needles suspended a few inches apart on water will, after a few seconds, assume parallel positions, the extremities pointing more or less north and south. If two of the similarly pointing ends be made to approach, repulsion ensues, while attraction results if the north-pointing end of one needle is placed sufficiently near to the south-pointing end of the other. To magnetise the sewing-needles, they may be drawn a few times over one of the poles of a magnet, always drawing in one direction, either from eye to point, or point to eye. The end of the needle which last touches the magnet becomes of opposite polarity to that of the end of the magnet used. Thus, if the north end of a magnet be used, and a needle passed over it a few times, beginning at the eye, then the point will be south (and the eye, of necessity, north). This follows as a matter of course, from the law that like polarities repel, and unlike attract, for we may easily conceive that the north makes itself evident at the eye (the part most remote from the magnet) in obedience to the repulsion by the north, and similarly that the point becomes south because of the closer proximity of the magnet-pole to the point than to the eye.

Suppose now that above or below a copper wire capable of carrying a current of electricity from two or three cells we suspend an unmagnetised needle at right angles with the copper wire. On passing the current, the needle will become a more or less powerful magnet, particularly if the wire is placed east to west, so that the needle is north to south, when the inductive effect exerted by the current is aided by the magnetism of the earth, that magnetism which caused the suspended magnetised needles to point north and south. If the needle be afterwards turned so as to point in some other direction, it will, when free, turn again to the north and south position, and will, in fact, assume all the properties of an ordinary magnet. Had the needle been an iron instead of a steel one, a different result would have followed. The iron would have been magnetised on the passage of the current, just as the steel was, only more powerfully. On the cessation of the current, however, its effect upon the iron needle would have instantly ceased, although the needle would continue in obedience to inertia and to the feeble influence of terrestrial magnetism to point north and south. The difference between iron and steel is further seen on moving the former into any other position than that of north and south. When this is done all trace of magnetisation is gone, and the iron exhibits no tendency to reassume the longitudinal direction. Had the iron been placed originally in any other than a north and south position it would not have felt, and, therefore, could not have retained the small effect produced by the magnetism of the earth.

So far as the magnetisation due to the current is concerned, it is quite immaterial whether the previously unmagnetised needle be placed in a longitudinal or any other direction whatever, so long as the current is made to cross it at right angles. It follows, obviously, that if we encircle a needle by a ring or loop of copper-wire, and send a current through the wire, the electricity in any one part of the circle conspires with or aids the current in every other portion. A proportionate increase in the intensity of magnetism naturally ensues. Carrying this principle a little farther, if, instead of one circular loop we employ several similar loops (wound round the needle in one constant direction, so that the current in traversing the wire is compelled to keep travelling from end to end without doubling back on itself) then the magnetising effect due to a single line or loop is proportionably multiplied. Again, if we employ two or more concentric loops, such as we should get, for example, by winding the wire in a manner similar to that of a watch-spring, we shall produce a corresponding increase. It is apparent, then, how proportionately great must be the effect produced by a current passing through a long coil composed of several layers, as compared with that resulting from the passage of the same current through a single wire at right angles to the needle.

The polarity which the needle assumes is dependent on the relative direction of the current. With a current passing over the needle from, say, south to north, the eye or the point, whichever it may be that is in the west, assumes a north polarity, while that extremity of the needle which lies to the east of the wire becomes a south pole. Generally, to adopt an illustration of Ampère's, assuming a little man to be swimming in the wire in the same direction as the current, and to have his face turned constantly towards the needle, that end will become north which is on his left hand. The same principle is involved here as in the case of galvanometers, and demonstrates the multiplying power of coils of wire.

When a soft iron wire is used instead of the steel needle, the effect produced by a current traversing the enveloping coil of wire ceases with the current, just as the effect produced by a current in a single length of wire was no longer felt when the current disappeared. Of the relation subsisting between the effective power of a single wire and a coil, more will be said presently.

Before we can predetermine the polarity an iron wire or rod will assume in response to the inductive effect exerted by a coil of wire, we must bear in mind that there are two ways of winding a coil, and that the electromagnetic effects exerted by these two coils are opposite. This may be experimentally demonstrated with the aid of an iron rod such as, for want of something else, a clean poker, a yard or two of cotton-covered or other insulated wire (rather stout, say No. 16, B.W.G.), a magnetised sewing-needle, and two or three cells of, say, a bichromate battery. First, float the needle on a glass of water by laying it on a small piece of paper or cork. (If the hand and the needle are dry, the film of air adherent to or surrounding the needle will, generally speaking, prevent it from sinking.) Then, holding the handle of the poker and one end of the wire in the left hand, held out from the body, proceed to wind the wire over the other end of the poker with the right hand, moving the hand continuously in the same direction as that taken by the hands of a watch, as seen when looking at its face. In other words, taking the wire in the right hand, pass it from the upper side down the right side across the bottom, and back up the left side. In this way cover the square end of the poker with one layer or thickness of wire. Such a coil of wire is called a helix, and helices are divided into two classes—called right-handed and left-handed (according to the direction of winding). The helix just constructed and illustrated in Fig. 1

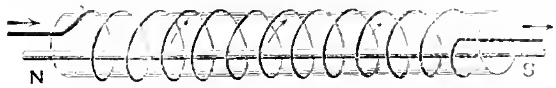


Fig. 1.

(depicting an iron rod, N S, inside of a piece of glass tubing, over which the wire is wound), is a left-handed one—a current on entering it at either end travelling through it in a direction opposite to that of the hands of a watch. To secure a right-handed helix (Fig. 2),

Fig. 2.

wind the wire round the poker from right to left, or move the hand in the opposite direction to that of the watch hands. The current in flowing through this helix travels in the opposite direction to that taken in the other, and, as we might anticipate, different causes produce different effects.

(*To be continued.*)

THE ANTARCTIC REGIONS.

By R. A. Proctor.

(*Continued from page 7.*)

It is singular how confidently geographers have spoken of the great Antarctic continent, when we remember that only an inconsiderable extent of coast line has even been seen by Anctarctic voyagers in any longitudes, except where Ross made his nearest approach to the South Pole. There is absolutely not a particle of evidence for believing that the ice-barriers which have been encountered—Sabine Land, Adélie Land, Victoria Land, and Graham Land—belong to one and the same land region. It is not, indeed, certain that all the mapped coast-line is correct—for it must not be forgotten that where Commodore Wilkes charted down a coast-line Ross found an open (or only ice-encumbered) sea, *and sailed there.*

Yet Dr. Jilek, in the "Text-book of Oceanography," in use in the Imperial Naval Academy of Vienna, writes thus confidently respecting the Antarctic continent:—"There is now no doubt," he says, "that around the South Pole there is extended a great continent, mainly within the polar circle, since, although we do not know it in its full extent, yet the portions with which we have become acquainted, and the investigations made, furnish sufficient evidence to infer the existence of such with certainty. This southern or Antarctic continent advances farthest in a peninsula S.S.E. of the southern end of America, reaching in Trinity Land almost to 62 degrees south latitude. Outwardly these lands exhibit a naked, rocky, partly volcanic desert, with high rocks, destitute of vegetation, always covered with ice and snow, and so surrounded with ice that it is difficult or impossible to examine the coast very closely."

A singular, and indeed fallacious, argument has been advanced by Captain Maury in favour of the theory that the Antarctic regions are occupied by a great continent. "It seems to be a physical necessity," he argues, "that land should not be antipodal to land. Except a small portion of South America and Asia, land is always opposite to water. Mr. Gardner has called attention to the fact that only one twenty-seventh part of the land is antipodal to land. The belief is, that on the polar side of 70 degrees north we have mostly water, not land. This law of distribution, so far as it applies, is in favour of land in the opposite zone." Surely a weaker argument has seldom been advanced on any subject of scientific speculation. Here is the syllogism: we have reason to believe (though we are by no means sure) that the Arctic regions are occupied by water; land is very seldom found to be antipodal to land; therefore, probably, the Antarctic regions are occupied by land. But it is manifest that, apart from the weakness of the first premiss, the second has no bearing whatever on the subject at issue, *if the first be admitted*: for we have no observed fact tending to show that water is very seldom antipodal to water, which would be the sole law to guide us in forming an opinion as to the regions antipodal to the supposed Arctic water. On the contrary, we know that water is very commonly antipodal to water. We have only to combine what is known respecting the relative proportions of land and water on our globe with Mr. Gardner's statement that twenty-six out of twenty-seven parts of the land are antipodal to water, to see that this must be so. There are about 51 millions of square miles of land and about 146 millions of square miles of ocean. Now about 49 millions of square miles of land are antipodal to water, accounting therefore for only 49 millions out of the 146 millions of square miles of ocean surface; the remaining 97 millions of square miles of ocean are, therefore, not antipodal to land, but one half (any we please) antipodal to the other half. In fact, we have this rather singular result, that the ocean surface of the globe can be divided into three nearly equal parts, of which one is antipodal to land, while the other two parts are antipodal to each other. This obviously does not force upon us the conclusion that an unknown region must be land because a known region opposite to it is oceanic; and still less can such a conclusion be insisted upon when the region opposite the unknown one is itself unknown.*

* Whether the relation above-mentioned respecting land regions is noteworthy may very well be questioned. It will be seen that Captain Maury regards it as seemingly a physical *law* "that land should not be antipodal to land." Now this is by no means satisfactorily indicated. As a question of probability it is not certain that the present relation, by which twenty-six parts out of twenty-seven of the land are antipodal to water, can be regarded as antecedently an unlikely one, when nearly three-fourths of the whole surface are occupied by water, and when, also, the bulk of the land and water regions consist of such great surfaces as those we call continents and oceans. Granted these preliminary conditions, it would appear, indeed, that only by a very remarkable and, as it were, artificial arrangement of land and water could any but a small proportion of the land be antipodal to land. The stress laid by Maury on the observed relation seems to me, indeed, as unwarranted as that laid by Humboldt on the fact that the great southerly projections of the land lie nearly in the same longitude as the great northerly projections.

So far, indeed, as the geographical evidence extends, it seems probable that there exists within the Antarctic circle an elevated region bearing somewhat the same relation to the great promontories terminated by Cape Horn and the Cape of Good Hope, as well as to the relatively elevated region indicated by the islands to the south and south-east of Australia, which the Hindoo Koosh bears to the great mountain-ranges of Asia. We seem to have in the Antarctic high lands the great central elevation whence three great lines of elevation extend. That the great mountain range which forms the backbone of South America is continued under water, rising again in the south Shetland Isles and Graham's Land, would, indeed, seem altogether probable; and it may be remarked as a coincidence of some importance that the mountains seen by Ross on the other side of the Antarctic Circle—Mounts Sabine, Crozier, Erebus, and Ross—lie in a chain tending in the same direction. But although we might thus be led to regard the Antarctic regions as forming a great central region of elevation, it by no means follows that this region is of the nature of a table land.

Meteorological considerations have been urged by Maury for the theory of Antarctic lands in large masses, "relieved by high mountains and lofty peaks." He considers that it is to such mountains (performing the part of condensers) that the steady flow of "brave" winds towards the South Pole is to be ascribed. "Mountain masses," he says, "appear to perform in the chambers of the upper air the office which the jet of cold water discharges for the exhausted steam in the condenser of an engine. The presence of land, therefore, not water, about this south polar stopping-place is suggested." And he attaches considerable weight, in this connection, to the circumstance that the barometric pressure is singularly low over the whole Antarctic Ocean,*—as though there were here the vortex of a mighty but steady whirlwind. "We may contemplate the whole system of 'brave west winds,' circulating in the Antarctic regions, in the light of an everlasting cyclone on a gigantic scale—the Antarctic continent in its vortex—about which the wind in the great atmospherical ocean all round the world, from the pole to the edge of the calm belt of Capricorn, is revolving in spiral curves, continually going with the hands of a watch, and twisting from right to left." However, it would be unsafe to base the theory of an Antarctic continent on speculations such as these. And still less can we assume with Maury that Antarctic volcanoes play an important part in the economy of southern meteorological phenomena. There is no reason for supposing that active volcanoes have any special action in determining atmospheric relations. Capt. Maury suggests that we may, "without transcending the limits of legitimate speculation, invest the unexplored Antarctic land with numerous and active volcanoes," and this certainly may be granted, for two volcanoes (one in action) have been seen there. But it would be unsafe to infer that such volcanoes are "sources of dynamical force sufficient to give that freshness and vigour to the atmospherical circulations which observations have abundantly shown to be peculiar to the southern hemisphere." Volcanoes would need to be so numerous and so active, in order to produce the imagined effect, that the whole southern continent would be aglow like a gigantic furnace. A hundred Etnas would not produce the thousandth part of the in-draught which Maury ascribes to Antarctic volcanoes. Assuredly, we may say with Maury, but more significantly, that "volcanoes are not a meteorological necessity." "We cannot say that they are," he proceeds, "yet the force and regularity of the winds remind us that their presence there would not be inconsistent with known laws." He believes, in fact, that the steady winds may be partly formed as an in-draught feeding volcanic fires. It is as well to remember, when ideas so wild are mooted, that, as Maury himself remarks, "we know, ocularly, but little more of the topographical features of Antarctic regions than we do of those of one of the planets." "If they be continental," as he proceeds, "we may indeed, without any unwarrantable stretch of the imagination, relieve the face of nature there with snow-clad mountains, and diversify the landscape with flaming volcanoes;" but we must not forget that this *is* a work of imagination, not a theory which can be insisted upon as though it represented a geographical fact.

While on this subject, however, I cannot refrain from quoting a very striking passage from a letter by Capt. Howes, of the *Southern Cross*, because, although it relates in reality to the phenomena of an Aurora Australis, it presents a scene such as we might conceive to accord with the conception of an Antarctic region covered with volcanoes whose combined action made the whole continent at times as one vast furnace. Apart from fancies such as these, the description is full of interest:—"At about half-past one," he says, "on the second of last September, the rare phenomenon of the Aurora Australis manifested itself in a most magnificent manner. Our ship was off Cape Horn, in a violent gale, plunging furiously into a heavy sea, flooding her decks, and sometimes burying her whole bows beneath the waves. The heavens were as black as death; not a star was to be seen when the brilliant spectacle first appeared. I cannot describe the awful grandeur of the scene; the heavens gradually changed from murky blackness till they became like livid fire, reflecting a lurid, glowing brilliancy over everything. The ocean appeared like a sea of vermilion lashed into fury by the storm; the waves, dashing furiously over our side, ever and anon rushed to leeward in crimson torrents. Our whole ship—sails, spars, and all—seemed to partake of the same ruddy hues. They were as if lighted up by some terrible conflagration. Taking all together, the howling, shrieking storm, the noble ship plunging fearlessly beneath the crimson-crested waves, the furious squalls of hail, snow, and sleet driving over the vessel and falling to leeward in ruddy showers, the mysterious balls of electric fire resting on our mast-heads, yard-arms, &c., and above all the awful sublimity of the heavens, through which coruscations of auroral light would often shoot in spiral streaks and with meteoric brilliancy, altogether presented a scene of grandeur and sublimity surpassing the wildest dreams of fancy."

(*To be continued*).

* This curious circumstance cannot be explained, as Maury supposes, by the existence of upflowing currents of air, however occasioned. The total pressure of the air over any region is not affected by motions taking place within the air, any more than the total pressure of water upon the bottom of a tank is affected by motions taking place in the water. There are reasons for believing that the true explanation of the low Antarctic barometer lies in the fact that the ocean surface is in Antarctic regions *above*, and in Arctic regions *below*, the mean level. The excess of ocean surface in the southern hemisphere indicates an overflow, as it were, of water southwards, which must lead to such a relation.—See my "Light Science for Leisure Hours," Second Series.

Erratum.—In the paragraph at the bottom of second column, page 9 (last week's Knowledge) for "equatorial circle" read "equatorial coudée."

The Western Union Telegraph Company at a meeting last month, declared the usual $1\frac{3}{4}$ per cent. quarterly dividend. The present quarter closes the fiscal year, which exhibits gross earnings of nearly 26,000,000 dols., about 500,000 dols. more than last year, but, on account of expenses during the strike, the net earnings will not be quite so large. The last and present quarters show an excess of net earnings over the corresponding quarters of last year.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from p. 482.*)

WE stated on p. 307 that light travels in straight lines, but we must now introduce a qualification into this general statement, and add, *as long as it is passing through a homogeneous medium—or one of absolutely uniform density throughout.* This is the way we proceed in physical science. We first enunciate a law which we assume to be universal, and then we deal with what are—or seem to be—exceptions to it: and ascertain and show whether they are really so, or whether both they and the facts on which our original assumption was founded may not in reality be susceptible of inclusion in a higher and more general law still. Now while it is perfectly true, as we have just said, that the propagation of light is absolutely rectilinear (or in straight lines) in a medium of uniform density, when it passes from a rarer medium into a denser one, or *vice-versâ*—save in a direction accurately square to the surface bounding such two media—it is bent from its original direction, or, to use the technical term, "refracted." This may be well shown, and an approximation made to the determination of the law of refraction, by the simple apparatus depicted in Fig. 14.

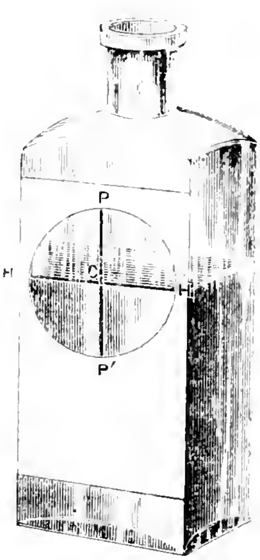


Fig. 14.

It is nothing more than a clear glass (18-oz.) physic bottle, on the front of which a piece of white paper is pasted. Prior to sticking the paper on, an accurate circle must be cut out of it; and, when all is dry, two thick diametrical lines, P, P' H H', may be ruled in ink on the glass, the first vertical and the second truly square to it, of course horizontal. Or, if preferred, two pieces of stout silk cord may be gummed across the aperture. A piece of blackened card should be cut out to cover one of the narrower sides of the bottle, and near the top of this a hole; or, perhaps, preferably a horizontal slit should be cut. The slit must be a very narrow one. We must now fill our bottle exactly up to the line H, H' with water, *just* coloured with a little milk, and, immediately before beginning our experiment, puff a mouthful of cigar smoke into the mouth of the bottle. We employ the milk and the smoke in order that we may see our beam of light, for the student will recollect (p. 306) that light passing in a direction across our line of sight is absolutely invisible. Very well, then, we have next to obtain our beam of light; and, undoubtedly, for the majority of optical experiments, direct sunlight is the best. In the present case, though, this involves the use of a darkened room with a narrow beam of sunlight admitted through a hole in the shutter. If the reader has any apartment at his disposal which he can so employ, and which is sufficiently light-tight, so much the better; if not, he may use a good kerosine lamp and a bull's-eye condenser, and conduct his investigation at night. Whichever source of light he employs, he must, by the aid of a looking-glass or otherwise, throw the beam proceeding from it through the slit in the blackened card at the side of the bottle, shifting the mirror about until the line of light strikes the surface of the water at C. Our puff of tobacco smoke will enable him to do this. Now trace the course of the light through the slightly turbid water, and carefully note the path it takes. Is no longer preserves its original direction, but is bent *towards* PP'; in other words, its track becomes more upright. Bear in mind that, coming through the side of the bottle, it has originally struck the surface of the water obliquely. Had we sent it through the mouth of the bottle truly square to the surface of the water it would have preserved its perpendicular direction throughout—much in the same way (though, of course, in one sense, for a different reason) that a perpendicular ray which falls on a mirror is reflected accurately back along the line by which it originally travelled. This by the way. To return to our experiment. Note where the beam of light cuts the semicircle H, P, H', before entering the water; as also the point where it crosses the semicircle H, P', H', after having done so, and draw ink lines from these points to the perpendicular P, P', taking care that those lines are parallel to H, H'. If we measure these lines carefully with a pair of compasses we shall find that the one above the water is—as nearly as may be—$1\frac{1}{3}$ times the length of the lower one. And, what is particularly to be remarked, that while the length of these respective lines varies with the obliquity with which the light falls on the surface of the water, the *proportion* between them remains invariable. Before proceeding to investigate the law of Refraction we may just remark incidentally that, as our experiment has been so far conducted, evidently part of the light has been reflected from the surface of the water, the unreflected portion alone, of course, penetrating it. For our present purpose, however, we may neglect this reflected part altogether, and consider that the whole incident beam enters the water, and is bent at the surface where it does so. By the aid of Fig. 15 we may now explain the law in virtue of which

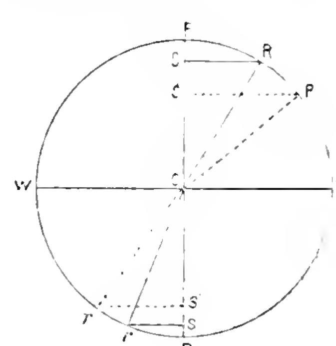


Fig. 15.

light follows a fixed and definite course in passing from any medium into another of different density—a law discovered by Snell during the first quarter of the seventeenth century. We have said above that had we sent our beam of light perpendicularly into the water it would have pursued a rigidly rectilinear path throughout. If, though, light struck its surface at all obliquely, refraction would occur at once. As we have had ocular demonstration by the aid of our bottle, when light passes from a rarer medium into a denser one it is bent towards a perpendicular to the refracting surface. On the other hand, when it passes from a denser medium into a rarer one it is bent from the perpendicular. And this brings us to the incidental mention of the principle of reversibility. By whatever path light travels from air into water, by that same path will it return from water into air. So, again, in Figs. 6, 10, 11, the object and its reflected image may be regarded as interchangeable in their respective positions. We shall probably have occasion to reiterate and insist upon this law, lying as it does at the root of numerous optical phenomena. Reverting, however, to our figure. The law discovered by Snell was this—that when light passes from any medium to another of different density the sine of the angle of incidence always bears a fixed and definite ratio (or proportion) to the sine of the angle of refraction. The sine of an angle is defined in old mathematical books—in a way much more intelligible to the learner than that employed in more modern ones—as a line drawn from one extremity of an arc at right angles to the diameter from the other extremity. Thus, in Fig. 15, R S is the sine of the angle R C P; R′ S′ the sine of the angle R′ C P; *r s* the sine of the angle *r* C P′, and *r′ s′* the sine of the angle *r′* C P′. A little attention will show how these conform to the definition just given. Then, Snell's law says this: if (as we shall find to be the case) R S is $1\frac{1}{3}$ times the length of *r s*, R′ S′ will be $1\frac{1}{3}$ times the length of *r′ s′*, and so on for any angle of incidence we may select. Now, here we will pause to call attention to a very remarkable circumstance. We have said that light passing from air into water will be refracted, if it do so, "at any angle of incidence;" but, if the student has followed us attentively so far, he will see that the converse of this will not hold good, and that our choice of angles of incidence in the passage of light from *water to air* is not unlimited. For it is easy to see that the angle of incidence might be so great that the sine of the angle of refraction being $1\frac{1}{3}$ times as large must be greater than CW, the radius of the circle, which is impossible; or, to put it another way, he may select such an angle of incidence in water that the light must emerge parallel with the surface, and when we increase such angle the light *cannot get out of the water at all*, and is totally reflected. The incidental angle at which the emergent ray is parallel to—or, rather, *in*—the surface of the water, is known technically as "the critical angle." Total reflection may be observed by looking obliquely upwards at the inner surface of the water in a clear glass tumbler at the image of a candle, a silver spoon, or other bright object held on the other side of the tumbler. It may also often be noticed in aquaria, such as the one at Brighton, in which the surface of the water seen at the proper angle from beneath reflects the fish near it, and shines like molten silver. Or, by turning our card, which covers the side of the bottle in Fig. 14, upside down, so that the slit in it is below the level of the water, we may reflect our beam of light upwards to its inner surface, and trace its reflection visibly. The "mirage" of the desert is believed to have its origin in total reflection from the surface formed by two adjacent strata of air of different temperatures and densities. We have spoken of the sine of the angle of incidence of a ray of light passing from air into water being $1\frac{1}{3}$ times the length of the sine of refraction. It is more accurately 1·336 times that length; and this number 1·336 is called "the index of refraction" of water. The denser a body the higher its index of refraction. Thus it is 1·575 in flint glass, and sometimes as high as 2·75 in the diamond. Hence the incomparable lustre of this stone. Numerous illustrations of refraction will occur to the reader. One of the most familiar is none the less instructive. Let him get a pie-dish, and put a sixpence at the bottom of it. Now, let him walk backwards until the side of the dish just hides the sixpence, and remain perfectly still while some one else pours water into the dish. The effect will be to bring the sixpence into view again. Fig. 15 will show how the water bends the rays of light from the coin over the rim of the dish. Or he may vary the experiment by so placing a lamp that the side of the pie-dish casts a long shadow on the bottom of it when empty. Then, as before, on pouring in water, the shadow will be seen to shorten perceptibly, and to approach the side casting it. So an oar or a stick partly immersed in water seems broken or bent at the surface; and a fisherman looking obliquely at the bottom of a clear lake from its bank sees it apparently only about three-quarters of its real depth. Or, instead of water, we may employ a thick piece of plate-glass to produce refraction; and, hiding some writing behind the edge of a thin book lying flat on a table, as we did the sixpence with the edge of the pie-dish, bring it into view again by placing our piece of plate-glass upon it. And the mention of plate-glass suggests to us here to investigate the course of a ray of light passing through such a medium. In Fig. 16, G G is a section

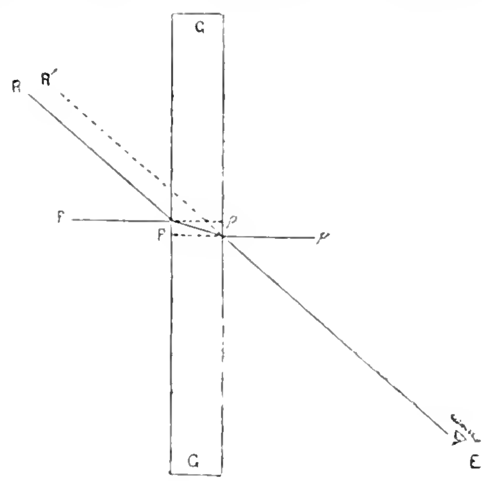


Fig. 16.

or edgeways view of a window-pane; R P, a ray (suppose from a tree-top) incident on the outside of the glass at P. Then, as we have seen above, this ray will be bent *towards* the perpendicular in the glass. On reaching the other surface, however, at *p*, it will be bent *from* the perpendicular, and will follow the direction *p*E, parallel to RP, and will be seen by an eye at E as though it emanated from R′, thus slightly raising our imaginary tree-top. Inasmuch, however, as the whole landscape is equally raised, *for the same obliquity of vision*, no sensible distortion is apparent. Quite obviously, objects from which rays fall square on to the surface of the glass suffer no apparent change of position whatever. It must be pretty evident that the higher the refractive index of any substance, the greater the displacement of a ray of light passing through it; so that if we could conceive a window formed of sheets of diamond, and one pane to be left open, the landscape would be very notably raised as viewed through a closed pane contiguous to the open one. A most beautiful experiment, illustrating both refraction and total reflection (for the idea of which we are indebted to a little book on "Light," by Mayer and Barnard, published by Macmillan & Co.), will probably come in here most appropriately. Fig. 17 is intended to illustrate it.

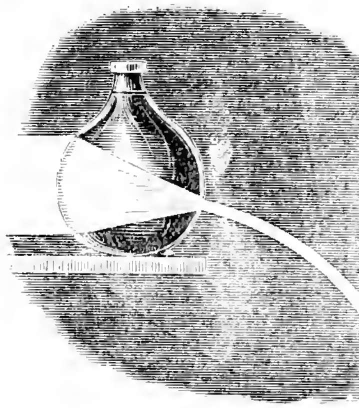


Fig. 17.

The reader should buy the biggest globular glass flask that he can obtain, and have a hole drilled in its side at the shop where he buys it. Stopping this hole with a cork, the bottle must be filled with water, and a parallel beam of light from a kerosine lamp and a bull's-eye lens be projected on to the side of the flask, in the way illustrated by our figure. It must be so managed that the refraction shall bring the rays of light, of which the beam is composed, to a focus on the cork, and the lamp should be enclosed in a box, or otherwise so surrounded by opaque material, that the room would be dark but for the light passing into the bottle. This condition of things being secured, a pail may be placed on the floor, and the cork taken out of the side of the bottle; when a most beautiful effect will be perceived. The light will be totally reflected from the *inner* surface of the issuing jet of water, which will appear like a stream of molten silver, and the interposition of coloured glasses between the source of light and the bottle will tinge this of their own hues. Of course, sunlight or the electrical light will give even more brilliant results still. It was by the aid of the latter, projected in this way through variously-coloured media, that the so-called "Fairy Fountain" was managed which was exhibited at the defunct Panopticon in London.

In our next paper we shall enter upon the subject of refraction through successive surfaces, which, unlike those of the window-pane spoken of above, are inclined to each other.

The conversazione of the Society of Telegraph Engineers and Electricians was held at King's College last Thursday evening. Several highly interesting pieces of apparatus were exhibited, including an artificial cable, representing, in resistance and inductive capacity, about 8,000 miles of submarine line, viz., about 16,000 ohms and 2,450 microfarads, by Latimer Clark, Muirhead, & Co. (Limited); Professor Dr. Dvorak's acoustic experiments, showing the conversion of sonorous vibrations into a continuous current of air; and the model Paris legal ohm (sent by Professor Mascart), by W. H. Preece, F.R.S. In the Physical Lecture Theatre, Mr. H. Tomlinson exhibited and explained experiments on the effects of mechanical stress on the electrical resistance of nickel, which showed that up to a certain point the stress reduces the electrical resistance of nickel, notwithstanding the fact that the wire is increased *in* length and proportionately decreased in sectional area.

THE INTERNATIONAL HEALTH EXHIBITION.

VII.—WATER AND WATER-SUPPLIES.

(*Continued from p. 9.*)

RECENT researches in the natural sciences have one characteristic of value in common, they commence with the simplest condition of the individual, and trace it step by step through the progressive stages of its development and degeneration. A somewhat analogous process to that of the evolutionist might be applied here in the record of the cycle of events which constitute what we may term the life-history of a drop of water.

The principle of the conservation of matter teaches us that do what we will we cannot create, nor can we destroy, a single atom. The water at present in our terrestrial globe equals in quantity the water of the mystic age when all was void or nebular; but the changes to which it has been subjected through countless periods remind us that although matter is immutable, that other great entity called energy can, through its transformations, remodel it, as it were, until its original forms become obscured.

In our universe we always start with something tangible; in this case let us commence with a drop of water, and try to interpret some of the varied phenomena which are to be attributed to its agency. In this way shall we learn what a powerful sway it exercises over the destinies of our earth, how it helps to endow it with that which distinguishes it as a *living* in contradistinction to a *dead* world, and how we are enabled to find therein a striking exemplification of the laws of matter and of energy which we have just cited.

The heat of the sun acting upon the waters of the earth, whether they are in the form of oceans, rivers, snow-fields, or glaciers, causes the original solid or liquid to give place to the gaseous condition. The invisible vapour thus produced rises in the atmosphere according to the law of diffusion of gases, and remains thus until the air containing it cools below its point of saturation, or dew-point. A change then takes place, which is usually brought about in two principal ways; either by contact of a colder current of air with the moisture-laden stream, or by the rise of the latter into the colder upper stratum of the atmosphere. The condensation takes place through deposition on free surfaces, either by contact with the cold earth or mountain sides, or if at a great elevation, with excessively minute particles which pervade the air,* thereby giving rise to the formation of mists and clouds. In any case vapour is formed, and remains suspended in the atmosphere in tiny particles of liquid, or if the temperature be low enough, as aggregates of icy dust. A continuation of the process adds to the size of the cloud particles, until they can no longer be suspended, and hence descend upon the earth, in virtue of gravitation, as rain, sleet, hail, or snow. The theory of condensation around nuclei of cosmic or other origin, divests rain, even in the uppermost regions, of its character of absolute purity, and by the time it reaches the earth, it no longer bears the slightest semblance to chemically pure water, but is highly charged with matters, both solid and gaseous, which are destined to create profound changes during its action as a geological agent. We will not here consider the progressive stages undergone by water which comes to the earth in a solid form to feed the snow-clad regions of its lofty mountain ranges, as, after all, it resolves itself ultimately

* Coulier and Mascart, "Naturforscher," 1875, p. 400; Aitken, Proc. Roy. Soc. Edin., December, 1880.

into liquid water, and thenceforward behaves precisely as in the case of ordinary rain-water.

In virtue of its absorbing properties, our drop of rain-water, on reaching the surface of the earth through its envelope of air and dust, has partaken of certain gases, such as carbonic acid, oxygen, and a small proportion of nitrogen. Carbonic acid gas preponderates, as it is more easily soluble in water than the other gases; it contains between thirty to forty times more of that gas than the atmosphere. Of solid impurities in England, it is estimated that there are about 3·95 in 100000 parts.* In certain districts other gases and substances are superadded, such as sulphurous acid, and sulphuretted hydrogen in the districts of active volcanoes, and sulphuric and nitric acids in the vicinity of manufacturing towns. It is needless to observe that water thus charged would tend very largely to modify the surface of the earth generally, and buildings, &c., more markedly, by a conversion, *e.g.*, of the lime of mortars, marble monuments, &c., into sulphate of lime through the action of the sulphuric acid. Examples of such action have been carefully recorded by Angus Smith,† and more recently by Geikie.‡ Sulphates of alkalies and alkaline earths, and chlorides, especially common salt in the neighbourhood of coasts, swell the list of impurities which crowd into a drop of water before it commences its work upon the crust of the earth. Other inorganic particles which have been detected vary in character with the surrounding circumstances; amongst them may be mentioned specks of fine terrestrial dust, and dust of cosmic origin, containing minute spherules of iron.‖ Some of the organic impurities of rain-water which have been derived from the air were discoursed upon at length in our last communication.

Thus fortified, rain-water is peculiarly adapted to commence its work of modification upon the crust of the earth. Its carbonic acid is augmented in quantity, and it thus becomes a powerful solvent, particularly upon substances composed of or containing lime salts. Now, since vast tracts of country are formed of limestones, marbles, chalks, and other calcareous rocks, its action must indeed be enormous. Large quantities of lime are dissolved and carried away by the water which percolates through the earth to its underground reservoirs. In some instances these calcareous waters drop through caverns, and so highly are they charged with lime that evaporation of the water, as it leaves the roof of the cave and reaches the floor, is sufficient to deposit the lime in concentric rings, which afterwards take on a radiated structure, and give rise to more or less complete pillars, some dependent, and some in the form of upright bosses on the floor,—stalactites and stalagmites. Deposition through evaporation also goes on in rock fissures and cavities; veins and druses full of crystals, sometimes of rare minerals in exquisitely developed and perfect forms, are thus evolved. A quantity of the water is often held in these crystals as water of crystallisation, and subsequent action, such as that of heat or pressure, may entirely change the character of these deposits; instances may be found in the mineral calcite and its allied forms.

The influence of the carbonic acid of rain-water upon rock structure is sometimes most complicated, and a vast field of inquiry lies open before the experimental petrologist in this direction. As an example, we may point to the large group of metamorphic rocks of which the serpentines are the most noteworthy: here§ the carbonated waters appear to remove the oxidised iron and magnesia of the mineral olivine (in serpentines derived from olivine-rocks), as precursory to its conversion into the beautiful green material which is so much admired in architectural decorations and ornaments. Even the silicates, as of lime, soda, and potash, crumble away in time before its action; and thus are the felspars of granite and diorite broken down into sands and clays; their alkalies are removed as soluble carbonates, and the silica is generally liberated in the form of a hydrated bisilicate of alumina called *kaolin*, a substance not unknown to Messrs. Doulton & Co., of Lambeth, whose exhibits we recently reviewed.

The oxygen taken up by rain-water is also added to during its percolation through the soil. Its action upon calcareous rock-masses is not of very great importance, unless they happen to contain a large proportion of iron; but in regions where the rocks are chiefly of igneous origin, as in Devon, Cornwall, the lake district, Cymric mountains, and Scottish Highlands, minerals such as hornblende, augite, olivine, apatite, &c., occur largely, and the oxygen plays an important part in the conversion of certain of the mineral components into ferrous and manganous oxides. The rocks thus weather or crumble away to form soils through which future waters penetrate, and from which they take their character. The formation of soil from volcanic rocks which are rich in apatite or phosphate of lime, through this chemical disintegrative action of water, is of the first importance to the agricultural economist.

Our remarks upon the organic impurities in water were confined to such of them as are chiefly derived from the air in the germ condition. On reaching the earth, however, rain-water becomes the vehicle for enormous quantities of other organic matters which exercise profound chemical changes; they act upon minerals to a degree which would scarcely be credible at first sight. The so-called humus or ulmic acids, which they create, combine with mineral bases to form soluble substances which are afterwards changed into carbonates. A detailed account of these reactions may be gleaned from the researches of Senft* and Julien.†

What is more apparent, however, is the reducing action of water through the agency of contained organic matter. Any one who has visited districts abounding in red sandstones, as along the northern and eastern coasts of Scotland, would be struck by the numerous whitish and greenish-white spots and streaks which mottle the rock every here and there. The cause of these discolorations has been explained thus:—The organic matter in the water abstracts oxygen from the ferric oxide, which imparts the red colour to the stone, and reduces it to the condition of a ferrous oxide, which is thereafter removed by becoming a soluble carbonate or an organic salt. Organic matter also acts as a deoxidiser by the conversion of sulphates into sulphides, and is thus capable, for instance, of completely metamorphosing districts composed of sulphate of lime, &c. Whilst speaking of gypsum, or sulphate of lime, we are reminded that a certain proportion dissolved in water gives the latter undesirable characters which are often difficult to eradicate; we shall have occasion to discuss this subject when we come to treat of the practical details of water supplies. Gypsum contains a large quantity of water in its composition; when deprived of this water it is called anhydrite, and in becoming thus changed it loses in bulk; this is a feature of considerable interest to the dynamical geologist, who finds in it an explanation for unaccountable upheavals in districts where

* Sixth Report of the Rivers Pollution Commission, p. 29.
† "Air and Rain," 1872, p. 444.
‡ "Proc. Roy. Soc. Edin., 1879-80," p. 518.
‖ Jung, "Bull. Soc. Vaudoise Sci. Nat.," xiv., p. 493; Von Lasaulx in "Tschermak's Mineral. Mittheil.," 1880, p. 517.
§ Dana, "System of Mineralogy," 5th Ed., p. 258.

* "Zeits. Deut. Geol. Ges.," xxiii., p. 665; xxvi., p. 945.
† "On the Geological Action of the Humus Acids." Proc. Amer. Assoc., xxviii., 1879, p. 311.

anhydrite obtains to any large extent; its conversion by hydration into gypsum being accompanied by a sensible increase in bulk.

Of the mechanical action of rain-water upon the earth, we cannot do more than allude briefly to its power as a denuding and disintegrating agent. The formation of rivers and lakes—and, indeed, the whole landscape scenery of the world—is largely determined by the action of water. The rain that does not sink into the ground flows off in channels which it grooves for itself down the sides of hills to rivers, lakes, and the sea. In its passage over the rocks the water of rivers acts both mechanically and chemically; it holds in suspension not only insoluble particles, but dissolved matters, which vary with the character of the soil it has traversed; it is augmented by springs which may bring to it water which has accumulated from a distant and distinct region; it is crowded with diverse forms of plant and animal life, and may be polluted by the sewage and other offensive products, not only of densely-populated districts, but even of isolated tenements. This is well shown in the subjoined figure (Fig. 14), for the use of which we are indebted to the courtesy of Mr. P. A. Maignen, of Great Tower-street, E.C.

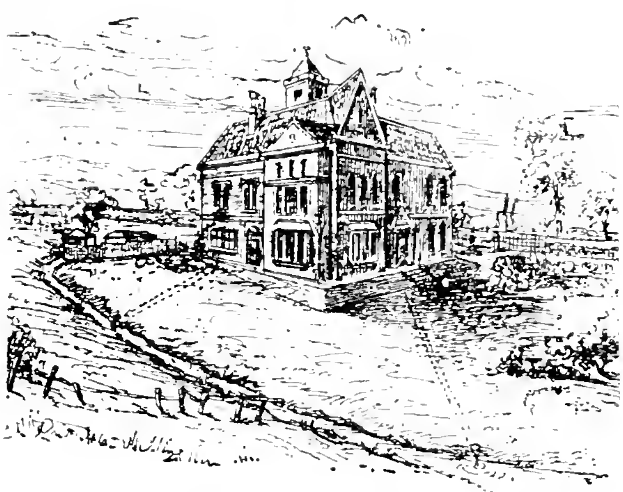


Fig. 14.—Excellent mountain stream, affording a supply to a country-house, and at a lower point to a small village. Defective drains and overflow from cesspools (shown by dotted lines) polluting the stream.

In continuation of our remarks, we shall trace the history of a drop of water from other sources, with special reference to the waters of the Thames and the London water-supply. We trust that these notes will enable our readers to form an adequate estimation of the value of the practical appliances which we shall soon place before them, as in pointing out the details of mechanism it will be found necessary to refer constantly to what we have here attempted to explain.

Curious Case of Cause and Effect.—During a storm at Greenville, R.I., May 9, the lightning ran by the telephone wire to the Windsor Mill, where there is no telephone, but the wire is disconnected just outside the building. The lightning was led by the wire to the corner of the mule and weaving rooms, and entered the building under the jet. It followed the water-pipe and set the sprinklers going, and at the same time fired the stock in the mules. By this singular provision of an active extinguishing agent at the moment the fire started, serious loss was prevented, as the fire was soon drowned out. Many of the spindles in the mules lost their temper, and some of the belts were burned, but the mill was saved. —*Scientific American.*

Reviews.

SOME BOOKS ON OUR TABLE.

Freemasonry Traced from Prehistoric Times, &c. By A Master Mason. (London. 1884.)—We are just in this tremendous difficulty with the tract whose title heads this notice: its author is inspired! At least he says he is—and he ought to know. He traces Masonry from the Magi, and suggests the establishment of a Supreme Grand Lodge and a Supreme Grand Chaplain of the whole world. He further is good enough to inform us on the cover that "All known substances are not only held together by electricity, but all things, atoms included, are composed entirely of electricity." This is Jachin and Boaz, Hiram and Tubal Cain run mad with a vengeance.

On an Error in Elliptic Motion. By A Student. (Leeds: John Lennox. 1884.)—The "Student" regards the Dynamics of Tait and Steele as radically unsound, has mounted a piece of apparatus to illustrate elliptic motion, and gives a sketch of a "Typical orbit. Diagram obtained by placing magnet beneath plane and oiling sphere," among other illustrations. None are so blind as those who *won't* see.

The Unlimited Debt. By F. W. D. Mitchell. (Dublin: A. Thom & Co., 1884.)—Mr. Mitchell is a disciple of Mr. George's, and apparently—with Proudhon—regards property (in the form of land) as theft. He essays—not very successfully—to answer the Duke of Argyll's article, "The Prophet of San Francisco," in the April number of the *Nineteenth Century.* One elementary fact is certain—either land must remain in private hands, or it must become the property of the State. In the latter case rent and taxation must become synonymous; and then God help the cultivator of the soil!

The Abuse of Blue Ribbonism. By a Moderate Drinker. (London: Hitle & Son.)—This is a temperate protest against the rant but too often heard upon teetotal platforms. Starting with the axiom that drunkenness is both a curse and a sin, the author shows, alike from Scriptural teaching and from the every-day experience of mankind, that the use of a strictly moderate amount of fermented liquor is at once pleasant, harmless, and conducive to health.

The Slide-rule Extended. By Major-General Hannyngton. (London: E. & F. N. Spon. 1884.)—By an extension of the slide-rule, General Hannyngton has produced an instrument which cannot fail to be of value to all engaged in much logarithmic computation of the kind involved in reducing astronomical observations, making intricate divisions in a clearing-house, finding the cubic contents of timber, and the like. His pamphlet explains the principle of such extension, and illustrates the use of the improved rule by examples.

A Short Exposition of Massage, &c. By G. Fenton Cameron. (London: Baillière, Tindall, & Cox.)—Massage appears from this tract to be a kind of medical shampooing, or rather kneading; and the tract itself may be looked upon as a message to such as may need it.

Hints on Sanitary Laws, &c. By G. F. Chambers, F.R.A.S. (London: Allman & Son. 1884.)—This short digest of the numerous Acts of Parliament regulating the sanitary condition of London is issued by the National Health Society, and will be found useful by all interested in the health of the metropolis. It gives a clear exposition of the law, and teaches the householder at once with what sanitary requirements he must himself comply, and how to enforce obedience to them on the part of his neighbours. It is followed (in an Appendix) by a Directory of the Sanitary Officers, &c., District Asylums, and Hospitals for Infectious Diseases in the metropolitan area. It is noted by Mr. Chambers in his Preface that the Public Health Act of 1875, under which every other rural and urban sanitary authority in the kingdom is governed, excluded London! a curious illustration of the result of that plethora of empty verbiage and absence of real work which characterises the House of Commons.

Moffat's Class Register—Moffat's Half time Register—Amner's Inspector's Test Cards—Matthew's unexcelled Series of Arithmetical Test Cards. (London: Moffat & Page.)—These publications are adapted to the latest requirements of the Education Department, and, as is generally the case with works issued by Messrs. Moffat & Co., are unexcelled for use in Public Elementary Schools. The test cards are designed to supply the examiner with a series of questions (and replies to them) calculated to show the progress of the pupils in the various standards.

Sewing made Easy, with Notes of Lessons on various Stitches. (London: Moffatt & Page, 1884.)—We have purposely exclnded this most practical work from the previous heterogeneous heading, inasmuch as its use is by no means confined to the schools for which it was apparently primarily intended. We have snbmitted it to a lady skilled in needlework, for her unbiassed opinion, which we append. "This," she says, "is an excellent little book, on a most simple system: by the aid of which sewing of all sorts may be easily taught. No mistress should be without it. There is a good list of cheap paper patterns, sold by the publishers, at the end of it, illustrations of garments of various sorts, and explicit directions for every kind of darning and marking. You may very safely recommend it." Which, on the strength of such testimony, we hereby do.

The Book of Health. Part I. Edited by Malcolm Morris. (London: Cassell & Co.)—This first part of what promises to be a succinct Encyclopædia of Hygiene contains an introductory chapter by Mr. W. S. Savory, F.R.S., extending over 100 pages, and the commencement of an essay by Sir Risdon Bennett, M.D., F.R.S., "On Food and its Uses in Health." It gives promise of being at once a useful and a readable work.

The Countries of the World. Part I. By Robert Brown, M.A., F.R.G.S., Ph.D. (London: Cassell & Co.) With its really admirable illustrations, and its chatty and readable letterpress, Dr. Brown's pleasant introduction to geography and ethnology can hardly fail to command an extensive circle of readers. An excellent map of the world, on Mercator's projection, accompanies this first part.

Cassell's Popular Gardening. Part I. Edited by D. T. Fish. (London: Cassell & Co.)—This profusely-illustrated book supplies just the kind and amount of information required by every possessor of a garden, whether in lordly proportions it may surround a country mansion, or take the form of the two narrow strips of "back and front garden" of a suburban villa. Garden-pots and potting, ground operations, florists' flowers, ferns, kitchen-gardening, and greenhouse plants are only some of the subjects treated of in the number before us.

Cassell's Household Guide. Part I. (London: Cassell & Co.)—Here is the first instalment of another encyclopædia—this time, however, devoted to domestic economy. Domestic finance, house furnishing, cookery, domestic surgery, household carpentry, dogs, gymnastics, chicken-keeping, and decorative art, we may select at random from the contents of this number to show its scope and character.

European Butterflies and Moths. Part I. By W. F. Kirby. With coloured plates. (London: Cassell & Co.)—This book, with its superb illustrations, will doubtless soon be upon the shelves of every lepidopterist in the three kingdoms. Supplying, as it does, the means of identification of every leading form of European butterfly and moth, it may well be commended to the traveller and the sojourner in the country. Like the four previously mentioned works, this is published at a price which suggests the idea that it must almost entail a loss upon every one concerned—save always the fortunate purchaser.

Amateur Mechanics. No. 18, Vol. 2. (London: Iliffe & Son.)—A handy and useful monthly publication for the amateur turner, joiner, fitter, and engineer.

The Sanitary Engineer. British and Continental Edition. (New York.)—A weekly paper containing much that is interesting to all concerned with the question of health, on both sides of the Atlantic.

Illustrated Sports is a monthly journal made up of articles on athletics and advertisements in about equal proportions.

The Laundry Guide, by W. J. Menzies, referred to in our last issue, is published by McCorquodale & Co., Newton-le-Willows. Price 6d.

Miscellanea.

We hear that the delay in the issue of the current number of Mr. F. G. Heath's "Fern Portfolio" has arisen wholly from the elaborate nature of the work and the great size of the stones employed in the colour-printing.

Amongst the prominent Americans expected in London this month (says our chatty and readable contemporary *Society*) is the celebrated astronomer Dr. Draper, who will be accompanied by his fascinating wife, one of the most charming of American women, as accomplished as an Italian of the sixteenth century and as brilliant as a Parisienne of the eighteenth.

Shakesperiana.—To the July part of the "Miscellanea Genealogica" Mr. Stephen Tucker, Somerset Herald, has communicated a most interesting account of the Assignment of Arms to the father of the poet. This account is illustrated by five *fac-similes* of documents from the Heralds' College Records. These have been most carefully executed in photo-lithography, and will be heartily welcomed by all those interested in Shakesperiana.

Vivisection.—During the year 1883, according to the annual report just issued to Parliament, five hundred and sixty-nine experiments were performed on living animals in the United Kingdom, thirty-four of these being carried out in Ireland. Fifty-five experiments were performed without anaesthetics, and one hundred and twenty-two under certificates giving permission to preserve the life of the animal after recovery from anaesthesia. Concerning this last class of experiments, the report states that in one hundred and fourteen cases the operation consisted of inoculation with various septic matters or morbific organisms, for the greater part connected with an important inquiry into the nature of tubercular affections. No pain was inflicted in these cases except in about fourteen or fifteen instances, in which disease was produced, but which was very trifling. In the remaining eight cases, in which more serious operations were required, as these were effected under anaesthesia, the only suffering in the animals that survived would be that which attends the ordinary repair of a "surgical injury."—*Medical Press and Circular.*

The April Earthquake.—Swiftly as the shadow of a summer cloud sweeps over wide country tracts, so glided by the invisible power, and ruins marked its course. When the actual active force of the calamity had come and gone, then terror had its turn. A mighty fear overcame most living things. Birds flew wildly hither and thither, uttering sharp, startled cries. Beating in blind haste, perhaps, against trees or walls, many a little feathered victim fell lifeless to the ground. A flock of sheep being driven up a hill-side could with difficulty be kept together, and one poor woolly matron died within a few minutes of the shock—her fate being shared by two lambs of very tender age. Farmyard fowls huddled together in abject fright. Dogs howled and cowered in amazement. Cottage folk tell almost unanimously, how they "wholly looked to be swallowed up!" And as for the womankind, rushing terror-stricken out of their falling homes, it seems that with one accord, to use their own emphatic phrase, "they shruck." "'T must be London blown up!" was one man's scared suggestion; but "Nay, mate," made answer a more reasoning mind. "Not if all London *was* blown up 'twouldn't shake we like this. It's something wuss!" And for the panic that ensued, all who, like the writer, have made a pilgrimage through only part of the afflicted district, must own there is ample reason."—"*Cassell's Family Magazine*" for July.

WE are glad to notice conspicuous examples of boldness among our lay contemporaries in their discussion of and dealing with the burning question of vivisection; notably, the *Illustrated London News* recently devoted a whole page of matter and illustration to the humane and deeply interesting experiments of Pasteur, whose efforts to prevent human suffering and save human life are so well known as beyond all praise. At any rate they are far beyond the hysterical howlings of the class of the Cade and Jesse school, and of whom the *Dispatch* writes:—"We should remember that the sufferings of men and women are quite as acute, and accompanied with more mental anguish, than those of the inferior animals, and, no longer confining our sympathy to dogs and cats, we should take care that nothing in our Statute-book lessened the chance of alleviating human pain and lengthening the duration of healthy lives. The subject of wanton cruelty either to dumb animals, or children, or helpless women, should be legislated for on totally different grounds from those on which we proceed in the case of useful scientific experiment. It is an insult to include amongst the possible occurrences of such a crime the work of a great physiologist seeking the discovery of new truths. The Act of 1876 has resulted in almost extinguishing original physiological research in this country. This must be recognised by the thoughtful politician as a very great cruelty to present and future human beings suffering from diseases as yet but little understood."—*Medical Press and Circular.*

RUNNING AWAY FROM A RUNAWAY ENGINE.—A curious and very nearly a disastrous collision occurred on the Rock Island and Peoria Road recently. The engine of a gravel train got off the track near Coal Valley, a station about fourteen miles from Rock Island. A wrecking train was sent out from Galva to get the engine on the track again. Passenger train No. 2, going to Peoria from Rock Island, met the disabled engine first, and after considerable work the track was cleared. The train then started on, but had not got far, when the wrecking train was met on a sharp curve, the engine to which was backing up. Both engines were reversed as quickly as possible, but the trains came together with quite a shock. The passengers were badly shaken up, but no one was seriously hurt. The engineer and fireman of the engine attached to the wrecking train had jumped to the ground, and when the collision occurred the tank became detached, while the rest of the engine started forward at a terrific rate, the engineer having pulled the throttle wide open before he jumped. Passenger train No. 1 from Peoria was about due as the wild engine started down the track directly towards it. Both engines, however, approached on a straight track, and the engineer on the passenger train reversed his engine and started on the back track, closely followed by the wild engine. The chase was kept up for several miles, until the steam finally gave out on the runaway engine, and it was captured. Thus two narrow escapes from a fearful collision occurred in a short space of time.—*Railway Review* (Chicago).

WEIGHTS AND MEASURES CONFERENCE. One of the latest organisations formed for the purpose of furthering the knowledge of the public on scientific and technical subjects is that known as the British Association of Inspectors of Weights and Measures, whose annual conference opened in Glasgow on Tuesday of the present week, Bailie Fullarton, of Greenock, presiding at the first sitting. One of the subjects discussed was embodied in a resolution proposed by Mr. Walker, of Glasgow. In that resolution the Association respectfully submitted to the Board of Trade that they did not consider it at all necessary, and certainly not desirable, that a new standard weight of 112 lb. should be legalised, and for the reasons that it was so near in size to the central or 100 lb. weight, and in consequence liable to be used fraudulently; that any on requiring such a large weight could use the already legalised central; that if a concession was to be made to one business the Board of Trade could not consistently refuse to grant a special weight to any other business; and that the concessions asked for by the ironmasters, if granted, would destroy the main principle of the Weights and Measures Act of 1878. Mr. Walker stated that there were already ninety-four standard weights at present in use. The secretary of the Association, Mr. Wimhurst, Manchester, dealt with the inspection of the weights and scales used in post-offices, which was considered to be not only desirable but absolutely necessary for the protection of the public. Mr. Pickering, of Sunderland, drew attention to the vagaries which distinguish the manufacture and stamping of ordinary commercial weights, and at the afternoon sitting of the Conference Mr. Shaw, of Edinburgh, read a paper entitled "Observations on the Weights and Measures of Apothecaries and the Necessity existing for Exactness, and for Comparing and Verifying the Same."—*Engineering.*

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

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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SAVAGE NAMES.

[1331]—The superstitions about names mentioned by Mr. Clodd (KNOWLEDGE, June 27) were shared by the Aryans of India. I am many miles from a copy of a Brahmana, but, either in the Aitareya or the Satapatha Brahmana, we find that Indra had a name which (like Mr. Clodd's savage friend) he would not divulge. When Indra fled after the slaying of Vrittsa (as Apollo fled after slaying the Python), he was in such an abject fright that he dropped his name from his lips involuntarily. In other respects, the results of his terror were exactly like what Odin experienced when he flew away with Suttung's mead. A. LANG.

COLOURS OF CLOUDS.

[1332]—I should feel obliged to any of your readers who would give a satisfactory explanation of a singular appearance which I witnessed one afternoon last week, and which I can remember to have noted on several occasions in past years, though not, I think, recently. The day was one of especial clearness and beauty, with a gentle breeze from W. or N.W., and scarcely a cloud, except a few of light texture and very small dimensions, floating at a low elevation near the N. horizon. There was nothing remarkable about these except their peculiar colouring, which was of a brownish grey, as though they had lain in shadow instead of being in the fullest solar illumination. One of rather greater dimensions and apparent consistency showed a whiter and more luminous centre, but its edges in every direction, above as well as below, were of the same sombre tint as its neighbours. I must confess my inability to understand how the vapour of water, which under ordinary circumstances is only visible by its pure white reflection, should assume so shadowy a hue, though perhaps the difficulty is no greater than that presented by the coppery tone frequently exhibited by portions of a thunder-cloud. T. W. WEBB.

ACARINA AND *ORIBATIDÆ.*

[1333]—Mr. Slack's very pleasant and interesting little article on the *Lacidæ*, in your number of June 27, contains an error which I may as well correct, although it is probably a mere slip of the pen, because it might mislead others who are not so well acquainted with the organisation of the *Arthropoda* as the author of "Pond Life" is.

In the article in question I am credited with doubting the respiratory functions of the so-called stigmata of the *Acarina*, and with supposing them to be sense-organs. This would be correct if the word *Oribatidæ* were substituted for *Acarina*, but my observations are confined to the *Oribatidæ*, and do not apply to any of the other numerous families of *Acarina*. It must not be supposed that I, for a moment, deny that the *Oribatidæ* possess stigmata, like other tracheate creatures; all I assert is that the conspicuous organs on the dorsal part of the cephalo-thorax of these tiny beings are not the stigmata, and are not connected with the tracheæ, but that these are sense-organs, and that the real stigmata, from which the tracheæ arise, are situated in the acetabula (basilar cavities) of the legs. ALBERT D. MICHAEL.

TESTS OF DIVISIBILITY.

(A reply to the general question involved in Letter 1274.)

[1334]—To determine whether a number (N) is divisible without remainder by another number n (n being any number prime to 10).

1. Divide 999 . . . . by n until there is no remainder. It can be algebraically proved that this will happen when $(n-1)$ 9's have been used. In practice a smaller number will often be found sufficient. For instance, if $n=41$, only *five* 9's are needed, $\left(=\frac{n-1}{8}\right)$.

2. Count the *number* of 9's used in the division, and mark off N in periods of the *same* number of figures, commencing from the right.

3. Add the periods together, marking off and adding again if the number of figures in the sum exceed the proper number in a period.

3A. When the period consists of an *even* number of figures, mark off the sum just obtained into *semi-periods*, and subtract one from the other. (This is in principle the same thing as the rule in Letter 1274, where alternate semi-periods are added in the first place, but I think my method will be found a little shorter in practice.)

4. Divide the final result in 3 (or 3A) by n. If there be no remainder, N is divisible by n. W.

PROPERTY OF NUMBERS.

[1335]—Thank you for publishing the problem under the above title (1295, p. 424), which if not difficult is novel and interesting I solve it as follows:—Let the remainders upon division by 3, 5, 7, and 11 be t, f, s, and e, respectively, then the number is $385t+231f+330s+210e$, less such a multiple of 1155 as must be subtracted to reduce the number to one of three figures. It is evident that a number expressed by the above formula will divide by each of the divisors with the given remainder, and that no other number will do so unless the difference between it and this number is divisible by 3, 5, 7, and 11, that is, is a multiple of 1155.

It is easy to construct formulas for similar problems with different divisors. A limit must be fixed so that the number shall not exceed the product of all the divisors. [And the divisors must have no common factors.] Then the co-efficient of each remainder must be a number which divides by the divisor, producing that remainder with 1 remainder, and by all the other divisors without remainder. If the divisors were 7, 11, and 13 the co-efficients would be 715, 364, and 924.

The principle of this problem suggests to me a trick to be played with cards, as follows:—

Mix together two whole packs of cards and request some one to cut the double pack into two portions, and to divide one portion into seven equal packets, adding the superfluous cards, if any, to the other portion, then leaving the seven packets to divide the other portion into five equal packets, handing any superfluous cards to the performer of the trick, then mixing the five packets to divide again into three equal packets, again handing any superfluous cards to the performer, who will thereupon state how many cards are contained in each of the three packets and in each of the seven packets. Perhaps some of your readers may like to search for the solution of this trick. ALGERNON BRAY.

New York, June 18, 1884.

AN ANIMAL ATTEMPTS SUICIDE.

[1336]—Did not the poor animal referred to in letter 1308, already suffering from heat, and smoke, and fright, mistake the broken glass for ice or water, and carry it to its mouth with the hope of relievi.g its sufferings, rather than with the idea of suicide? M. J. C.

COINCIDENCES, &c.

[1337]—Most people have heard of the "War Office Ghost," the story of which is given in "Footfalls on the Boundaries of Another World,"—how the wife of an officer who was killed at Sir Colin Campbell's relief of Lucknow saw him at Cambridge the night of his death, and thereby detected an error of one day in the date as given in the official returns. Now, in the published account it is mentioned that he appeared to her with his shirt-front stained with blood, but it is most unusual for an officer in regimental uniform to show any shirt front at all. It happens, however, that shortly before his death he had a fancy patrol coat made, the front of which was cut open, showing a great deal of linen. I had been with him at Cawnpore a week or two before he was killed, and particularly noticed this. It would seem as if his wife actually saw him in the very dress he was killed in, without having previously been aware of the peculiarity of that dress. By-the-bye, it should have been stated at what hour of the day he was killed, so as to allow for difference of longitude. Thus, if his death happened at 8 a.m. his wife ought to have seen him between 1 and 2 a.m.

MUSAFIR.

[1338]—On Saturday, June 7, I had been writing to a young lady, on her death-bed, as it proved. I had finished my letter a few moments before one o'clock. Just at this moment she awoke from a dosing sleep. She called her sister, and asked her if she had been writing a letter to her. She replied she had not. "Then," replied the dear girl, "if you have not Mr. W—— has, and he has blotted it in two places." She died early on the following Monday morning, between three and four a.m. About ten a.m. that day my letter arrived, and on the first sheet, sure enough, there were two blots. This had occurred by a little accident, and I had not time to write a second letter. G. WATSON.

LETTERS RECEIVED AND SHORT ANSWERS.

E. L. GARRETT. Woe is me! that ever I admitted your Noah's rainbow letter. It has brought me not only about a ream—more or less of controversial matter, but your own prodigious reply to my short comments in your last. The discussion must close, or else a whole number must be given up to it—which I must respectfully decline to suffer. No doubt, comets are very numerous (albeit Kepler was scarcely an authority on this point), and we must have run into or through plenty, as we shall do over and over again, without producing the slightest sensible effect upon the earth —beyond, perhaps, the apparition of a rather finer shower of shooting stars than usual. You should know more of the rudiments of Logic than to assume that aqueous comets must be held to exist until the contrary is proved. It would be quite as rational for me to assert that the inhabitants of Venus eat pork chops on a Friday, as you cannot prove the contrary! A. B. C., and R. LAING.—As you will see from the preceding reply, the Noah's Rainbow and Flood discussion is closed.—F. W. HENKEL. I am sorry that my decision to stop the Flood discussion excludes your really valuable and important communication.—A. GOODALL. Your letter to the publishers was considerably delayed, thanks to its being addressed to the Editor.—J. You must read KNOWLEDGE with very little attention, or you would know that theology is rigidly excluded from its columns, and your own letter is a theological one pure and simple. Acquire some rudimentary idea of what *evidence* is from Mill's "Logic," or any similar work. H. P. DEANE and S. MACKIE. Thanks; but I was many miles away from South Kensington on July 2.—D. M. Your letter on "Tricycle Tracks" is very much longer than the interest of its subject warrants.—PROTEA. The black disc of Venus herself forming the base of the shadow cone, how can you possibly expect to see her shadow in any degree "sideways" during her transit either at ingress or egress? Why, the whole diameter of the sun is little more than half a degree. Besides, upon *what* do you suppose the shadow would be projected, even were we looking (as it were) edgeways at the whole arrangement? The latest edition of my "Transits of Venus" was published in 1878. I know of no other work covering the same ground. My lectures are always announced in KNOWLEDGE, but I have ceased for the present to deliver them.—E. PINFOLD and W. COOMBER. Your letters have been needlessly delayed owing to your omission to address "the *Chess* Editor."—DEPRECIATION. Mr. Wyman regrets that he has received no actuarial training.—T. MURRAY. The "P. D." theory is Pure Drivel, neither more nor less. Pray do not waste your time in sending me expositions of it; they one and all find their way immediately into the waste-paper basket.—T. MANN. "Polyglot's" article could not have been written to enable all his readers to dispense with the services of a patent agent, inasmuch as it points out that in complicated cases such aid is indispensable. Can you refer me to the number and page of KNOWLEDGE in which the statement to which you refer occurs?—HAROLD ROWNTREE. Sorry that the compositor should have taken liberties with your name. Thanks for your description of the approximate trisection of an angle; but, as in the case of nineteen-twentieths of the communications I receive, it is too long for insertion.—JAMES CRAM. I have received a "magic cube" from this gentleman which is really a marvel, and worthy of notice by all interested in what may be called numerical tricks.—A. G. PULLER. I am away from my books where I write, but will look up my authority on my return.—W. COMMON. The change, *if* made at all, would be made in longitude 180°; but it is not a practical matter, as all civilised races may be held to be comprised between such limits of longitude, that while it is noon at Greenwich on, say, July 11, it is 3h. 10m. a.m. of the same day at Vancouver Island, and 11m. 38m. p.m. at Wellington, New Zealand. Ships returning from circumnavigation of the world of course change their day on coming to the first port within these meridians.—William Wigan. I regret that I am powerless to help you.—Drum sends a newspaper cutting of the score of a cricket match between two towns named Lennoxvale and Adelaide. In the first innings Lennoxvale scored 2 and Adelaide 1. The second was not played out. Seemingly the wicket soon ceased from troubling, and the weary were at rest.—Phobos. Depend upon it our contributor knows most thoroughly what he is writing about. I cannot conscientiously recommend you a cheap instrument. Neither of the gentlemen you name ever made a telescope in his life. I am quite uncertain about coming to town.—Julia Usher. No telescope of less than 2½ inches in aperture is of the slightest use for astronomical purposes; and the lowest price at which a first-class instrument of this size is procurable is seven guineas, or thereabouts. I cannot undertake to recommend individual makers, of whom, by the way, there are very few; though sellers of telescopes abound.—O. P. As a really admirable introduction to the subject, nothing surpasses the "Marvels of Pond Life," by Mr. H. J. Slack, published by Groombridge & Son, London. For an exhaustive account of Cyclops, Daphnia, &c., see Dr. Baird's "Natural History of the British Entomostraca," published by the Ray Society. The "Micrographic Dictionary," published by Van Voorst, contains a mass of information concerning microscopic objects of every description—animal, vegetable, and mineral. For the adequate study of Infusoria proper, the "Manual of the Infusoria," by Mr. W. Savill. Kent, published by Bogue, London, must be consulted. The last two works named are both bulky and somewhat costly.—Gerty Girton. I do not insert your jeu d'esprit, just to show that I can resist temptation; but your P.S. put an amount of pressure upon me almost too great for even an editor to withstand.—Ada Heather Bigg. Your able paper unfortunately occupies more space than I could devote to a subject of comparatively limited popular interest.—James Gillespie. My mere silence might have sufficed to indicate what I "think of" your pamphlet. I stand in a species of dumb amazement at any one who is so hopelessly ignorant of the most elementary facts of the subject, presuming to dogmatise upon them. I should no more dream of arguing with you than I should with a gentleman in a straight waistcoat who alleged that he was the Podasokus, or little Oozly bird. Any child of eleven who knows the principal constellations will tell you that we do *not* see the same stars in the September night sky that we do in the March one. Your prose is bad, your "poetry" verse and verse. As for letting you "know what you should do to bring it out," I would implore you, if you value your reputation, to keep it in, with all your might and main.—W. Hill & Son send a description of a "Hygienic Bakehouse," which would appear to present a delightful contrast to the filthy underground cellars in which Londoners have been from time to time shocked to learn that some of their bread is made.—W. P. Thompson Boult. Your "New Patent Convention" received, but its great length precludes its insertion.—Rev. T. W. Webb. Received.—John A. Stewart sends an account of the rescue of a man from a mine after three weeks' imprisonment, in consequence of a woman dreaming that he was immured in it. His entombment was quite unsuspected otherwise. This happened forty years ago.—T. A Vligk (*sic*) takes exception to the statements on p. 9 as to the danger to be apprehended from disease germs.—J. F. O. I can only regret that the very great length to which your communication on "Fortune-Telling extends prevents its insertion, and I scarcely see my way to curtail it without destroying the sequence of your argument.

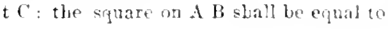
Our Mathematical Column.

NOTES ON EUCLID'S SECOND BOOK.

By Richard A. Proctor.

In the second book Euclid deals with the relations between the rectangles contained by straight lines and the parts into which they may be divided. The method he adopts is somewhat cumbrous—so far, at least, as Problems 2 10 are concerned. The student must not deal with problems on the second book in Euclid's manner. In order to illustrate the proper method of dealing with such deductions we give new solutions of Propositions 4 to 10, premising that Propositions 2 and 3 are particular cases of Prop. 1.

Euc. II., Prop. 4 should be thus established:—



Let A B be the given straight line divided into any two parts in the point C: the square on A B shall be equal to the squares on A C, C B, together with twice the rectangle A C, C B.

By Prop. 2 the square on A B is equal to the rectangle A B, A C, together with the rectangle A B, B C.

But by Prop 3, the rectangle A B, A C is equal to the rectangle A C, C B, together with the square on A C; and the rectangle A B, B C is equal to the rectangle A C, C B, together with the square on B C.

Hence the square on A B is equal to twice the rectangle A C, C B, together with the squares on A C and C B.

Cor.—If a straight line be divided into two equal parts the square on the whole line is equal to four times the square on either half.

Prop. 4 may be enunciated thus, *If a straight line be divided into any two parts, the square on one part is less than the square on the whole line by twice the rectangle contained by the parts together with the square on the other part.*

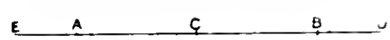
Prop. 5 should be established thus; let the straight line A B be divided into two equal parts in C, and into two unequal parts in D; then the rectangle A D, D B together with the square on C D shall be equal to the square on C B.

Since A D is made up of A C, C D whereof A C is equal to C B, the rectangle A D, D B is equal to the rectangle C D, D B together with the rectangle C B, D B (Euc. II., 1): that is, to twice the rectangle C D, D B, together with the square on D B (Prop. 3). Add the square on C D. Then the rectangle A D, D B together with the square on C D, is equal to twice the rectangle C D, D B together with the squares on C D, D B; that is, to the square on C B (Prop. 4).

Cor. Since the square on A C or C B is equal to the rectangle A C, C B, it follows that if a straight line is divided into unequal parts the rectangle contained by these is less than the rectangle contained by the halves of the line; and also (the deficiency being the square on C D) that the more unequal the parts the smaller is the rectangle contained by them.

Prop. 6 should be established thus,—

Let the straight line A B be bisected in C, and produced to D; then the rectangle A D, D B together with the square on C B, shall be equal to the square on C D.



Produce D A towards A to E, making E A equal to B D, so that C E is equal to C D and B E to A D. Then by Prop. 5, the rectangle E B, D B together with the square on C B is equal to the square on C D; that is, the rectangle A D, D B together with the square on C B is equal to the square on C D.

Props. 5 and 6 may be included in one enunciation thus—*The rectangle contained by the sum and difference of two straight lines is equal to the difference of their squares* (A C, C D *being the two lines referred to*) *; or thus, taking* A D *and* B D *as the two lines of reference, the rectangle contained by two lines is equal to the square of half their sum diminished by the square of half their difference.*

Prop. 7 is proved thus:—

Let the straight line A B be divided into any two parts in C; the squares on A B, B C, shall be equal to twice the rectangle A B, B C, together with the square on A C.

The square on A B is equal to the squares on A C, C B, with twice the rectangle A C, C B (Prop. 4). Add the square on C B. Then the squares on A B, C B are together equal to the square on A C, twice the square on C B and twice the rectangle A C, C B; that is to the square on A C together with twice the rectangle A B, B C (Prop. 3).

Prop. 7 may be enunciated thus:—*The square on the difference of two lines* (A B *and* B C) *is less than the sum of the squares on those lines by twice the rectangle contained by them.*

Prop. 8 is proved thus:—

Let the straight line A B be divided into any two parts in C; then four times the rectangle A B, B C together with the square on A C is equal to the square on the straight line, made up of A B and B C together.

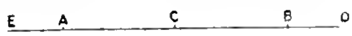
Produce A B to D making B D equal to B C, so that A D is the line made up of A B and B C together. Then the square on A D is equal to the squares on A C, C D together with twice the rectangle A C, C D. But the square on C D is equal to four times the square on C B (Prop. 4, Cor.) and the rectangle A C, C D is equal to twice the rectangle A C, C B (Prop. 1). Hence the square on A D is equal to the square on A C, together with four times the square on C B and four times the rectangle A C, C B; that is, to four times the square on A C and four times the rectangle A B, C B (Prop. 3).

Cor.—If A C is equal to B C and therefore to C D, we have the square on A D equal to the square on A C, and eight times the square on D C; that is, to nine times the square on A C. Hence if a straight line be divided into three equal parts, the square on the whole line is equal to nine times the square on any one of the parts.

Prop. 9 thus,—Let the straight line A B be divided into two equal parts at the point C, and into two unequal parts at the point D; then the squares on A D, D B are together equal to double the squares on A C, C D.

The square on A D is equal to the squares on A C, C D, together with twice the rectangle A C, C D; that is, the square on A D is *greater than* the squares on C B, C D by twice the rectangle C B, C D. And the square on D B is *less than* the squares on C B, C D by twice the rectangle C B, C D (Prop. 7, 2nd enunciation). Hence, adding the squares on A D and D B are together equal to double the squares on C B, C D.

Prop. 10 thus,—Let the straight line A B be bisected in C, and produced to D; then the squares on A D, D B shall be together double of the squares on A C, C D.



Produce D A to E making A E equal to B D; so that E C is equal to C D and E B to A D. Hence, by the preceding proposition, the squares on E B, B D are together double the squares on E C, C B. That is, the squares on A D, B D are together double the squares on C D, C B.

Props. 9 and 10 may be included under one enunciation thus,—

The squares on two lines (A D and D B) are together double the squares on half the sum and half the difference of the two lines;

or thus

The squares on the sum and difference of two lines (A C *and* C D) *are together double the squares on the two lines.*

COR.—Since the squares on A D, D B exceed the squares on A C, C B by twice the square on C D, it follows that when a straight line is bisected the sum of the squares on the two parts is least, and the sum is greater as the difference between the two parts of the divided line is greater.

(To be continued.)

EASY RIDERS ON EUCLID'S FIRST BOOK.

WITH SUGGESTIONS.

(Continued from page 19.)

149. If the opposite sides of a quadrilateral figure are equal the figure is a parallelogram.

150. If the opposite angles of a quadrilateral figure are equal the figure is a parallelogram.

151. The two straight lines A B, A C, intersect in A, and P is a point within the angle B A C. It is required to draw a straight line B P C so that B P may be equal to P C.

Suppose B P *equal to* P C; *join* A P *and produce to* D *so that* P D *may be equal to* A B. *Then* A B D C *is a parallelogram, &c.*

152. With the same construction, Q is a point without the angle B A C. It is required to draw Q B C so that Q B may be equal to B C.

Take a point E *in* A B *produced, so that* B E *may be equal to* A B. *Then* Q E C A *is a parallelogram (if* Q B *be assumed equal to* B C.

153. From a given point in one of two intersecting lines it is required to draw a line terminated by the second, and such that the line drawn from the point of intersection of the given lines to the bisection of the required line may make given angle with one of the given lines.

154. From a given point P it is required to draw three straight lines P A, P B, and P C equal respectively to three given straight lines, and having their extremities A, B, and C in one straight line and A B equal to B C.

Suppose the lines drawn as required P B lying between P A and P C; then if P B be produced to D so that B D is equal to P B, P A D C is a parallelogram, &c.

155. Draw a straight line through a given point such that the part of it intercepted between two given parallels may be of a given length.

156. Draw a straight line through a given point lying between two parallels, so that the line may be terminated by the parallels, and divided by the given point into two parts having a given difference.

157. If the diameters of a quadrilateral figure bisect the angles the figure is a rhombus.

158. If one diameter of a parallelogram bisect opposite angles it is a rhombus.

159. If the diameter of a parallelogram intersect at right angles it is a rhombus.

160. Straight lines bisecting adjacent angles of a parallelogram intersect at right angles.

161. Straight lines bisecting opposite angles of a parallelogram having unequal sides are parallel to each other.

162. If the diameters of a parallelogram are equal it is a rectangle.

163. If the diameters of a quadrilateral figure bisect the angles and are equal the figure is a square.

164. Find a point such that the perpendiculars let fall from it on two given straight lines may be equal to one another.

165. Between two given straight lines draw a straight line which shall be equal to one straight line and parallel to another.

166. On A B a side of the parallelogram A B C D a parallelogram A F E B is described, so that E B is in the same straight line with B D, and F B with B C. Show that E B is equal to B D.

167. Equilateral triangles are described on the four sides of a parallelogram.

168. On A B, D C opposite sides of a parallelogram, equilateral triangles A B E and C F D are described towards the same parts; show that F E A D and F E B C are parallelograms.

169. If in Ex. 168, C F D and A E B are described towards opposite parts, then D E B F and C E A F are parallelograms.

170. From A, C, opposite angles of the parallelogram A B C D, are drawn the four lines, A F, A E, C G, C H, perpendicular respectively to the sides A D, A B, C B, and C D, and on the side remote from the parallelogram; also A F is equal to C G, and A E to C H. Show that E G H F is a parallelogram.

171. Equilateral triangles are described on the four sides of a parallelogram. Show that the vertices of these triangle fall on the angles of a parallelogram,—

(i.) When all the triangles are towards the same parts as the parallelograms.

(ii.) When all the triangles are towards opposite parts.

(iii.) When two triangles on opposite sides are towards the same parts, and the other two triangles towards opposite parts.

172. On the sides A B, B C, and C D of a parallelogram A B C D three equilateral triangles A B E, B C F, and C D G are described, A B E and C D G towards the same parts as the parallelogram and B F C towards opposite parts. Show that E F and F G are respectively equal to two diagonals of the parallelogram.

Show that the triangle B F E *is equal in all respects to the triangle* A B C.

173. Show that the same holds good if B F C lies towards the same parts as the parallelogram and A B E, C D G, towards opposite parts.

174. In the parallelogram A B C D, the angle A D B is equal to the angle A C B. Show that A B C D is rectangular.

(To be continued.)

Our Chess Column.

BY MEPHISTO.

CHESS GOSSIP.

A TESTIMONIAL is now being raised for England's Chess Champion, Mr. Blackburne, who has recently undergone a severe illness.

The *Field* devotes a leading article in discussing the desirability of having a National Chess Association. That such an institution would benefit the cause of Chess goes without saying.

The same writer condemns the proceedings of the Counties Chess Association. It is quite unworthy of amateur Chess players to appeal to the public for funds, and at the same time exclude those players in whose performances the public take the most interest.

We are afraid the secretary betrayed the weakness of his cause when he thought desirable to put forth the names of MacDonnell and Bird as likely competitors, with a general promise to admit first-rates. It may also be reckoned a very clever move to exclude first-rates, after once having attracted the notice of the public by the bait.

The following story, which comes from an eye-witness, may throw some light upon the matter.

Scene: a meeting of the Counties Chess Association. A prominent member of C.C.A. playing with a fairly strong player from London. Prominent member, being in difficulties, takes half an hour to consider his move. Time limit twenty moves an hour London player politely (but with just a suspicion of sarcasm) "Your sand is running out, sir." Prominent player of the C.C.A (who sees a way out of his difficulties) to London player *most severely*: "It is very rude, sir, to make any remarks. The fact is, sir, you are a professional player, and I shall not play with you any more."

London player is given £5 to go home, and prominent player and supporter of the C.C.A. wins sundry prizes.

A Mr. Miller has stated in the press that Morphy could have given Zukertort a Knight. On his visit to Cincinnati, Zukertort meets this Miller at a large party, and plays with him ten games, winning every game. Says the champion, within hearing of the company: "A namesake of yours has declared that Morphy could give me a Knight! do you think so?" Collapse and discomfiture of Miller.

We wonder whether this is the same Mr. Miller who has taken upon himself the inglorious task of reprinting the third edition of Cook's "Synopsis." Has he asked the author's permission?

Besides, as a fourth edition of the "Synopsis" is in the press, and Mr. Marriott has, likewise, a useful book all but printed, we would warn the American public against making a useless investment, and keep their money for the fourth edition, which we hear will be a great improvement on the third.

A BRITISH CHESS ASSOCIATION.

In an ably-written leader in the *Field*, the writer advocates the establishment of a British Chess Association, to take the place of and supersede the Counties Chess Association. That which strikes me as being the most important consideration seems to have been quite overlooked in the arguments in favour of the scheme; for to attempt for one moment to draw comparison between Chess and other sports, is to assume, *primâ facie*, a false standpoint altogether. Although the number of devotees to the noblest and most fascinating of games is undoubtedly on the increase, the fact cannot be denied that all outdoor sports, inasmuch as they are easily appreciated by the masses, besides being healthy and exhilarating, will, as long as the world stands, command a far greater patronage than Chess.

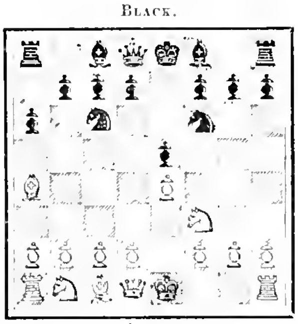
It is, therefore, open to doubt whether, even with the assistance of Royal patronage, the necessary constant supply of funds will always be forthcoming for carrying out the annual tourneys and prize competitions projected.

The consummation of the project, however, would, I am sure, be hailed with delight by all British Chess-players, amateur and professional alike. In the interest of the Royal game, it is sincerely to be hoped that it will be a success. All players will then undoubtedly welcome the Chess Editor of the *Field* as the "Mahdi" of Chess.

Borealis.

THE RUY LOPEZ (*continued from page 419*).

Black.



White.

If in this position White plays 5. P to Q4. Black can arrive at a position already dealt with:—

5. P to Q4	5. P × P
6. P to K5	6. Kt to K5
7. Castles	7. B to K2
8. R to Ksq	8. Kt to B4
9. B × Kt.	9. QP × B
10. Kt × P	10. Castles,

with a safe game.

Should White play 5. Kt to QB3, Black may continue with 5. B to Kt5, followed by Castling, and the positions will be fairly equal.

The strongest although the least attacking continuation is 5. P to Q3. This move will be found in many games of the London Tournament. This move brings about a struggle for position only, and is, therefore, more suited for match play than for ordinary practice. By P to Q3 White protects his own Pawn and threatens B × Kt, followed by Kt × P. Now the question is which way best to defend the KP. Q to K2 would, of course, not be a good move; there remains, therefore, only 5. P to Q3. In this case, however, Black's KB will only find development by way of P to KKt3, while the white KB will be well placed either on Kt3, or if P to QB3 has preceded, on B2. The disadvantage of Black's position is somewhat similar to the Philidor defence. Having indicated the general principle of this opening, we do not think we need give any particular variation, as White has nothing to do but to develop his game. It is a thoroughly reliable opening.

No solution having reached us of Mr. Carpenter's Problem, we defer the solution till next week.

During Dr. Zukertort's stay in New Orleans, he contested altogether twenty-two games with Mr. Jas. McConnell, of which the doctor won fourteen, lost five, and drew three.

The last game between the players during Dr. Zukertort's visit, at New Orleans, May 12, 1884:—

PHILIDOR'S DEFENCE.

White. Mr Jas. M'Connell.	Black. Dr. Zukertort	White. Mr. Jas. M'Connell.	Black. Dr. Zukertort.
1. P to K4	P to K4	13. Kt × QP	B to Kt2
2. Kt to KB3	P to Q3	14. Castles (QR)	P × P (*g*)
3. B to B4 (*a*)	Kt to QB3 (*b*)	15 Kt to K6(ch)!	B × Kt
4. P to QR3 (*c*)	P to KB4	16. Q × QP (ch)	K to Ksq
5. P to Q3	Kt to KB3	17. B × B	Kt to Q4
6. B to KKt5	P to KR3 (*d*)	18. Q to Q7 (ch)	K to Bsq
7. B × Kt	Q × B	19. B × Kt (*h*)	R to Qsq
8. Kt to QB3	Kt to K2	20. Q × KtP	Q to B5 (ch)
9. Kt to QKt5(*e*)	K to Qsq	21. K to Ktsq	B × Kt
10. Q to Q2	P to QB3	22. Q × BP!	B to B3
11. Kt to B3	P to KKt4	23 B × P	
12. P to Q4	P × QP (*f*)		

And Black resigns.

Notes.

(*a*) A continuation favoured by Mr. Boden, but generally held inferior to 3. P to Q4. Of late, however, some strong players, notably among them Mr. Blackburne, we believe, have shown a predilection for the text move.

(*b*) 3. ** B to K2, introduced by Harrwitz in his match with Loewenthal, is more usual and apparently stronger.

(*c*) Evidently to provide a retreat for the Bishop, should the adverse Knight attack from R4; but 4. P to Q4 seems preferable either on this or White's next move.

(*d*) Here once again 6. ** B to K2 appears best.

(*e*) A well-timed advance. White has now secured a marked advantage in position.

(*f*) Would not 12. ** Kt to Kt3, instead, have been a much stronger reply?

(*g*) Too covetous by half, and seemingly quite unprepared for the pretty stroke of play with which his opponent at once replies.

(*h*) Even 19. Kt × Kt would have been safe, for Black had nothing but a few unavailing checks. Indeed, the latter's game has been most seriously compromised, if not defenceless for some time past.—*Times Democrat*.

ANSWERS TO CORRESPONDENTS.

**** *Please address Chess Editor.*

The Owl.—We regret to say that Problems are not suitable. The Problem cannot be done in two moves.

Mrs. H. W.—It is desirable that all variations should be given in a solution. Solution correct.

A. W. Overton.—Solution of above Problem correct.

Contents of No. 140.

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LONDON: FRIDAY, JULY 18, 1884.

CONTENTS OF No. 142.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

BY MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

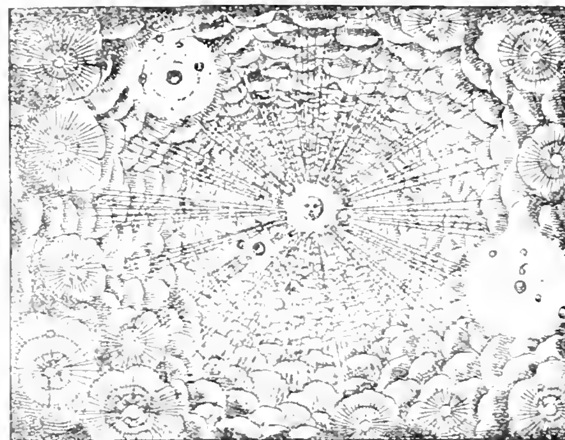
TO MONSIEUR L.

TO give you, Sir, a particular account how I pass'd my time in the country with the Marchioness of G . . . . , would amount to a volume; and what is worse, a volume of philosophy. I know you expected entertainments of other kinds, such as dancing, gaming, hunting, &c. Instead of which, you must take up with vortex's, planets, and new worlds: these were the subject of our conversation. And by good luck, as you are a philosopher, it will be no great disappointment to you, but on the contrary, I fancy, you will be pleas'd, that I have brought over the Marchioness to our party; we could not have gain'd a more considerable person, for youth and beauty are ever inestimable: If wisdom would appear with success to mankind, do you think she would do well to take upon her the person of the Countess? And yet was her company but half so agreeable, all the world would run mad after wisdom. But tho' I tell you all the discourse I had with the lady, you must not expect miracles from me. It is impossible, without her wit, to express what she said, in the same manner she spake it: For my part, I think her very learned, from the great disposition she has to learning. It is not poring upon books alone that makes a man of understanding. I know many that have done nothing else, and yet I fancy are not one tittle the wiser. But perhaps you expect, before I enter upon my subject, I should describe the lady's house, with its situation, &c. Many great palaces have been turn'd inside outward upon far less occasion. But I intend to save you and myself that labour; let it suffice that I tell you, I found no company with the Marchioness, and I was not at all displeas'd at it. The two first days drain'd me of all the news I brought from Paris; what I now send you is the rest of our conversation, which I will divide into so many parts, as we were evenings together.

THE FIRST EVENING.

That the earth is a planet which turns on itself and round the sun.

We went one evening after supper to walk in the park: the air was extremely refreshing, because that day had been very hot; the moon had been up about an hour, and her lustre between the trees made a most agreeable mixture of light and darkness; the stars were in all their glory, and not a cloud appear'd throughout the sky; I was musing on this awful prospect; but who can think long of the moon and stars in the company of a pretty woman! I am much mistaken if that's a time for contemplation.



1 Mercury. 2 Venus. 3 the Earth. 4 Mars 5 Jupiter. 6 Saturn.

"Well, madam," said I to the Marchioness, "is not the night as pleasant as the day?" "The day," said she, "like a fair beauty, is clear and dazzling; but the night, like a brown beauty, more soft and moving." "You are generous, Madam," I reply'd, "to prefer the brown, you that have all the charms that belong to the fair; but is there anything more beautiful in nature than the day? The heroines of romances are generally fair; and that beauty must be perfect, which has all the advantages of imagination. "Tell not me," said she, "of perfect beauty, nothing can be so that is not moving. But since you talk of romances, why do lovers in their songs and elegies address themselves to the night?" "'Tis the night, Madam," said I, "that crowns their joys, and therefore deserves their thanks." "But 'tis the night," said she, "that hears their complaints, and how comes it to pass the day is so little trusted with their secrets?"

"I confess, Madam," said I, "the night has somewhat a more melancholy air than the day; we fancy the stars march more silently than the sun, and our thoughts wander with the more liberty, whilst we think all the world at rest but ourselves: besides, the day is more uniform, we see nothing but the sun, and light in the firmament; whilst the night gives us variety of objects, and shows us ten thousand stars, which inspire us with as many pleasant ideas." "What you say is true," said she; "I love the stars, there is somewhat charming in them, and I could almost be angry with the sun for effacing 'em." "I can never pardon him," I cried, "for keeping all those worlds from my sight." "What worlds," said she, looking earnestly upon me; "What worlds do you mean?"

"I beg your pardon, Madam," said I; "you have put me upon my folly, and I begin to rave." "What folly?" said she. "I discover none." "Alas!" said I, "I am ashamed, I must own it, I have had a strong fancy every star is a world. I will not swear it is true, but must think so because it is so pleasant to believe it. 'Tis a fancy come into my head, and is very diverting." "If your folly be so diverting," said the Marchioness," "pray make me sensible of it; provided the pleasure be so great, I will believe of the stars all you would have me." "It is," said I, "a diversion, Madam, I fear you will not relish. 'Tis not like reading one of Moliere's plays; 'tis a pleasure rather of the fancy than of the judgment." "I hope," replied she, "you do not think me incapable of it. Teach me your stars, I will show you the contrary." "No, no," I reply'd, "it shall never be said I was talking philosophy at ten of the clock at night to the most amiable creature in the world. Find your philosophers somewhere else."

But in vain I excused myself: who could resist such charms? I was forced to yield, and yet knew not where to begin; for to a person who understood nothing of natural philosophy you must go a great way about to prove that the earth may be a planet, the planets so many earths, and all the stars worlds. However, to give her a general notion of philosophy, I at last resolved on this method.

(To be continued.)

THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

XXXVIII.—COUNT RUMFORD'S COOKERY.

IN my last I referred to Rumford's anticipation of the results of modern chemical analysis in his selection of the materials for his economical feeding of the poor of Munich; but, as may be supposed, all his theoretical speculations have not been confirmed. The composition of water had just been discovered, and he found by experience that a given quantity of solid food was more satisfying to the appetite and more effective in nutrition when made into soup by long boiling with water. This led him to suppose that the water itself was decomposed by cookery, and its elements recombined or united with other elements, and thus became nutritious by being converted into the tissues of plants and animals.

Thus, speaking of the barley which formed an important constituent of his soup, he says, "It requires, it is true, a great deal of boiling; but when it is properly managed, it thickens a vast quantity of water, and, as I suppose, *prepares it for decomposition*" (the italics are his own).

We now know that this idea of decomposing water by such means is a mistake; but, in my own opinion, there is something behind it which still remains to be learned by modern chemists. In my endeavours to fathom the rationale of the changes which occur in cookery, I have been (as my readers will remember) continually driven into hypotheses of hydration, *i.e.*, of supposing that some of the water used in cookery unites to form true chemical compounds with certain of the constituents of the food. As already stated, when I commenced this subject I had no idea of its suggestiveness, of the wide field of research which it has opened out. One of these lines of research is the demonstration of such true chemical hydration of cooked gelatine, fibrine, cellulose, casein, starch, legumin, &c. That water is *with* them when they are cooked is evident enough, but that water is brought into actual chemical combination with them in such wise as to form new compounds of additional nutritive value proportionate to the chemical addition of water, demands so much investigation, that I have been driven to merely theorise where I ought to demonstrate.

The fact that the living body which our food is building up and renewing contains about 80 per cent. of water, some of it combined, and some of it uncombined, has a notable bearing on the question. We may yet learn that hydration and dehydration have more to do with the vital functions than has hitherto been supposed.

The following are the ingredients used by Rumford in "Soup No. 1":—

	Weight. Avoirdupois. lb.	oz.	Cost. £	s.	d.
4 *viertels* of pearl barley, equal to about $20\frac{1}{3}$ gallons	141	2	0	11	$7\frac{1}{2}$
4 *viertels* of peas	131	4	0	7	$3\frac{1}{4}$
Cuttings of fine wheaten bread	69	10	0	10	$2\frac{1}{4}$
Salt	19	13	0	1	$2\frac{1}{2}$
24 *maass*, very weak beer, vinegar, or rather small beer turned sour, about 24 quarts	46	13	0	1	$5\frac{1}{2}$
Water, about 560 quarts	1,077	0		—	
	1485	10	1	11	9

	£	s.	d.
Fuel, 88 lb. dry pine wood	0	0	$2\frac{1}{4}$
Wages of three cook maids, at 20 florins a year each	0	0	$3\frac{2}{3}$
Daily expense of feeding the three cook maids, at 10 creutzers (3 pence $\frac{2}{3}$ sterling) each, according to agreement	0	0	11
Daily wages of two men servants	0	1	$7\frac{1}{4}$
Repairs of kitchen furniture (90 florins per ann.) daily	0	0	$5\frac{1}{2}$
Total daily expenses when dinner is provided for 1,200 persons	1	15	$2\frac{2}{3}$

This amounts to $\frac{422}{1200}$ or a trifle more than $\frac{1}{3}$ of a penny for each dinner of this No. 1 soup. The cost was still further reduced by the use of the potato, then a novelty, concerning which Rumford makes the following remarks, now very curious. "So strong was the aversion of the public, particularly the poor, against them at the time when we began to make use of them in the public kitchen of the House of Industry in Munich, that we were absolutely obliged, at first, to introduce them by stealth. A private room in a retired corner was fitted up as a kitchen for cooking them; and it was necessary to disguise them, by boiling them down entirely, and destroying their form and texture, to prevent their being detected." The following are the ingredients of "Soup No. 2," with potatoes.:—

	Weight. Avoirdupois. lb.	oz.	Cost. £	s.	d.
2 viertels of pearl barley	70	9	0	5	$9\frac{1}{2}$ $\frac{3}{2}$
2 viertels of peas	65	10	0	3	$7\frac{5}{8}$
8 viertels of potatoes	230	4	0	1	$9\frac{9}{11}$
Cuttings of bread	69	10	0	10	$2\frac{1}{4}$
Salt	19	13	0	1	$2\frac{1}{2}$
Vinegar	46	13	0	1	$5\frac{1}{2}$
Water	982	15		—	
Fuel, servants, repairs, &c., as before			0	3	$5\frac{5}{12}$
Total daily cost of 1,200 dinners			1	7	$6\frac{2}{3}$

This reduces the cost to a little above one farthing per dinner—$1\frac{1}{40}$ exactly.

In the essay from which the above is quoted, there is another account, reducing all the items to what they would cost in London in November, 1795, which raises the amount to $2\frac{3}{4}$ farthings per portion for No. 1, and $2\frac{1}{2}$ farthings for No. 2. In this estimate the expenses for fuel, servants, kitchen furniture, &c., are three times as much as the cost at Munich, and the other items at the prices stated in the printed report of the Board of Agriculture of November 10, 1795.

But since 1795 we have made great progress in the right direction. Bread then cost one shilling per loaf, barley and peas about 50 per cent. more than at present, salt is set down by Rumford at 1¼d. per lb. (now about one farthing). Fuel was also dearer. But wages have risen greatly. As stated in money, they are about doubled (in purchasing power, *i.e.*, real wages, they are three-fold). Making all these allowances, charging wages at six times those paid by him, I find that the present cost of Rumford's No. 1 soup would be a little over one halfpenny per portion, and No. 2 just about one halfpenny. I here assume that Rumford's directions for the construction of kitchen fireplaces and economy of fuel are carried out. We are in these matters still a century behind his arrangements of 1790, and nothing short of a coal-famine will punish and cure our criminal extravagance.

The cookery of the above-named ingredients is conducted as follows:—"The water and pearl barley first put together in the boiler and made to boil, the peas are then added, and the boiling is continued over a gentle fire about two hours; the potatoes are then added (peeled), and the boiling is continued for about one hour more, during which time the contents of the boiler are frequently stirred about with a large wooden spoon or ladle, in order to destroy the texture of the potatoes, and to reduce the soup to one uniform mass. When this is done, the vinegar and salt are added; and, last of all, at the moment that it is to be served up, the cuttings of bread." No. 1 is to be cooked for three hours without the potatoes.

As already stated, I have found, in carrying out these instructions, that I obtain a purée or porridge rather than a soup. I found the No. 1 to be excellent, No. 2 inferior. It was better when very small potatoes were used; they became more jellied, and the purée altogether had less of the granular texture of mashed potatoes. I found it necessary to conduct the whole of the cooking myself; the inveterate kitchen superstition concerning simmering and boiling, the belief that anything rapidly boiling is hotter than when it simmers, and is therefore cooking more quickly, compels the non-scientific cook to shorten the tedious three-hour process by boiling. This boiling drives the water from below, bakes the lower stratum of the porridge, and spoils the whole. The ordinary cook were she "at the strappado, or all the racks in the world," would not keep anything barely boiling for three hours with no visible result. According to her positive and superlative experience, the mess is cooked sufficiently in one-third of the time, as soon as the peas are softened. She don't, and she won't, and she can't, and she shan't understand anything about hydration. "When it's done, it's done, and there's an end to it, and what more do you want." Hence the failures of the attempts to introduce Rumford's porridge in our English workhouses, prisons, and soup kitchens. I find, when I make it myself, that it is incomparably superior and far cheaper than the "skilly" at present provided, though the sample of skilly that I tasted was superior to the ordinary slop.

The weight of each portion, as served to the beggars, &c., was 19·9 oz. (1 Bavarian pound); the solid matter contained was 6 oz. of No. 2, or 4¾ oz. of No. 1, and Rumford states that this "is quite sufficient to make a good meal for a strong, healthy person," as "abundantly proved by long experience." He insists, again and again, upon the necessity of the three hours' cooking, and I am equally convinced of its necessity, though, as above explained, not on the same theoretical grounds. No repetition of his experience is fair unless this be attended to.

The bread should *not* be cooked, but added just before serving the soup. In reference to this he has published a very curious essay entitled "Of the Pleasure of Eating, and of the means that may be employed for increasing it," the discussion of which must be postponed until my next, together with the details of the more luxurious *menu* of the first company of the Elector's own Grenadiers, who were fed upon boiled beef, soup, and dumplings at the large cost of twopence per day, and other regiments variously fed at about the same cost.

Before concluding this paper, I must add a few words in reference to the amusing fiasco of Mr. Albert Dawson, described in No. 139, page 486. I scarcely thought it necessary in writing for intelligent people to remind them that the length of time which any kind of moist food may be kept varies with the temperature and the place in which it is kept. Most people know that a leg of mutton which, on the average, should hang for about a week, may advantageously hang for a month or more in frosty weather, and be spoiled if kept at midsummer in an ill-ventilated place for two days. The fate of Mr. Dawson's porridge is an illustration of this simple principle. Judiciously kept, it becomes slightly sour; this sourness is due to the conversion of some of the starch into sugar, and the acetous fermentation of some of this sugar. The vinegar thus formed performs the function of that supplied by Count Rumford to his porridge. It renders it more digestible, and assists in its assimilation. The re-heating of the oatmeal porridge drives off any disagreeable excess of acid that may have been formed, as acetic acid is very volatile.

Tastes may vary as regards this constituent. For example, my old friend (to whom I referred), the late William Bragge (so well known in Birmingham, Sheffield, and South America), preferred his porridge when thus soured: other members of his family say that it lost the original aroma of the oatmeal. Be that as it may, I have no doubt that the ensilaged porridge, ounce for ounce, supplied more nutriment and demanded less work from the digestive organs than the freshly-made porridge. Probably this advantage may be obtainable more agreeably by Rumford's three hours' boiling, and his wilful addition of the vinegar.

MAN AND NATURE.

It is well known that the larger game of the far West has been long diminishing in numbers. This is especially true of the bison, an animal which is unable to escape from its pursuers, and which can hardly be called a game animal. The once huge Southern herd has been reduced to a few individuals in North-western Texas. The Dakota herd numbers only some 75,000 head, a number which will soon be reduced to zero if the present rate of extermination continues. The Montana herd is now the object of relentless slaughter, and will soon follow the course of the other two herds. When scattered individuals represent these herds, a few hunters will one day pick them off, and the species will be extinct.

Let the Government place a small herd in each of the national parks, and let the number be maintained at a definite figure. Let the excess escape into the surrounding country, so as to preserve the species for the hunters. Let herds of moose, elk, big-horn, black and white-tailed deer, and antelope, be maintained in the same way. Let the Carnivora roam at will; and in a word, protect nature from the destructive outlawry of men whose prehistoric instincts are not yet dead. Let the newer instinct of admiration for nature's wonders have scope. Let the desire for knowledge of nature's greatest mystery—life—have some opportunity. Let there be kept a source of supply for zoological societies and museums, so that science may ever have material for its investigations. By securing the preservation of these noblest of nature's works, Congress will be but extending the work it has so grandly sustained in the past, in the support of scientific research and the education of the people.—*The American Naturalist.*

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from page 34.*)

We have seen what happens (Fig. 16, p. 33) when a ray of light passes from a rarer medium into a denser one, whereof the boundaries are parallel, and out again into the rarer medium. Let us investigate now what will occur if, instead of our plate of, say, glass having parallel sides, those sides are inclined to each other.

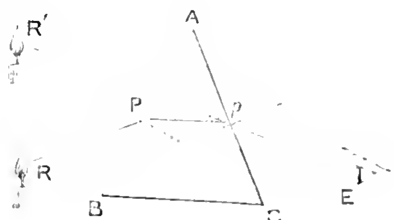


Fig. 18.

Let A B C in Fig. 18 represent the section of such a stalk of glass (known technically as a prism), and bearing in mind the principles enunciated on p. 32, and illustrated in Fig. 15, let us trace the course of a ray of light, R P p E, incident on one face of our prism at P; then at P we draw the perpendicular to the surface A B, represented by the dotted line. Now it will be seen that on passing from air into glass our ray R P will be bent *towards* this perpendicular, and will travel in the direction P p. At p we erect another perpendicular, and, as the student by this time must be well aware, the emergent ray will now be bent *from* this, and will travel in the direction p E. Hence any object, such as a candle-flame, placed at R, and viewed through a prism with its base downwards, by an eye situated at E will be seen in the direction R′ p E. It will not only be seen to be thus displaced, but its edges will appear to be fringed with the exquisite colours of the rainbow, though with this phenomenon we have no immediately present concern. It has its origin in the fact that ordinary white light is a compound of coloured lights, and that each of these colours is bent at a different angle, red being the least bent, and violet or lavender the most deflected. It is this dispersion of light which lies at the basis of what is called Spectrum Analysis, of which our Editor has announced his intention of himself treating in these columns. For our present purpose we must consider that we are dealing with light all of one colour. Very well then, with this temporary qualification, the angle formed by R P and p E is called "the angle of deviation," and the greater the angle between the sides of our prism, or the greater the refracting power of the material it is composed of, the greater will this angle of deviation become. Note here particularly that in whatever position we place the prism, the emergent ray, p E, will deviate towards the thicker part, or base, of the prism B C. Now, everybody knows what a convex or magnifying-glass is, and if we suppose Fig. 19 to represent a section of such a glass, we shall see that, in effect, it consists of two prisms, A B C, D B C, placed base to base, and that parallel rays, R R R, &c., from a distant object will be so bent as all to unite at F, the principal focus of the lens, when they will form an image of the object, just as in the case of the

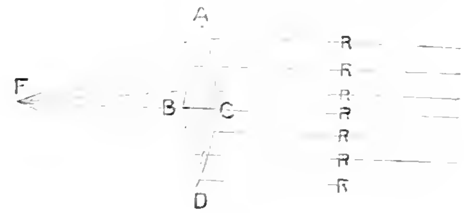


Fig. 19

concave mirror whose action was described and illustrated on p. 436. And here, again, we have an illustration of that law which can never be too often insisted on—viz., that rays of light go and return by the same route, for if we place a very small bright light at F, the rays diverging from it will be rendered parallel by the lens, and emerge in that condition on the other side of it. Suppose, though, that we remove our light to a point outside of the principal focus of the lens, then, instead of the rays issuing from its distal face being parallel, it will be seen that they will be convergent; in fact, an image of the source of light will be formed on a screen held at a suitable distance on the other side of the lens. Conversely, if the light be shifted to the position occupied by the screen, its image will be formed at the point which it occupied before such shifting. These interchangeable points are called the "conjugate foci" of a lens. All this may be compared with the properties of a concave mirror explained on p. 436. It is evident that, if we obtain a lens whose focal length equals the width of the room shown in Fig. 2 (p. 306), and put this in the place of the simple hole in our shutter, we shall obtain a much more brilliant and distinct image of the external landscape on the wall; in fact, we shall have constructed a primitive form of the camera obscura. The form the camera takes, as arranged for public exhibition, is shown in Fig. 20.

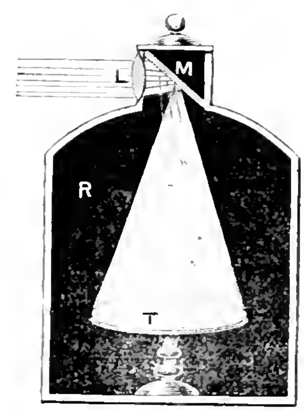


Fig. 20.

Here we have a light-tight room, R, usually of octagonal or cylindrical shape, containing a table T covered with plaster of Paris or painted with dead-flat white paint. Above is a box turning in a ring containing the convex lens L placed vertically, and behind it the mirror M at an angle of 45°, the effect of this arrangement obviously being that the image formed by the lens is reflected down on to the table T, where the spectator sees a charming miniature view of the external landscape, with its drifting clouds, running water, and moving forms of animal life. One of the most familiar uses of a convex lens is that illustrated in Fig. 21.

We mean as a magnifying glass. Here the object (suppose a tiny arrow) *a w* is placed just within the principal focus of the lens, and the rays from it being caused to converge to the eye at E seem to come from a much larger arrow A W. The image thus perceived is, of course, a *virtual* one only, as contradistinguished from the real image formed by the camera obscura, as just described. It is needless to discuss the passage of light through a concave lens here, as we are not writing a treatise on optics. It may suffice to say that, *mutatis mutandis*, its action is comparable with that of a convex mirror (p. 437)—*i.e.*, it renders rays of

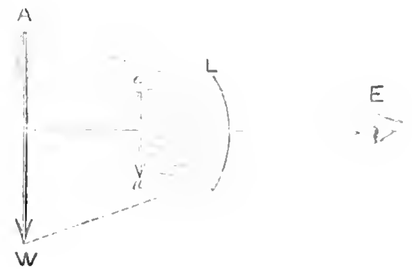


Fig. 21.

light passing through it more divergent, just as is the action of a convex lens with the effect produced by a concave mirror, in causing them to converge more. A convex lens, too, fulfils another function—that of grasping a number of rays of light, which varies as the square of its aperture. A "burning-glass" illustrates this property admirably. Let us suppose that we have a convex lens of 3 in. in diameter and of 6 in. focus. Then the image of the sun formed in that focus will be only 0·0558 in. in diameter. But this image is formed by *all* the rays incident on the 3-inch aperture of the lens; and, as we know that the area of circles vary as the squares of their diameters, we have only to divide 3^2 by $0{\cdot}0558^2$ to see at once how relatively enormous must be the concentration of light and its concomitant heat in the sun's image projected by a lens of our assumed size and focus. When such a lens is made of sufficient dimensions, its effect is astounding. Parker constructed a flint lens of 32 in. in diameter, of 6 ft. 8 in. focus; using together with it a second one of 13 in. diameter and 29 in. focus to further concentrate the converging rays. These lenses were so arranged that their combined focal length was 5 ft. 3 in. With this combination, 10 grains of slate were melted in 2 sec., and 10 grains of pure platinum in 3 sec. Nay, even so utterly refractory a substance as rottenstone disappeared in vapour in 1 min. 20 sec. under the inconceivable intensity of the heat thus generated! Similar experiments were made a few years ago with a lens built up of segments, at the Crystal Palace, under which a halfpenny was vaporised in a comparatively few seconds.

(To be continued.)

ELECTRO-PLATING.

VIII.

By W. Slingo.

As was intimated a fortnight since, a deposit of copper, if it is allowed to assume any considerable thickness, loses very materially in definition, so far, that is, as concerns the outer or exposed surface. Although the deposit may often, under the most advantageous circumstances, be made to retain the general features and beauties of the mould, such a result must not be habitually looked for; but where plating is preferable to typing, the necessity for allowing only a thin deposit must not be overlooked. It is far better, where a good and substantial deposit is required, to obtain a type. Even, however, were it otherwise, the mere production is in itself interesting and instructive, and is certainly a stepping-stone to higher and better achievements.

It is in the nature of things that casts should be more or less undercut, and as it is my purpose here to deal with the problem of copying models in high relief, it will probably be better for us to concentrate our attention upon some particular form. Let us imagine that we desire a representation in copper of a small bust or statue, classical or otherwise. Now, it will be apparent on the briefest reflection that such a model cannot be copied in plaster or any other of the rigid materials used in making moulds from comparatively flat models such as coins or medals. Were our model a metal bust we could, of course, take a copy of it by enveloping it in a bath of wax or some other acid-proof substance, and then dissolve out the metal by means of acid, but that plan would rarely be desirable, more particularly if the metal were valuable, or of an obstinate nature, requiring nitric acid to dissolve it.

A better way, by far, is to use what is known as an elastic mould. A brief reference was made to such a material in the fifth of this series of articles (Knowledge, No. 134). It was there said that such a mould could be made from glue and treacle. If the figure to be copied is small, two pounds of the finest glue is broken up into small pieces and soaked in cold water until it becomes quite soft. Any water that remains unabsorbed is poured off, and the gelatinous mass is then placed in a glue-pot with half-a-pound of treacle, and heated to nearly 100° C. (boiling point of water). To comply with this does not, of course, require a thermometer. A glue-pot, properly speaking, consists of two pots, one inside the other, the inner one containing the glue and the outer one containing water. The two so fitted are placed on the fire, and, as doubtless most people are aware, the most intense fire is incapable of raising the glue to a higher temperature than that of the water through which the heat is transmitted, and that water, as water, cannot, above the sea-level, be raised to a higher temperature than 100° C. (or 212° F.), any heat passing into the water after such a temperature has been attained being absorbed in the conversion of the water into steam. So long, then, as there is water in the outer vessel, the temperature of the inner one cannot exceed the boiling-point of water.

The mixture of glue and treacle during the process of heating should be thoroughly stirred, so as to ensure a uniform resultant compound. An ounce or so of beeswax may be added with advantage.

Supposing, now, that the bust or figure to be copied is made of plaster, its surface must manifestly be well prepared so as to make it non-porous, otherwise the mixture will get into the interstices and render it impossible to effect a separation. The plaster, therefore, should be stood or laid in a shallow dish containing oil and thoroughly saturated. If a metal or other "solid" model, it requires well oiling to prevent the mixture adhering to it. A vessel, such as a jar, or a pail if the figure is a large one, is then procured and its interior well oiled. Presuming the model to be hollow, it is filled with sand, in order to increase its weight. It is then placed head downwards in the jar, a mark being made on the outside to indicate the position of the back of the figure. The mixture being warm, is then poured in, but not too rapidly to prevent the escape of any air bubbles that might collect in one or other of the various crevices of the figure. The jar is filled up to an inch or two above the figure. Thus filled, the jar is placed aside for a couple of days or so, until, in fact, the mixture is thoroughly set. The jar is then turned upside down, and a tap or two releases the mixture from the sides of the jar, that is unless the shape is an unusual one, preventing the mould from slipping out. It is scarcely necessary to say that the best form of vessel is one that tapers slightly towards the bottom. The position of the back of the model being known (by the mark placed on the outside of the jar), a clean, thin sharp knife is inserted in the mould over the head of the model, and passed down its back, keeping close to the figure. The mixture which has cooled over the base of the model is also carefully removed. The mould, being highly elastic, may then be opened with the hands, and another pair of hands being called into requisition, the model may be removed. The mould, in virtue of its elasticity, springs back on being released, and we thus obtain a good negative representation of the figure. We may, if we so please, take our copy from this mould, but the task is rather a troublesome one, and the result often disappointing. The admixture of treacle with the glue prevents the shrinking which would otherwise take place on cooling, but it does not overcome the tendency to absorb water. Such an absorption would matter little were it not that it produces a considerable swelling, when the proportions of the figure would be entirely lost. Nor would our troubles end here. The absorption may, however, be prevented by adding to the hot mixture of glue and treacle a small quantity of tannic acid to the extent of two per cent. of the quantity of glue when cold. Another mode of excluding water is to immerse the elastic mould in a weak solution of bichromate of potash and allow it to dry in the sun. A thin impervious film is thereby deposited. A good waterproof coating is that previously referred to as guttapercha varnish, made by dissolving the percha in bisulphide of carbon. This, obviously, must not be applied to the interior of the mould, or we should get no deposit. The inner surface may, however, be well protected by a thoroughly good coating of plumbago, which must be deposited, as facilities do not present themselves for rubbing the blacklead in. Of this, however, more anon. The mode of procuring the deposit must also be deferred for a few minutes.

Whether the elastic mould is or is not used to receive the copper deposit, it should be bandaged up so as to prevent it falling out of form, as its elasticity would otherwise cause it to.

When the deposit is not intended to be taken in the elastic mould, it may be placed back in the vessel in which it was moulded. A second mixture is then made by melting together 2 lb. of beeswax, $1\frac{3}{4}$ lb. of resin, and a $\frac{1}{4}$ lb. of tallow. During the heating the materials require to be well stirred so as to ensure an intimate mixture. The vessel containing the mixture should then be placed on one side for a short time, until it has nearly set. It is then poured gently into the cavity in the elastic mould until it is filled up. The jar thus filled is put aside for some hours until everything is quite cool, when it is inverted, and the elastic mould with the beeswax mould inside it slips out. The former may be again opened, and the latter withdrawn. Had the beeswax been poured in when warm it would most probably have melted, and maybe have united with the treacle mixture, and so have spoiled it. The beeswax mould thus obtained is obviously a copy of the model, and can hardly be used to obtain an electrotyped copy direct. It is, however, placed in the jar in a position akin to that occupied by the original figure. A thin plaster of Paris paste is next prepared and poured steadily into the jar up to the level of the base of the mould. When the plaster is thoroughly dry, the beeswax copy is melted out, and we have thus a plaster of Paris negative.

It is evident that such a mould cannot have plumbago rubbed over its internal surface. To get a conducting surface the cavity is washed out two or three times with a solution composed of 32 grains of phosphorus to 480 grains ($1\frac{1}{8}$ oz.) of bisulphide of carbon. After this it is washed-out with a solution of silver nitrate, one pennyweight of the nitrate being dissolved in a pint of distilled water. The plaster mould being prepared, it is placed in the bath, or it may, for the matter of that, form its own bath. The cavity is filled with the blue-stone solution, and, the conducting surface being connected with the zinc pole of the battery, the copper pole is connected to the anode, which should consist of a mass of copper as near the general proportions of the figure as possible. It has previously been pointed out that a great deal depends upon the resistance in the bath, that is to say upon the relative distance between the anode and the mould. It is almost impossible to emphasise too strongly the necessity that really exists for keeping the anode as nearly parallel as possible with the various parts of the mould. When the substance to be coated is cylindrical, it is almost enveloped by two bent sheets of copper. When the mould is full of irregularities, it is placed at a considerable distance from the anode so that the relative differences of resistance are reduced to a minimum. The resistance introduced by increasing the distance is compensated for by the addition of another cell, that is to say, by increasing the electro-motive force. Where there are a few cavities, the deposit is sometimes started in them first by using a small anode, and placing it in them. Another device is that of employing leading wires, as indicated a fortnight since.

It is advisable, when coating a mould, such as the one in hand, to cause a current of the liquid to flow through it, otherwise the solution will degenerate. This is considerably facilitated by boring a small hole in the bottom of the mould, somewhere near or on the back of the head.

Sometimes, more especially when the model is a large one, the mould is made in two, or perhaps a number of pieces. To make it in two, the model is embedded to half its depth in fine sand, the surrounding surface being made fairly level, two or more pegs are stuck in the sand, and then, a little thin plaster having been brushed rapidly into the crevices, a quantity of plaster is poured on. When it has set it is removed with the model. The level surface of the sand being spread over with oil, the reverse side of the model is moulded in a manner similar to that adopted with the first half. The plaster is then placed in a shallow tray containing stearine until it is well saturated, when it is taken out and thoroughly and carefully plumbagoed. The electrotype is taken in halves, and when both halves have attained a sufficient thickness they are trimmed, and the edges soldered together, the joint being carefully bronzed over. This process, however, cannot be adopted where there is any considerable undercut, such as would be met with, for example, in taking a copy of a figure recumbent on a base. The number of pieces would then have to be more numerous, unless the elastic mould process were resorted to.

Very large objects are generally sacrificed, but of this more in my next.

The Gas Company at Leipzig intends, says a contemporary, to ask the Municipal Council of that town for a concession for lighting the streets and houses by electric light.

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE MIDDLE DEPTHS (*continued*).

About a month after the hatching of the eggs, it is time for this aquatic life to close, and an existence less gross and far more ethereal now lies before the little creature, which has, however, by this time nearly completed the cycle of its mortal life, and so has but scant opportunity left to enjoy the greater freedom and pleasures which the acquisition of superior powers will bring. Within that ugly, limbless pupa case has been formed a delicate, long-legged, feathery-horned, two-winged, sylph-like being, which, like the Prince in the old story of "Beauty and the Beast," is but waiting the removal of its hideous disguise to appear in all its rightful elegance and grace. The moment of deliverance having at length arrived, the pupa tail is brought up level with the surface, a considerable part of the thorax being thereby caused to rise above the water. The skin then splits between the two horns, and the imprisoned fly begins to emerge at the opening. This is the most critical moment in its whole career, for with head and thorax released, but legs still encumbered by their encasement, the creature is perfectly helpless and, at the same time, rather top-heavy, so that a sudden gust of wind may in a moment capsize the tiny boat and disappoint the hopes of the half-liberated fly, which can then look forward to nothing but a miserable death by drowning. If, however, no such mishap occurs, the struggling insect gradually drags out first one pair of legs and then another, and then, leaning forward, rests them on the water and draws out the third pair; then making use of the empty pupa skin as a sort of canoe, it soon dries its wings and mounts aloft to join its companions, who everywhere around are at the same time putting on their adult costume. In their society we will leave it for the present, hoping to meet it again later on.

The larvæ of the midges are called bloodworms, and are probably familiar to everyone who has kept a rain-water butt, for such receptacles often swarm with the wriggling, blood-red, worm-like things. They are also abundant in ponds, and, indeed, in any stagnant water. The remarks made above concerning the life-history of the gnat apply in great measure to the present insects also. These red, worm-like things, however, must not be confounded with a certain red worm that also inhabits fresh water, forming vertical burrows in the mud of rivers; they are gregarious, and crowd their tiny burrows close together, remaining with their bodies partly protruded, and thus forming large red patches upon the mud, and it is amusing to see the sudden disappearance of such a patch as they all sharply retreat into their holes on the approach of an intruder. These, however, are not insects at all, but true worms, or, as they are called in scientific language, annelids, and have reached, in this vermiform condition, the highest stage in their development. The fly, which is the parent of the red wrigglers of the water-butt and stagnant pond, is called *Chironomus plumosus*. The larva is rather more worm-like than that of the common gnat, and the pupa carries some elegant plumes of fine hairs on its ungainly thorax.

There is a beautiful little creature, clear and transparent as crystal, that is the larva of another member of this group, and is noteworthy for the variety of curious appendages it carries on the fore-part of its body. Imagine an animal with a pair of arm-like bodies consisting of a stem with long bristles at the end, and used to lash the water, then a stout bundle of hairs movable *en masse*, then a pair of little saws, then a kind of policeman's truncheon, with bunches of hairs at the end, also capable of swaying backwards and forwards, and then a pair of jaws and a set of bristles, and you will see at once that *Corethra plumicornis*, as it is called, must have enough to do to manage properly all these contrivances. Such is its transparency, that it may easily elude observation till its wriggling, jerky motions betray its presence. This same transparency, however, affords wonderful facilities to the microscopist for the study of its internal anatomy and physiology, for, by aid of the microscope, all that is going on in its interior is made plainly visible. It is, of course, a distinct advantage to be able to study the action of an animal's internal organisation without interfering with the free action of its parts, or placing it under abnormal conditions, as there is thus less chance of mistaking for essential peculiarities accidental ones, such as might be induced by the altered circumstances. It is not to be wondered at, therefore, that this creature has become classic by having been made the subject of elaborate investigation by more than one observer; and, indeed, there are few more entrancing occupations to those who have a desire to search out the secrets of nature than to watch, hour after hour, under a good microscope, the varied actions and vital processes of this and other minutiæ of animal life. It must not be ignored, however, that the very transparency of parts tends also to introduce a certain element of difficulty into the investigation; for where several organs overlie one another it is not always easy to trace their relative position, and it becomes necessary to examine the object from different points of view before such a matter can be settled.

Through the transparent skin of Corethra can be seen, first the whole of the digestive apparatus, forming a long tube of varying diameter, stretching almost from one end of the body to the other; then, on one side of this (the mouth side) can be traced the greater part of the nerve system, looking like a long string, with knots tied in it at tolerably regular intervals. Where it approaches the mouth, however, the string divides, and sending one branch on each side of the throat tube, terminates on the opposite side of the digestive tract in a double mass of nervous matter, which is all the representative of brain the poor creature possesses. Then all down the back (to be traced with a little more difficulty, on account of its extreme transparency) is the "dorsal vessel," as it is called, which is an insect's equivalent of a heart. Those who have kept silkworms or other pale, smooth-skinned caterpillars, will probably have noticed this apparatus as a dark line running along the back just underneath the skin, and alternately contracting and expanding from behind forwards at the rate of from forty to fifty pulsations per minute; in the present insect the pulsations are not so rapid, being only about twelve per minute. Then there can be seen the numerous oblique bands of muscles by which it is enabled to effect its wriggling movements, as well as those strips by which the motions of its various appendages are controlled. Again, at each of two places, one near the head, the other much farther down, will be noticed a pair of black bags, which are air-receptacles connected with the system of breathing-tubes distributed over the body; the tracing of these latter, however, is, on account of their extreme minuteness a matter of much more difficulty. At the tail there are two tufts of feathery hairs, one at the end, the other at the side; small though they are, the hairs are hollow, and connected at their base with the tracheal system, and, whatever other function they discharge, they evidently take part in that of respiration. All these aquatic fly larvæ are more or less transparent, but we have chosen the present for more detailed reference, because its superior transparency renders it best adapted for microscopical investigation. Like the rest of its brethren, it is carnivorous, and its favourite dish seems to be the quaint little creatures called, from their spasmodic, jerky movements, water fleas, though they are not fleas at all, nor, indeed, even insects, but belong to the group of animals of which crabs, lobsters, and shrimps are the most familiar representatives. These specks of creation, which are considerably more minute than our household fleas, are caught and crunched by Corethra in considerable numbers, and with great avidity. To facilitate the crushing of their hard horny skin, it is furnished with a pair of strong jaws, carrying stout, tooth-like projections.

(*To be continued*).

SUPERSTITION.

It is noteworthy how closely superstition and ignorance are allied. The dynamiters have shown us what a low and ignorant class of savages still exists in Ireland, and beyond a doubt most of the trouble which exists in Ireland, and is caused by the Irish lower classes wherever they make their abode, arises from the sheer ignorance of the race. There is no country in Europe, perhaps, unless it be in the more murderous parts of Italy, where superstitions of the stupidest sort are more prevalent than in Ireland among the ignorant members of the community. Consider, for instance, the edifying scene presented at a spot about 100 yards from the place where the Dublin Invincibles were hanged. Here is a well called the Well of St. John, the foulness of whose waters, though to the eye they seem tolerably clear, has caused medicinal properties to be imputed to them, after the customary notion of the ignorant that the effectiveness of medicines is proportional to their loathsomeness of taste or smell, or both. But (probably because these waters become particularly offensive at midsummer) the ignorant of that region regard the water of this well as especially curative if taken thence on the eve of June 24, now St. John's day, though the tradition dates unquestionably from times long preceding the Christian era. This silly superstition (amazingly silly in this age) is so firmly believed in by the ignorant, and there are so many ignorant folk round about Kilmainham, that, on June 23 last, quite 5,000 people assembled at the well, having made a pilgrimage thither from greater or less distances. It is regarded by these unfortunate idiots as essential that the water should be drawn before daylight on St. John's eve, and the pilgrims came provided with every class of vessel to bring away the precious fluid (precious stuff). The well is in a recess under a wall, we are told, and candles had to be used to light the people down the steps, so that the scene presented was of a weird character. I have seen such *weird* scenes, and most melancholy they are. Watch a detachment of the Salvation Army going along with the savage and silly noises in which they delight and note the degraded type of countenance of every single member of the procession. Imagine 5,000 persons of still stupidier and more animal type groping about with candles to gather foul water in dirty vessels, mumbling unmeaning incantations to strengthen its virtue—a scene weird enough for a Rembrandt to paint; only, if he would not make it too utterly melancholy for all who long to see the human race becoming better and wiser, he should let gloom and darkness hide all the worst features of the scene. Truly, a man must keep such scenes from his thoughts, even as he must refrain from thinking of the squalor of our ill-fed and worse clothed poor, if he would believe that man is but a little lower than the angels, or else he must have strange ideas of the angels. Thinking of the ways of some who are closely akin to these superstitious and ignorant beings—I mean the dynamiters—he might well conclude that man is but a little higher than the devils, according to accepted ideas as to these folk.—R. A. Proctor, in the *Newcastle Weekly Chronicle*.

THE INTERNATIONAL HEALTH EXHIBITION.

VIII.—WATER AND WATER-SUPPLIES—(*continued*).

A RETROSPECTIVE inquiry into the statements made in our last communication would show that it is chiefly by the action of carbonic acid gas, oxygen, organic matter, and hydration, that water is enabled to act upon the substratum of our earth. By means of these reactions it is endowed with properties which it would otherwise never possess, and a little reflection would convince one that those attributes are wholly dependent upon the character of the formations through which it penetrates. Let us now proceed to trace the physical history of the water which saturates the earth's crust, and which is destined to play a most important part in the laboratory of Nature; in doing so we shall be able to unravel the mysteries of the Plutonic region. and gain an insight into the principles which we shall have to bear in mind when we come to consider the practical aspect of the water question in its relation to man.

The dry bones of natural philosophy are capable of being rendered highly delectable when the results of abstruse calculations are reduced to round numbers and put forth as astounding realities; at least, so they seemed to us in our college days, when the learned professor laid aside the garb of austerity to discourse upon the wonders of the "unseen universe," and material creation, to his awe-stricken class of undergraduates. We were taught that in the far-off hazy annals of the world, at a time which is only so far definite as to allow of a licence of computation between twenty to forty millions of years ago, the earth was in the condition of the sun of our present era, and that through the radiation of the heat into space, it slowly cooled down to become fitted for the habitation of living things. (On the authority of our University pedagogue, we may state that sufficient heat leaves the earth per annum to melt a film of ice one quarter of an inch thick, spread over its entire surface). It does not much matter to us whether that happy time was consummated six millions, or only six thousands of years ago; suffice it to say that the only evidences we have of the former intense heat of the earth now are to be traced to the vestiges of internal temperature, which we are made aware of in our comparatively trivial borings, which show a rise of about 1° C. for every 100 feet of descent into a mine, and to those natural operations which manifest themselves in volcanic outbursts, fiery lakes, and thermal springs. The late Principal Forbes has shown that irrespective of the nature of the soil, the changes of temperature due to the rotation of the earth upon its axis, or that caused by day and night, is only perceptible to a depth of one foot; and that the seasons do not affect the earth's crust, as far as temperature is concerned, to a greater depth than from 28 to 30 feet.

Water which penetrates into the earth, then, has to contend against these thermal sources; by them it is endowed with solvent and other properties, in addition to those which it possesses as a chemical re-agent. The densest rock and the stiffest clay are yet so porous as to give it ready access, and so great is the power of capillarity, in virtue of which it descends, that Daubrée's experiments* have proved conclusively that it is able to resist the great effects of counter pressure of vapour and internal heat, and to establish itself in the form of a gas at the roots of volcanoes and far down in the depths of the earth; how far has not yet been ascertained.

But, although stiff clays are permeable, they may be regarded as practically impervious; they are only stiff clays because they hold, in intimate admixture, a large proportion of water. Suppose, then, that a stratum of clay supports a sandy porous soil as at Fig 15, which represents the condition of things which obtain at Hampstead Heath. The major portion of the rain-water is filtered by the sand,

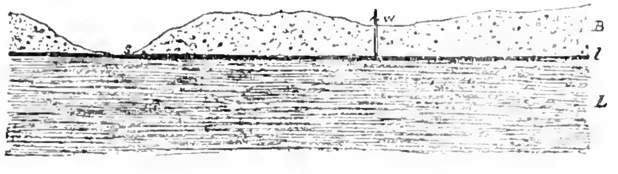


Fig. 15.—B., Bagshot sand; *l*., water-bearing stratum; L., London clay; *s*., spring; *w*., well.

and collects above the clay in a sort of water-bed. At certain parts the clay is laid bare by a cessation of the overlying sand, by a natural depression, as at *s* (Fig. 15), or by an artificial boring as at *w* (Fig. 15); *s* gives forth a natural spring, *w* is called a well. Now, remove all the Bagshot clay and lay bare the London clay, as at Fig. 16, which depicts an hypothetical section across the London basin. The sandy strata, known as the Lower London Tertiaries, underlie the clay, and the whole rests upon the uppermost beds of the mesozoic age, termed the cretaceous or chalk formations. The London clay takes

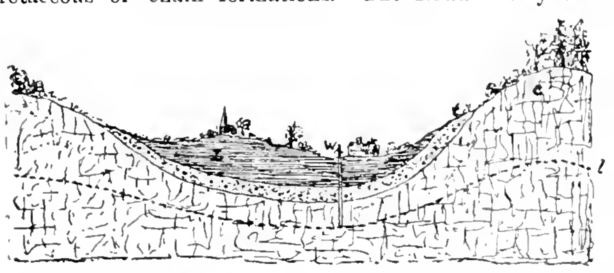


Fig. 16.—Hypothetical section across the London basin. L. London clay; *t*., porous strata of the Lower London Tertiaries; *c*., chalk; *l*., water-level; *w*., well.

in but little water; the exposed surface of the sandy tertiaries at *t* and the chalk at *c* are saturated, and the water finds its way through both until it reaches the so-called water level (indicated by the dotted line in Fig. 16), or underground reservoir, which pervades the crust of the earth irregularly, and at depths which vary with the nature of the soil, the seasons, and the external configuration of the surface.† Thus, under a plain, it is in reality tolerably level; beneath a hill it becomes convex; in a valley somewhat concave, or, it may be, altogether irregular on account of the differences of the rock textures through which the water is forced to pass, or because of their unconformability. A boring such as that shown at *w*, Fig. 16, is called a well; since *t* and *c* are at higher levels than *w*, the water, in virtue of the law of hydrostatics, rises up the bore of the well to its outlet, and forms the kind of artificial spring called an Artesian well.*

Thus far we have only taken into account springs and wells such as obtain in comparatively unbroken strata. In other regions, however, where seismic action has been rife, where numerous faults intersect the country, and where the rocks lie more or less out of their strict order of succession, springs are to be sought for chiefly at escarpments and in the line of faults. In Fig. 17 the water-bearing strata are shown in shaded bands, whilst the sandy beds are dotted; *f, f*, are the outlets of powerful springs which rise up the fissures due to faults.

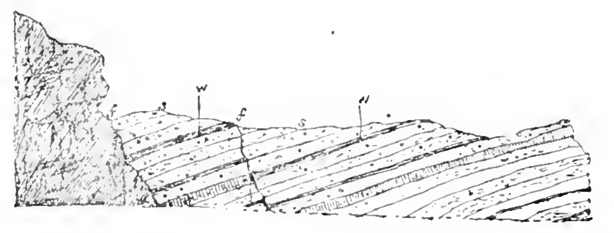


Fig. 17.—*f, f*, Powerful springs rising at faults; *s*, porous sandy beds; *w*, water-bearing strata.

Thus it appears that the rain-water which penetrates the earth is not permanently removed from the surface, but rises again to well forth as springs, along joints and fissures, charged with substances in solution and suspension which are characteristic of the formations through which it passes. Some of the water, however, is absorbed, and other portions combine chemically with certain constituents in the rocks. Its underground course, moreover, is not confined to capillary percolation, but often assumes the character of subterranean streams and reservoirs,† which are the extended representatives of former crevices and fissures. These are so pronounced in some cases as to materially affect the water-supply of rivers—to drain or to swell them; curious facts illustrative of this have been recorded by Desor,‡ and the occasional presence of plant-stems, leaves, and even of fish, in recently-made Artesian springs, are additional and interesting proofs of the underground circulation of water.

The descent of rain-water into the depths of the earth to regions of peculiar mineral salts, and their subsequent rise in the form of springs, provides us with the so-called natural mineral waters, for a detailed account of which we must refer the reader to Gairdner's exhaustive "Memoir."§ In like manner, thermal springs are the result of heat derived from the interior of the earth. If we attribute the heat thus gained by the water to the greath depth of its origin, then, by allowing 1° Fahr. for every 60 feet of descent, when the surface temperature is about 50° Fahr., the springs of Bath, which average 120° Fahr., ought to come from a depth of at least 4,200 feet.

Let us now turn to a consideration of the London

* "Géologie Expérimentale," p. 274; Tschermak, "Sitz. der Wiener Akademie," March, 1877; Reyer, "Beitr. zur Physik. der Eruptionen," § 1.

† In the case of chalk formations, the surface waters which are absorbed by the upper strata find their way by capillary percolation and through fissures into the deeper portions, which then become saturated and simulate retentive clays. It is in this way that water-bearing strata are extemporised in chalk, and, as one would expect, they are often transitory.

* So-called after the village of Artois, in France.

† A paper on "The Underground Waters of England and Wales" was read before the Geologists' Association on June 6, last, by Mr. C. E. De Rance.

‡ "Bull. Soc. Sci. Nat.," Neufchâtel, 1864.

§ "Essay on the Nature, History, Origin, and Medicinal Effects of Mineral and Thermal Springs," Edinburgh, 1832.

water supply as an example of special interest to the inhabitants of this vast metropolitan centre. The eight water companies, whose graceful pavilion in the Exhibition we shall visit ere long, derive their water almost wholly from the Thames district. Five of them draw upon the Thames and its tributaries directly, two have recourse to the river Lea, whilst the Kent company resort to deep wells in the chalk for its supply.

The sixth report of the Rivers' Pollution Commissioners states that the "catchment basin" of the Thames is one of the finest which has ever come under their notice. Of an area of 6,000 square miles, more than one-half consists of cultivated porous soil, its yield of water being delivered chiefly through springs. The remaining impervious superficial strata consist chiefly of meadow and pasture lands, and from them the rain-water drains off into the runnels which feed the river and its tributaries.

The extreme western tributary of the Thames, called the Churn, arises in the "Seven Springs," situated about four miles from Cheltenham, on the road to Cirencester. These springs rise from the clay beds of the Lias, the water having accumulated through the porous formations of the inferior oolitic limestones, which contain large underground reservoirs; they yield about 150,000 gallons of water daily. About four million gallons of water, which have passed through similar formations, are derived daily from the Syreford spring, at the head of the river Colne. Three million gallons are daily pumped up at the Thames' head, from a depth of 35 feet, to the level of the Thames and Severn canal; this water passes through the lower oolitic formations, known as the Bath or the Great Oolite, to be stored by the marls and clays of the so-called beds of the Fuller's earth. Other springs of importance which originate in the Fuller's earth are those of Boxwell, Ewen, and Ampney. Minor tributaries of the Thames derive their supply from the Gault clays, which underlie the beds of the Upper Greensand, the porous collecting-ground of which consists of siliceous and calcareous sands, with green grains and chert nodules.

With the exception of the river Loddon, which is supplied from the Bagshot sands resting on the London clay, nearly all the rest of the water of the Thames is derived from the chalk formations. Of this character are the supplies of the Kennet, which culls its waters from the downs near Marlborough and Hungerford, the Colne, and the so-called New River. In addition to all these sources, the Thames is largely fed by springs which arise in its own bed, the most famous examples of which are situated between Reading and Wallingford.

From what has been stated it may be gathered that the water of the Thames is essentially a calcareous water, all its chief sources of supply being derived from limestones and calcareous sands, with the single exception of the river Loddon, which flows through the ferruginous and other sands of the Bagshot series. The Kent Company's water, which is obtained from deep chalk wells, is even more calcareous than the Thames water; so that we may here make the general statement that the most characteristic feature of the London water is its hardness.

THE class of workmen who have been actively employed in railroad construction for the last few years have probably suffered more from want of work than other classes (in America) during the comparative quiet that has lately existed in many industries. This has been especially the case with Italians and other foreigners who came to the country in large numbers during the flush labour times, but are now in large numbers without employment in Chicago and other large cities. Their want of knowledge of any other labour but railroad work tells against them.—*Railway Review* (Chicago).

BRITISH SEASIDE RESORTS,

FROM AN UNCONVENTIONAL POINT OF VIEW.

By PERCY RUSSELL.

I.

IT was the favourite idea of the author of the "History of Civilisation"—that imposing fragment of a grand conception—that a people would correspond psychologically to the nature of their immediate physical environment. The idea is in itself in no way new, and has been universally found to furnish the key to all the peculiarities of national temperament, and thence it may, I think—passing from the abstract to the concrete—be fairly assumed that the love of the sea in general will be found proportioned to the extent of coasts in any particular country, and very especially in proportion to the sinuosities and general accessibility of the coast itself, while, of course, the question of average temperature and other meteorological conditions are necessarily important, and sometimes determining factors in the creation of a general national fondness for "blue water."

For one thing, it is difficult for the average Englishman to understand the utter indifference of the mass of the inhabitants of Central Europe for the ocean in any of its aspects, and the notion of a "seaside season," which is with ourselves a matter of course, would be an idea really impossible to convey adequately to the normal mind of a dweller in Central Europe.

It may, perhaps, however, be news to some that the number of islands, great and small—many very small indeed—composing what is known as the group of the British Isles, exceeds five thousand. It is true, certainly, that many of these are mere shelves of rock, but still the fact remains that the geographical term, Great Britain and Islands, implies an archipelago of over five thousand islands. Irrespective, too, of the mass of the outlying islands, from the Scilly group to the Orkney and Shetland Isles, the total length of the coast-line from Berwick to the South Foreland, thence to the Land's End, and from the Land's End to Berwick again, approaches two thousand miles, taking bays, inlets, and harbours into account, and thus it is possible for the excursionists around our own shores to accomplish a distance equal to a fourth of the actual diameter of the entire globe!

These are very rudimentary facts indeed, but they escape many among us who are commonly reckoned, and probably justly so, as being well informed generally. They are, however, I think very suggestive facts, and, for one thing, unquestionably furnish the clue to the undoubtedly strong passion of Englishmen for the sea, which was, curiously enough, much more intense as a passion before the epoch of iron ships began.

Whether or no our maritime character is becoming considerably modified by the various material influences and altered conditions of our present complex civilisation, it is not my business to inquire in this place, but it may be safely said that the normal Englishman, Englishwoman, and child are longing for the sea in summer, and directly the mercury rises in the thermometer to a certain point, that very large class known as the social "Everybody," begins to hasten coastwards, and the seaside season fairly sets in. It goes without saying that, as a general rule, English people are not remarkable for method or thought in their pleasures and recreative arrangements, and thence it is that, in general, comparatively a few watering-places are thronged and packed with visitors for a season, and a large proportion of people made very uncomfortable, and not a few exceedingly ill, simply because the vast majority of heads of families deciding on a seaside holiday are led by names rather than things, and all flock off to comparatively a few places, which most of them know a little better than their own neighbourhoods, having had more leisure for the study; and thus it follows that, to a great extent, the essential framework and normal conditions of town life are precipitated on the select and fashionable places of seaside resort, and a number of unsanitary conditions produced which ought never to exist, while the special pleasures which would be derived from the seaside, minus these conventional municipal features, are but rarely attained, and are even unknown to many who have, however, had the barren experience brought to them of very many annual seaside seasons. For one thing, the majority of persons are lamentably ignorant, I fear, as to the character of the coasts of their own country, beyond the few miles of it that they have actually seen at the very few watering-places they have visited. They continue going, mechanically almost, to the same place, and thus continue to reproduce in their recreative environments the very same viciously monotonous conditions which they are professedly seeking to escape when, with exhausted bodies and weary minds, they at last decide on a change.

Many excellent and truly scientific* monographs now exist as to the thermal conditions and general meteorological aspect of the principal British coasts and surrounding seas, and any one desirous of such information can easily ascertain the exact character of the prevalent winds at any particular place, the chemical constituents of the air, and so forth. This, however, is the higher science of what may be called our seaside philosophy, and taking humbler and more easily practicable phases, I would first give a rapid sketch of the salient and picturesque features of the coasts of the British islands, and having noticed rapidly their principal picturesque features, I shall then proceed to give an outline, with all the needful practical particulars for guiding aright intending visitors, of sundry places of beauty and interest on our own coasts which are even now little known, and less frequented, by the mass of people as places of health-resort or recreative retirement. It is manifestly absurd for people to continue visiting the same places, or the same small group of familiar places, year after year, and then, as some do, proceed abroad on the plea that there is nothing fresh for them to see in their own country!

First, however, let me say a word as to the general features of the coasts of the United Kingdom. The western coast, broadly, then, is formed by four deep and very wide bays, divided by enormous buttresses of land thrust far out to sea. The scenery is wild and magnificent. Tremendous cliffs and masses of rocks fortify the shore, and generally tower above the sea with rugged, but grand, profiles. These cliffs are mostly composed of exceedingly ancient and very hard rocks, and have for ages successfully resisted wind, frost, and even the insidious rain, and still present very much the same features seaward that they have done for the last two or three thousand years. As a natural effect of this formation we have here a very deep sea and remarkably powerful tides. Here, too, the waves may be studied in their might, and present an aspect under even a moderate gale which is altogether unlike anything ever to be seen on the south coast.

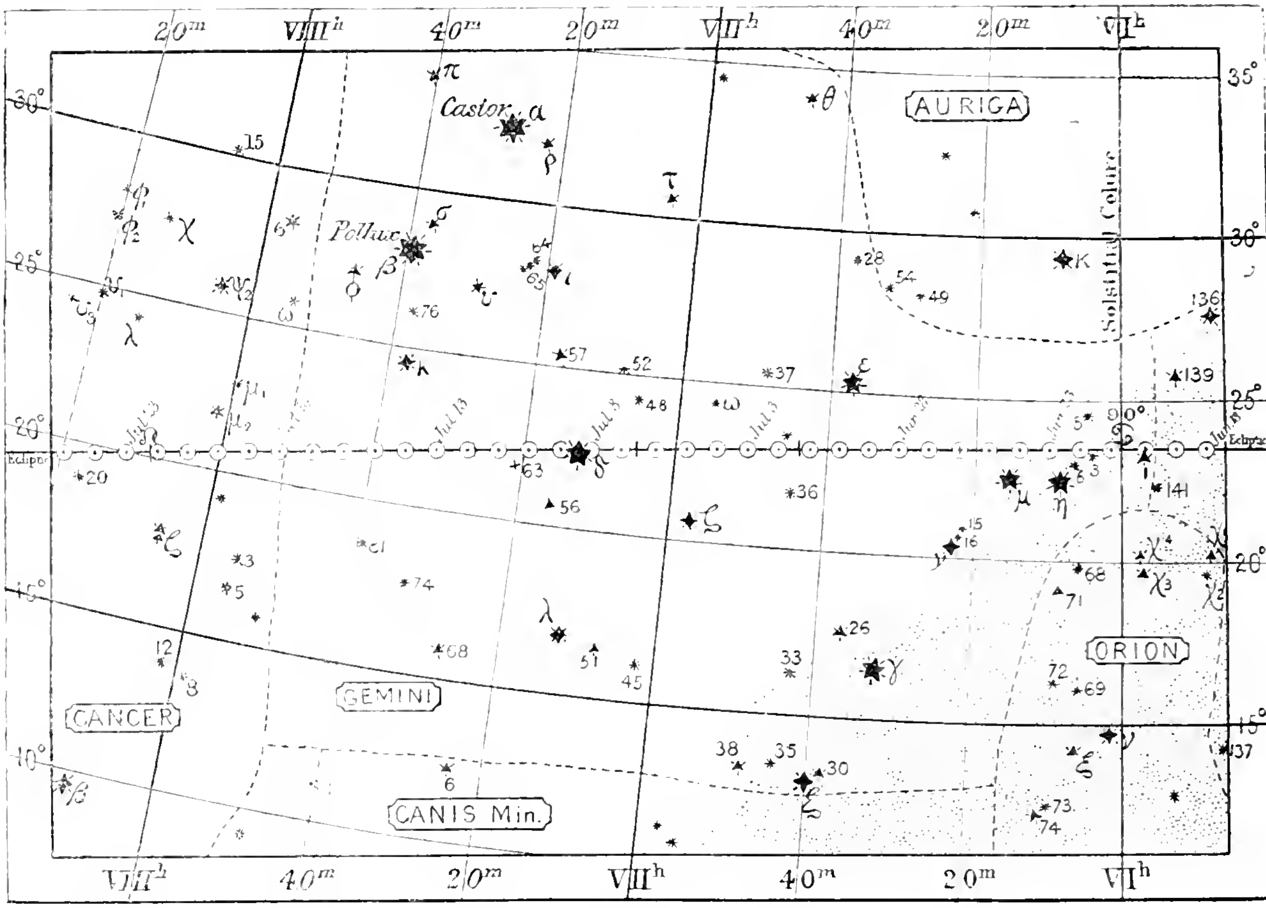
On the east, in strong antithesis to the west, we find a rather monotonous coast, usually sloping away south-east, and having few or only comparatively unimportant headlands and not much cliff. The bays, or rather their equivalents, are generally formed by rivers discharging into the sea, and such cliffs as exist are comparatively soft and continually wearing away. The outline of the coast here has been much modified by time and the sapping effects of the tides, although these last are generally gentler in both their ebb and flow, and century after century enormous quantities of material is accumulating off the coast, rendering the ocean bed comparatively shallow. The southern coast, indeed, to some extent unites the characteristics both of the western and the eastern shores of these islands, and as we pass westward along the Channel the sea becomes deeper and its waves grow in magnitude until, at the Land's End, we find ourselves in view of veritable Atlantic billows. In truth, the whole of England, Wales, and, to some extent, Scotland, is an inclined plane, having its most elevated side on the west, and having there, too, its hardest rocks. Cardigan Bay is nearly useless for shipping, and generally speaking, with the exception of the Bristol Channel and the mouth of the Mersey, commerce is by no means the presiding genius of our great western coasts, where there may still be found innumerable beautiful nooks and unsurpassed vantages wherein to study the most picturesque aspects of the sea under unusually favourable conditions.

Then, again, to revert to my original contention as to the capital and common blunder of recurring to a few familiar places only as seaside resorts year after year. While hundreds of thousands of regular seaside visitors know the Isle of Wight more or less thoroughly, how many are acquainted with the Scilly Islands, the Isle of Man, or, more interesting still, put up at the Isle of Anglesea, to say nothing of the Hebrides and other northern groups, which, when they are set for a brief period in summer seas, are in all senses places which repay the visitor a thousand-fold for the little extra trouble involved in getting thus far out of the beaten track? Then, again, while so many of us are familiar with Portsmouth Harbour, Southampton Water, and the very faint stretches of blue water off the south coast, how many, comparatively speaking, are familiar with the magnificent Bristol Channel, with Swansea Bay, Milford Haven, St. Bride's Bay, Morecambe Bay, and the splendid Solway Firth? How few, again, among the tens of thousands who throng the esplanades of the fashionable and popular south and east coast watering-places are acquainted with the formation of the Devonian heights which rear themselves in such stately beauty and culminate at last at a height of 1,700 feet, while on the north this lofty table-land falls grandly to the sea in precipitous cliffs? Then there are the beautiful Cornish highlands, combining much of the romantic and stern beauty of North Britain with the softer graces and luxuriant vegetation of the sunny south. These remarkable hills, which commence on the lovely shores of Bideford Bay, contracting thence, form but a single line of remarkable heights—a kind of English Apennines—sloping abruptly to the sea on each side, and ending in the bold and splendid headland at the extremity of Cornwall, where may be studied the volcanic cliffs off Lizard Point, and where the Scilly Isles, far out at sea, remain mute but eloquent witnesses of the extent of this remarkable peninsula before some awful convulsion rent away its southern extremity and swallowed up what must have been in pre-historic times a kind of Italy attached to a group of islands, which seemed to some of the ancient Romans to be lost among the dreary snowstorms of the Ultima Thule.

(To be continued.)

* See "English Seaside Resorts," Vol. II., pages 3, 18, 39, 91, 109, 162, 176, 211, 306.

As a protection against blow-flies, the best thing is creosote. If placed in various positions near and around the meat, no fly will go near it. Pyroligneous acid has the same effect.



Day Sign for the Month.

ZODIACAL MAPS.

By Richard A. Proctor.

WE give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

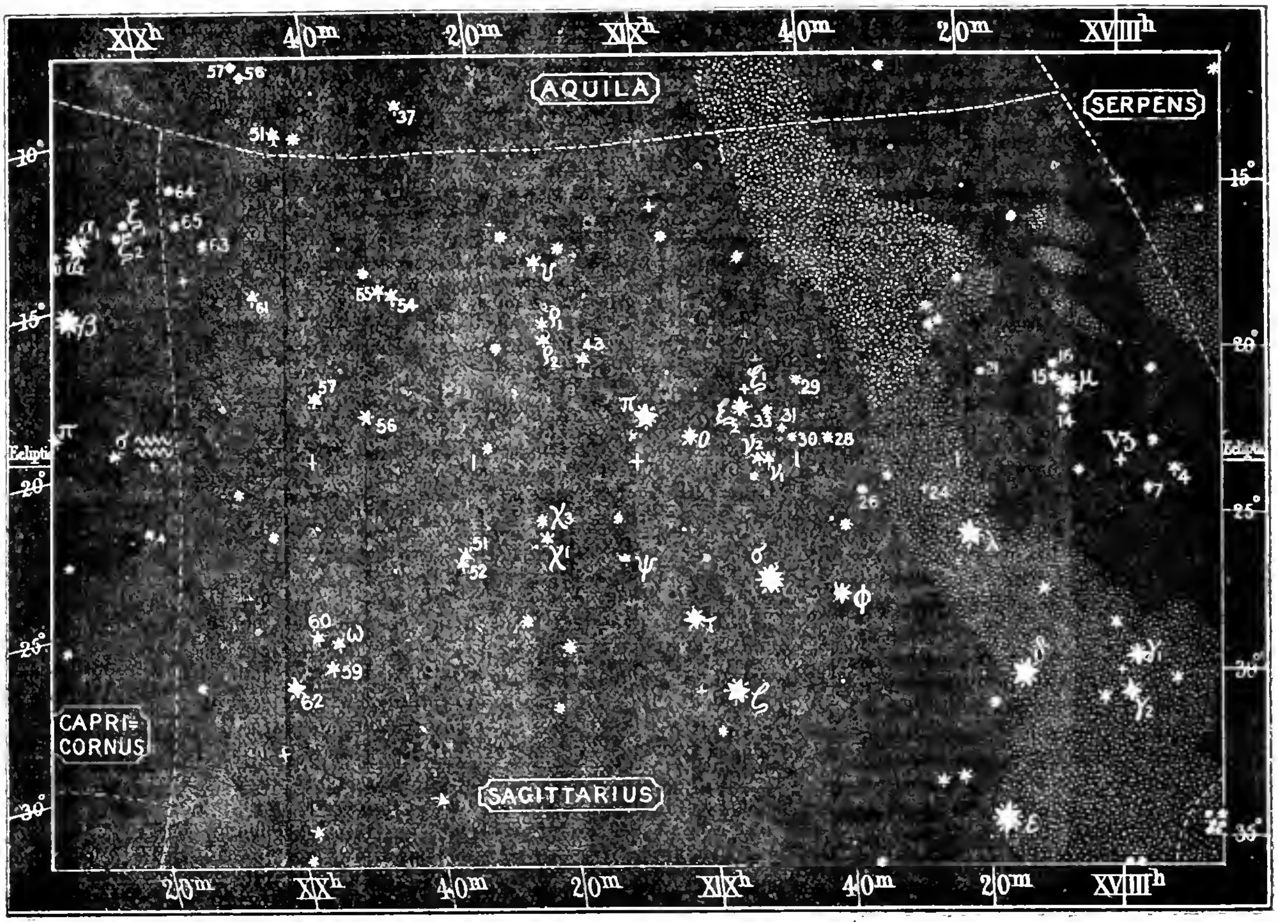
THE ANTARCTIC REGIONS.

By R. A. Proctor.

(*Continued from page* 31.)

THE enormous icebergs which come from out the Antarctic seas suggest interesting conclusions respecting regions as yet unexplored. This will be understood when it is remembered that all the larger and loftier icebergs have in reality had their origin in immense glaciers. Vast masses of ice are formed, indeed, in the open sea. Each winter the seas which have been open during the summer months (December, January, and February) are covered over with ice of enormous thickness, and when summer returns the ice-fields thus formed are broken up, and the fragments, borne against each other during storms, become piled into gigantic masses. But the agglomerations thus formed, vast though they are, are far exceeded in magnitude by the true icebergs. "Among the drifting masses of flat sea-ice," says Tyndall, "vaster masses sail which spring from a totally different source. These are the icebergs of the polar seas. They rise sometimes to an elevation of hundreds of feet above the water, while the height of ice submerged is about seven times that seen above." "What is their origin?" he proceeds, speaking of those met with in the northern seas. "The Arctic glaciers. From the mountains in the interior the indurated snows slide into the valleys, and fill them with ice. The glaciers thus formed move, like the Swiss ones, incessantly downwards. But the Arctic glaciers reach the sea, and enter it, often ploughing up its bottom into submarine *moraines*. Undermined by the lapping of the waves, and unable to resist the strain imposed by their own weight, they break across, and discharge vast masses into the ocean. Some of these run aground on the adjacent shores, and often maintain themselves for years. Others escape, to be finally dissolved in the warm waters of the ocean."

It is important to notice that the Antarctic icebergs are vaster and more numerous than those formed in Arctic seas. How large these last are will be understood from the instance referred to by Tyndall, who, citing Sir Leopold MacClintock, describes an Arctic iceberg 250 ft. high, and aground in 500 ft. of water. But Captain Maury speaks of Antarctic icebergs in the open sea, hundreds of feet high and "miles in extent." "The belt of ocean that encircles this globe on the polar side of fifty-five degrees south latitude is never free from icebergs," he adds; "they are formed in all parts of it all the year round. I have encountered them myself as high as the parallel of thirty-seven degrees, . . . and navigators on the voyage from the



Night Sign for the Month.

Cape of Good Hope to Melbourne, and from Melbourne to Cape Horn, scarcely ever venture, except while passing Cape Horn, to go on the polar side of fifty-five degrees." As he justly remarks, "the nursery for the bergs to fill such a field must be an immense one; such a nursery cannot be on the sea, for icebergs require to be fastened firmly to the shore until they attain full size. They, therefore, in their mute way, are loud with evidence in favour of Antarctic shore-lines of great extent, of deep bays where they may be formed, and of lofty cliffs whence they may be launched."

It is remarkable, however, that Maury fails to notice that the evidence of these enormous icebergs is opposed to the theory of an Antarctic continent, or is, at least, by no means in favour of that theory. It might at once be objected, indeed, to the inferences derived by Maury from the Antarctic icebergs, that similar reasoning would show the unknown parts of the Arctic regions to be mainly occupied by land masses. But, apart from this, all that we know of glaciers teaches us to recognise the fact that they are formed only in regions where vast mountain ranges exist, and where the lower levels are reached by ravines and valleys gradually diminishing in slope as they descend. Now, wherever this is the contour of the land, we have in the surrounding regions one or other of the three following conditions:—Either (i.), flat land regions around the base of the mountain ranges; or (ii.), inland seas upon which the valleys debouch; or (iii., and lastly), open sea, in which the mountain ranges form islands or pinnacles complicated in figure. It is clear that only the third of these formations corresponds to the conditions indicated by the Antarctic icebergs. There must be a communication between Antarctic seas and the mountain-slopes of Antarctic lands, and this communication must be by long and deep valleys, descending to fiords, bays, and gulfs. It is thus as certain as such a matter can be until the eye of man has actually rested on these regions, that the Antarctic shores are extremely irregular; and it seems altogether more probable that the land-masses of Antarctic regions consist of a number of large islands like those in the seas to the north of America, than that there is a great continental region, broken along its border, like the Scandinavian peninsula, into bays and fiords.

But, strangely enough, Captain Maury actually recognises the necessity for a suitable region within which the icebergs are to be formed, but seems to feel bound (by the opinion of geographers respecting the unknown Antarctic regions) to reconcile the existence of such a region with the theory of a great Antarctic continent. "Fiords, deep bays, and capacious gulfs loom up," he tells us, "before the imagination, reminding us to ask the question, Is there not embosomed in the Antarctic continent a Mediterranean, the shores of which are favourable to the growth and the launching of icebergs of tremendous size? and is not the entrance to this sea near the meridian of Cape Horn, perhaps to the west of it?" But the condition of the Antarctic seas will not permit us to adopt such a view of the origin of southern icebergs. Even if the imagined Antarctic

Mediterranean were not icebound, it would be sufficiently difficult to conceive that the glaciers formed around its shores would pass out in stately procession through the imagined straits south and west of Cape Horn. How should currents sufficiently strong be generated to bear these glacial masses away? How could collisions, blocking up the mouth of the strait, often for months together, be avoided? And when the consideration is added that an Antarctic Mediterranean would almost certainly be frozen over the whole year through, the theory that it is within such a sea that Antarctic glaciers are formed becomes, in our opinion, altogether untenable. If such a sea exists, it must be blocked up with ice too completely for any considerable movements to take place within it. Even the glaciers on its borders must be unlike the glaciers known to us, because the downward motion of the ice-masses composing them must be so checked by the resistance of masses already accumulated, as to be scarcely perceptible even in long periods of time.

(To be continued.)

THE ABSOLUTE CAPACITY OF A CONDENSER.

At the last meeting of the Physical Society, Mr. R. T. Glazebrook, M.A., F.R.S., of Cambridge University, described some interesting experiments he had made to determine, in absolute measure, the electrical capacity of a condenser sent to him for the purpose by Messrs. Latimer Clark, Muirhead, & Co., the well-known makers. The general method employed by Mr. Glazebrook is that given by Clerk Maxwell in his treatise on "Electricity," vol. II., sec. 776. A commutator driven by a tuning-fork is fitted to the condenser in such a manner that the plates of the condenser are alternately connected to two points at different electrical potentials, and then put into communication with each other. The condenser and commutator are inserted as one of the arms of a Wheatstone bridge, and Maxwell has shown that if the period of vibration be sufficiently slow, the combination is approximately equivalent to a resistance of $\frac{1}{n\,C}$ where n is the frequency of the tuning-fork, and C the capacity of the condenser. Thus, if a be the resistance of the arm conjugate to the condenser, c and d resistances of two other conjugate arms, we have the condition for a balance $\frac{a}{nC} = c\ d$, or $n\ C = \frac{a}{c\ d}$. Thus C can be found if a, c, d, and n be known. Mr. J. J. Thomson has, however, shown ("Phil. Trans.," part iii., 1883) that Maxwell's formula is only approximate, and has given the correct formula. It was this which Mr. Glazebrook used in his tests, and the arrangement of apparatus is shown in the figure. The condenser and commutator were placed on the bridge arm B D, and P is the moving piece commutator, which, when in contact with S, changes the condenser, and, when in contact with R, discharges it. The tuning-forks used had frequencies of 16, 32, 64, and 128 to the second, as determined by careful comparison with a clock by the method of Lord Rayleigh. The corresponding values of the capacity were, in terms of the legal ohm., ·3336 mf. (microfarads), ·3340 mf., ·3335 mf., and ·3337 mf., the mean being 3337 microfarads. The experiments do not show any variation in the capacity, as the time of charging is changed from 1-16th to 1-128th of a second. The formula also gives a ready and accurate means of determing the pitch of a tuning-fork, for if the capacity of the condenser used is known, the value of n can be determined. Mr. Glazebrook has successfully used it for this purpose. A question arose at the meeting as to the efficacy of mercury contacts in such experiments, and Dr. W. H. Stone stated that he found mercury and iron contacts to be free from sticking. Whether this is an advantage or not in making a good contact is doubtful. Recent experiments within our knowledge would seem to point to a microphone action in such contacts.—*Engineering.*

Reviews.

SOME BOOKS ON OUR TABLE.

Picture-making by Photography. By H. P. Robinson. (London: Piper & Carter. 1884.)—Many a photographer whose technical manipulation is perfect, whose plates never fog, and the half-tones of whose negatives leave nothing to be desired, fails dismally in the production of anything resembling an artistic picture. That it will not merely suffice to that end to stick up a camera in front of a view or group, and subsequently to expose and develop a plate, Mr. Robinson's excellent manual not only conclusively shows, but points out definitely why, in the plainest and most comprehensible manner. His little book should be in the hands of every one who is anxious to preserve the element of beauty in his reproductions of nature, and is not contented with a mere wooden and mechanical copy of the objects he depicts by the aid of the camera.

The London Water Supply, its Past, Present, and Future. By G. Phillips Bevan, F.S.S. (London: Edward Stanford. 1884.)—Beginning with an account of the water supply of mediæval London from the Thames, the Fleet, the Tybourne, the Wallbrook, &c., Mr. Bevan carries us down to the existing provision for the metropolis, and gives full details with reference to the various water companies to which we are indebted for it, their plant, sources of supply, and profits; concluding his book with an account of the various schemes which have been devised for a large increase in the amount of water to be furnished, by bringing it from distant sources, such as Wales and Cumberland. Considering how probably imminent legislation is on the subject of the water supply of London, and how vastly its 4,000,000 inhabitants are interested in the question of the purity and economy of such supply, Mr. Bevan's small work should address a very large public indeed.

The A B C Guide to Physical Geography. (London: Thomas Young, 1884.)—The leading physical features of the earth's surface are set forth in this little book in a way calculated to give a fair rudimentary idea of them. After two perusals of it, we have come to the conclusion that the author means to be funny; but we speak with some hesitation on this point.

Gas-Burners, Old and New. By Owen Merriman. (London: Walter King. 1884.) Mr. Merriman gives us a complete history and description of gas-burners, from Murdock's original crude nipple, with its three perforations, through the bat's-wing and fish-tail forms down to the highly complicated and elaborate ones devised by Siemens, Clamond, and others; and the more simple, but practically equally efficient, burners of Sugg, Bray, and Brönner. The work before us may well tend to dissipate a good deal of unreasoning prejudice against gas-lighting, and to indicate how—at all events for domestic purposes—it will hold its own against the electric light for many a long day yet.

Vivisection in its Scientific, Religious, and Moral Aspects. By E. D. GIRDLESTONE, B.A. (London: Simpkin, Marshall, & Co. 1884.) *The Utility and Morality of Vivisection.* By G. GORE, LL.D., F.R.S. (London: J. W. Kolckmann. 1884.)—We have classed these two pamphlets together, inasmuch as they have one common aim: to plead for our right to experiment (of course under due restrictions) on the lower animals, for the benefit of mankind. Any impartial person who will read these *brochures* through with the attention that they deserve, will be able to estimate at its true worth the cant of those who ride and drive horses which have been subjected to a most painful form of "vivisection" (as probably as not by an ignorant country farrier), who eat veal that has been slowly bled to death, who will leave a pheasant with its thigh shattered by shot to die in a ditch, but who shriek with horror if a frog is decapitated, or the larynx of a dog opened, to obtain knowledge that may benefit thousands of suffering human beings.

Vaccination, by ALEXANDER WHEELER. (London: E. W. Allen. 1883.)—More anti-vaccination juggling with statistics! Mr. Wheeler gets hold of one table of mortality and finds that ten years of least small-pox had more deaths than ten years of most small-pox: and then of another, showing that ten years of most small-pox had more deaths than ten years of least small-pox; but they all (according to him) prove the same thing! We all remember how Bret Harte took the number of people who were annually killed on railways and the number of those who died in their beds, showing conclusively that it was almost indefinitely safer to travel by rail than to go to bed. The anti-vaccinationists appear to us to deal with their statistics on a strictly cognate principle.

Solar Physics. An Almanack of the Christian Era, &c. By A. H. SWINTON. (London: W. H. Allen & Co. 1883.)—After wearily wading through this curious muddle of science and non-science (or, more shortly, nonsense) in its gorgeous cover, whereon a sun like a gilt crumpet reposes on an azure ground, we found that it concluded with a "list of subscribers." This, at all events, sufficed to explain the otherwise incomprehensible fact of its ever having been published at all. Our idea, gathered from its perusal, is that the author is a perfectly sincere and conscientious fanatic, who has been patted on the back by what has been not too politely called "the sunspot ring," in this country, for the sake of the respectability shed upon their professed views by their proclamation by a disinterested person. At all events, he quotes from a contribution of his own to the organ devoted to the pecuniary advancement of the gentry referred to. But he really ought to be right in his facts. To begin at the beginning, he sets down 1882 as the year of maximum sunspots, whereas the Astronomer Royal (on p. 8 of his "Report to the Board of Visitors of the Royal Observatory Greenwich, read on June 7, 1884), says:—"The mean spotted area of the sun was slightly greater in 1883 than during the preceding year." So, again, with his allegation (p. 46) that years of Sunspot Maxima are those of the greatest rainfall: Can his friend, Mr. Symons (p. 70), give him no information on the British rainfall during 1883 and 1884? The argument on pp. 61 and 62, however (if it can be dignified by that name), is perhaps as typical of our author's reasoning capacity as anything he advances. "Mr. F. Chambers," we are told, "has stated that when the sun is most spotty, then the mean yearly pressure on the barometer at Bombay is least; while at St. Petersburg, from 1822 to 1871, the mean height of the barometer is said, contrariwise, to have accorded with the spottings of the sun. . . . . Certainly the spots affect the barometer" (!) This "certainly" is delicious, and strongly suggests the dialogue in the immortal street drama of *Punch*. "About six weeks ago," says the original owner of Toby, "I lost this dog." "And," responds Mr. Punch, "about six weeks ago I found him." "Well," says his interlocutor, "that shows he's mine" "No," says Punch, "that shows he's mine." Is not the parallel perfect?

The Student's Guide to Scientific Botany. By ROBERT BENTLEY, F.L.S., &c. (London: J. & A. Churchill, 1884.)—We have one fault to find with Mr. Bentley's excellent little book, and that is the absence of a glossary of botanical terminology from its pages. But for this, it would be as invaluable to the beginner as it now is to the advanced student. Under existing circumstances, the incipient botanist who was struggling to identify one of (say) the Liliæ might rather fail to ascertain whether the specimen under investigation had its "Anthers introrse" and its "Fruit a loculicidal capsule," in the absence of any idea what "introrse" and loculicidal" could possibly mean? If, however, we conceive him to have mastered these and cognate terms, he could hardly possess a handier or more useful companion in his rambles in search of plants than the work before us. As the majority of the illustrations are taken from British medicinal plants, this small volume would seem to have been chiefly written as a text-book for the botanical examination of medical and pharmaceutical students; but any one who, by the aid of Mr. Bentley's book, will honestly work through the various genera of plants he describes must assuredly obtain a sound and comprehensive knowledge of the princip es of systematic botany, to whatever purpose he may ultimately apply it.

Wonders of Plant Life under the Microscope. By SOPHIE BLEDSOE HERRICK. (London: W. H. Allen & Co., 1884.)—This pretty and pleasantly-written volume deals with some of the more remarkable facts in structural and physiological botany, and is well calculated to create, or strengthen, an interest in plant-life, and to invite attention to the marvels which it presents. We note one or two trivial errors in points of detail, but none of sufficient importance to detract from the value of a delightful book. Assuming that the object of its fair authoress has been to make the study of plants attractive, assuredly she has succeeded.

Confessions of an English Hachish-Eater. (London: George Redway, 1884.)—Accepting the recorded experiences of the author of this work as genuine, they present a certain amount of interest to the toxicologist and psychologist. By taking tincture of hemp he appears to have induced a sequence of wild waking dreams and nightmares, which he sets forth in somewhat rhapsodical language. Fortunately we find it hard to conceive that he will make many converts to his peculiar method of intoxication—at all events, in this country.

ON page 8 of the "Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory at Greenwich," presented at the Annual Visitation of the Royal Observatory, June 7, 1884, we read that "The mean spotted area of the sun was slightly greater in 1883 than during the preceding year." Hence it is pretty obvious that 1883 was the year of sun-spot maximum of the current cycle. Turning now to p. 34 of the "Results of the Meteorological and Magnetical Observations for 1883," at Stonyhurst College Observatory, we find Father Perry saying that "The rainfall for the year was nearly two inches below the average" (for the last thirty-six years). Certain members of a remarkable association at Brompton, known as "The Committee on Solar Physics," are now tired of assuring the uninstructed and unscientific public that years of maximum sun-spots are invariably those of maximum rainfall too; and that it is only necessary to pay sufficiently highly to have the one watched to enable the other to be predicted. It is as well that the real truth should be known in this matter before the National Exchequer is further called on to subsidise those who make such baseless assertions.

THE FACE OF THE SKY.

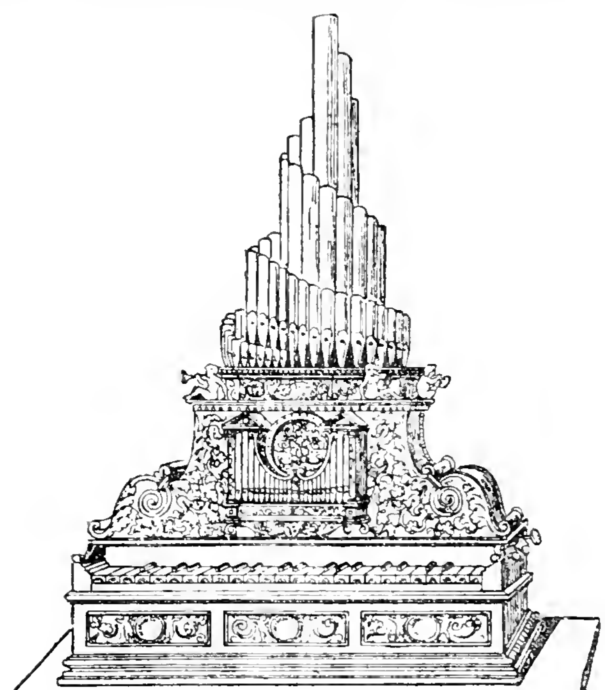
FROM JULY 18TH TO AUGUST 1ST.

BY F.R.A.S.

SUN-SPOT activity, albeit somewhat subsiding at last, continues sufficiently to render the Sun an interesting object of daily examination. Map VII. of "The Stars in their Seasons" furnishes the present aspect of the night sky. Mercury is an evening star, but by no means well placed for the observer. Venus is a morning star, and may be seen before sunrise with the naked eye. To the student who possesses the means of directing a telescope on her during the daytime, she will appear as a lovely object. These are the two solitary planets now visible. The Moon will scarcely come into view for the purpose of the ordinary observer until about the 27th, being New 54 minutes after noon on the 22nd, and travelling southward in the sky. One occultation of a star only will be visible during the period covered by these notes. It occurs on the 27th, when the 6½th magnitude star, B A C 4,294, will disappear at the dark limb of the moon at 8h. 16m. p.m. at an angle from her vertex of 164°, and reappear at her bright limb at 8h. 50m. p.m. at a vertical angle of 229°. The Moon is in Taurus to-day at noon, and remains in that constellation until 6 a.m. on the 20th, when she passes into the northern part of Orion. This she traverses in, as nearly as may be, 12 hours, entering Gemini at 6 o'clock in the evening of the same day. She does not leave Gemini for Cancer until 6 a.m. on the 22nd, and, oddly, it is 6 p.m. on the 23rd when she crosses the boundary into Leo. At 9 p.m on the 24th she descends into Sextans, emerging into Leo again about 9h. 30m. the next morning. At 11 a.m. on the 26th she enters Virgo, a constellation which she does not quit for Libra until 7 p.m. on the 29th. She is crossing Libra until 9 o'clock at night on the 31st, at which instant she passes into the narrow northern strip of Scorpio. Her path over this is traversed by 7h. 30m. the next morning, when she emerges in Ophiuchus. There we leave her.

DESIGN FOR PARLOUR ORGAN.

OUR engraving shows a design of an organ made many years ago, in which all the pipes are said to have been made of silver. We present it to our readers with the hope that it may



serve as a suggestion leading to the production of something new and good in the form of musical keyed instruments. We are tired of the present stereotyped shapes of our pianos and organs. Will not somebody strike out in a new direction? A suitable design of so novel and popular a character that people must have it would be worth many thousands of dollars to the manufacturer who secured it.—*Scientific American.*

Miscellanea.

THE Royal Microscopical Society, after careful deliberation, have decided upon admitting ladies to all the privileges of fellowship, attendance at the ordinary meetings excepted.

A CORRESPONDENT, writing anent a paragraph which appeared in p. 37, says that there must be some mistake in it, inasmuch as both the astronomical Doctors Draper, father and son, are, unhappily, dead.

To get rid of the smell of paint, plunge a handful of hay into a pail of water, and let it stand in any room newly painted. The smell will be greatly lessened.

IT is stated that the gas sold in the metropolis continues to increase, the quantity in 1883 being more than 20,000 millions of cubic feet. The quantity is vast, and the consumption of coal is proportionate, the weight carbonised being more than 2,000,000 tons.

AN article on "Patent Medicines" appears in our contemporary the *Lancet* for July 5, which may be perused with advantage by all who labour under the delusion that the Government stamp affords the slightest security against even the poisoning of the purchaser of any advertised nostrum.

IN 1882 the colony of Victoria was required by the courts to pay £120,000 to persons injured by accidents on the States railroads, of which it had 1,355 miles. The sum was 17 per cent. of the total net earnings of its railroads. Most of these accidents were on one comparatively short line, and the payments for injuries exceeded the net earnings of this line by about £25,000.

THE following quantities—in tons—of zinc were produced in 1883, by the different countries named:—The Rhine district and Belgium, 123,891; Silesia, 70,405; Great Britain, 27,661; France and Spain, 14,671; Poland, 3,783; Austria, 2,870; United States, 32,790; totals, 276,080. These figures all show increase on previous years, except as relates to France and Spain and to Poland, which show a decrease.

SIR LOUIS MALET, late Under Secretary of State for India, Sir Evelyn Baring, late Minister of Finance in India, and Mr. Westland, Comptroller and Auditor-General to the Government of India, have addressed a letter to Mr. Henry Dunning Macleod to be forwarded to the Civil Service Commissioners, earnestly recommending that his works on Political Economy should be adopted in the Civil Service examinations.

SOME time since, Dr. Morris, of Birmingham, succeeded, as he believed, in photographing a third sort of blood corpuscle, which, being of the same colour and the same refractive index as the liquor sanguinis, was invisible to the eye. Grave doubt has been thrown on the objective existence of these corpuscles by Mr. St. George St. Clair, who, as the result of a series of experiments, has, he conceives, demonstrated that Dr. Morris's corpuscles are nothing but photographic ghosts.

IT is estimated that the total annual production of watches in Switzerland at the present day exceeds 1,600,000, with an aggregate value of 88,000,000 francs, the total number of workmen employed averaging 40,000. A novel kind of watch has been recently invented by Mr. Paul Kramer, at Neuchâtel. This watch is called *à aiguilles universelles*, and indicates simultaneously the times of different countries; one, for example, shows the different times for Paris, Suez, Bombay and Hué, another for New York and San Francisco.

THE Anti-Vivisection Society have lodged a protest against the crucial experiment by which M. Pasteur proposes to demonstrate the efficiency of his vaccine for rabies. Mrs. Kingsford, M.D., who made herself prominent on this occasion, exclaimed that M. Pasteur was not justified in "torturing thousands of animals" with the object of abolishing so "very rare" a disease. The "thousands" when translated into the language of sober reason shrink to forty! As for the "rarity," we must remember that twenty-one persons died of hydrophobia in the Department of the Seine within twelve months.—*Medical Press and Circular.*

A DEPUTATION from the City Commissioners of Sewers visited Wimbledon recently to see the result of the experiments in electrical street lighting which have been conducted for some months past by Mr. Preece. From these it appears that the most efficient practical mode of distributing light for a main street, like that of Wimbledon, is by means of 50-candle lamps, fixed 20 ft. high, at intervals of 100 ft. The effects were admitted to be remarkably striking, and to furnish a capital example of efficient street lighting. We hear that it is within the range of probability that similar experiments will, ere long, be tried in some of the busier City thoroughfares where are lights, although not a failure, have apparently fallen short of their anticipated success.

ELECTRO-MAGNETIC INDUCTION.—At the Physical Society recently Mr. C. V. Boys exhibited the phenomenon first observed by Faraday, that a copper disc suspended bifilarly between the poles of an electro-magnet, so as to cross the lines of magnetic force at an angle, is suddenly kicked or twisted parallel with the lines of force when the magnet is excited. If the disc be perpendicular to the lines of force it is repelled by a pole when the magnet is made and attracted by the same pole when the magnet is unmade. Mr. Boys has investigated the phenomenon very fully, and points out that it offers a quick and ready means of measuring the intensity of an electro-magnetic field, as well as a means of finding the electric resistance of plates and discs of metal.—*Engineering.*

MR. CHARLES BATCHELOR, who has been engaged in developing the Edison system in Europe, states that the contracts on hand at the factories on the Seine are more than the 400 *employés* can carry out at present. Mr. Batchelor proceeds :—"The French company is completing a 20,000 light circuit for Paris. It covers the very heart of the city, the Rue de l'Opera, and other points which have heretofore been unsuccessfully attempted to be covered, by the best class of arc lights. The company has lighted already the Hôtel de Ville, and has over 6,000 lights in the Grand Opera House, 2,000 in the Eden Theatre, 1,200 in the Comique, 1,200 in the Vaudeville, and 1,200 in the Grand Hotel. Mr. Batchelor thinks it a fair estimate to say that the contracts of the company now cover about 26,000 private lights to which no power is furnished, but only the globes, &c. There are 600 lamps in La Nouveauté, 500 in La Variété, 500 in La Bouffe Parisenne. They are to be found in all the *cafés* from the Madeleine to the Variété, and as far north as the Gare St. Lazare, and as far south as the Hôtel Continental. Through all this district, the most important in the city, the company has the option of the right of way for all private lighting purposes on the payment of two and a half million francs, and its rights are guaranteed by the Government.

AT the meeting of the Geological Society, on June 25, the following communication was read :—"Additional Notes on the Jurassic Rocks which underlie London." By Professor John W. Judd, F.R.S., Sec. G.S. Since the reading of the former paper on the subject (Feb. 6, 1884), the well-boring at Richmond has been carried to a depth of more than 1,360 ft. The point reached is, reckoning from Ordnance-datum line, 220 ft. lower than that attained by any other boring in the London basin. A temporary cessation of the work has permitted Mr. Collett Homersham to make a more exact determination of the underground temperature at Richmond. At a depth of 1,337 ft. from the surface, this was found to be 75½° Fahr., corresponding to a rise of temperature of 1° F. for every 52·43 feet of descent. The bore is still being carried on in the same red sandstones and "marls," exhibiting much false-bedding, which were described in the previous communication. The Rev. H. H. Winwood, of Bath, has had the good fortune to find the original fossils obtained by the late Mr. C. Moore from the oolitic limestone in the boring at Meux's Brewery in 1878. A careful study of these proves that though less numerous and in a far less perfect state of preservation than the fossils from the Richmond well, they in many cases belong to the same species, and demonstrate the Great Oolite age of the strata in which they occurred.

THE DESTRUCTION OF WILD BIRDS IN INDIA.—Under the auspices of the East India Association, a meeting of naturalists, planters, sportsmen, and others interested in the affairs of India wes held on Friday, July 11, at the rooms of the Zoological Society, under the presidency of Professor Flower, LL.D., F.R.S. (Director of the British Museum Natural History Department, and President of the Zoological Society), for the purpose of urging the necessity of Government measures for the preservation of wild birds in India. The principal address was delivered by Mr. Robert H. Elliot, sometime planter of Mysore, and a well-known writer upon Indian topics. He pointed out that every civilised Government, with the exception of that of India, has recognised the value of birds as insect eaters, and has adopted measures for their preservation; and that the absence of legislation forebodes, where it has not yet presented, serious results to planters and agriculturists. As the most convenient season for the destruction of birds is during the fine weather that succeeds the heavy rains of the monsoons, and as this season is also the breeding time, the destruction of insect-eating birds proceeds at such a rate as must soon lead to almost absolute extermination, unless preservative measures are speedily adopted. There was a general agreement in the meeting that legislation on the subject is imperatively required, and it was resolved that a representation to that effect should be addressed to the Government of India.

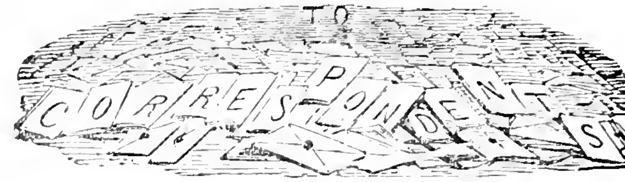
BIRDS CAUGHT AND KILLED BY THE ELECTRIC LIGHT.—A despatch from Winona, Minn., describes a very curious incident in connection with the use of the electric light there. It says :—Every night this week thousands of migratory birds have gathered about the electric light on the stand-pipe in this city. Between the hours of one and two o'clock the birds were seen in swarms about the light, and hundreds fell to the ground. A few were caught alive, but the larger part were dead. Prof. Holzinger, of the normal school, reports the following species among those collected during the past two nights at the waterworks :—Catbirds, grossbeaks in variety, scarlet ranagers, golden crown thrushes, water thrushes, chestnut-sided warblers, blackburnian warblers, Tennessee warblers, magnolia warblers, Carolina rails, yellow-throated vireos, black and white creepers, traels, fly-catchers, green-crested fly-catchers, Savannah sparrows, white-throated sparrows, Maryland yellow-throats, black-billed cuckoos, helldivers, indigo birds, and yellow-bellied woodpeckers. On Tuesday night the grossbeaks predominated, and on Wednesday night the rails. Catbirds were numerous on both nights. The birds which breed in this locality were noticeably absent. Valuable additions from these birds are being made to the museum of the Society of Arts and Science, and a set of duplicates of most of the varieties has been furnished by Prof. Holzinger to the high school collection. Many of the birds which were caught alive may be seen in cages at the engine-house of the waterworks. —*Electrical World* (New York).

IT has been stated that the *Times* of June 14 is the largest production that has ever issued from the daily press with the exception of the *Times* for June 21, 1861. We, therefore, have pleasure in drawing attention to the following :—The *Times* issued June 14 consisted of twenty-four pages, each containing six columns—144 columns in all; the total length of which was 264 feet—52 feet higher than the monument; and they contained enough matter to fill two volumes of 480 pages. Almost every week, at least one issue of the *Daily Detroit Free Press* consists of twenty-four pages of seven columns each. On June 2, 1878, it consisted of thirty-two pages of seven columns each. On June 8 this year, in celebration of its removal into the new Free Press Building, Detroit, and on or about its fifty-third birthday, *The Daily Detroit Free Press* consisted of thirty-six pages of seven columns each—the largest paper ever printed in the world, we believe. This gives 252 columns, whose total length is 420 feet —double the height of the Monument, and sixteen feet to spare. The paper used to print this edition, run off the reels in a straight line, would extend 108 miles; while, spread out wide, it would cover 25 acres; piled sheet on sheet, as folded, it would tower up nearly three times the height of the Monument; and, in book form, it would fill two volumes of 600 pages each. The mechanical work —composing, stereotyping, and printing—occupied 148 men; and the literary matter, outside the reports of the Associated Press, was furnished by no less than thirty-five editors, reporters, and regular contributors attached to *The Free Press* staff, and forty-two correspondents in various parts of the world. The price was five cents, as usual.

COLOUR-BLINDNESS.—There is every reason to believe that the new apparatus for combining colours, devised by Mr. Offert and by Lord Rayleigh, will lead to a thoroughly scientific investigation of colour-blindness. Considering how common Daltonism is, and how essential it is that railway men and others working with coloured signals should be free from it, or at least know the extent to which they suffer from it, some simple means of investigating it is desirable. Lord Rayleigh's apparatus is based on double refraction, and the obtaining of two overlapping spectra, which the person under examination looks at, and describes as green, blue, or purple, whatever it appears to his or her sight. Lord Rayleigh has, we believe, tested the vision of numerous friends, and is willing to extend his observations further. So far he has found that the majority of persons tried require only half as much red in the mixed spectra to turn a given yellow into green as he himself does. People vary from each other in matching colours, and there are grades of "colour-blindness." Ordinary colour-blindness is blindness to red, but the father of Mr. Stanley, the optician, was colour-blind to green. As an engineer, when engaged in colouring plans, he had to single out his green pigments by their names. To him they appeared a kind of brown. Lord Rayleigh has not, we understand, noticed any striking differences between the two eyes of the same person, except what is due to fatigue of one eye and freshness of the other. Dr. Guthrie, who is colour-blind to red, believes himself more than usually sensitive to blue; and Lord Rayleigh has found persons abnormally sensitive to red, as well as abnormally insensitive to it. It would be interesting to discover whether such persons can see further down the red end of the spectrum than is usual. Perhaps the modification of Lord Rayleigh's apparatus, by Mr. Glazebrook, for measuring the distance on the spectrum, which any one can see, will answer this part of the inquiry.—*Engineering.*

FIREPLACES.—Now is the time to embellish the fireplaces. But what are we going to choose, floral decorations or paper? Let us hope not the latter, for nothing shows the want of good taste so much as when one enters a room, and is immediately faced by an array of red tinsel, or some such fiery stuff, to hide the empty grate. Therefore we will put paper out of our thoughts, and seek some other more suitable subject. Plants are exceedingly ornamental, that is, when nicely arranged. But then the question arises, What have we got suitable? Palms, grasses, dracænas, ferns, are excellent, the point being to secure plants with neat and graceful foliage. Then we shall want a fair proportion of colour to light up the group. For this purpose the flowers should be choice as well as showy. A huge geranium or pelargonium placed in the centre of the grate is decidedly unsuitable, because it betrays bad taste. A neat tuft of white Marguerites peeping out from amongst grassy leafage will be decidedly preferable to a large lumpy calceolaria or geranium. The plants will want renewing constantly, because it does not look well to have sickly plants in such a prominent position. It is customary with many to fit a mirror to the entire opening of the fireplace, and then group the plants in front; this produces a fine effect when the plants are nicely arranged. It is necessary that the plants are clean and dry when placed in position, but the soil in the pots should be moist enough to last a few days. If the plants are not kept too long in the parlour, they will be none the worse for the change.—*Amateur Gardening.*

INTRODUCTION OF THE ELECTRIC LIGHT AT MR. J. F. MILNER'S FLOUR MILL.—A short time ago, a description was given in the *Guardian* of the new system of grinding corn by the roller process introduced by Mr. J. F. Milner at his Woodside mill. Mr. Milner has now introduced the method of electric lighting at his premises, so that the Woodside mill is now one of the most complete premises for corn grinding to be met with in the north of England. As the mill is run day and night, the introduction of electric lighting will, it is believed, prove to be an immense advantage in many ways. The experiment was tried for the first time on Thursday night, and was found to work admirably, the lamps giving out a clear, steady, and brilliant light. A brief description of the working will be of interest to many readers. The installation consists of one Crompton Burgin compound self-regulating dynamo-machine, and some seventy-six 20-candle power Swan incandescent lamps. The machine, however, is capable of supplying some ninety such lamps, and it is intended to add to the number on the completion of Mr. Milner's new offices. It is also intended that there shall be an arc lamp on each side of the mill, for loading purposes; these will be of the well-known Crompton Crabbe double differential type, of 2,000 actual candle-power. The Crompton Burgin machine is now so well-known that we need not again go into its details; suffice it to say that any number of lamps can be turned out without affecting the remainder, and that the power absorbed is diminished in proportion thereto. The Swan lamp, too, is noted for its durability and economy, and has long been recognised as one of the best in the market. The machine is placed on the top floor, where it is driven by a small separate engine, which, although intended to drive the hoist, answers admirably for driving the lights, as it can always be kept running if desired. It is driven by a countershaft, at a speed of 1,400 revolutions per minute. Near the dynamo is a neatly-polished pitch pine switch-board, containing three main switches, which convey the current to the mill, warehouse, screens, &c., respectively. We may here remark that a very ingenious arrangement has been tried in regard to the staircase, whereby all the lights on the landings can be left burning when the others are turned out, thus enabling any one to see his way down the steps after turning out the lights in his own room. On the switch-board are also a pair of fusible cut-outs (Hedge's patent), which serve the same purpose as a fusible plug in a steam-boiler. There are also small cut-outs to each lamp, so as to prevent the possibility of fire from any cause whatever. The question of reducing fire-risk in corn-mills is especially interesting. The loss by fire in corn-mills has increased from £42,000 in 1877 to £154,000 in 1883, and this has resulted in the insurance companies raising their rates of premium. The adoption of the electric-light, however, will, it is believed, be a great step towards reducing this risk to a minimum, and it is hoped that ere many months have passed, the insurance companies will recognise its advantages, and reduce their present high rates. The work has been carried out under the superintendence of Mr. J. T. Baron, on behalf of Mr. Wilson Hartnell, electric-light contractor, of Leeds, who recently lighted up the new mill of Messrs. James Clay & Sons, Luddenden Foot.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

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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NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

"THE PROPHET OF SAN FRANCISCO."

[1339]—I fear I am asking more than I ought to ask of your kind indulgence by begging you to insert such a letter as this, referring, as it does, to a review you were so good as to give in your last number of my pamphlet—"The Unlimited Debt:" but I cannot help feeling that some injustice has been done me by your calling me "a disciple of Mr. George's," without stating that I differ from him in a very important particular, by disapproving of confiscation.

Secondly, you say that if rent took the place of taxes, "God help the cultivator of the soil;" but the whole point of the question is this:—If private property in land is unjust, then that largest of all classes, the poor—including the poor of the towns and the labourers of the country—are those whose case calls most for pity. If the land belonged to the State, they, as part of the State, would benefit by rent; now they have none of it.

As for the tenant, the object of your pity, it must not be forgotten that he also has now no share of rent, and that he would under the State system have, in addition to his share of rent, the protection of a court of law corresponding exactly to the Irish Land Commission, which has, in fact, been called into existence owing to the necessity of protecting him from the exactions of *private owners.* It was obviously impossible for me to provide against all possible objections within the short compass of a threepenny pamphlet, I am therefore the more emboldened to beg the insertion of this letter.—I am, sir, your faithful servant,

F. W. D. MITCHELL.

[I have yet to learn that the Irish Land Commission has proved such a success as to invite its reproduction in any other country in the civilised world.—ED.]

MEALWORMS.

[1340]—In consequence of absence of home, I missed seeing the number of KNOWLEDGE containing F. M. Duplock's inquiry as to mealworms, and only came across it for the first time a few hours ago, when looking through some back numbers. I trust Mr. Duplock will accept this explanation as my apology for the delay in replying to his courteous letter.

I fear an article on mealworms is impracticable at present, but perhaps the following notes may be useful. Mealworms are the larvæ of two kinds of elongate blackish beetles, *Tenebrio molitor* and *T. obscurus*, which are the only British representatives of the genus. They closely resemble one another in general appearance, but the latter, which is usually a little the larger of the two, may be at once distinguished by its duller appearance. It is said that the mealworms from the East-end of London are generally those of *T. obscurus*, and those from the West, *T. molitor*. The beetles may be found in bakeries, flour-mills, granaries, &c., where they devour anything farinaceous they can get hold of.

They are noted also for the depredations they commit on ship-biscuits. They occasionally fly to gas-lamps like moths. The larvæ of the two species are also much alike, that of *T. obscurus* being somewhat darker in colour, and having the terminal segment rather longer. They are said to live two years in the larval state, and then, without forming a cocoon, change to a pupa which displays the form of the future beetle, and is probably the "tiny ghost," and "corpse-like thing" referred to, though on this point we can scarcely speak definitely in the absence of a more accurate description. The pupa state usually lasts about six weeks, but its duration would be largely dependent upon temperature. The beetle, on emergence from the pupa, is soft and of a reddish colour, but, after a while, hardens and darkens.

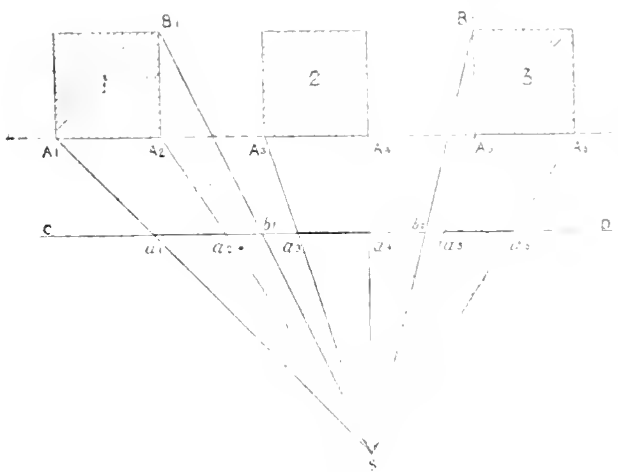
The query as to variation in size and growth of perfect insects will be found answered in KNOWLEDGE, No. 138, p. 450. Sex and differences in quality and quantity of food are the principal factors in producing differences in size. Amongst beetles, this variation is greatest in those that feed on solid wood. E. A. BUTLER.

7, Turle-road, Tollington-park, N.

TRUE AND FALSE PERSPECTIVE.

[1341]—A perspective drawing of an object may be defined as any section of a sheaf of rays of light proceeding from that object to a given point, at which the eye may be placed.

If the section be correctly made, the perspective drawing is absolutely true in all cases, and on the application of the eye to the apex (*i.e.*, the given point) of the sheaf of rays the representation on the section has precisely the appearance of the object; or if the representation be made opaque it will exactly hide the object from the eye. If we decide on making a vertical plane section of the sheaf of rays parallel to the face of the object, that decision becomes the governing element in the problem.



Ground Plan.

In the accompanying diagram 1, 2, 3 are ground plans of cubes. The spaces marked A1, A2; A3, A4; A5 and A6, are equal to each other; the sides A, B are also equal. To the point S lines are drawn from all the angles of the cubes, which would be seen on placing the eye at S. These lines may be called the leading lines of light from the objects to that point. The *section* line C, D is *parallel* to the *object*, as decided.

The spaces on the section line marked *a*1, *a*2; *a*3, *a*4; and *a*5, *a*6 are equal to each other in the section as they are in the objects. It is evident that on placing the eye at S the space at *a*1, *a*2 will exactly cover the space A1, A2. All the other spaces of the section will exactly cover all the corresponding spaces of the objects in like manner, and if we make them opaque they will hide the spaces of the ground-plan and *stand for them*.

What has been demonstrated of a ground plan is equally true of a vertical section. JOHN BACON.

STRANGE SKY EFFECTS IN NEW ZEALAND.

[1342]—I have just received a letter from a young niece in New Zealand, dated May 20. She writes from near Christchurch, Canterbury:—"We have been having the strangest weather lately, and such curious skies for some months past. The other morning, about 11 a.m., I looked out towards the east, and the sky was all golden and crimson as if it were sunset, as if the sun had made a mistake and was going to bed at the wrong time and in the wrong place. At night, we have the most lovely, rosy lights in the sky; but, beautiful as the skies are, and much as one admires them, they seem to give one a sort of uncanny feeling as if something were going to happen." COSMOPOLITAN.

LETTERS RECEIVED AND SHORT ANSWERS.

SENECA. If you are going to try to teach yourself French, probably the "French" in Prendergast's "Mastery Series" is as good a book as you can get.—FOREIGNER disagrees with Délille's classification of "mon," "ton," "son," with "le mien," "le tien," &c. —W. Thanks; marked for insertion.—EDWIN W. MORRIS and A. MACKAY. I regret to say that I have been compelled to relinquish lecturing entirely—at all events for a considerable time to come.—M. B. Obviously a misprint, the figures being transposed.—H. G. has found some earwigs in strawberries! Well, they are not pleasant to look upon; but, doubtless, in the words of the poem, they are "nourishing, very." W. C. B. demurs to the idea that a polluted river is necessarily unwholesome, as over and on the banks of one—"a mass of festering filth, chocolate in colour, molasses in consistency, and of stench simply indescribable"—many of his workpeople live hale and hearty, as did he and a large family for fifteen years. Moreover, twenty cows, always well and thriving, drink this filth in preference to pure spring water. Just so; *de gustibus non est disputandum!*—F. W. D. MITCHELL. Your pamphlet was reviewed on p. 36.—J. P. BOURNE sends me a "Handy Assurance Guide," consisting of a tabular mass of statistics having reference to ninety-five of the principal insurance offices in the kingdom. Intending assurers can gather the position and prospects of any one of them from it at a glance.—E. D. WAREING saw his own ghost in bright sunshine in 1882, and wants to know whether the comet of that year had a disturbing effect upon light? Unless comets make people light-headed, I should say, no. He further opines that the brain is affected by light, the heart by electricity, and the lungs by oxygen, and that the difference in the shape of light (!) would make the distinction between man and beast, &c. "I have written," says my correspondent, "all this very diffidently, feeling not quite sure whether you may not think it great nonsense." Which—in the most sacred confidence—I don't mind admitting to him that I do.—ARTHUR A. WEST. Having adopted my suggestion (on p. 16) as to drawing the outline of a cube placed behind, and with one face parallel to, a sheet of glass, finds that, under the prescribed conditions, "the top and bottom margins of the face are parallel." His two remaining figures I fail to understand, as one represents a sketch made "on glass facing the centre of the cube" (what is the *visible* centre of a cube?), and the other "on glass placed facing away from the cube." This is delightfully vague.—W. A. COOPER. You may turn the telescope you wish to test upon the following objects:—ζ Herculis, λ Ophiuchi, τ Ophiuchi, π Aquilæ, ψ Cygni, 49 Cygni (2° south-west of ε), δ Cygni, in twilight only. The ring Nebula between β and γ Libræ, and see if you can see the small star close to and to the east of it. The companion to Vega, ϵ^1 and ϵ^2 Lyræ, in connection with which try how many stars you can see between the two principal pairs. If the instrument resolves all these tests satisfactorily, buy it.—H. A. BULLEY. When "F.R.A.S." speaks of a planet as "visible," he means visible for the purpose of the observer with the telescope. Perhaps you will kindly look at Mars (subtending, as his diameter now does, an angle of less than 6″), and tell us how much detail is visible on his surface, and in what material respect—saving in the exhibition of a rather larger disc—his aspect differs from that of Antares. Mercury is a totally different object, because he is essentially a daylight star, and, under your supposititious conditions, would exhibit phases.—H. G. S. It is quite news to me that the erratic genius to whom you refer was an excellent mathematician. But even assuming this to be true, with my present tremendous amount of preoccupation, I certainly cannot spare the time to expose the fallacy of a mere assertion of his, so transparently erroneous, and, moreover, unsupported by the slightest attempt at demonstration.—M. R. Do you seriously expect me to wearily puzzle out the numerical value of 55 figures in succession, with the thermometer standing at 84·4 Fahr. in the shade?—ALFRED EDWARD HUNT. Everybody upon the earth, *ex necessitate*, partakes of the earth's motion, which affects it utterly irrespective of any other motion that may be impressed upon or imparted to it. The next time you are in a railway train going 50 miles an hour, drop any object from a point immediately beneath the lamp-glass, and you will find that it will fall vertically beneath that glass on the floor of the carriage, although the carriage has meanwhile moved perceptibly forward. Read Tomlinson's "Rudimentary Mechanics" in Weale's Series.—J. A. R. Have I not said, over and over again, that I must rigidly exclude theology from these columns? If I admit such a letter as yours, and (say) Dr. Aveling or Mr. Bradlaugh were to reply to it, upon what principle of justice could I refuse to insert their answers?—R. JONES, having made the experiment suggested on page 16, and finding the result in entire accordance with the views he previously advanced, offers to forward a proof of the truth of them to Rosalie Vansittart and "An Old Draughtsman" privately, should that lady and gentleman desire it.—An Old Draughtsman. Scarcely relevant to the general subject.—John Bacon. With the excisions rendered imperative by the wholly needless length of your letter, it has been marked for insertion. Thanks for your offer of an article; but original matter is provided for some time to come. Besides, you must pardon me for saying that you have yet to learn the art of writing briefly and to the point only.—Jos. Lucas and Son. I strongly urge you not to part with anything to the person you name, who is certainly an impostor. No member of our staff would be suffered (or, in fact, would condescend) to accept goods, that favourable notices of them might appear in the pages of Knowledge.—E. B. G. McDougall. Thanks, but none such of any importance reach me.—W. J. C. suggests that the experiment should be tried of artificially extending the wings of a dead bird and attempting to fly it like a boy's kite.—Maude Le Baille describes, at wholly inordinate length, how she succeeded in teaching a little girl to read who had previously defied the efforts of three or four governesses. Briefly she did so by first teaching her to write. The child was allowed to draw on her slate, as well as form letters and figures, the letters being later on combined into monosyllabic words. At this stage, to her own surprise, she found herself capable of reading a page of "Mamma's Lessons." No one but an editor would believe that this is told on nine pages and a half (!) of exercise paper.—William Singer. As is so perpetually the case with correspondents, the length of your letter forbids its appearance.—Jas. Stanley Little intimates that the reviewer of his book (on p. 12) was in error in supposing him (Mr. L.) to be an artist. He has never attempted to produce even the simplest drawing since he left school.—St. E. There are but few works on "animal"—as contradistinguished from human—physiology. Probably Shea's "Manual of Animal Physiology," published by Churchills, would be as good a book as you could obtain.—Rev. S. B. Handley, and many other correspondents. As stated in my reply to Messrs. Morris and Mackay above, I have entirely ceased lecturing. Should I ever resume it, due notice will be given.—G. C. I should be very sorry to sleep myself, and assuredly would not suffer a child of mine to sleep, in a bedstead placed in the position indicated in your diagram during a heavy thunderstorm.—P. Macleod Yearsley sends an anecdote of a dog which, finding a piece of meat larger than it could eat, went to the very top of the house to fetch a lady down to cut it up.—Wm. Wilson, M.A., LL.D. Your difficulty seems to arise from the omission by Colenso of the word "whole" before number. Other writers on arithmetic add this word. Of course, in one sense any number, whole or fractional, which divides two or more whole numbers exactly, is a common measure of them, and would be rightly so described.—The Secretary of the National Smoke Abatement Institution. I regret that absence from London prevented my attendance.—E. C. R. Atmospheric electricity presents to a great extent still an unsolved problem. It is, however, safe to assume that the electric force, which would otherwise cause a dispersion of the cloud particles, is feebler than the other forms of force which cause and maintain a condensation of the originally charged attenuated vapour particles. When the cloud charge attains a high potential, it doubtless experiences a strong tendency to approach the oppositely-charged earth surface bodily. The intervention of the air prevents this, and acting with the electrical attractions, the cloud is broken up. Probably the attraction exerted by the opposite charge on the earth prevents the breaking of the clouds in those higher regions where, under ordinary circumstances, the discharge of rain would commence, and eventually the drops assume larger dimensions.—R. G. T. Madame Blavatzky's trick of causing a bell to sound in the air may be bought at Hamley's, the Noah's Ark, Holborn; Bland's, New Oxford-street, or at any good shop where conjuring apparatus is sold; under the title "Is your Watch a Repeater?"—Norwich. Many thanks for your kind and friendly letter. Gossip has been rather crowded out for a week or two. —Thos. Maclean. Believe me, I was *not* indebted to your suggestion for the idea of the gyroscope. It has been a familiar one to me long enough. Alex. Gustafson sends me a little pamphlet on the "Medicine Stamp Tax," which well illustrates the evils arising from the quasi-Government sanction given to all sorts of quack remedies.

In reply to numerous letters and communications addressed to the office of Knowledge, *its Editor begs to announce that he has now concluded his Lecturing Tour, and has, in fact, definitely ceased to lecture altogether. Should he (which is very doubtful) at any future time resume his lectures on Astronomy, due and ample notice will be given of such resumption in these columns.*

Our Mathematical Column.

EASY LESSONS IN CO-ORDINATE GEOMETRY.

By Richard A. Proctor.

(*Continued from p. 19.*)

We shall now present two forms of the equation to a straight line which are often found useful.

52. Prop.—*To find the equation to the straight line in terms of the perpendicular let fall from the pole upon the straight line, and the angle which this perpendicular makes with the axis of x.*

We have already seen (45) that the polar equation to the straight line in terms of p the perpendicular from the pole on the line and α the angle which this perpendicular makes with the initial line, is

$$r \cos (\theta - \alpha) = p \quad \text{(i)}$$

that is

$$r \cos \theta \cos \alpha + r \sin \theta \sin \alpha = p$$

but transforming to rectilinear co-ordinates we have

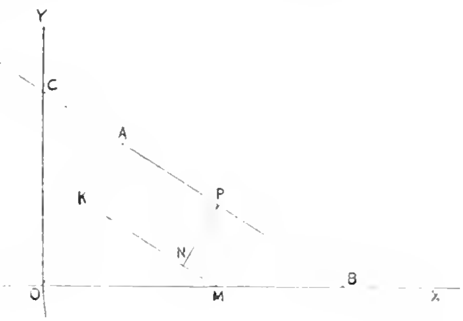
$$r \cos \theta = x \text{ and } r \sin \theta = y$$

thus (i) becomes

$$x \cos \alpha + y \sin \alpha = p$$

the required equation.

53. On account of the importance of this form of the equation to a straight line we add an independent investigation.



Let C A B be a straight line on which the perpendicular O A is let fall from O. Suppose $OA = p$, and $\angle AOB = \alpha$. From P any point in C B draw P M perpendicular to O X, and draw M K parallel to B C, and P N parallel to A K—that is, perpendicular to K M. Then

$$OA = OK + KA = OK + PN = OM \cos \alpha + PM \sin \alpha;$$

that is

$$x \cos \alpha + y \sin \alpha = p,$$

as before.

54. As an illustration of the mode of obtaining any one form of the equation to a straight line from another form, we shall show how the equation just obtained may be deduced from the equation

$$\frac{x}{a} + \frac{y}{b} = 1 \quad \text{(i)}$$

in terms of the intercepts a and b.

In 53 (using the same figure) and

$$a = OB = p \sec \alpha \text{; and } b = OC = p \operatorname{cosec} \alpha;$$

substituting these values in (i) we get

$$\frac{x}{p \sec \alpha} + \frac{y}{p \operatorname{cosec} \alpha} = 1$$

that is

$$x \cos \alpha + y \sin \alpha = p,$$

as before.

55. *Note.* It is necessary that the student should carefully observe in what manner equations of the form just obtained are to be interpreted. And first of the perpendicular p and the angle α, it is to be noted that a positive distance p is to be measured along a line inclined to OX at an angle α (measured as described in former articles. The required line is then to be drawn at right angles to the line thus obtained, through its extremity. Thus in the equation

$$x \cos \alpha + y \sin \alpha - p = 0$$

p is invariably a positive quantity.

56. To put the general equation

$$Ax + By + C = 0 \quad \text{(i)}$$

into the form just obtained, proceed as follows:—Divide each term by $\sqrt{A^2 + B^2}$ giving that sign to the radical which will make the constant term C negative. Thus (i) becomes

$$\frac{A}{\sqrt{A^2+B^2}} + \frac{By}{\sqrt{A^2+B^2}} + \frac{C}{\sqrt{A^2+B^2}} = 0$$

in which the last term is negative. This is of the required form since

$$\left(\frac{A}{\sqrt{A^2+B^2}}\right)^2 + \frac{B}{\sqrt{A^2+B^2}}^2 = 1$$

57.—The student will find it a useful exercise to transpose an equation to a fixed, straight line into the different forms we have been examining. He will find that when proper attention is paid to the directions in which lines and angles are measured, no difficulty can occur in interpreting the constants which appear in different forms of the equation. On one point comment is necessary. The angle which a straight line makes with either axis is not necessarily the acute angle between the line and that axis. Thus the line B C (B on O X, C on O Y) makes with O X is not the angle C B O but the angle C B X, since this is the angle through which a line coincident with O X would have to revolve in the positive direction, about the point B, to become coincident with C B. We might also say that the line C B is inclined to O X at a negative angle C B O, or at a positive angle π + C B X, or 2π + C B X, or in fine, generally, at an angle $n\pi$ + C B X where n is any integer positive or negative. This would in no way affect the interpretation of the particular equation involving this angle, that is of the equation

$$y = m\,x + c$$

where m is the tangent of the angle we are considering; since we learn from trigonometry that $\tan a = \tan(n\pi + a)$ whatever integral value n may have.

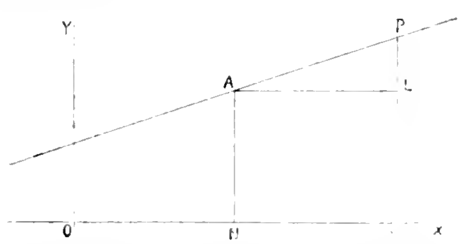
58. In Figure 53, ∠ A O B = ∠ C B X − ∠ O A B; that is the angle a in the equation

$$x \cos a + y \sin a = p$$

is less by one right angle than the angle at which the line it represents is inclined to the axis of x. Proper consideration of the directions in which angles are measured will show that this relation must always subsist. Thus since the general expression for the angles at which a line is inclined to the axis of x is $(n\pi + \iota)$ the corresponding general expression for the angle at which the perpendicular upon the line is inclined to the axis of x, is

$$n\pi + \left(\iota - \frac{\pi}{2}\right), = \text{that is } \frac{(2n-1)\pi}{2} + \iota.$$

59.—PROP. *To find the equation to a straight line in terms of the co-ordinates of a point on the line, and of the angle at which the line is inclined to the axis of x.*



Let A P be a straight line, passing through a point A whose co-ordinates are h, k. Let a be the angle at which A P is inclined to O X. Draw P M, A N parallel to O Y, A L parallel to O X. Then

$$\frac{PL}{AL} = \tan a.$$

that is

$$\frac{y-k}{x-h} = \tan a. \qquad \text{(i.)}$$

the required equation.

It may be noted that (i.) is clearly the equation obtained from the form $\frac{y}{x} = m$ of 30, by transformation of co-ordinates.

Equation (i) may be written into the form.

$$\frac{y-k}{\sin a} = \frac{x-h}{\cos a} \qquad \text{(ii)}$$

and since $\frac{PL}{AP} = \sin. a$, we have, putting A P $= r$

$$\frac{y-k}{\sin a} = r = \frac{x-h}{\cos a}$$

a mode of writing the equation which is often found convenient in practice.

60. OBLIQUE CO-ORDINATES.—The equations of forms considered in 57 to 59 can be readily obtained for oblique axes. Thus, if we suppose ∠ X O Y = ω and ∠ A O C ($= \omega - a$) $= \beta$ it would follow, as in 44, that

$$O A = O K + P N = O M \cos a + P M \cos \beta$$

that is

$$\cos a + \cos \beta \quad p$$

the required equation, in which $\beta = \omega - a$.

In place of equation (i) of 59 we should clearly obtain

$$\frac{y-k}{x-h} = \frac{\sin a}{(\sin \omega - a)}$$

which may be written

$$\frac{y-k}{\sin a} = r = \frac{x-h}{\sin(\omega - a)}$$

(*To be continued*).

EASY RIDERS ON EUCLID'S FIRST BOOK.

WITH SUGGESTIONS.

(*Continued from p. 41.*)

174 In the parallelogram A B C D, the angle A D B is equal to one-third part of the angle A E B; also A C and B D intersect at an angle equal to one-third part of two right angles. Show that one of the diagonals is at right angles to opposite sides of the parallelogram.

175. If the angle between two adjacent sides of a parallelogram be increased, while their lengths remain unchanged the diagonal through the point of intersection will be diminished.

176. If two opposite sides of a parallelogram be bisected, the lines drawn from the points of bisection to the opposite sides trisect the diagonal.

177. If A B a side of the parallelogram A B C D be divided into n equal parts, show that a line drawn from C to the division point nearest to B cuts off from the diagonal B D one $(n+1)$th part,—measured from B.

Take for n any convenient number—say 7. Divide A B and C D into 7 equal parts, and join C with the division nearest to B, the division nearest to C with the next division from B and so on. It will then be easy, in the manner of the preceding example, to show that any one of the 8 parts into which the diagonal is thus divided is equal to any other part—or, in other words, that the diagonal is divided into 8 equal parts.

178. In the straight line A B C, A B is equal to B C. Show that perpendiculars drawn from the points A, B, and C upon any straight line meet it in equi-distant points.

(i.) When the line passes between A and C.

(ii.) When the line does not pass between A and C.

179. In case (ii.) of Example 178, show that the perpendicular from A and C are together double of the perpendicular from B.

180. In case (i.) of Example 178, show that the difference of the perpendiculars from A and C is double of the perpendicular from B.

181. If straight lines be drawn from the angles of any parallelogram perpendicular to a straight line which is outside the parallelogram, the sum of those from one pair of opposite angles is equal to the sum of those from the other pair of opposite angles.

182 Determine a point in the base of a triangle from which lines drawn parallel to the sides, to meet them, are equal.

183. If an hexagonal figure admits of division into three parallelograms each pair of opposite sides are equal and parallel.

Show that in general such an hexagonal figure admits of being divided into three parallelograms in two different ways.

184. If each pair of opposite sides of a hexagon are parallel, and one pair equal, the other pairs are also equal.

185. If each pair of opposite sides of a hexagon be equal and parallel, the three straight lines joining opposite angles will meet in a point.

186. If each pair of opposite sides of a rectilinear figure having an even number of sides be equal and parallel, all the lines joining opposite angles meet in a point.

187. Describe a rhombus within a given parallelogram, so that one of the angular points may occupy a given point on the perimeter of the parallelogram.

188. Describe a rectangle within a given parallelogram, so that one of the angular points may occupy a given point on the perimeter of the parallelogram.

In examples 187 and 189 it suffices that the angles of the constructed figures should lie on the sides or the sides produced of the parallelogram. Previous examples show the relations which hold when a parallelogram is a rhombus or rectangular, and these will be found sufficient for the solution of Examples 187 and 189.

189. The three sides of a triangle are together less than the three lines drawn from the angles to the bisections of the opposite sides.

Complete a parallelogram having two sides of the triangle as adjacent sides. Then show that these sides are together greater than the diagonal which passes through the bisection of the base, &c.

Our Chess Column.

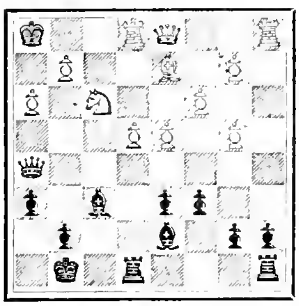
By Mephisto.

PLAYED July 9 in the Handicap at the Divan. Remove Black's King's Bishop's Pawn.

White. Mundell.	Black. Gunsberg.	White. Mundell.	Black. Gunsberg.
1. P to K4	P to Q3	26. Kt to Q3	B × P
2. B to B4 (a)	Kt to KB3	27. P to KKt4	Q to B3
3. Kt to QB3	P to K4	28. R to K3 (i)	B to B2 (j)
4. P to Q3	Kt to B3	29. Q to K2	B to Kt3
5. B to Kt3	Kt to Q5	30. R to KB sq.	B to K5 (ch)
6. QKt to K2 (b)	Kt × B	31. K to R2 (k)	R to KB sq.
7. RP × Kt	B to K2	32. R to B2 (l)	B × Kt (m)
8. P to KB4	P × P	33. R × B	B to Q3
9. Kt × P	Castles	34. R (Q3) to B3	B × B
10. Kt to B3	P to B3	35. R × B	Q to Q3
11. Castles	P to KR3	36. Q to K5	Q × Q
12. B to K3 (c)	Kt to Kt5	37. P × Q	R × R
13. B to Q2	B to B3	38. R × R	R to K sq.
14. P to Q4	Q to Kt3	39. R to B3	P to Kt3
15. P to B3	R to K sq.	40. R to B6	K to Kt2
16. R to K sq.	B to Q2	41. R to Q6	K to B2 (n)
17. Kt to R5 (d)	B to K2		
18. P to R3	Kt to B3		
19. Kt × Kt	B × Kt		
20. K to R sq.	Q to Kt4		
21. P to QKt4	Q to KR4 (e)		

Position after Black's 21st move.

White.

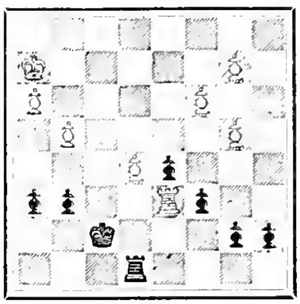


Black.

22. B to B4	B to K2 (f)
23. P to K5	P to Q4
24. P to K6 (g)	QB to B sq.
25. Kt to K5 (h)	Q to B4

Position after Black's 41st move.

White.



Black.

42. R to Q7(ch)(o)	R to K2
43. R × R	K × R
44. P to KKt5 (p)	P to KR4 (q)
45. K to Kt3	K to K3
46. K to B4	P to Kt3
47. P to Kt3	P to R3
48. P to B4	P × P
49. P × P (r)	P to R4
50. P to B5	Resigns (s)

NOTES.

(a) This can hardly be considered as good as 2. P to Q4.

(b) To disengage his Queen's side, and make both Knight's available for attack on the K's side.

(c) This move gives Black time to develope his pieces.

(d) If P to R3, then Kt to K4. Black has brought his pieces well into play.

(e) A very useful flank movement. The Queen now occupies a good position.

(f) With a view to playing R to B sq., which might give a chance for B × RP.

(g) Although tempting, this is weak, as the P will sooner or later be captured.

(h) If Black plays Q × Q. 26. QR × Q, B × P. 27. Kt × P.

(i) To guard against Q to R5, also to double his Rook on the K's file.

(j) To bring the B into good play.

(k) K to Kt sq. was the proper move.

(l) To guard against P to KKt4.

(m) Black now brings about the exchange of four pieces, remaining with a superior end position.

(n) If R × P White could equalise the game by playing R to Q7 (ch), followed by R × P and R to B7, &c.

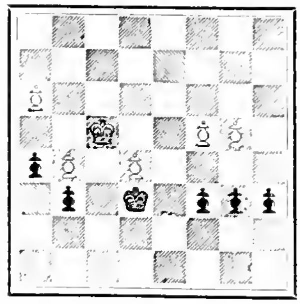
(o) This is playing Black's game. White ought to have played R to B6 (ch), driving the K back again.

(p) A good move. It would be dangerous to take, as by K to Kt3 and Kt4 White would gain a decisive advantage.

(q) Now, of course, the game is virtually over, as White has but the one square on B4 to defend his KP, and when short of a move he will have to move his K.

(r) Now comes the most extraordinary part of the game, which should serve as a warning that a game is never won until checkmate is given. By playing P to B4 Black wins, as the Rook's Pawn becomes free to advance whether White replies with P × P or P to Kt5. Instead of winning the game on the move Black lost it on the move by hastily advancing the wrong Pawn without examining the consequences. Besides losing the well-earned victory in a hard fought game, Black loses all chance to play for first and second prize, although this is the only game lost out of eight games played.

White.



Black.

(s) The game is not to be saved if Black plays P to R5 then P × P, P to R6. P to Kt7 (it would be quite useless to play the K on account of P to K6) P to R7. P to Kt8 (Q), P to R8 (Q). Q to Q6 (ch), K to B2. P to K6 (ch), K to Kt sq. Q to Kt8 (ch), K to R2. Q to B7 (ch), K to Kt sq. Q to B7 (ch), K to R sq. Q to B6 (ch) and wins.

SOLUTION OF PROBLEM, p. 490.

1. Q to K4 (threatening Kt to Kt3(ch) and Kt to Q7 mate)	1. Kt to KB3(best)
2. Q to Kt4	2. Any.
3. Kt mates accordingly.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions received from C. T. Grey and Eugene Hamburger.

Paired for correspondence play, Senex v. Clarence.

The Diamond Beds of Brazil.—The diamond beds of Bahia and Minas Géraës, in Brazil, are very similar in character as regards the minerals composing them and their plateau form, or situation on watercourses. A new bed has been recently opened on the Rio Pardo in Bahia, which presents some differences to those hitherto known in Brazil. The country around is low and marshy, and covered with forests. The working of these forests has led to the discovery of the diamonds, which are found in a white clay along with beds of decomposed leaves. The deposit appears of modern formation. The minerals of the clay accompanying the diamond are, according to M. Gorceux, quartz, silex, monazite, zircon, disthene, staurotede, grenat almandine, corindon, and some oxides of iron. There are no oxides of titanium, or tourmalines, as is frequently the case in diamond beds. The clay appears to be from its character and situation the *débris* of the granite mountains bordering on the Bahia coasts.—*Engineering.*

Contents of No. 141.

SPECIAL NOTICE.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, JULY 25, 1884.

CONTENTS OF NO. 143.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By EDWARD CLODD.

V.

THE confusion in the barbaric mind between the objective and the subjective, and between the name and the person or thing, which has been illustrated in the foregoing chapters, will enable us to see more clearly how the like confusion must enter into the interpretation of such occult and compound phenomena as dreams, and all their kind.

They supply the conditions for exciting and sustaining that feeling of mystery which attends man's endeavour to get at the meaning of his surroundings. The phantasies which have defiled through the brain in coherent order, or danced in mazy whirl about its sinuous passages when complete sleep was lacking, leave their footprints on the memory, and they are strong of head and heart, true pepticians, like the countryman cited by Carlyle, who, "for his part, had no system," whose composure on awaking is not affected by the harmonious or discordant, the pleasant or disagreeable illusions which have made up their dreams. In the felicitous words of Lucretius, "when sleep has chained down our limbs in sweet slumber, and the whole body is sunk in profound repose, yet then we seem to ourselves to be awake and to be moving our limbs, and amid the thick darkness of night we think we see the sun and the daylight; and though in a confined room, we seem to be passing to new climates, seas, rivers, mountains, and to be crossing plains on foot, and to hear voices, though the austere silence of night prevails all round, and to be uttering speech, though quite silent. Many are the other things of this marvellous sort we see, which all seek to shake, as it were, the credit of the senses: quite in vain, since the greatest part of these cases cheat us on account of the mental suppositions which we add of ourselves, taking those things as seen which have not been seen by the senses. For nothing is harder than to separate manifest facts from doubtful, which the mind without hesitation adds on of itself."*

* *De rerum Natura*, B. IV. ll. 453-468.

While for us dreams fill an empty moment in the telling, albeit now and again nurturing such remains of superstition as cling to the majority of people, they are to the untrained intelligence, unable to distinguish fact from fiction, or to follow any sequence of ideas, as solid as the experiences of waking moments. As a Zulu, well expressing the limits of savage thought, said to Bishop Callanay, "Our knowledge does not urge us to search out the roots of it, we do not try to see them, if anyone thinks ever so little, he soon gives it up, and passes on to what he sees with his eyes; and he does not understand the real state of even what he sees." Nor does his language clear the confusion within when he tells what he has seen and heard and felt, where he has been and what he has done, for the speech cannot transcend the thought, and therefore can represent neither to himself nor to his hearers the difference between the illusions of the night and the realities of the day. The dead relatives and friends who appear in dreams and live their old life, with whom he joins in the battle, the chase, and the feast, the foes with whom he struggles, the wild beasts from whom he flees, or in whose clutches he feels himself, and with shrieks awakens his squaw, the long distances he travels to sunnier climes lit by a light that never was on land or sea, are all real, and no "baseless fabric of a vision." That now and again he should have walked in his sleep, would confirm the seeming reality; still more so would the intensified form of dreaming called "nightmare," (or night-spirit) when hideous spectres sit upon the breast, stopping breath and paralysing motion, and to which is largely due the creation of the vast army of nocturnal demons that fill the folk-lore of the world, and that, under infinite variety of repellent form, have had place in the hierarchy of religions.

Dreams are in the main referred by the savage either to the entrance into him of some outside spirit—as among the Fijians, who believe that the spirit of a living man will leave the body to trouble sleeping folk—or to the real doings of himself.

When the Greenlander dreams of hunting, or fishing, or courting, he believes that the soul quits the body; the Dyaks of Borneo think that during sleep the soul sometimes remains in the body or travels far away, being endowed, whether present or absent, with conditions which in waking moments are lacking. Wherever we find a low state of mental development the like belief exists. In Mr. im Thurn's elaborate work on the Indians of Guiana, already reviewed in this journal, we have corroborative evidence, the more valuable because of its freshness. He tells us that the dreams which come to the Indian are to him as real as any of the events of his waking life. To him dream-acts and waking acts differ only in one respect—namely, that the former are done only by the spirit, the latter are done by the spirit in its body. Seeing other men asleep, and afterwards hearing from them the things which they suppose themselves to have done when asleep, the Indian has no difficulty in reconciling that which he hears with the fact that the bodies of the sleepers were in his sight and motionless throughout the time of supposed action, because he never question that the spirits, leaving the sleepers, played their part in dream-adventures. Mr. im Thurn illustrates the complete belief of the Indian in the unbroken continuity of his dream life and waking-life by incidents which came under his own notice, and which are quoted as serving the argument of this paper better than any theorising.

"One morning when it was important to me to get away from a camp on the Essequibo River, at which I had been detained for some days by the illness of some of my Indian companions, I found that one of the invalids, a young

Macusi, though better in health, was so enraged against me that he refused to stir, for he declared that, with great want of consideration for his weak health, I had taken him out during the night and had made him haul the canoe up a series of difficult cataracts. Nothing could persuade him that this was but a dream, and it was some time before he was so far pacified as to throw himself sulkily into the bottom of the canoe. At that time we were all suffering from a great scarcity of food, and, hunger having its usual effect in producing vivid dreams, similar events frequently occurred. More than once, the men declared in the morning that some absent man, whom they named, had come during the night, and had beaten, or otherwise maltreated them; and they insisted on much rubbing of the bruised parts of their bodies. Another instance was amusing. In the middle of one night I was awakened by an Arawak named Sam, the captain or head-man of the Indians who were with me, only to be told the bewildering words, 'George speak me very bad, boss; you cut his bits!' It was some time before I could collect my senses sufficiently to remember that 'bits,' or fourpenny-pieces, are the units in which, among Creoles and semi-civilised Indians, calculation of money, and consequently of wages, is made; that to cut bits means to reduce the number of bits, or wages, given; and to understand that Captain Sam, having dreamed that his subordinate George had spoken insolently to him, the former, with a fine sense of the dignity of his office, now insisted that the culprit should be punished in real life. One more incident, of which the same Sam was the hero, may be told for the sake of the humour, though it did not happen within my personal experience, but was told me by a friend. This friend, in whose employ Sam was at the time, told his man, as they sat round the fire one night, of the Zulu or some other African war which was then in progress, and in so doing inadvertently made frequent use of the expression, 'to punish the niggers.' That night, after all in camp had been asleep for some time, they were raised by loud cries for help. Sam, who was one of the most powerful Indians I ever saw, was 'punishing a nigger' who happened to be one of the party; with one hand he had firmly grasped the back of the breeches-band of the black man, and had twisted this round so tightly that the poor wretch was almost cut in two. Sam sturdily maintained that he had received orders from his master for this outrageous conduct, and on inquiry, it turned out that he had dreamed this."*

Taking an illustration from nearer home, although from a more remote time, we have in the Scandinavian Vatnsdæla Saga a curious account of three Finns who were shut up in a hut for three nights, and ordered by Ingimund, a Norwegian chief, to visit Iceland, and inform him of the line of the country where he was to settle. Their bodies became rigid, and they sent their souls on their errand, and, on their awaking at the end of three days, gave an accurate account of the Vatnsdal, in which Ingimund ultimately dwelt. No wonder that in mediæval times, when witches swept the air and harried the cattle, swooning and other forms of insensibility were adduced in support of the theory of soul-absence, or that we find among savages—as the Tajals of the Luzon islands—objections to waking a sleeper lest the soul happens to be out of the body. As a corollary to this belief in soul-absence, fear arises lest it be prolonged to the peril of the owner, and hence a rough and ready theory of the cause of disease is framed, for savages rarely die in their beds.

That disease is a derangement of functions interrupting their natural action, and carrying attendant pain as its indication, could not enter the head of the uncivilised; and, indeed, among ourselves a cold or a fever is commonly thought of as an entity in the body which has stolen in, and, having been caught, must be somehow expelled. With the universal primitive belief in spiritual agencies everywhere inhaled with the breath or swallowed with the food or drink, all diseases were regarded as their work, whether, as remarked above, through undue absence of the rightful spirit or subtle entrance of some hostile one. If these be the causes to which sicknesses are due, obviously the only cure is to get rid of them, and hence the sorcerer and the medicine-man find their services in request in casting out the demon by force, or enticing him by cajolery, or in bringing back the truant soul.

* "Among the Indians of Guiana," pp. 344-346.

THE ANTARCTIC REGIONS.

By Richard A. Proctor.

(Continued from p. 56.)

If we consider the nature of the Antarctic Seas, and particularly the circumstance that the Antarctic summer is far colder than the Arctic summer, it will appear most probable that within the Antarctic regions land and water are so distributed that, while the shore-lines are of great extent, there is very free communication with the open Antarctic Ocean. In other words, it seems reasonable to conclude that there are many large islands within the Antarctic circle, that these islands are separated from each other by wide passages, and not by straits readily blocked up and encumbered with ice in such sort as to impede the outward passage of the great icebergs. And nothing which has been ascertained by Antarctic voyagers is opposed to this conclusion. It is, indeed, very easy to fall into the mistake of inferring otherwise from the study of an ordinary chart of the Antarctic seas. If, for example, we look at the chart in Maury's "Physical Geography of the Sea," we are apt to imagine that the boundary line indicating the limits of Antarctic explorations points to the existence of a continuous barrier of ice, the advanced line of defence, as it were, behind which lies as continuous a barrier of precipitous shore-line. But a very slight study of the records of Antarctic voyages will suffice to show how erroneous is such an impression. We find that long before coast-lines have been seen, the hardy voyagers have found themselves impeded and often surrounded by masses of floating ice. Wilkes, Ross, and D'Urville, when struggling to advance towards the southern pole, were repeatedly compelled to retreat without seeing any signs of land. Land has not been seen, indeed, along more than one-sixth part of the circuit of the Antarctic barrier, and it has only been in the neighbourhood of Victoria Land that a continuous coast-line of any considerable extent has been discovered. Wherever land has been seen, it has been mountainous and rugged—a circumstance which suggests great irregularity of outline in the land-regions, and the high probability that these regions are broken up into islands resembling those in the north-polar seas.

Certainly, there is much in what has been learned or may be inferred respecting the Antarctic regions, to suggest the wish that further explorations may one day be undertaken. When we consider what has been done with sailing-ships, it seems by no means unlikely that with steam-ships suitably constructed the Antarctic seas might be successfully explored. I would not encourage the idle ambition to penetrate so many miles farther southward than has hitherto been found practicable. But there are many and legitimate considerations in favour of further exploration. "Within the periphery of the Antarctic circle," says Captain Maury, "is included an area equal in extent to one-sixth part of the entire land surface of our planet. Most of this immense area is as unknown to the inhabitants of the earth as the interior of one of Jupiter's satellites. With the appliances of steam to aid us, with the lights of science to guide us, it would be a reproach to the world to permit such a large portion of its surface any longer to remain unexplored. For the last 200 years. the Arctic Ocean has been a theatre for exploration; but as for the Antarctic, no expedition has attempted to make any persistent exploration, or even to winter there. England, through Cook and Ross; Russia, through Billingshausen; France, through D'Urville; and the United States, through Wilkes, have sent expeditions to the South Sea. They sighted and sailed along the icy barrier, but none of them spent the winter, or essayed to travel across and look beyond the first impediment. The expeditions which have been sent to explore unknown seas have contributed largely to the stock of human knowledge, and they have added renown to nations, lustre to diadems. Navies are not all for war. Peace has its conquests, science its glories; and no navy can boast of brighter honours than those which have been gathered in the fields of geographical exploration or physical research."

It does not appear that Antarctic voyages would be attended with any excessive degree of danger. No ship has hitherto been lost, I believe, in explorations beyond the Antarctic circle. It may be said, indeed, that such attempts are rather arduous than dangerous. It may even be found that the Antarctic barriers are impenetrable, but this has certainly not as yet been demonstrated. And it is far from being improbable that, if success could be achieved, an important field of commercial enterprise would be opened. The Antarctic regions are not mere desert wastes. The seamen under Ross found Possession Island covered by penguins standing in ranks like soldiers, and too little familiar with the ways of man to attempt escape. More valuable animals live and thrive, however, in Antarctic seas. Whales and seals exist there in abundance, and, as Captain Maury has well remarked, "of all the industrial pursuits of the sea, the whale fishery is the most valuable." In Arctic fisheries, he tells us, three thousand American vessels are engaged, and "if to these we add the Dutch, French, and English, we shall have a grand total of perhaps not less than six or eight thousand, of all sizes and flags, engaged in this one pursuit." There are reasons for believing that whale-fisheries in Antarctic regions would afford a richer, as they would certainly afford a far wider, field for maritime enterprise.

SENSATION IN A SEVERED HEAD.

DURING the murderous horrors of the great Revolution stories were current of heads retaining consciousness and sensibility after the guillotine had separated them from the bodies of the victims, and it has been a question of interest to physiologists and philanthropists how soon absolute death supervenes upon decapitation. A curious case is mentioned in our issue for June 27, but later observations and experiments have been published.

On the 30th April last, a criminal, whose real name was not revealed, but who went under that of Campi, was executed in Paris, and arrangements were made by M. Laborde to experiment with his remains. A curious custom prevented the doctor from receiving his subject until a funeral service had been performed at a cemetery, and thus an hour and twenty minutes elapsed between the fall of the knife and the beginning of the experiments, of which a full account will be found in the *Revue Scientifique* for the 21st of June. While assistants were connecting the carotid artery of a dog with the severed artery of the head in order to supply it with the stimulus of freshly-circulating blood, M. Laborde endeavoured to excite the spinal marrow by electric shocks, but without effect, whether he operated upon the portion connected with the trunk, or upon that of the head. The muscular system responded to the electric excitation, but the nervous system was impassive—it had become totally and irrecoverably insensible an hour and a half after the decapitation. M. Laborde's conclusion was that "the nervous tissue in general is the first to lose its power when the circulation is stopped, and that the head is the first part of it to be dispossessed of its functions.' "In order," he said, "to restore to this organ perception and consciousness, it would be necessary not only to replace experimentally its conditions of circulation, but to do so as quickly as possible, before there was time for a definite and irremediable loss of functional power."

But, however interesting to science, both humanity and morality would be shocked if any wretched victim of the law were recalled to even momentary life and suffering.

The failure of the experiments with Campi led to an abominable trial with a dog, subjected to decapitation and transfusion of blood. when the animal is reported to have recognised a familiar voice by a smiling motion of its mouth. More lately, M. Petitgand has contributed to these inquiries observations he made in 1875, when witnessing the execution of an Annamite at Saigon. According to his account in the *Revue Scientifique* for July 5, the execution took place on the sandy Plain of the Tombs, the cemetery for the Annamites and Chinese. Four pirates, captured in arms, were the sufferers. Their chief was a strong man in the prime of life, and meeting his fate with calm courage, the doctor determined to keep his eyes fixed upon him. According to the local mode of execution, the prisoner has his hands tied behind him and fastened to a post. He has then to kneel down and bend his head, so as to stretch the intervertebral substance as much as possible, and if the victim shrinks, an assistant holds him in the right position by his long hair. In this case no such aid was required. The executioner marked the spot he wished to strike with betel juice, and then, with the sweep of a long, broad, and thin sabre, effected his business at one stroke. M. Petitgand remarks that, when decapitation is skilfully performed in this manner, there is no contusion of the spinal marrow, which occurs with the guillotine, unless it happens to cut neatly through an intervertebral disk. When the head is roughly severed, as in Campi's case, he supposes the shock so stupefies the nervous centres as to render any subsequent manifestation of function of the brain quite impossible.

In the Annam case he did not for an instant lose sight of the condemned man, but addressed some words concerning him to the officer superintending the execution, in a loud voice. He noticed, also, that the patient examined him with the most lively attention. When the preparations were finished, the doctor retired a couple of mètres, and the victim, before bowing his head, exchanged glances with him. The head fell less than two mètres from him, and did not roll as usual, but stood upright on the sand, which reduced the hæmorrhage to a minimum. "At this moment," exclaims the doctor, "I was alarmed to see the eyes of the victim fixed upon mine. Hesitating to believe this a manifestation of consciousness, I moved quickly in a quarter-circle round the head, and I can affirm that the eyes followed me. I then returned to my first position, moving more slowly. The eyes still followed for a very brief moment, and then suddenly left me. The face, at this instant, expressed manifest anguish—the poignant agony of a person suffering acute asphyxia. The mouth opened visibly, as if struggling for air; the head then lost its balance and rolled on one side, the contraction of the maxillary muscles being the last sign of life. From fifteen to twenty seconds had expired."

M. Petitgand considers that when a head is separated from a body, and the loss of blood does not exceed certain limits, and it contains sufficient oxygen to stimulate the nervous function, sensation may last for possibly half a minute. Thus, in certain cases, beheading may be a barbarous punishment, and "the patient may be conscious some time after his execution; but, in a great majority of cases, fears of such a survival are chimerical. It is almost impossible that the vertebral column, struck obliquely by the knife of the guillotine, should not occasion a shock sufficient to suspend all the cerebral functions." In the case of the Annamite, the heart made twelve or fifteen pulsations after the severance of the head.

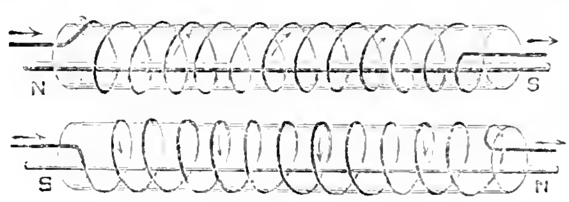
It may be concluded from these observations of M. Petitgand that the hanging of criminals in the manner now practised in this country must produce immediate insensibility, as the dislocation of the spine must occasion the violent shock which he believes instantly paralyses the nervous system. S.

THE ELECTRO-MAGNET.

By W. Slingo.

(*Continued from p.* 30.)

A little careful study of the two small diagrams (Figs. 1 and 2) which appeared in the previous article (and which are here reproduced for the sake of reference) will have made clear the distinction between a



Figs. 1 and 2.

right and a left handed helix. The idea is perhaps more easily grasped by a reference to the accompanying additional illustration (Fig. 3), where both modes of winding

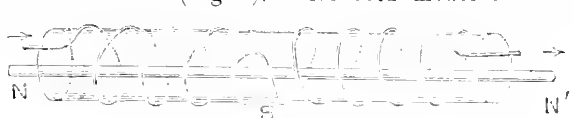


Fig. 3.

are applied to a single coil. The winding commencing at N, the first half of the coil, N S, is a left-handed helix, while the second half, S N′, is a right-handed helix. It will be seen that at S the wire is turned back on itself, and the direction of winding reversed.

Now for the polarity induced. The arrows in each case indicate the direction taken by the current. Thus in Fig. 1 the current enters at the end marked N, and passes round the glass in the opposite direction to that taken by the hands of a clock. Remembering, however, what was said about the little man swimming with the current, that is, that when facing the iron or the axis of the coil, the north pole would be on his left hand, we can easily determine the polarity of the helix and the iron embraced by it. Thus, if we imagine the little man to be in the upper portion of the first ring or loop, he must, to follow out the conditions referred to, lie face downward with his head in the direction of the retreating current (or away from the reader's eye). Clearly his left hand will be towards N, and his right hand towards S. Supposing the miniature man to be in any other portion of the ring, he will still have his left hand N-wards, and consequently every ring or every fraction of a ring helps to increase the intensity of magnetisation. It may, however, be observed that the rings are not perfect, but that in passing from one ring to the next there is a slight longitudinal deviation. The sum total of these deviations, supposing the iron rod to be covered from end to end, is equal, evidently, to a single wire the length of the coil, or of its iron core. The effect of such a wire would be exerted at right angles to that of the series of rings; but inasmuch as the single wire is materially less effectual than the rings, and for other reasons which need not here be dwelt upon, such an antagonistic tendency as that exerted by the wire is so infinitesimal as to be lost sight of. Thus, then, in a left-handed helix the end where the current enters becomes a north pole, the other end becoming a south pole.

Conversely it will be seen that in Fig. 2, where there is illustrated a right-handed helix, the arrows indicate that the current pursues the same direction as the watch-hands (viewed from the end at which the current enters), and that to comply with Ampere's conditions the little man in the upper portion of any loop or ring must lie face downwards, with his head towards the reader, when his left hand will be extended towards the extremity of the iron rod marked N, or in the opposite direction to that indicated in the previous figure. The polarity of the iron rod is therefore reversed, and it may be well to note that with a right-handed helix the point of entry becomes a south pole, the other end becoming consequently a north pole.

But now the interesting question presents itself: What is the effect of changing the heliacal direction, or the direction of winding around one and the same core? To take the simplest case, we may place a left and a right-handed helix end to end on a common core, and then, joining them together, we shall get a result resembling the accompanying illustration (Fig. 3). Here the current enters a left-handed helix at N, but at S it leaves the left-handed and enters a right-handed helix, through which it passes, emerging at N′. In this case, the coil and its core have three poles, one south and two norths, and a little reflection or re-perusal of what has been previously said will make clear the appearance of a south polarity at S, due in the first place to the current emerging from a left-handed helix, and strengthened by the current entering a right-handed helix. In both cases the tendency is to create this south pole. Similarly, the two extremities of the core become north poles on account of the current at N entering a left-handed helix, and at N′ leaving a right-handed helix. It may be as well to point out here that, although we may maintain that the two magnetic conditions are equal in every magnet, it does not follow that every magnet contains or possesses only two poles at the extremities separated in the centre by a neutral line or zone. This idea is more prevalent than most people imagine, and it is on this account that the point is here referred to. We may introduce as many extra or "consequent" poles (as they are styled) as we please, bearing in mind, however, that every two north or every two south poles will be separated by a south or a north pole, as the case may be, and that between every two poles there is a region of neutrality—neutral, not in consequence of the absence of magnetism, but because the two poles are opposite and equal. We are furthermore accustomed to say, and that truly, that the two polarities in any magnet are equal, and for this, if for no other reason, neither of the north polarities (Fig. 3) can equal the south polarity. Were we able to eliminate every modifying influence, we should find that the single south pole equalled in strength the sum of the two norths.

These effects may be easily and effectively obtained by coiling a little wire around a knitting-needle and sending a current through it. The needle being steel, it will retain the magnetism induced, and by placing its various parts in in the neighbourhood of one or other of the poles of a suspended or floating magnet, experimental confirmation of its assumed magnetic condition may be afforded.

Supposing, in the next place, that our battery-power is limited, and that the effect produced by sending the current through a single helix (such as Figs. 1 or 2) is incapable of performing a certain task, the question arises: How are we to increase the magnetic effect exerted upon the iron without submitting to a corresponding increase in the battery-strength? This may be attained by increasing the coil of wire, or, in other words, by increasing the number of turns or loops. Presuming the coil to be closely wound, it is only possible to increase the number of turns in a single helix by using a thinner wire. It must, however, be borne in mind that by so doing we shall materially raise the resistance in circuit, and consequently cause a proportional diminution in the strength of the current traversing it. Thus, supposing that we substitute a wire half the diameter of that previously used, we should be able to envelope the core with, approximately, twice the number of rings or loops. This means twice the length of wire; and the resistance offered by a piece of wire varies directly as its length—or, more simply, twenty yards of wire offer twice the resistance that would be presented by only ten yards. But this is not all, for resistance also varies inversely as the cross section, which is the same as saying that it varies inversely as the square of the diameter. Now our thinner wire has only half the diameter of the other, or their diameters are as 1:2, the squares of which are 1 and 4. Thus, for equal lengths of the thin and thick wires the respective resistances will be 4 and 1. But it was said that the iron core would carry twice the length of thin wire, so that the resistance of such a helix would be eight times as great as the one composed of the thicker wire. The effect upon the current-strength is easily seen. Suppose we have two cells giving an electro-motive force of two volts, and having an internal resistance of 1 ohm per cell. Then, with the stout wire helix having a resistance of, say, 1 ohm, we get, according to Ohm's law (which declares that the current produced varies directly as the electro-motive force (E), and inversely as the total resistance, including that of the battery (r) and of the external circuit (R)),

$$\frac{E}{R+r}=\frac{4}{1+2}=1\cdot\dot{3}.$$

And with the thin wire helix (having eight times the resistance of the other, and therefore offering 8 Ohms) we get:—

$$\frac{E}{R+r}=\frac{4}{8+2}=\cdot4.$$

The bearing of these figures in demonstrating that in the second case we get less magnetic force developed than in the first case may be readily seen, and will be dealt with next.

(*To be continued.*)

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By MONS. DE FONTENELLE.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p. 44.*)

"ALL philosophy," said I, "madam, is founded upon two things, either that we are too short-sighted, or that we are too curious; for if our eyes were better than they are we should soon see whether the stars were worlds or not; and if, on the other hand, we were less curious, we should not care whether the stars are worlds or not, which, I think, is much to the same purpose. But the business is, we have a mind to know more than we see. And, again, if we could discern well what we do see, it would be too much known to us; but we see things quite otherwise than they are. So that your true philosopher will not believe what he does see, and is always conjecturing at what he does not, which is a life, I think, not much to be envied. Upon this I fancy to myself that nature very much resembles an opera; where you stand, you do not see the stage as it really is, but as it is placed with advantage, and all the wheels and movements are hid, to make the representation the more agreeable. Nor do you trouble yourself how or by what means the machines are moved, though certainly an engineer in the pit is affected with what does not touch you; he is pleased with the motion, and is demonstrating to himself on what it depends, and how it comes to pass.

"This engineer, then, is like a philosopher, though the difficulty is greater on the philosopher's part, the machines of the theatre being nothing so curious as those of Nature, who disposes her wheels and springs so out of sight that we have been long a guessing at the movement of the universe. Suppose, then, the sages to be an opera—*i.e.*, Pythagoras, Plato, Aristotle, and all the wise men who have made such a noise in the world for these many ages; we will suppose them at the representation of Phaeton, where they see the aspiring youth lifted up by the winds, but do not discover the wires by which he mounts, nor know they anything of what is done behind the scenes. Would you have all these philosophers own themselves to be stark fools, and confess ingeniously they know not how it comes to pass? No, no, they are not called wise men for nothing; tho', let me tell you, most of their wisdom depends upon the ignorance of their neighbours. Every man presently gives his opinion, and how improbable soever, there are fools enough of all sorts to believe 'em: One tells you Phaeton is drawn up by a hidden magnetick virtue, no matter where it lies; and perhaps the grave gentleman will take pet if you ask him the question. Another says Phaeton is compos'd of certain numbers that make him mount; and, after all, the Philosopher knows no more of those numbers than a sucking child does of Algebra. A third tells you, Phaeton hath a secret love for the top of the theatre; and, like a true lover, cannot be at rest out of his mistress's company; with an hundred such extravagant fancies, that a man must conclude the old sages were very good banterers.

"But now comes Monsieur Descartes with some of the moderns, and they tell you Phaeton ascends, because a greater weight than he descends; so that now we do not believe a body can move unless it is push'd and forc'd by another body, and as it were drawn by cords, so that nothing can rise or fall but by means of counter-poise; to see nature, then, as she really is, you must stand behind the scenes at the opera."

"I perceive," said the Marchioness, "philosophy is now become very mechanical." "So mechanical, madam," said I, "that I fear we shall quickly be ashamed of it: they will have the world to be in great, what a watch is in little, which is very regular, and depends only upon the just disposing of the several parts of the movement. But pray tell me, madam, had you not formerly a more sublime idea of the universe? Do not you think then that you honour'd it more than it deserv'd? for most folks have the less esteem for it since they have pretended to know it."

"I am not of their opinion," said she: "I value it the more since I know it resembles a watch; and the whole order of nature, the more plain and easy it is, to me it appears the more admirable."

"I know not," said I, "who has inspired you with these solid notions, but I am certain there are few that have them besides yourself. People generally admire what they do not comprehend, they have a veneration for obscurity, and look upon nature, while they do not understand her, as a kind of magic, and despise her below legerdemain, when once they are acquainted with her: but I find you, madam, so much better disposed, that I have nothing to do but to draw the curtain and shew you the world.

"That then which appears farthest from the earth (where we reside) is called the heavens, that azure firmament, where the stars are fasten'd like so many nails, and are call'd fix'd, because they seem to have no other motion than that of their heaven, which carries them with itself from east to west. Between the earth and this great vault (as I may call it) hang at different heights,* the sun, and the moon, with the five other stars, Mercury, Venus, Mars, Jupiter, and Saturn, which we call the planets: these planets, not being fastened to the same heaven, and having very unequal motions, have diverse aspects and positions; whereas the fixed stars in respect to one another, are always in the same situation: for example, the Chariot, which is compos'd of the seven stars, has been, and ever will be,† as it now is, tho' the moon is sometimes nearer to the sun, and sometimes farther from it; and so it is with the rest of the planets. Thus things appear'd to the old Chaldean shepherds, whose great leisure produced these first observations, which have since been the foundation of astronomy; which science had its birth in Chaldea, as geometry sprung from Egypt, where the inundation of the Nile confounding the bounds of the fields, was the occasion of their inventing exacter measures, to distinguish every one's land from that of his neighbour. So that astronomy was the Daughter of Idleness, Geometry the daughter of Interest: and if we did but examine Poetry, we should certainly find her the Daughter of Love."

"I am glad," said the lady, "I have learnt the genealogy of the sciences, and am convinced I must stick to astronomy; my soul is not mercenary enough for geometry, nor is it tender enough for poetry; but I have as much time to spare as astronomy requires; besides, we are now in the country, and lead a kind of pastoral life, which suits best with astronomy."

"Do not deceive yourself, madam," said I, "'tis not a true shepherd's life to talk of the stars and planets: see if they pass their time so in Astræa."

"That sort of shepherd's craft," replied she, "is too dangerous for me to learn: I love the honest Chaldeans, and you must teach me their rules if you would have me improve in their science. But let us proceed."

(To be continued.)

* The use of the word height by the old astronomers where we say distance illustrates curiously the former prevalence of the old idea of a flat earth.—R. P.

† The proper motion of the stars had however been already detected by Halley when this was written, and the absolute fixity of the stars and unchangeableness of the constellations could no longer be asserted.—R. P.

NOVEL TRICYCLES.

By John Browning,

(Chairman of the London Tricycle Club.)

Not contented with the important improvements he has introduced in rear-steering tricycles, Mr. Rucker is bringing forward a new machine which will in my opinion eclipse all he has hitherto done, and possibly all that other makers have done in this direction.

It is well known that Mr. Rucker has for some time made an excellent front-steerer with central gearing.

The new rear-steering tricycle is also central-geared, and, with great ingenuity, a single vertical tube is made to carry both the seat-rod and saddle, as well as the lower chain-wheel bracket and pedals; and it will shortly be made to carry the steering-rod centrally arranged so as to allow the machine to be open to mount or dismount from it in the rear on either side.

It is easy to dismount from this machine in front, if it should be found necessary to do so.

The machine is very light, drives easily up hills, and is as safe as a hind-steerer can be made; that is to say, that any person with a few hours' practice can ride down a tolerably steep hill at the rate of from six to eight miles an hour, and a skilful rider at the rate of from ten to twelve miles an hour, and I think there are very few riders who would wish to do more.

There has been a great demand this year for "Tandems," particularly for "Convertible Tandems." Messrs. Hillman, Herbert, & Cooper have produced a new machine of this class, which they have named the "Kangaroo" Tandem.

The construction of this machine is very simple. The steering-wheel of a front-steering tricycle is removed, and replaced by the driving-wheel and back-bone of a "Safety" bicycle with a 36-in. driving-wheel, which is geared up by means of chains, so as to run at the same speed as the driving-wheels of the tricycle behind it. Of course, this bicycle portion requires no hind wheel, as it is supported by the front part of the framework of the tricycle. The steering is done entirely by the front rider, who should, I think, have also a good break under his control.

The machine I saw weighed about 120 lb., but a machine could, I should suppose, be made for careful riders to weigh less than 100 lb. if it were required.

The "Kangaroo" Tandem possesses several important advantages over most other tandems. The riders do not sit so close behind each other as to look uncomfortable. The machine is light. It can have two breaks instead of relying upon one. It has no small steering-wheel, and thus has less friction and less vibration than those machines which have, and, with the addition of a small hind wheel to the front portion, it can be converted in a few minutes into two complete machines, *i.e.*, an excellent safety bicycle and a first-class front-steering "Premier" tricycle.

Mr. Rucker has just completed for me one of his new two-chain two-speed machines, to my own specification. It is the most perfect front-steering machine I have yet ridden, answering in every respect my utmost anticipations.

As regards speed, I can drive the new "Rucker" quite as fast as what I have been accustomed to regard as my inimitable little "Humber," for I have ridden three miles in a quarter of an hour on the main Brighton road between Crawley and Reigate; and I have also ridden 15 miles of rather rough and hilly by-roads at the rate of nearly 10 miles an hour. Probably I should not be able to maintain the same steady rate of speed as I can on the "Humber," because the "Rucker" weighs full 25 lb. more than the "Humber," and weight tells in time. But the low-speed, or hill-riding gear, will give the heavier machine a great advantage. My "Humber" is geared to 48 in., the same as the high gearing of the "Rucker." On this, after I have ridden from 30 to 50 miles, hills begin to tell upon me if at all steep. With the "Rucker" I can drop down to the low gearing, which is about 33 in., and get over a stiff hill without any particular strain. This will allow me to ride much farther without getting tired than I should be able to do if I were compelled to keep riding always with the high gearing.

The pace at which I can drive the new machine I believe to be due partly to the fact that I can ride it with the saddle farther in front of the pedals than I can on the "Humber," on which, though I ride almost leaning against the handle-bar and with my legs occasionally quite touching the axle (on this point I am quite certain) I yet feel that I should like to be farther in front of my pedals.

I fear that some of my readers will come to the conclusion that with me the last machine is always the best. Lest this should be thought the case, I would beg to point out that for each machine I order I draw the specification so that it shall avoid disadvantages I have experienced with previous machines, and possess special advantages of its own; and again, that I am precluded from saying anything here about machines I have tried and found wanting, as the publication of such remarks might cause serious inconvenience to the editor. The new Rucker has driving-wheels only 38 in. in diameter.

In my next article I shall give the results of my experience with other small-wheeled machines which I have been riding this season.

* * * *

Since writing the above I have ridden fifty miles with Mr. Arthur Salmon, one of the fastest riders in my club, for the purpose of testing the new machine. I rode from Reigate to Merstham, on through Redhill and Balcombe to Cuckfield and Lindfield—a series of hills; then returned over Hand Cross Hill to Crawley, back through Redhill to Reigate.

After riding about forty miles over this series of hills, I covered the ten miles from Crawley into Redhill, without making any perceptible effort, within an hour.

THE INTERNATIONAL HEALTH EXHIBITION.

IX.—WATER AND WATER-SUPPLIES—(*continued*).

THE quality popularly termed "hardness" has been most appropriately chosen to designate waters which offer a peculiar resistance to the sense of touch; it is a harsh or rough feeling when compared with the smooth gliding sensation experienced by the use of rain, or, as it has been called, "soft" water. The hardness is due to the presence of dissolved mineral salts, more notably to the carbonates and sulphates of lime and magnesia. It becomes distinctly appreciable when those salts obtain in quantities of over three or four grains in each gallon; and, in technical operations, it is customary to speak of the *degrees* of hardness in water, as determined by the "soap test." The unit of hardness is represented by the maximum amount of curdiness produced by one grain of chalk per gallon of water when soap is used. It is thus evident that before soap can be made available as a detergent, when used with a hard water, a certain amount is destroyed or decomposed by the substances which produce that hardness, and the waste so occasioned is directly proportional to the hardness of the water.

We have now reviewed all the most important factors which bear upon natural water-supplies, with the single exception of upland surface waters, excellent examples of which are to be found in those which feed the rivers and lakes of Cornwall, Devonshire, Northern England, Wales, and Scotland. In all the districts just enumerated, the gathering grounds are chiefly formed of igneous and metamorphic rocks and sandstones. The water thus differs widely from that which we considered in our last communication, in being characteristically soft. The upland waters of the Millstone Grit and non-calcareous parts of the Coal Measures, which supply portions of Yorkshire and Lancashire, are also particularly soft. But there are other British upland waters, which are decidedly calcareous; they are derived from the limestone and other formations which include the basins of the far-famed Trent, the Tyne, Mersey, Wear, Tees, Tweed, Forth, and Clyde. All these upland surface waters, however, are more or less tainted with harmless colouring matters and objectionable odours. These undesirable items are due to their percolation throughout superficial layers of the peat derived from the decayed remains of successive growths of shrubs, heather, grasses, mosses and other cryptogamic plants.

Lastly, the influence of man and other animals upon the water-supply demands our attention. The words guano-mounds, kitchen-middens, cesspools, and sewage are all suggestive of the presence of the "lords of creation"; but when we come to churchyards and cemeteries, it seems as though modern civilization had undergone a process of retrograde development. The refining influences of our social system have their drawbacks: they foster feelings which in themselves are noble in the ideal, but are too often proved to be practically pernicious, and even ghastly, in real life. In spite of the warnings of able geologists and doctors of medicine, the vast majority of persons in this country prefer to give their friends what they erroneously call a "Christian burial." When the ceremony is over, they little think that they have merely contributed their iota to a hotbed of festering filth, which has been shown over and over again to be only something short of a wholesale system of manslaughter. We have of late come into contact with many gravediggers and undertakers who loathe their trades so strongly, that nothing short of the hard struggle for existence keeps them to their uncoveted employments. How disgusting the disinterment of a leaden coffin, after perchance a lapse of some years, is, is perhaps only known to the few individuals whose unhappy lot is cast amongst the dead forgotten. Let us ask, with Dr. Attfield* :—"How much longer will a misguided sentiment, an ill-guided superstition, or simple ignorance, sanction the poison-breeding process of interment, when the highest religion and the best interests of humanity point to the harmless practice of cremation?"

To soothe the feelings of the bereaved, would it not be better and more worthy of their creed to follow the dictates of reason? If they desire to perpetuate the memory of beloved ones, how much wiser, to say the least of it, would it be to erect something of value to their fellow-beings. The drinking-fountain dedicated to Greyfriar's Bobby, in Edinburgh, might well be taken as an example in this

* "Water and Water-Supplies," &c., 1884, p. 3.

direction; and may we not hope that the time is at hand when pestiferous cemeteries, with their gloomy tombs, tablets, wreaths, and misshapen marble doves, will give place to drinking-fountains, seats for the weary and foot-sore, shelters and food for the houseless, and health and happiness for all?

The evil gases and germs arising from graveyards are only too manifest to those whose duty leads them perpetually to such scenes; not only does the air become vitiated, but the most serious cause for apprehension is to be sought for in the drainage. The rain-water carries the foul products from the atmosphere, and in greater abundance from the soil, into the underground circulation. If the strata happen to slope downwards to a district of water-supply from wells, the latter become perpetual sources of disease. To a less marked extent is the influence of man felt in the deterioration of water through cesspools and pits; yet they are oftentimes sources of great danger. See Fig. 18, which we avail ourselves of through the kindness of Mr. P. A. Maignen.

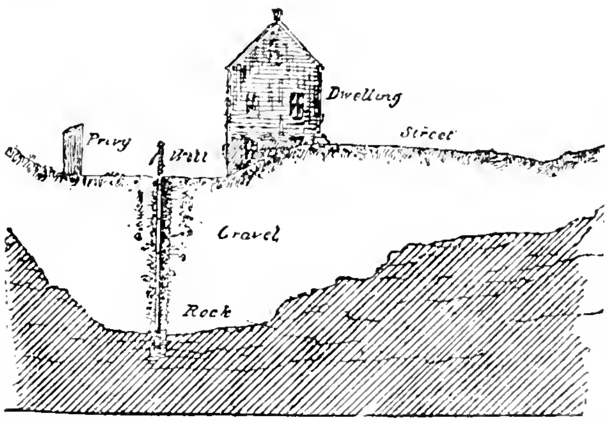


Fig. 18.—Reproduced from the Tenth Annual Report of the Massachussetts State Board of Health. There were twelve cases of typhoid fever among persons using this well water and the house became the centre of infection for a whole neighbourhood.

Samples of Water.

We now propose to submit to our readers a series of samples of water, both natural and artificial, with a brief summary of their properties, as preliminary to a sketch of the methods employed to render them valuable for specific purposes. In doing so we shall have occasion to lead them once more to the collections at South Kensington, there to view the numerous apparatus and inventions which have been designed to secure the purification of waters.

I. Natural Waters.—To this category belong the following types:—1. Ice and snow; 2. Rain, dew, and hoar-frost; 3. Marsh and Pond water; 4. Lake water; 5. River water; 6. Underground water; 7. Sea water.

1. *Ice and Snow* are characteristic of all regions where the conditions of temperature and atmospheric pressure are such as to maintain the water in its solid forms. It usually obtains thus during wintry seasons in the temperate zones, and permanently on mountain snow-slopes and glaciers, at altitudes of from eight to ten thousand feet and upwards above the sea-level, and in the circumpolar areas. Frozen water is, as a rule, almost free from impurities; and, when liquefied, yields a remarkably pure fluid, in which dissolved mineral salts and suspended solid particles are only accidental.

Unlike most substances, water expands on cooling. But only between the limits of 39·25° Fahr. and 32° Fahr.; it becomes frozen, and in virtue of its relative lightness remains on the surface of the water. The lower levels are thus prevented from radiating heat into space, and the warmth so necessary to the maintenance of life is thus retained by the earth. The bracing climate of a mild wintry country is too well known and appreciated by those who live in it to require any comments here. If we were writing a treatise on domestic medicine, we would consider it our duty to devote at least one chapter to ice and snow. In the kitchen, ice is a most desirable luxury; and in the preservation of diets, we have but to turn for a tangible example to the gridiron of Messrs. Bertram & Roberts, at the foot of the passage leading to the Aquarium in the Exhibition buildings, to enjoy an excellent, well-matured mutton chop all the way from New Zealand.

2. *Rain, Dew, and Hoar-frost.*—The properties of these waters have already been detailed at some length.* The usefulness of rain-water depends to a very large extent upon its softness and freedom from suspended particles. It is, perhaps, the largest source of supply of practically pure natural water in existence. Of possible impurities, dust and dirt, leaves and twigs, soot and ashes, traces of such acids as hydrochloric, sulphuric, and nitric acids, sulphates, chlorides, and ammonia, besides the gases of the air, are liable to affect rain-water most of all.

Dew, the frozen variety of which is termed hoar-frost, generally contains a somewhat larger percentage of soluble and suspended impurities than rain water, which it abstracts from the air. In England, it has been shown that dew possesses 4·87 in 100,000 parts of solid impurity, and about ·198 parts of ammonia.† In our remarks upon the formation of dew,‡ we noted that a deposition of moisture from the invisible vapour held in the atmosphere takes place when the moisture-laden medium comes into contact with bodies which are ever so little colder than it is itself; the exact temperature at which this occurs can be ascertained by means of a little instrument called after its inventor, Daniell's ether hygrometer, and is termed the *dew point.* On a clear night the leaves of plants, &c., radiate more heat into space than they receive back, and are thus rendered colder than the surrounding air, and, in consequence of this, dew is formed; on a cloudy night, however, the heat is radiated back by the clouds, and the deposition of dew thus curtailed. During the summer months, an immense amount of vapour is taken up by the warm air, and, as the nights are usually clear, enormous quantities of dew are produced and absorbed by the vegetation and surface soils of the earth. This state of affairs is, of course, more pronounced in tropical countries, where the source of water-supply through the agency of dew is an all-important factor in the maintenance of the conditions of life during the protracted period of drought commonly called the "dry season."

3. *Marsh and Pond Waters* are local collections of rain, or, in the neighbourhood of sea-coasts, of rain and spray. They usually harbour vegetable and animal growths and decaying matters; and upon the absence or presence of these, in larger or smaller quantities, does the value of the water entirely depend; it may thus range from a good, soft water to one which may be described as the essence of contamination.

4. *Lake Water* may represent the accumulated drainage of a large area which empties into a natural reservoir. The character of the water, which is primarily derived from rain, thus depends wholly upon the nature of the surrounding formations. The water of lakes without efferent streams, generally becomes saline, through evaporation and con-

* *Ut supra*, p. 34, *et sequentes*.
† "Rivers Pollution Commission," 6th report, p. 32.
‡ See this Journal, p. 34.

sequent precipitation and re-solution of dissolved mineral salts, often to a prodigious degree. In the well-known Dead Sea, in Southern Palestine, one gallon of the water weighs about $11\frac{3}{4}$ lb., or $1\frac{3}{4}$ lb. more than a gallon of ordinary fresh water. Other lakes, as the salt lakes of Utah and Russia, are almost, if not quite saturated solutions; whilst still others afford a further stage in being destitute of liquid water; of this character is the borax lake of California. Doubtless the presence of mines of salt in this country, Prussia, and elsewhere, point to former lacustrine deposits which have taken place under analogous operations on the surface of the earth or in vast underground reservoirs.

Other lakes are merely expanded portions of rivers, or depressions occasioned by glacial erosion; and they are commonly provided with both affluent and effluent streams. In such cases the waters are, of course, identical with those of rivers; their physiographical surroundings, however, make them the recipients of the first upland drainage, and, as a rule, the water-supply from such sources is particularly free from impurities. As instances we may point to the waters of classic Loch Katrine, with its "silver strand" and "Helen's Isle," and of Thirlmere, in Cumberland; they contain only about two grains of solid impurity in each gallon.

5. *River Water.*—Enough has been stated with regard to the sources of the Thames water to afford a typical example of what may be expected from a river-supply of water.

6. *Underground Waters* furnish us with by far the most extensive supply in the world. We must once more refer our readers to our foregoing remarks, from which they will gather that rivers and lakes are very largely augmented, and that springs and wells are wholly derived from subterranean sources. A species of intestine warfare seems to be perpetually carried on between the pure and impure varieties of this element beneath the surface of the earth; and, on the whole, a kind of equilibrium is established. Surface-waters which become contaminated by their passage through dissolvable soils and rocks, are operated upon by the counter effects of internal heat and other agencies; they are compelled to give up portions of what they have taken, and may thereafter find an escape to the surface of the earth, from which they originally came, considerably purified. On the other hand, they may reappear surcharged with the substances they have collected on the way. As a rule, however, the tendency of extensive underground circulation is to render the water purer in the sense of its becoming more valuable to man, and these changes are chiefly brought about through the oxidation or destruction of harmful organic matters, which may accrue from sewage, graveyards, abundant manuring, decaying vegetation, &c.

7. *Sea Water* occupies but a subordinate place in ordinary domestic economy. Its saline character is chiefly due to the continued accession of dissolved salts from the earth, which are brought to it by rivers, and which remain behind in the water whilst evaporation is constantly going on from its surface. As a bath, sea-water is often more invigorating than fresh water. In the vessels of the British Navy, and in many recently-built crafts, the waste steam from sea water is utilised by condensation, aërated, and used for drinking and culinary purposes. If a quantity of fresh water be represented by a weight of 1,000 lb., an equal volume of sea water would weigh $1{,}027\frac{1}{2}$ lb. In consequence of this the boiling point of sea water is much higher than that of fresh water, because an additional amount of heat is necessary to overcome the adhesion between the water and the saline matters.

(To be continued.)

THUNDERSTORMS.

THIS is a topic to which we shall, when an opportunity presents itself, have occasion to refer with a view to demonstrate that it is possible to guard against such annual calamities as frequently accompany lightning discharges.

On the three closing days of the week ending July 5 thunderstorms of more than ordinary violence passed over England and Scotland. Reports show considerable loss of human life and destruction of property. The storms were accompanied by heavy showers of rain and hail. Some of the hailstones, when picked up, were found to measure seven-eighths of an inch square, and weigh over two pennyweights. Subjoined is a summary compiled by a contemporary of the effects produced in England and Scotland.

ENGLAND.

Aston, near Wallingford.—Two men, while working in a field, were killed. Their clothing was completely consumed. A horse in the neighbourhood was also killed.

Burnley.—Two men were seriously injured.

Liverpool.—At Holy Trinity Church the lightning passed through the roof and through the gallery floor, filling the building with a pale blue flame. The current passed between two boys, paralysing the arm of one and scorching the boot of the other. The bell was rendered useless, and coping stones were hurled some distance.

Peterborough.—A number of sheep and cattle killed.

Weardale.—Wesleyan Chapel struck, and two men at work on the spire were knocked down insensible, but recovered consciousness afterwards. At Burn Hope a house was partially destroyed.

Northampton.—Lightning struck several dwelling-houses, demolished the turret of a shoe factory, and injured a girl.

Wymeswood.—Three men, who were at work in the hay-field, took shelter under a hedge. One of the men felt a sharp pain on his thigh, and became insensible. On recovery he found that one of his companions had fallen, while the other was sitting, looking placid and apparently undisturbed; but on examination he found both were dead.

Skipton.—Tree struck and cut, and a cartload of hay which was being put into a barn set on fire.

Wingham.—A stable on the farm of Sir Brook Bridges was struck by lightning and set on fire, three valuable horses being burnt to death.

Cambridge.—A woman was killed and several buildings were struck by lightning,

Deddington.—A painter was killed whilst sitting under a tree during a thunderstorm.

Consett.—Whilst nursing an infant on his knee a miner was struck by lightning and killed, the child escaping.

SCOTLAND.

Hamilton.—The storm, which was at its height about half-past one, continued for fully two hours. About half-past one o'clock, what is described as a ball of fire burst over the Clydesdale Bank, a large three-storey structure in Cadzow-street. The lightning struck the chimney head, racking and displacing the solid stonework, and passing, it is believed. down the chimney. The consternation of the inmates, including the officials of the bank, may be conceived. In the room with which the vent communicated, the grate was thrown out on to the floor, and the apartment filled with soot, plaster, and *débris.* Something similar happened in the room on the second floor. The bank office is immediately below on the street floor. The accountant was startled by the noise and falling *débris.*

Mr. Lightbody, who was standing inside his shop door on the opposite side of the street, was almost knocked off his feet against the side of the door. His workmen in the bakehouse behind thought the premises had been struck, and the beam and scales were knocked against the wall. The tailors in Mr. Park's workshop, which adjoins the bank, felt stunned, and thought their skylight window had been struck. Three independent witnesses standing in the neighbourhood at the time state that they noticed a ball of fire momentarily suspended over the bank.

Lockerbie.—Several houses struck and their roofs damaged.

Kilbirnie.—Two houses damaged; the lightning passing from the one to the other.

Beith.—Intense darkness accompanied the storm, and business had to be suspended for fully an hour, during which time flash succeeded flash at intervals of four minutes.

Ardrossan.—The most severe storm ever experienced. The flashes of lightning were very vivid, and the peals of thunder sharp and loud. Hailstones, weighing over two pennyweights, and measuring three-quarters of an inch in circumference, were picked off the streets.

Saltcoats.—Two houses struck, and their gas-pipes cut in two.

Kirkintilloch.—The lightning entered the room of a house, passed along the attics and out by the chimney, shattering the plaster and chimney top.

Rothesay.—Valuable milch cow killed.

Vale of Leven.—Darkness intense. The flashes of lightning very vivid, and the peals of thunder, which were loud, continued from ten to twenty seconds.

Stonehouse.—Hailstones of large size, vivid lightning, and a series of tremendous sharp, and prolonged peals of thunder. Cow killed and a tree struck.

Newmilns.—Thunder peal followed thunder peal in rapid succession, and sometimes three of them were heard at the same time. Outside stair and belfry of the Council Chambers damaged.

Loans.—Two cows and a bull killed.

Sinclairtown.—Dwelling-house struck, followed by an explosion of gas; damage not serious. Stack of hay set on fire and completely destroyed.

Kirkcaldy.—Ventilator at the top of malting kiln at Gallatown struck, and one of the large beams supporting the ventilating apparatus shattered, some of the splinters being carried away a distance of about 200 yards. In a private house a valuable picture was destroyed, and the woodwork set on fire.

Stanley.—A house was set on fire, and a portion of the structure knocked down on two women, rendering them insensible for a time.

Stow.—Eight sheep instantaneously killed, and a ninth had to be afterwards destroyed.

Hawick.—The storm lasted for upwards of two hours, and so dark was it that gas had to be lighted. The lightning entered two houses and damaged a number of articles.

Girvan.—Several cattle killed.

Busby.—The lightning was most brilliant and vividly coloured, blue in many instances. From three to four flashes were seen before thunder heard. Three girls employed in Busby Mills fell into a state of fainting, and remained in a trance for several hours. A cow grazing in a field was killed, its hide being singed. A building in the printworks was stripped of the lead and slates.

Ayr.—The lightning very bright and the thunder almost incessant. Several of the flashes were of a violet tinge. Some little panic was created in Ayr woolworks by the girls getting frightened at the lightning gleaming on the spindles.

Leith.—The lightning entered a house, ran round the cornice of a room, tearing it open. The window-curtains were set on fire, the roof singed, and a number of articles which were lying about damaged. The lightning escaped through the window, scorched the framework, and smashed several panes of glass. A gentleman sleeping in the room had a very narrow escape, as the lightning in its course went within a few feet of his head; he was much shaken. After leaving the house the lightning had, judging from a quantity of plates dislodged, run down the outside of the house and entered the earth.

Edinburgh.—The *Scotsman* says:—"Just as the storm began, one of the telegraph clerks in the *Scotsman* office had a narrow escape from being injured by the lightning. Word had come over his wire that the House of Commons had been counted out at 2.30 a.m., and he rose from the Morse instrument to carry the sheet into the adjoining sub-editor's room. As he re-entered the telegraph room a loud report like the discharge of a rifle was heard, and the thick glass cover of the relay was blown several feet into the air, and smashed one of the glass globes. The relay was completely destroyed.

Dumfriesshire.—Reports give accounts of considerable destruction of farm stock. Mr. Phillips, Clarencefield, had two fine bullocks killed, Mr. H. Baird, Blackford, had one killed, and Mr. Aitken, a farmer in the parish of Johnstone, had sixteen sheep killed. While a lad was harrowing turnips in a field the lightning struck the ground in the next ridge, and covered him with earth, and a man leading a horse had a very narrow escape, he having just passed when a large tree was struck and thrown across the road. Heavy rain accompanied the storm.

Arisaig.—Mr. Lewis Macdonald (28 years of age), crofter, Ardnish, was on the hill above the croft, taking home the cattle at about 4 p.m., on Friday last week, when he was struck with lightning and killed instantly. When found it was discovered that there was a mark like a bullet hole on the right side of the head above the ear, and from the appearance of the body it is evident that the electric fluid struck his head first, and then passed through his body.

Appin.—There were several extremely vivid flashes of forked lightning passing straight down from a dense cloud overhead to the earth. Four sheep were struck by lightning and killed; and altogether the storm was one of the most severe remembered for some years.

ERRATA.—P. 57, col. 2, line 8 from bottom, "now tired," should be "never tired. P. 60, letter 1340, line 1, "absence of home" should be "absence from home."

RAINFALL RECORDS AT GLASGOW OBSERVATORY.—On the authority of Professor Grant, F.R.S., some interesting rainfall records at Glasgow Observatory have been made available for public use. Their publication was suggested by the heavy rainfall at Glasgow during the twenty-four hours ending at ten o'clock on the morning of the 11th inst., which is said to have been the most excessive that has occurred during the past twenty-two years. The downpour was heralded by a smart shower which commenced about 1 p.m. on the preceding day (Thursday), and lasted but a few minutes, when fair weather was again enjoyed for about an hour. A little after 2 p.m. there was registered by the self-recording instrument of the observatory, a drenching shower, which, although happily shortlived, was remarkable for the rapidity with which it fell. At 4.15 p.m., the sky, which was destitute of sunshine for several hours previous, again sent down rain in perfect torrents. During the evening, 1 in. of rain fell in five hours. During the twenty-hours referred to, the rainfall amounted to 2·12 in., and during none of the twenty-two years preceding 1884 did the rainfall at Glasgow Observatory ever exceed 1·77 in. in the same period of time. That was in the month of July, 1866.—*Engineering.*

Reviews.

SOME BOOKS ON OUR TABLE.

Text-Book of Descriptive Mineralogy. By HILARY BAUERMAN, F.G.S. (London: Longmans, Green, & Co. 1884.)—In his volume on "Systematic Mineralogy," in Messrs. Longmans' admirable series of "Text-books of Science," which preceded the one whose title heads this notice, Mr. Bauerman considered the methods followed in the systematic determination of the form, structure, and composition of minerals, and he now proceeds to apply such determination to the description of every important species known. This is done in a way as convenient and intelligible to the student as it well can be, and no less than 203 woodcuts of crystalline forms illustrate the text. It is curiously illustrative of the advance of mineralogical science that the capital index (of the names of minerals alone) with which Mr. Bauerman's work concludes occupies twenty closely printed columns.

Simple Lessons in Water-Colour: Marine. By EDWARD DUNCAN. (London: Blackie & Son.)—In no more agreeable form can reminiscences be secured of a holiday tour than in that of water-colour sketches, made by the tourist himself, of the localities which he has visited; and the sea-coast will always supply him with a boundless variety of subjects for his pencil. Mr. Duncan's book will furnish him with all needful information as to the best method of reproducing the various forms which he will meet with, and the atmospheric effects which add so much to their charm and beauty. The possession of a box of moist water-colours, a sketch-block, and this volume of "Simple Lessons" will add a new and very real pleasure indeed to a visit to the sea-side.

Tea and Tea-Drinking. By ARTHUR READE. (London: Sampson Low, Marston, & Co.)—Mr. Reade, who is very keen and enthusiastic indeed about tea, does his best, and far from unsuccessfully, to interest the general reader in the same subject. Beginning with its introduction into this country in 1610, and tracing the gradual spread of its use, he goes on to describe its growth and preparation, teaches us how to make it, discourses on its effects on physical endurance, its employment as a stimulant, and winds up with some details of the extent to which it is a source of revenue. The book is both chatty and amusing, and will while away an idle half-hour pleasantly enough.

John Bull's Neighbour in her True Light. By a "BRUTAL SAXON." (London: Wyman & Sons. 1884.)—How far what may be termed an International "Slanging-match" is a seemly or edifying spectacle, must be left to the judgment of individual readers. Within a comparatively recent period, however, certain French writers have taken upon themselves to revile and vituperate England and the English in a manner which was certain sooner or later to provoke reprisals. That the inhabitants of these islands are faultless, either morally or socially, it would be idle to contend; that, however, on the other hand, we are the besotted, debauched, ignorant poltroons depicted by some of our highly-imaginative neighbours across the Channel, it would be equally idle not to deny. Stung, then, apparently by taunts as baseless as they are brutal, our author, who seems to be an English resident in Paris, has set himself to let a little light in upon French life, social and official; and a most melancholy *exposé* he gives us of ghastly immorality, filthiness, bragging, cowardice, and venality on the part of our critics. The "Brutal Saxon" is, at any rate, both eadable and amusing, and probably by this time MM. Max O'Rell," Hector France, et Cie, are (like Lord S haftesbury's parrot) "sorry they spoke."

The Straight Line and Circle. With a Chapter on the other Conics. By A. LE SUEUR, B.A. Cantab. (London: Baillière, Tindall, & Cox.)—This handy little rudimentary book on Analytical Geometry and the Conic Sections will be found useful to the student preparing for examination. A very excellent feature in Mr. Le Sueur's work is the insertion after the proof of the various formulæ, of exercises, in the shape of numerical applications of them. Nothing, in our experience, appeals so immediately to the mind of the beginner as a concrete numerical example of a merely literal equation, and such examples are supplied in abundance in the book before us. General ones are also given at the ends of the chapters on the line and circle, as well as the questions set at the London University Examinations for the B.A. and B.Sc. degrees from 1840 to 1883. The author has done his unpretentious work well.

The Blowpipe in Chemistry, Mineralogy, and Geology. By Lieut.-Colonel W. A. ROSS, R.A., F.G.S. (London: Crosby Lockwood & Co. 1884.)—This is apparently a reprint of a series of articles which originally appeared in our contemporary, the *English Mechanic.* Be their origin, however, what it may, there can be no doubt of the value and utility of these lessons in what their author appropriately calls "Poor Man's Chemistry." No one can read Colonel Ross's book without recognising the power and usefulness of the method of anhydrous analysis which he so lucidly explains; and we have little doubt that the perusal of his book will tend to bring into fashion a mode of recognising mineral substances at once so simple, cheap, and efficacious as to render it remarkable that it should ever have been suffered to fall into desuetude. Nothing can be plainer or more perspicuous than our author's description of the apparatus employed and the method of using it.

Calculating Scales. Designed and patented by LALA GANGA RAM. (London: W. F. Stanley.)—A week or two ago we reviewed (p. 36) a tract of General Hannyngton's in which he gave a description of an extension of the slide rule for the purpose of executing logarithmic computations; and now there lies before us an illustrated description of another form of the same instrument, devised by a well-known Indian Civil Engineer for finding the scantlings of timber, strains on girders and trusses, the thickness of retaining walls or by inspection. These scales ought to be useful to the working civil engineer.

In the Watches of the Night. Poems (in eighteen volumes). By Mrs. HORACE DOBELL. Vol. II. (London: Remington & Co., 1884.)—As an example of moderately bad poetry it would be hard to find anything more illustrative than this series. Take one at random, "Sea Shells and their Tenants":—

> And the little fish slip in and out,
> In the still calm hours of the June moonlight;
> And the wild winds rock them oft about
> In the tempest rude of a summer night.

And so on through 96 pages. Mrs. Dobell's "Watches" should be wound up forthwith.

We have also before us *Moffat's Test-papers* (London: Moffat & Page); Part 18 of *The Franco-German War,* Part 18 of *The Library of English Literature,* Part 2 of *European Butterflies and Moths,* all published by Cassell & Co., London; *The Subsidence Theory of Earthquakes,* by Dr. Keeland; *Compulsory Uniformity of Weight in the Sale of Corn,* by T. H. Chatterton; *The Journal of Botany,* (London: West, Newman, & Co.); *Suggestions for Popular and Educational Museums,* by Thos. Laurie (London: the Author); *The Tricyclist: The South American Journal: The Railway Review: The Boot and Shoe Trades Journal;* and the *The Hindu Excelsior Magazine* (Madras).

Miscellanea.

THE percentage of recruits in the Italian army who can neither read nor write varies from 27 in Piedmont to 74 in Sicily.

THE *Insurance Critic* asserts that there are more than 10,000 steam boilers in New York city, attended by 7,000 men, of whom not one-seventh are believed to be trustworthy and qualified for their responsible work; and yet dynamite cartridges are a terror to many people.

ACCORDING to Mr. Chamberlain, 120 applications for provisional orders have been made to the Board of Trade since the passing of the Electric Lighting Act. Of these 73 have been granted by the Board of Trade and confirmed by Parliament. There have been ten applications for licences. One for Colchester was to be granted in the course of a few days. The remainder have not been proceeded with by the applicants. The supply of electricity has not been commenced under any of the orders.

ONE of the most accomplished writers and artists of the day has recently been spending a short period in Holloway Gaol, as an imprisoned debtor, the object being to thoroughly show up and expose the gross iniquities of our law under which debt is still by a fiction treated as a crime. The series of prison sketches and notes will be commenced in *St. Stephen's Review* of the current week, under the title "Notes from a Debtor's Dungeon," and will rival the famous work of the "Amateur Casual."

ELECTRIC CONDUCTIVITY OF SOLUTIONS.—According to the recent researches of M. Bouty, the neutral salts in very extended solutions of water form a group apart as regard their electric conductivity. For example, ethylic alcohol, glycerine, erythrite and phenol, glucose and candied sugar, ordinary ether and dichlorhydrine, ethylic aldehyde and acetone, as well as albumen, all conduct very badly. M. Bouty has also come to the conclusion, from his experiments, that an anhydrous alkali or acid is not a conductor, but that a hydrated acid or alkali conducts like a salt.—*Engineering*.

WE have received from Messrs. Rowney & Co., Oxford-street, a specimen of "Wood's Adjustable Geometrical Ruler," which combines in a box of a very portable form, measuring 11½ inches by 2½ inches, an ordinary ruler, a T square, set square, protractor, &c., and a new contrivance for drawing and dividing circles and geometrical figures. After a little attention and practice the instrument will prove very handy and useful to any one who has frequent occasion to construct figures, etc., which by the ordinary rules of geometry take a considerable time in working.

ALMOST all the Sicilian sulphur ore is carried to the surface on boys' backs, consequently it does not pay to work below about 400 ft., as it then becomes necessary to employ hauling machinery. Hence the deposits lying below that level are hardly touched, and as many of the beds are nearly vertical, and do not diminish in yield as they descend, the still untouched resources must be very great. Various estimates have been made as to the period for which the supply will last at the present rate of consumption: these range from 50 to 200 years. There are said to be about 250 mines in the island, and no less than 4,367 calcaroni were reported in operation fifteen years ago. The average yield is stated not to exceed 14 per cent.

AT a recent Conference held at the Health Exhibition, it appeared from some statistics collected by Dr. Ord that gardeners had a better chance of life than any other class out of some eighty specified classes of workers, with the exception of clergymen. If 1,000 be taken as the average standard number of deaths within a given period among all classes taken together, then the number of gardeners who die during the period is barely more than half the average—*i.e.*, 559; that of clergymen, who have the best chance of all, 556; agricultural labourers, 633; farmers, 675; medical men, 1,125. The highest death-rate is among persons engaged in hotels, 2,205; inn-keepers, 1,521; brewers, 1,361—significant figures these! The proportion of medical men who die in a given time, though above the general average, is less than might have been expected from the harassing life they mostly lead, and the special risk they run.

THE PHYSIOLOGICAL ACTION OF HELODERMA POISON.—That this lizard, the Gila monster (Heloderma suspectum) is venomous, has been often asserted and as often denied. Weir Mitchell and Reichert find that its mouth-liquids are highly poisonous, killing frogs, pigeons, and rabbits in a few minutes. This establishes it as the only venomous lizard known. What is of even more interest, perhaps, is the fact that the physiological action of the poison is quite different from that of snake-poison: the latter kills essentially by paralysing the respiratory centre, the former by paralysing the heart. Heloderma venom causes no local injury when injected subcutaneously; and arrests the heart in diastole, from which condition the organ slowly passes into a contracted state. The heart-muscle entirely loses its irritability when the organ ceases to beat, and when other muscles and the nerves still readily respond to stimulation. The spinal cord is paralysed.

ELECTRIC LIGHTS FOR LIGHTHOUSES.—General Duane has, since August last, been carrying out a series of experiments as to the applicability of electric lights for lighthouse work for the United States Lighthouse Board. The experiments have been carried out at Tompkinsville, Staten Island, the electric portion being under the charge of Lieut. John Millis. The present result of the experiment is that the electric light is found to be ten times more powerful than the oil light, and that for a given amount of light it is the cheaper of the two. It is said that of the apparatus tried the most useful has been found to be that at present in use in the French lighthouses. Among the dynamos tried have been the Gramme, Elphinstone-Vincent, Siemens, and Weston. The report on these experiments is not expected to be ready for some months yet, but when it does appear it will be of the greatest interest. If the report of the committee now engaged in the same kind of experiments for the Trinity House at the South Foreland should appear contemporaneously with that of General Duane some interesting comparisons might be made.—*Electrician*.

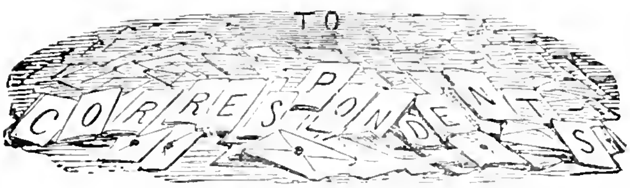
WHATEVER degree of truth may attach to Lamartine's remark that before the present century shall have run out Journalism will be the whole press of the world—the whole of human thought—there can be no doubt that the profession is becoming one of increasing importance, and one that attracts an ever-growing number of followers. Many an aspirant for journalistic fame is, however, at a loss how to set about the realisation of his ambition, and a good handbook or guide affording trustworthy information as to the qualifications necessary for each branch of the journalistic profession has not hitherto been available. With a view to supply this want a series of articles has been commenced in the *Printing Times and Lithographer* for July, dealing with every phase of the subject. The articles are from the pen of Mr. A. Arthur Reade, well known as the author of the "Literary Ladder," "Study and Stimulants," "How to Write English," &c. The popularity which these several works have enjoyed entitles one to anticipate an equally favourable reception for the present series of articles, which have, moreover, had the benefit of revision by a number of leading journalists.

AUSTRALIAN TIMBER.—A Board appointed to inquire into and experiment on the best kind of timber grown in the Australian colonies, and adapted for the construction of railway vehicles, has sent in its report. Among the woods which the Commissioners mention as suitable are blackwood, mountain ash, bluegum, and Gippsland mahogany. Under test the blackwood presented results which were superior to any other timber. The mountain ash was second to the blackwood for railway purposes. It should be felled, the Commissioners think, during the winter months, when it has attained maturity, and is between 4 ft. and 5 ft. in diameter, and it might remain felled for six months before being broken down into planks for seasoning. Bluegum should be treated in the same manner. Going somewhat beyond its reference, the Board deals with the question of timber licenses, and recommends that getters be compelled to pay for the timber felled, and to confine their operations to a given area, or otherwise that selected lots of trees be sold by tender. It is also strongly recommended that a forest board should be called into existence. [The above, taken from *Engineering*, serves to show that the continually-increasing demand for timber is causing considerable anxiety, not only in Europe and America, but in every quarter of the civilised world.]

A VALUABLE contribution to the literature of physical astronomy * has recently been made in the issue by the Bureau of Navigation at Washington of Parts I. and II. of Vol. II. and Part I. of Vol. III. of "Astronomical Papers prepared for the Use of the American 'Ephemeris and Nautical Almanac.'" In the first of these parts the formulæ necessary for expressing the corrections to the geocentric right ascension and declination of a planet are deduced in terms of correction to the elements: the expressions thus obtained being deduced to numbers for the planets Mercury and Venus, and tables for those two planets respectively being appended. The second part of Vol. II. contains investigations of corrections to the Greenwich Planetary Observations, 1762–1830; and, to the general reader, will probably be found the most interesting of the three, if it be only for the succinct history of the instruments employed at

* We use these words in the original and legitimate sense, and by no means in the modern one of watching sunspots to predict rain and periods of stock-jobbing insolvency.

our British National Observatory (and the nature of their errors) during the period specified. Part I. of Vol. III. of these "Astronomical Papers" is purely technical, and is "On the Development of the Perturbative Function." In it the subject is first treated analytically in an exhaustive manner, and the tables are appended for the numerical development of it. It is instructive to compare the liberal and judicious expenditure of the Government of the United States in perfecting their National Ephemeris, with the parsimony of that of our own country in connection with our *Nautical Almanack*, in which, to take a single example, the phenomena of Jupiter's satellites are still computed from the imperfect and erroneous tables published by Damoiseau nearly fifty years ago. This will serve as well as anything to illustrate the merely mechanical—or barrel-organ kind of principle on which the annual calculations are ground out in Verulam Buildings. Meanwhile, any one who is sufficiently pushing and impudent, and can obtain the ear of members of the Government personally ignorant of science, seems to have no difficulty in dipping his hands into the public purse. If the money, absolutely and utterly wasted every year on a shallow sham called "The Committee on Solar Physics," at South Kensington, were devoted to the improvement of the *Nautical Almanack*, the advantage to astronomical science could hardly fail to be very great indeed.



"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

DICKENS'S STORY LEFT HALF TOLD (No. 139).

[1343]—Being the writer of what Mr. Thomas Foster calls "a recent rather feeble article on the subject in the *Cornhill Magazine*," I should like, with your permission, to make a few observations.

Not having read "Leisure Readings," I am not well aware what Mr. Foster's theory really is, and should therefore be glad to learn in what number of Knowledge his former article on this subject appeared.

Until I have had the pleasure of reading it, I will only ask whether Mr. Foster has seen the article, "How Edwin Drood was Illustrated," which appeared in the *Century Magazine* for February, 1884?

From that I quote the following few sentences:—"The central crime of the book can never have been intended by the author to be a mystery; the secret that Charles Dickens intended to keep, and kept in effect, was the manner of the discovery. He is a keen reader who has ever found out who and what was Mr. Datchery, and of this Mr. Fildes knows no more than does the public."

"But, finding that Mr. Fildes knew a great deal, Charles Dickens went on to make the principal revelation which concerned the central figure; he told his illustrator that Jasper was to be brought to justice in the end of the story. A drawing of this originally and most strongly-conceived criminal locked up in the condemned cell (which was to have been studied at Rochester) was then planned between the two as one of the final subjects."

Mr. Foster contends that Edwin Drood is alive, though Jasper does not know it. That he should keep his very existence a secret for six months—causing terrible grief to Rosa and others—for the purpose of taking a deadlier vengeance in the end on Jasper, does not, I confess, appear to me reasonable; but then I suppose I am what Mr. Foster calls "a commonplace reader."

In conclusion, I may mention that I received letters from two gentlemen—both strangers to me—insisting that Baggard is Datchery. One wrote from Boston, U.S., the other from Jersey. But on this point I agree with Mr. Foster, and differ from my correspondents as widely as their homes are distant. H. E.

[As Mr. Foster is, I imagine, by this time on the other side of the Atlantic, a fortnight or three weeks must certainly elapse before I can receive any reply or comment on the above letter from him. —Ed.]

THE SOLAR GLOW.—VENUS IN INFERIOR CONJUNCTION.

[1344]—In connection with the letter (1342, p. 61) of "Cosmopolitan," it may be of interest to mention that I have received a letter from that careful and painstaking observer, Mr. T. R. Clapham, of Austwick Hall, near Lancaster, describing the appearance of the solar glow as seen by him on the 12th inst. It was (naturally) most favourably seen when the sun himself was obscured by a cloud, leaving the surrounding sky clear. Under these circumstances, the ruddy glow seemed very approximately to follow the outline of the cloud; but there was also one fine reddish streamer, with almost parallel edges, above the cloud; in shape, exceedingly like one of the beams of light visible when, as the country people say, "the sun is drawing water." This is illustrated by a water-colour sketch, which could not, of course, be reproduced here in colour. My correspondent goes on to say that the after-glow was stronger on the night of July 13 than he had known it for some weeks. Assuredly there is *something* still permeating the atmosphere in its upper regions.

Mr. Clapham adds that at 10h. 30m. a.m. on Saturday 12, he could easily see the dark body of Venus with a 3¼-in. Wray telescope; but that he could not trace the dark limb right round. I mention this because on the previous day at 10h. 41m. a.m., I saw precisely the same thing with my 4·2 in. Ross equatorial, armed with a power of 151; the dark limb of the planet being traceable for a considerable distance beyond the cusps, but fading into the bright sky in its southernmost portion. William Noble.

Forest Lodge, Maresfield, Uckfield, July 18, 1884.

THE "WAR OFFICE GHOST."

[1345]—I take the following particulars from Wallace's "Miracles and Modern Spiritualism," pp. 72-3, where I happened to read it yesterday.

Captain Wheatcroft's "ghost" appeared, not only to his wife—who by the way was in bed at the time—but to another lady, in London. On inquiry, R. Dale Owen (from whose narrative Wallace draws most of his facts) gathered from this lady and her husband that it was about 9 p.m. of Nov. 14, 1857, that the spirit appeared in uniform. He was struck by a fragment of shell, it seems, in the breast, on the afternoon of the 14th, not the 15th, as the War Office certificate first put it. The times, therefore, are within the limits required on the assumption, which is quite unnecessary, that the apparition occurred *simultaneously* with the death. If anything really hinged on the exact synchronism it might be worth while to make more minute inquiries as to the circumstances of the Indian battle-field. But I really see none. It is quite sufficiently convincing as it is, so long as nothing essential is authoritatively denied. J. Herschel.

[Mr. R. Dale Owen can scarcely be accepted as a trustworthy authority on anything whatever having reference to the "supernatural." Readers interested in the spiritualistic imposture will not have forgotten his famous article in the *Atlantic Monthly*, on the bona fides of the apparition of "Katie King," through the mediumship of a Mr. and Mrs. Nelson Holmes; nor his subsequent humiliating confession of the way in which those people had humbugged him. If Mr. Wallace has no better voucher for his "facts" than Mr. Owen, assuredly they must be taken with something more than a grain (say a salt-cellar full) of salt.—Ed.]

A COINCIDENCE.

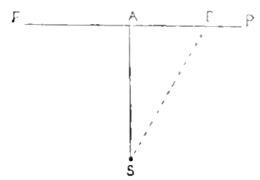
[1346]—In May last, a friend mentioned to me in conversation a poem by the late Dean Stanley, entitled "The Untravelled Traveller," and addressed to Prince Leopold on the latter's recovery from a severe illness at Oxford. I had never seen or heard of the poem before, and my friend, who was extremely anxious to procure a copy, begged me to let him know if I ever met with it, as he did not know where it was to be found. We then spoke of other things, and no further allusion was made to the subject—in fact, I quite forgot it till the next morning, when, quite casually taking up a small monthly magazine (which, by-the-by, I seldom read) from my sister's writing-table, almost the first thing that met my eye was a reprint of this very poem. It would have been the last place I should have thought of looking in.

ARDENNES.

PERSPECTIVE.

[1317]—Some of your correspondents seem to have got into a puzzle over their perspective. They seem to find a difficulty in understanding how parallel lines perpendicular to the line of sight—that is, lying in planes parallel to the plane of the picture, can be correctly presented to the eye of the spectator by parallel lines on the plane of the picture.

Your correspondent "C. E. Bell" seems to forget that, although the upper and lower edges of the cube *may* be shown by parallel lines in the picture, yet the *angle subtended with the eye* by the perpendicular edges of the cube varies with the distance to right or left, as the case may be, while the edges are from the centre of the picture or line of sight.



Thus, if P P in the annexed diagram be the plane of the picture shown in plan, S, the spectator's eye, and S A, the line of sight, it is obviously seen that a given dimension M on the plane of the picture at A will subtend a larger angle with the eye than the same dimension M at B.

Let "R. Jones," "C. E. Bell," and others simply examine the photograph of any rectangular object taken with the plate of the camera parallel to one face of the object, and they will find that all the horizontal lines in the object which are in planes parallel to that of the plate will appear as parallel lines in the picture.

In connection with this subject I would remark that artists are in the habit of showing the sea-line as a straight horizontal line. Now this is not strictly correct, and especially when the sea is viewed from a great height.

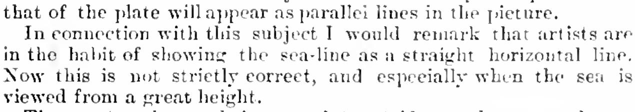
The spectator's eye being a point outside a sphere, may be regarded as the apex of a flat cone, the base of which is a circle whose radius is (approximately), the distance of the spectator from the horizon.

If a straight-edge be held up to the eye when looking towards the sea-line from a lofty cliff on the sea-shore, the curvature of the horizon becomes plainly visible. I commend this experiment to crazy Zetetics, though, doubtless, they can explain this as easily as every other fact that tells against them. E. W. YOUNG.

[What *is* "a flat cone"?—ED.]

SHIPS' LIGHTS.

[1318]—Apropos of your propositions respecting ships' lights in "Sent to the Bottom," in a former number of KNOWLEDGE, the reduction of the number of lights being most desirable, may I venture to offer for your consideration the following alteration, namely, that *two* lights on each side only be adopted, in lieu of three side and two end lights. Thus, let the foremost light be white on each side, and visible from right ahead to right astern, and placed 15 (?) feet from the sternmost, and 5 (?) feet above that light—the sternmost light to be particoloured—white showing ahead to well abeam, but say red astern to nearly abeam; steamships carrying a fifth masthead light as at present. A sketch may make my suggestion clearer:—



Starboard. (White.) Port. (White.) Ahead. (White.) Astern. (*a*. White.) (*b*. Red.)

The opening apart of the lights from a perpendicular line, as when seen from "right ahead," to their greatest distance apart, as when seen from "abeam," and their closing again, the lower becoming red, to their original position, as when seen from "right astern," would indicate the required information as to course of observed ship. The *regulation* interval between the lights being invariably adopted, would become by habit easily and surely recognisable as representing by their varied proximity the direction and distance of the observed ship.

I leave this suggestion with you, as you may in a few moments run over an imaginary series of positions as depicted in your excellent magazine, substituting the two lights alone in lieu of the five there shown, bearing in mind, at the same time, that ships at sea are not, as a rule, on an even keel or even beam, so to put it. A ship, say 30°—nay, 40°—out of the perpendicular, as often happens, and at a time when lights are most requisite and important, would materially alter the relative length of the perpendicular side of your triangle, and that of each of the other two. I recognise that that upright side forms the gauge by which the apparent lengths of the other two are measured, and so the course of the vessel estimated. What, therefore, are we to do to obtain that information when our gauge or foot-rule is liable to considerable variation from this heeling over of the ship at sea? Let it also be remembered that *perpendicular space* available for effectively showing lights from the side of a ship is very limited. What would our lee triangle be like with our bottom light in danger of entire submersion. The side lights now are carried almost invariably several feet above the top rail of bulwarks for this very reason, and if placed much higher would be eclipsed by the sails. All this, and more, I am sure, will present itself to your mind, and I need enlarge no further. My best thanks are due to you for many most instructive and enjoyable hours spent in company with you in KNOWLEDGE from No. 1.—I am, sir, &c., CHAS. RICE.

TESTS OF DIVISIBILITY.

[1319]—In letter 1331 (p. 39) I stated that 999 . . . to $(n-1)$ figures can be divided by n without remainder whenever n is prime to 10. I find it is not so.

When n is a *prime number* it will divide 999 . . . . to $(n-1)$ figures.

When n is composed of *unequal* factors a, b, c, &c., the number of 9's required is $(a-1)$ $(b-1)$ $(c-1)$ . . . . , or some factor of this.

When n contains *equal* factors (=say, $a^p b^q c^r$ . . . .), the number is

$$a^{p-1}(a-1)b^{q-1}(b-1)c^{r-1}(c-1) \cdot \cdot \cdot \cdot$$

or a factor of this.

Thus the number of 9's required can never exceed $(n-1)$.

W.

LETTERS RECEIVED AND SHORT ANSWERS.

FITZGREEN. The word "aperture," in the reply to which you refer, had reference to a refractor, but $2\frac{1}{2}$ inches was a misprint for $2\frac{1}{4}$ inches. This would have an approximate focal length of 30 inches, and would cost between £7 and £8. An instrument furnished with a $2\frac{1}{2}$-inch object-glass would be of about 3 feet focus. Either of these would bear a power of 200 on close double stars; the latter even a somewhat higher one. No reflector of less than $3\frac{1}{2}$ inches aperture is of the slightest use.—CASTOR. The cause to which you refer, viz., the production in the offspring in an aggravated form of diseases common to their consanguineous parents, is the generally-accepted reason given against marriage between cousins. On the other hand, as you say, two people standing in that relation, each healthy and of exceptional intellectual power, might fairly be expected to beget a high type of children. Still, every agriculturist knows the evil of "breeding in and in"; and what is so well established in the case of the brute creation may reasonably be held to apply to man in his animal relations.—A. C. D. C. suggests, in connection with a statement on p. 23 as to the origin of a rite held as sacred by Christians, "that Mr. Clodd should show that a similar one was observed in any religious system previous to the introduction of Christianity." He also finds fault with Mr. C.'s assertion that "the eastward position is the undoubted relic of worship of the rising sun," with which I am considerably more surprised, inasmuch as I imagined that this was admitted as an indisputable fact by all save a very few bigoted and ignorant people indeed.—W. A. LEONARD. Thanks, but I have already declined a series of articles on the same subject from a thoroughly competent member of our own staff.—J. MURRAY. The apology is sufficient.—SIGMA. Your reasoning is utterly fallacious. You deal with infinity as a quantity which can form a member of an equation! Were this possible, you might *multiply* it; but you can no more talk of five times infinity than you can of nothing². An "infinite circle" is absolutely unthinkable. It can have neither centre nor circumference.—W. BROOKS SAYERS. Would you be surprised to hear that a gentleman named Aristarchus of Samos (who died B.C. 212) anticipated you in your idea of determining the distance of the sun, by observing the angle subtended by him and the dichotomised moon, some 2,160 years ago? From the practical impossibility, however, of ascertaining when the moon is exactly half-full, he made out that the sun's distance from the earth was only nineteen times that of the moon; whereas, as we know, this is less than a twentieth part of its true value. Your absurd endorsement of "private" on your letter has delayed it exactly a week.—GARTH WILKINSON opines that the vaccine eruption is contagious.—T. MANN. The principal movements of the earth are:—1. The annual. 2. Her motion round the centre of gravity of herself and the moon. 3. The diurnal. 4. What you speak of as the precessional, or that conical motion of her axis which gives rise to the Precession of the Equinoxes. 5. The Nutational. 6. The secular change in the obliquity of the ecliptic. 7. The revolution of her apsides. 8. The secular variation is the eccentricity of her orbit, and, 9, her motion in space in common with the whole solar system. The contributor to whom you refer seems to have forgotten his promise.—A. MACKAY. See reply to you on page 61 and paragraph on page 62.—JAS. GILLESPIE. Do, for goodness sake, master the rudiments of your subject. Do you know that the earth's mean equatorial semi-diameter only subtends an angle of 8·85″ at the Sun, and that the Pole Star *is* actually vertically overhead in latitude 88° 11′ north? Polaris is not in the pole of the heavens, but 1° 19′ from it. You seem hopelessly incapable of comprehending that at the enormous distance of the fixed stars all lines simultaneously drawn to them from any parts of the earth's surface are parallel—nay, that so remote are they that even the diameter of her orbit shrinks to a point as viewed from them!—J. GREEVZ FISHER sends me "Five Rulez for Improving Spelling," for which I am much obliged: but fancy that I shall continue to employ, for some little time to come, orthography so thoroughly "understanded of the people" as that which he seeks to supersede.—POLYGLOT. Thanks. Certainly not at present.—NIGEL DOBLE. Premising that 66 inches is a ridiculously inadequate focal length for a 6-inch object-glass (which would perform infinitely better if it had a focus of 90 inches). I may tell you that you would need at least four eye-pieces for astronomical purposes, which, with a 66-inch objective, would be constructed as follows. each, of course, consisting of two plano-convex lenses, with the plane sides next the eye. No. 1 field-glass 1·65-inch focus, eye-glass 0·55-inch focus, 1·1 inch apart. This would give a power of 80. No. 2 field-glass, 0·73 inch focus, eye-glass 0·24 inch focus, 0·48 inch apart. This would magnify 180 diameters. No. 3 field-glass, 0·53 inch focus, eye-glass 0·18 inch focus, 0·36 inch apart. This would magnify 250 times. And No. 4 Field-lens, 0·26 inch focus, and eye-lens 0·09 inch focus, 0·17 inch apart. This would give a power of 500 for very close double stars. Each of these eye-pieces should have a diaphragm, to limit the field of view, placed in the focus of the eye-glass. I do not know the work you mention.—MALCOLM FYFE. The perusal of your letter suggests the dictum of the great American philosopher: "There's nothing new, and there's nothing true, and it don't much signify." In everything of the slightest value you have been anticipated by Mr. F. H. Wenham and others—years ago.—AUGUSTUS J. HARVEY suggests the appointment of a staff of commissionaires to conduct visitors to the principal points of interest of the Health Exhibition, and to explain the most important objects shown there.—THE PRESIDENT AND COUNCIL OF THE SOCIETY FOR THE STUDY AND CURE OF INEBRIETY. I regret that I was a good many miles from London on the evening of the 21st.—H. W. JACKSON. Please communicate with Messrs. Wyman & Sons, the publishers of KNOWLEDGE.—LAW. Prior to the receipt of your letter I was ignorant that there were any Whitworth *Law* Scholarships at all.—W. E. SNELL. No one, that I am aware of, has ever disputed in these columns the value of sanitation as one form of prevention of small-pox.—A. MCDONNELL. I will read your pamphlet as impartially as I can.—EYE-WITNESS. Something of the sort was attempted on p. 247 of our last volume, but did not seem to meet any general want. My large star-atlas would enable you to learn the constellations.—G. PINNINGTON. "I think *not*," says the lamb.—G. C. I do not know the particular book you mention, but the names of its joint authors afford a sufficient guarantee of its excellence. Bloxam's is *my* text-book. Churchills publish it, and it is first-class, but it cost rather more than your specified price.

In response to numerous applications, it has been decided to issue "The Index" to Volume V. of KNOWLEDGE, *with the present number, free of charge.*

Our Mathematical Column.

NOTES ON EUCLID'S SECOND BOOK.

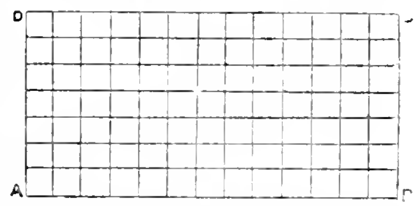
By RICHARD A. PROCTOR.

(*Continued from p. 41.*)

IT is well to notice the algebraical and arithmetical relations which the different relations presented in the preceding propositions serve to illustrate.

We must show first that if each of the two lines which contain a rectangle can be divided into an exact number of parts each equal to some unit of linear measurement, then the product of the two numbers represents the number of corresponding units of square measurement contained in the rectangle.

Let the rectangle A B C D be contained by the lines A B, A D; and suppose that a certain unit of length is contained 13 times in A B and 7 times in A D. Then if A B be divided into 13 equal parts and A D into 7 equal parts, each part of each line is equal to this unit of length. And



if we draw through the points of division in A B lines parallel to A D, and through the points of division in A D lines parallel to A B, it is clear that the rectangle A B C D will be divided into a number of squares each having its sides equal to the unit of length. Now each row of squares parallel to A B contains 13 such squares, and there are seven such rows. Therefore the whole rectangle contains 7 times 13 squares. Thus the product of the numbers 7 and 13, which represent the length of the sides in terms of the linear unit, gives us the number representing the area of the rectangle in terms of the corresponding unit of square measurement. And the proof would have been precisely the same whatever the number of units of linear measurement in the sides A B, A D,—so that, if A B contains a such units, and A D contains b, the rectangle A B C D contains $a\,b$ units of square measurement.

It would be easy to extend this proof to the case of a rectangle having incommensurable sides; but for the purpose of illustration the case of commensurable sides is sufficient. This commensurability is to be understood as implied in what follows.

In Euc., Book II., Prop 1, if the undivided line contain a units of length, the several parts of the divided line b, c, and d units, respectively, the proposition corresponds to the algebraical identity

$$a(b+c+d)=a\,b+a\,c+a\,d.$$

Prop. 2.—If the undivided line contain $(a+b)$ units of length, its parts a and b units correspond to the identity

$$(a+b)a+(a+b)b=(a+b)^2$$

In Prop. 3, on the same supposition, the algebraical identity corresponding to the proposition is

$$(a+b)b=a\,b+b^2.$$

Prop. 4, on the same supposition, corresponds to the identity

$$(a+b)^2=a^2+2\,a\,b+b^2$$

In Prop. 5, let A B$=2x$, and C D$=b$, so that A D$=(a+b)$ and D B$=(a-b)$ then the corresponding algebraical identity is

$$(a+b)\ (a-b)\ +b^2=a^2$$

that is, the well known relation

$$a^2-b^2=(a+b)\,(a-b).$$

But if we put A D$=a$ and D B$=b$, we obtain the relation—

$$a\,b+\left(\frac{a-b}{2}\right)^2=\left(\frac{a+b}{2}\right)^2;$$

that is, the well known formula—

$$(a+b)^2-(a-b)^2=4\,a\,b$$

We get the same identities in the case of Prop. 6, if we make corresponding suppositions, simply interchanging a and b.

In Prop. 7, put A C$=a$, and B C$=b$, then the algebraical identity corresponding to the proposition is

$$(a+b)^2+b^2=a^2+2b\ (a+b)$$

In Prop. 8 put A C$=a$, and B C$=b$; then the corresponding algebraical relation is

$$4(a+b)b+a^2=(a+2b)^2.$$

In Prop. 9 put first A B$=2\,a$ and C D$=b$; then the corresponding algebraical identity is

$$(a+b)^2+(a-b)^2=2(a^2+b^2).$$

Next put A D$=a$ and D B$=b$, and we obtain the relation

$$a^2+b^2=2\left(\frac{a+b}{2}\right)^2+2\left(\frac{a-b}{2}\right)^2$$

which is not a new relation, the change in our suppositions merely leading to the inversion of the former relation.

In Prop. 10 corresponding suppositions with the interchange of a and b give the same results.

It will be found that any theorem respecting rectangles may be shown to correspond to an algebraical identity,—and in like manner that any homogeneous algebraical identity of two dimensions may be made to supply one or more geometrical theorems respecting rectangles.

Let us take as an instance the following identity :—

$(a+b+c)^2 = a^2+b^2+c^2+2ab+2bc+2ca$; this resolves itself into the following proposition :—

Prop. I. *If a straight line* A B *be divided into any three parts in the points* C *and* D; *then the square on* A B *shall be equal to the squares on* A C, C D, *and* D B, *together with twice the rectangles contained by* A C, C D, *by* A C, D B, *and by* C D, D B.

By Euc. II., prop. 4, the square on A B is equal to the squares on A C, C B together with twice the rectangle A C, C B; that is (again applying Prop. 4) to the squares on A C, C D, D B, together with twice the rectangle C D, D B, and (Prop. 1) twice the rectangles A C, C D, and A C, D B.

Prop. II is an important one. It may be enunciated also thus,—*To divide a given straight line into two parts so that the squares on the whole line and on one of the parts may be together equal to three times the square on the other part.* That this enunciation is equivalent to the other follows immediately from Prop. 7. Prop. II offers a problem somewhat more difficult than most of those in Euclid. It is made use of by him in Book IV. Prop. 10; but when it is required for the solving of Prop. 30, Book VI., he appears to have forgotten that he had already solved it, and adopting a less happy mode of analysing it occupies three long propositions with its solution. We shall note an analogous proposition in our next contribution on this subject.

(To be continued.)

Our Chess Column.

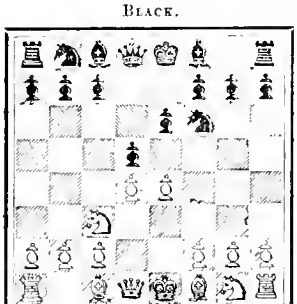
By Mephisto.

THE FRENCH DEFENCE.

1. $\frac{\text{P to K4}}{\text{P to K3}}$.

This is a perfectly sound and safe defence, and suitable whenever the second player wishes to play a close game or avoid the more attacking lines of play arising from 1. P to K4; White's best reply is 2. $\frac{\text{P to Q4}}{\text{P to Q4}}$. If now P × P, then P × P followed by Kt to KB3, B to Q3, and Castles with a safe game. White may also play 3. $\frac{\text{Kt to QB3}}{\text{Kt to KB3}}$—B to Kt5 would not lead to any favourable result. White now would not gain anything by advancing P to K5, as, after Kt to Q2, Black would vigorously attack the centre by P to QB4, Kt to B3, &c. If 3. P × P, P × P, and we have a normal position which Black follows up by B to K2 and Castles. White has now two lines of play, viz. :—B to Q3 and B to KKt5. If

Black.



White.

4. B to Q3	P × P
5. Kt × P	B to Q2
6. Kt to K2	B to B3
7. P to B3	B to K2
8. Castles	Castles

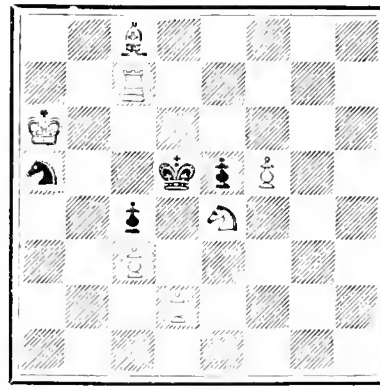
and in this variation White has a good position. It might perhaps have been better to play 5. P to QKt3, followed by B to Kt2, as that would leave the square on B3 open for the Knight. If instead

4. B to KKt5	B to K2
5. B × Kt	B × B
6. Kt to B3	Castles
7. B to Q3	P × P
8. B × P	Kt to B3

With two Bishops on the board, Black need not be afraid to have his Pawn doubled, the position being an even one.

SELECTED PROBLEMS.

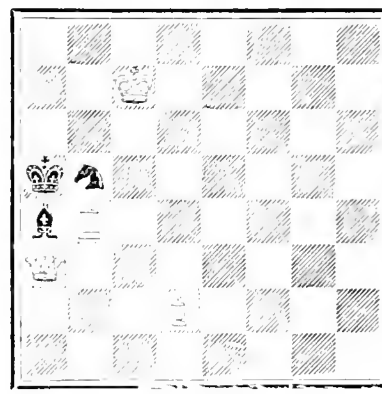
Black.



White.

White to play and mate in three moves.

Black.



White.

White to play and mate in two moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Frankford.—If 1. Q to K3, P to Kt6, 2. Kt to K6(ch), K to Kt5, 3. Q to Q5, K to R6.

Geo. W. Thompson.—Solution not quite correct. 1. Kt to B3, 2. Kt to Kt3(ch), Q × Kt, 3. Kt to Q7(ch), Kt × Kt.

George Gouge.—1. Kt to Bsq, 2. Kt × P, and mates next move.

Correct solutions received from M. T. Horton and A. Rutherford.

The Owl.—Part solution correct.

Contents of No. 142.

SPECIAL NOTICE.

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CONTENTS OF No. 141.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XXXIX. COUNT RUMFORD'S DIETETICS.

In the formula for Rumford's soup given in my last, it is stated that the bread should not be cooked, but added just before serving the soup. Like everything else in his practical programmes, this was prescribed with a philosophical reason. His reasoning may have been fanciful sometimes, but he never acted stupidly, as the vulgar majority of mankind usually do when they blindly follow an established custom without knowing any reason for so doing, or even attempting to discover a reason.

In his essay on "The Pleasure of Eating, and of the Means that may be Employed for Increasing it," he says:— "The pleasure enjoyed in eating depends, first, on the agreeableness of the taste of the food; and, secondly, upon its power to affect the palate. Now, there are many substances extremely cheap, by which very agreeable tastes may be given to food, particularly when the basis or nutritive substance of the food is tasteless; and the effect of any kind of palatable solid food (of meat, for instance), upon the organs of taste, may be increased, almost indefinitely, by reducing the size of the particles of such food, and causing it to act upon the palate by a larger surface. And if means be used to prevent its being swallowed too soon, which may easily be done by mixing it with some hard and tasteless substance, such as crumbs of bread rendered hard by toasting, or anything else of that kind, by which a long mastication is rendered necessary, the enjoyment of eating may be greatly increased and prolonged." He adds that "the idea of occupying a person a great while, and affording him much pleasure at the same time in eating a small quantity of food, may, perhaps, appear ridiculous to some; but those who consider the matter attentively will perceive that it is very important. It is perhaps as much so as anything that can employ the attention of the philosopher."

Further on he adds:—"If a glutton can be made to gormandise two hours upon two ounces of meat, it is certainly much better for him than to give himself an indigestion by eating two pounds in the same time."

This is amusing as well as instructive, so also are his researches into what I may venture to describe as the *specific sapidity* of different kinds of food, which he determined by diluting or intermixing them with insipid materials, and thereby ascertaining the amount of surface over which they might be spread before their particular flavour disappeared. He concluded that a red-herring has the highest specific sapidity, *i.e.*, the greatest amount of agreeable flavour in a given weight of any kind of food he had tested, and that, comparing it on the basis of cost for cost, its superiority is still greater.

He tells us that "the pleasure of eating depends very much indeed upon the *manner* in which the food is applied to the organs of taste," and that he considers "it necessary to mention, and even to illustrate in the clearest manner, every circumstance which appears to have influence in producing these important effects." As an example of this, I may quote his instructions for eating hasty pudding:— "The pudding is then eaten with a spoon, each spoonful of it being dipt into the sauce before it is carried to the mouth, care being had in taking it up, to begin on the outside, or near the brim of the plate, and to approach the centre by regular advances, in order not to demolish too soon the excavation which forms the reservoir for the sauce." His solid Indian corn pudding is, in like manner, "to be eaten with a knife and fork, beginning at the circumference of the slice, and approaching regularly towards the centre, each piece of pudding being taken up with the fork, and dipped into the butter, or dipped into it *in part only*, before it is carried to the mouth."

As a supplement to the cheap soup receipts given in my last, I will quote one which Rumford gives as the cheapest food which in his opinion can be provided in England:— Take of water eight gallons, mix it with 5 lb. of barley-meal, boil it to the consistency of a thick jelly. Season with salt, vinegar, pepper, sweet herbs, and four red herrings pounded in a mortar. Instead of bread, add 5 lb. of Indian corn made into a *samp*, and stir it together with a ladle. Serve immediately in portions of 20 ounces.

Samp is "said to have been invented by the savages of North America, who have no corn-mills." It is Indian corn deprived of its external coat by soaking it ten or twelve hours in a lixovium of water and wood ashes.* This coat or husk, being separated from the kernel, rises to the surface of the water, while the grain remains at the bottom. This separated kernel is stewed for about two days in a kettle of water placed near the fire. "When sufficiently cooked, the kernels will be found to be swelled to a great size and burst open, and this food, which is uncommonly sweet and nourishing, may be used in a great variety of ways; but the best way of using it is to mix it with milk, and with soups and broths as a substitute for bread." He prefers it to bread because "it requires more mastication, and consequently tends more to prolong the pleasure of eating."

The cost of this soup he estimates as follows:—

	d.
5 lb. barley-meal, at 1½d. per lb., or 5s. 6d. per bushel...	7½
5 lb. Indian corn, at 1¼d. per lb.	6¼
4 red herrings	3
Vinegar	1
Salt	1
Pepper and sweet herbs	2
	1/8¾

This makes 64 portions, which thus cost rather less than one-third of a penny each. As prices were higher then than

* Such lixovium is essentially a dilute solution of carbonate of potash in very crude form, not conveniently obtained by burners of pit coal. I will try the commercial carbonate, and report results in my next, stating quantities and other particulars. I have but just come upon this particular soup receipt for the first time.

now, it comes down to little more than one farthing, or one-third of a penny, as stated, when cost of preparation in making on a large scale is included. I have not yet tried this soup. In reference to the others specified in my last, I should add that I found it advantageous to use a double vessel—a water-bath constructed on the glue-pot principle. Such vessels are sold under the name of "milk-scalders."

The reason of this is, that with our ordinary fireplaces the heat is so great that the liability to char the bottom of the thick porridge is a source of trouble. Rumford's fireplaces were so skilfully constructed, and used with just as much wood fuel as was required to do the work demanded, and thus this difficulty scarcely existed. I have little doubt that one of the reasons why the thin broth of our workhouses and prisons takes the place of his thick soup is, that the liquid stuff demands no skill nor attention from the officials who superintend and the cooks who prepare it. Their convenience is, of course, sacred.

The feeding of the Bavarian soldiers is stated in detail in Vol. I. of "Rumford's Essays." Space will permit me only to take one example, and that I must condense. It is from an official report on experiments made "in obedience to the orders of Lieut.-General Count Rumford, by Sergeant Wickelhof's mess, in the first company of the first (or Elector's own) regiment of Grenadiers at Munich."

June 10, 1795.—Bill of Fare.

Boiled beef, with soup and bread dumplings.

Details of the Expense.

First for the boiled beef and the soup.

lb.	loths.		Creutzers.
2	0	beef	16
0	1	sweet herbs	1
0	0¼	pepper	0½
0	6	salt	0¼
1	11½	ammunition bread cut fine	2⅞
9	20	water	0
Total... 13	10	Cost ...	20⅝

The Bavarian pound is a little less than 1¼ lb. avoirdupois, and is divided into 32 loths.

All these were put into an earthenware pot and boiled for two hours and a quarter; then divided into twelve portions of $26\frac{7}{12}$ loths each, costing 1¾ creutzer.

Second for the bread dumpling.

lb.	loths.		Creutzers.
1	13	of fine Semel bread	10
1	0	of fine flour	4½
0	6	salt	0½
3	0	water	0
Total... 5	19	Cost...	15

This mass was made into dumplings, which were boiled half an hour in clear water. Upon taking them out of the water they were found to weigh 5 lb. 24 loths, giving 15⅓ loths to each portion, costing 1¼ creutzer.

The meat, soup, and dumplings were served all at once, in the same dish, and were all eaten together at dinner. Each member of the mess was also supplied with 10 loths of rye bread, which cost $\frac{5}{16}$ of a creutzer. Also with 10 loths of the same for breakfast, another piece of same weight in the afternoon, and another for his supper.

A detailed analysis of this is given, the sum total of which shows that each man received in avoirdupois weight daily:

lb.	oz.	
2	$2\frac{34}{100}$	of solids
1	$2\frac{84}{100}$	of "prepared water"
3	$5\frac{18}{100}$	total solids and fluids.

which cost $5\frac{17}{18}$ creutzers, or twopence sterling, very nearly. Other bills of fares of other messes, officially reported, give about the same. This is exclusive of the cost of fuel, &c., for cooking.

All who are concerned in soup-kitchens or other economic dietaries should carefully study the details supplied in these essays of Count Rumford; they are thoroughly practical, and, although nearly a century old, are highly instructive at the present day. With their aid large basins of good, nutritious soup might be supplied at one penny per basin, leaving a profit for establishment expenses; and if such were obtainable at Billingsgate, Smithfield, Leadenhall, Covent-garden, and other markets in London and the provinces, where poor men are working at early hours and cold mornings, the dram-drinking which prevails so fatally in such places would be more effectually superseded than by any temperance missions which are limited to mere talking. Such soup is incomparably better than tea or coffee. It should be included in the bill of fare of all the coffee-palaces and such like establishments.

THE TRANSMISSION OF POWER.

By A. Beringer.

If we admit that the local conditions are equally favourable to the four systems (viz., electricity, water under pressure, compressed air and telo-dynamic cables), that is to say, if we set on one side particular considerations which may render one or the other system more suitable in a given case, the comparison of prices shows that electricity and telo-dynamic cables are the most favourable agents for the transmission of power. Between these two we must choose the cable as effecting the cheap transmission up to a distance of 1 kilomètre, but for greater distances electricity is preferable.

We note, in passing, the interesting result that a hydraulic motive power transmitted by electricity to a distance of 20 kilomètres costs less than the same power produced on the spot by a large improved steam-engine, even if we calculate the water-power at 0·03 fr. per horse-power daily. It follows that a powerful waterfall will supply, within a radius of four leagues, power cheaper than that produced by steam-engines of 100 to 200 horse-power, and within a far wider radius it will compete advantageously with small steam-engines or with gas.

Although cables are very suitable for distributing power in the country to a few separate places, they are quite out of the question when it is required to effect unlimited subdivisions, *e.g.*, in a distribution of power from house to house in a town. In this case the three other systems remain alone in the field.

For instance, if less than 1 kilomètre electricity has only the advantage of a few centimes over air and water, but its advantage increases for longer distances. Thus the hourly cost per horse-power for ½ kilomètre is 0·24 franc, for 1 kilomètre 0·25 franc, and for 12 kilomètres 0·37 franc, whilst water and air reach this price for 1½ to 2 kilomètres.

Transmissions by water and air are therefore far surpassed by electric transmission, and if we wish to produce power by steam in a central establishment and distribute it from house to house within a radius of 10 kilomètres electricity alone could furnish an economical solution of the problem.

We must here remark that such a distribution of power can only be, for the present, useful in the small trades, for if more than 10 horse-power is required, a special motor is more advantageous.

If we divide the region to be supplied with power into squares of 8 to 10 kilomètres a-side, having each a large steam-motor, we may supply a horse-power at 0·25 franc hourly as against 0·32 franc, which would be the cost of a gas-motor, showing a considerable economy in favour of electricity.

There are numerous cases where local conditions render it impossible to set up a motor at the place where the power is required, and only certain systems of transmission can here be employed. Thus in mining and tunnelling, air and electricity only are applicable, and if we suppose that there is need for 10 horse-power, we see, on comparing the price of this power transmitted by compressed air and by electricity, that the advantage is greatly in favour of the latter. For more considerable transmissions of power the prices agree fairly well up to 5 kilomètres, but beyond this the advantage of electricity becomes very decided. In addition, an electric transmission is more easily established than the conduction of compressed air, and it is much easier to extend a system of the first kind than of the second.

Certain boring-machines with compressed air often suffice for ventilation, whilst an electric transmission of power requires to be accompanied by especial appliances for this purpose. Still the advantages of electricity as regards convenience and economy are so great that we cannot hesitate to employ it whenever there is no fear that sparks from the dynamo machines may occasion explosions, especially as electricity can at the same time serve for lighting.

In conclusion, in cases where telo-dynamic cables are not applicable, electric transmission is much preferable to transmission by water or compressed air. It is more economical than gas-motors for transmissions up to 5 kilomètres. Where transmission by cable is applicable it is more economical up to 1 kilomètre. From 1 to 5 kilomètres electricity has the advantage.—*Revue des Mines.*

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE MIDDLE DEPTHS (*continued*).

PASSING on now to the stouter-bodied, shorter-horned flies, our only example will be the insect called *Stratiomys chameleon*, the common chameleon fly, which belongs to a family containing several aquatic representatives. It is a broad, flat-bodied insect (Fig. 1), with a

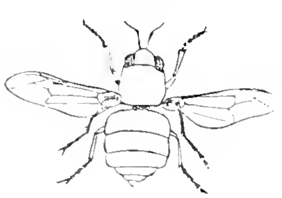


Fig. 1.—Chameleon Fly.

velvety black body, adorned with yellow markings, and is a near relation of those lovely, glossy, metallic-looking flies, with long, dark wings, and bodies of a greenish, purplish, golden, brassy, or bronzy tint, that are often seen sucking the honey of flowers in damp places, or sunning themselves, and displaying their beauty on the leaves of trees. The eggs are not launched in rafts, like those of gnats, but laid in overlapping rows, like roofing slates, on the underside of the broad leaves of the water plantain, *Alisma plantago.* The larva, which is of an elongate form, tapering greatly towards the tail, is chiefly remarkable for the perfect star of about thirty feathery hairs it carries at that extremity. As usual, this circlet of hairs is intended to assist in the respiratory function. To breathe, the insect slowly rises to the surface by serpentine wrigglings, and remains suspended there, the coronal hairs acting as a float, and by their capillary attraction causing the water to recede from the respiratory orifice which is situated in their centre, so that air can be taken in at pleasure. When this has been effected, the insect closes its hair star somewhat as one would shut an umbrella, and slowly descends to the depths again, carrying with it the spoils of the outer world in the form of a silvery globule of air entangled in its plume. Its jaws and other appendages of the head are in constant motion, creating currents which bring to it the minute creatures on which it feeds. During larvahood, then, it does not very greatly depart from the general style and method of life of the gnats and other long-horned flies, but when we come to the next stage we notice a great difference. Hitherto we have found the pupa shaped like a large comma, and breathing by appendages attached to the thoracic region. In the chameleon fly, however, a totally different arrangement is made. The true pupa is formed within the old larva skin, which retains its form so that but little change, except an inflexibility of body, is apparent outwardly. The pupa itself, however, reveals all the organs of the future insect, and with its wings and legs folded lengthwise along its breast looks like a miniature Egyptian mummy. It is much smaller than the larva, and so does not occupy nearly the whole of the space the old skin affords, the long tail-like part being converted into an air-chamber to supply with aerial nutriment the imprisoned mummy, which has its spiracles situated in the usual position down the sides. When the time for emergence arrives, a portion of the case near the head is removed, and the fly makes its exit through the opening.

There is a small family of moths whose caterpillars are aquatic, and may be found feeding on plants below the surface; but we will reserve a notice of these till we treat of the perfect insects, which are abundant amongst the rank vegetation fringing the edges of the pond.

Besides the bugs, beetles, and fly larvæ, which are the legitimate inhabitants of this part of our pond, certain perfect insects belonging to orders that one would assuredly not expect to find represented in the water—at least in the adult state—may occasionally be detected paying flying visits to these regions. About twenty years ago, Sir John Lubbock discovered that some minute insects allied to the ichneumon flies, and therefore belonging to the order Hymenoptera, are aquatic in habits. This was a most surprising discovery, for though the Hymenoptera form an enormously large order, the number of species having been estimated even at 30,000, not a single member of this vast host had previously been known to have any connection with water. Sir John Lubbock describes the discovery as follows:—"Great was my astonishment . . . when I saw in the water a small Hymenopterous insect, evidently quite at its ease, and actually *swimming* by means of its wings. At first I could hardly believe my eyes, but having found several specimens, and shown them to some of my friends, there can be no doubt about the fact. Moreover, the same insect was again observed, *within a week*, by another entomologist, Mr. Duchess, of Stepney . . . . It is a very curious coincidence that, after remaining so long unnoticed, this little insect should thus be found almost simultaneously by two independent observers." Twenty-one specimens in all were seen, and two-thirds of these were females. The tiny being (Fig. 2) measures no more than $\frac{1}{25}$ of an inch in length. It has no nervures in its wings, the hinder pair of which are so narrow as to be scarcely more than linear in shape, and both pairs are fringed round the edges with hairs. It belongs to a group which, like the ichneumon flies, are parasitic

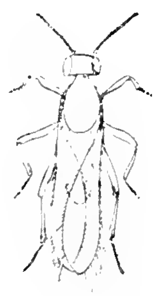


Fig. 2.—Polynema natans.

upon other insects, but many of the smaller species attack their hosts, not when the latter are in the larval condition, but actually while they are in the egg, the contents of a single egg being sufficient to furnish nutriment to the grub of the parasite during the whole of its brief larval career, and sometimes even one egg is the home of several parasites. The present insect, which was named by Sir John Lubbock *Polynema natans*, may, therefore, with much probability be presumed to have been in quest of the larva or eggs of some aquatic creature in which to deposit its own brood. It would seem, however, that this can hardly be the sole cause of the entry of these insects into the water, inasmuch as the males were found swimming as well as the females. The wings did not seem particularly effective as swimming organs, the progress of the insects being but slow, and in a series of jerks; sometimes, too, the swimming was abandoned in favour of crawling over the aquatic plants. Marvellous as it may seem that a creature should use as swimming-organs delicate membranous wings, apparently adapted only for aërial flight, the marvel becomes greater when it is remembered that the little diver is not in any way structurally adapted for an aquatic life, except it be by the fringes round the wings, but these it has in common with other members of the same group which never enter the water at all. There is no flattening of the legs, no tapering of the form in front, no arrangement to provide for subaqueous respiration. The breathing is conducted in the ordinary way by means of spiracles, and all the time the insect is under water, it has, so to speak, to hold its breath, just as one of the higher animals would have to do under similar circumstances. At first thought it would seem, therefore, that the tiny creature, in obeying its maternal instincts, incurs some risk of drowning, but it must be remembered that insects do not require a renewal of air anything like so frequently as the higher animals, and in the present instance the power of endurance seems to be much greater even than usual. Sir John Lubbock found that one of his insects could endure submersion for twelve hours without inconvenience, but that after fourteen hours it was to all appearance dead; however, on being transferred to a dry spot, it revived, and, after a time, became as lively as ever, so much so, in fact, that, notwithstanding its uncomfortable experience of temporary drowning, it did not hesitate, when an opportunity was again afforded, again to enter the water. Professor Westwood has suggested, however, in explanation of this power of enduring prolonged submersion, that the fringe round the wings may carry down entangled in its hairs a small quantity of air, sufficient for the wants of the insect during the time it would naturally remain below.

Curiously enough, a second aquatic species, a trifle larger than the other, and much less common, was discovered on the same occasion and by the same observer. It swam, however, not by aid of its wings, which were kept still, but by a rowing motion of the legs, and thus progressed more rapidly than its relative.

Ichneumon flies have recently been bred from the pupæ of a Gyrinus, or whirligig beetle, which, as will be remembered, is, in its larval state, subaqueous. It is not known, however, at what period in the history of the Gyrinus the ichneumon eggs are inserted in the body of the host, though, judging from analogy, it would seem probable that it is the larva that is thus victimised, and in that case either the ichneumon must dive, or the larva must be attacked during its temporary exposure on the aquatic plant on which it forms its cocoon; still, however, the eggs may be deposited in the pupa through the walls of the cocoon, the ichneumons possessing ovipositors long and powerful enough for the purpose.

Certain caddis flies, or water moths as they are sometimes called, and dragon flies have also been known voluntarily to submerge themselves in order to deposit their eggs in appropriate positions.

(To be continued.)

RAILWAY BRAKES.

BY "TREVITHECK."

DURING the past few years, a prolonged and, at times, an acrimonious discussion has been carried on concerning the advantages and disadvantages of brakes as applied to railway engines, carriages, and trucks. The speed of travelling is now on the average very high, the trains run in rapid succession, and the lines are gradually being called upon to work to the full extent of their capacity. All this means that if the work is to be got through with anything like efficiency, every possible chance of facilitating the traffic should be taken advantage of. Englishmen are, however, more phlegmatic and more inclined to repose implicit faith in the powers that be than they imagine, or would grant to be possible. It is, indeed, a stern reality, that it requires a great calamity to awaken them to the fact that one of man's first duties of citizenship is to see that what is done around him is the best that can be effected for his own comfort and for that of his fellow-creatures.

Such an awakening has been lately experienced, for during the past few weeks, embracing the longest days of the year, at a season when fogs have no place in our weather "forecasts" or "reviews," we have had our eyes rudely opened to the fact that the railway system of England is one that revels in disaster, torture, and death. Now it must be patent to the most superficial thinker that, if our climatic conditions are such as to preclude the jury from attributing a disaster, as they did the one near Oxford a few years back, to a "freak of nature," such disaster must be due to some cause in the main preventible. Be it observed, further, that the accidents now providing detailed horrors for the daily papers, happen for the most part in the full blaze of the sun, with a good road beneath, a good sky above, and a good light in front. Hundreds of trains seem to carry with them day by day and hour by hour a sure and effectual means for securing their own destruction, together with that of those persons being transferred from place to place. In the early days of railway travelling, when trains were few and far between, and when the pace was generally slower, the old-fashioned hand-brake applied by the guards to their own carriages were just good enough to be tolerated, but at the present day, when so many improved forms are on the market, it can only be regarded as little short of a crime to despatch a train upon its perilous journey bereft of what should be, in reality, its greatest safeguard. It requires but little argument to demonstrate that a brake, capable of being applied to only one or two carriages in a more or less lengthy train, may, at times, prove even worse than useless, for it begets in the minds of those in charge a false sense of security. And what I have just said may be even more strongly emphasized when we consider the condition of a train supplied with a continuous brake which can only be of use when every portion of it is in good order. That the recent catastrophe at Penistone may be ascribed to a state of things not far removed from the one depicted is, I fear, only too probable. Of this, however, I shall be at liberty to speak more fully later on. Suffice it for the present to say that in this particular case the engine was not pulled up by the brake, but went on for 570 yards from the spot where the axle of the engine broke, while the carriages from which it parted company only proceeded about half the distance mentioned, the wheels running on the track, and the rails being broken and torn up. There is every reason to believe that the brake which was in this case applied by the driver failed almost immediately, and may, therefore, so far as its effect is concerned, be regarded as having proved worse than useless. The Downton accident, on the South-Western Railway, was another of a somewhat similar character. The only important difference between them was in the loss of life and limb caused. The Wiltshire accident might have been averted had proper brake power been applied to the whole train instead of an imperfect one to a fraction of it. There a rupture in the connections permitted the carriages to obey one of Nature's first laws, and, instead of following the engine round the curve, they forsook the rails, and rushed down an embankment into a river. At Penistone the carriages ran down an embankment into a road below.

Accidents such as these carry with them great and practical lessons, which it behoves each one of us to bear in mind. It is more than proved that one of the essentials to safe travelling is that every train should be fitted with an efficient brake—nay, more than this, it is necessary that every individual carriage should be furnished with a means for arresting its own progress in the event of its being severed from the rest of the train.

There are at the present moment several forms of continuous brakes in use—brakes, that is, which are fitted and applied to each vehicle, and one great distinction is that while some of them are capable of performing their allotted task automatically, others only respond to the manipulation of those in charge. These two classes may be typically represented by the Westinghouse and the Smith brakes respectively. And perhaps the respective merits of the two could not be illustrated more forcibly than by quoting their behaviour from the chapter of accidents in July. On the 8th a Great Eastern express *en route* for Doncaster met with an accident. When nearing Spalding Station the axle of the driving-wheels broke. The train was instantly stopped by the application of the Westinghouse brake, and, a fresh engine having been procured, the train proceeded, after half-an-hour's delay. "Had," points out our contemporary *Engineering*, "a similar brake been in use at Penistone, it could have been at once brought into action by the parting of the train, even if it had not been applied earlier; and there are the best grounds for believing that twenty-three lives and much dreadful injury might have been saved." To quote another case, which might have ended in a most dreadful catastrophe :—

"In reply to inquiries respecting the details of an accident which lately took place near Chicago, Mr. Joseph Wood, the Superintendent, said :—'The train consisted of an engine, one baggage and three sleeping-cars, weighing about 190 tons. At the time of the accident, the train was on a descending gradient of 1 in 125, and was going at a speed of from 40 to 45 miles per hour. After leaving the rails, the engine went partly down an embankment, taking with it the baggage and the first sleeping-car, and stopping at a point 240 ft. from the point of derailment; the other two sleeping-cars remained on the road-bed; the rear end of the rear car being 75 feet ahead of the point of derailment, showing that from the time of the application of the brakes (when the engine was derailed and broken loose from the tender) to the point of stopping of these cars, they had gone a distance of 370 feet. These facts so strongly emphasise the efficiency of the brake, that further words seem unnecessary. I may add, however, that none of the passengers were injured sufficiently to delay their journey.'"

Such is the behaviour of the Westinghouse brake. The Smith non-automatic brake, on the other hand (the type employed on the Manchester, Sheffield, and Lincolnshire Railway), can only act so long as the various parts of the train remain coupled together, and the whole of the brake apparatus intact. It is controlled from the engine, and anything going wrong with the train, and causing a separation, the brakes become useless, for even if they are applied prior to the severance, they "proceed immediately to come off by themselves." A train equipped with such a "continuous" brake as this, is, under such circumstances, quite as helpless as was the South-Western train at Downton, which, as stated above, was without a continuous brake.

There is another class or, rather, a sub-class of brakes, which, while they respond very well at times, are unreliable if called upon with any degree of frequency. Such a brake is that known as the Clayton, and the use of which almost resulted in a disaster that would have resembled very closely the Downton affair. On the 12th of last month a Midland train, consisting of fourteen vehicles, came into violent collison with the buffer stops at Swansea. The passengers who were preparing to alight were thrown together and much shaken, fifteen of them being also cut about the face and head. A doctor was on the spot and promptly attended to the injured. The train was fitted with the "leak off" Clayton automatic vacuum brake, and the driver had applied it to stop about a quarter of a mile from the terminus, on account of the signals being against him. The line was cleared at once, and on again applying his brake to stop at the platform, the unfortunate driver found himself without brake power, and was unable to avoid the collision. This is by no means the first time such an incident has occurred in connection with this brake, and the accident (!) at Portskewet, Northampton, Liverpool, and Bradford, from the same cause, should have made it perfectly clear that this brake is not to be trusted for a second or third application.

The different forms of brake thus briefly referred to it is my purpose to describe more in detail hereafter. There is, however, one point that may be urged. One of the greatest objections to the uniform adoption of a good automatic brake is the expense. Such a contention is, however, more than answered by a report recently made by Mr. T. E. Harrison, Chief Engineer of the North-Eastern Railway.

A detailed statement of the cost of maintaining the Westinghouse brake on 2,666 vehicles for two years is given, and this is particularly instructive. From it we find that, including the cost of replacing the whole of this stock with new hose pipes, for reasons explained in the report, the total expenditure for maintaining both the brake proper and the brake rigging, exclusive of brake blocks, is under 9s. 6d. per vehicle per annum. As Mr. Harrison points out, however, the cost for hose pipes should be reduced by one-half to get an average, which brings the sum to only 7s. per vehicle. This amount includes everything but brake blocks, which are common to all brakes, and is made up as follows:—Maintaining and repairing parts of brake and rigging, 8d. per vehicle per annum; hose renewals, 2s. 4d. per vehicle per annum; men's wages, testing and overhauling, and inspectors' salaries, 4s.; total, 7s. This sum is equal to about $1\frac{1}{4}$ per cent. for the first cost of the brake proper and the brake rigging—a truly surprising result, which, as the report says, "shows conclusively that there is great economy in the maintenance of the Westinghouse brake."

Surely this, from so great an authority, should suffice to convince any one; but the question, viewed from a public standpoint is not, except to a very small extent, one of expense. If railway directors are determined to remain admirers of such appliances as the vacuum non-automatic brake because of their "simplicity and beauty," they must be convinced of the paramount necessity of ensuring, as far as possible, the safety of their customers. There is a Board of Trade requirement concerning brakes which, however, is not followed out, and signs are not wanting of an urgent appeal being made to Parliament to enforce compliance; but I take it that travellers have the question, to a great extent, in their own hands, and can call for reform with a voice more potent even than that of Parliament, by taking such alternative routes to their various destinations as will enable them to repose confidence in the appliances introduced for their security.

Speaking of the efficiency of the Westinghouse brake, Mr. Harrison, in the report above referred to, points out that the great object of the introduction of continuous brakes was not for the mere stopping of trains at stations, but that it might be used as an emergency brake to prevent accidents, and every day's experience shows more clearly the efficiency of this brake for this purpose and in diminishing the extent of damage when accidents do occur, and it is generally liked by all engine drivers who have used it. It has been found especially useful for working steep inclines, of which there are many on the North-Eastern system, in some the gradients being as steep as 1 in 37.

THE INTERNATIONAL HEALTH EXHIBITION.

X.—WATER AND WATER-SUPPLIES—(*continued*).

II. Artificial Waters necessarily include samples of the most varied characters. For the sake of convenience, we shall here group together those which are purposely prepared by man to meet certain ends, and others which result indirectly through the agency of living beings. To the former class distilled and aërated waters belong, to the latter, plant-waters and sewage.

1. *Distilled Water* may be prepared from any of the numerous varieties which we have already considered. The process is conducted in an apparatus called a still which consists of a suitable boiler of metal, glass, or stoneware, to the summit of which a pipe is fixed for the purpose of conveying away the steam or vapour produced by the boiling of the water into a condenser. The form of condensor usually adopted is a coiled tube immersed in a vessel of water, which is kept cold by a continuous current from a cistern. The steam on passing through the condenser becomes reconverted into water, and the liquid so produced is practically pure water, freed from most of its gaseous, and all its solid, impurities.

The "foreshot" of the distillate should be rejected, as it is liable to contain gases, organic matters, acids, and ammonia, which obtain in the original water. In like manner, the process should be discontinued before the still has been exhausted, in order to reduce the possibility of a passage over of residual products. Distilled water thus prepared is particularly greedy of dissolvable substances, and will even attack matters which natural waters would leave unaffected. Its preparation in vessels with pipes of metal, more especially of lead, and its storage in leaden receptacles, should be avoided, to prevent a chance of poisonous contamination. We would, therefore, once more direct the attention of our readers to Messrs. Doulton & Co.'s exhibit, where they may view with satisfaction the admirable utilisation of stoneware for chemical apparatus.

2. *Aërated Waters* are only manufactured for beverages; they do not come within the scope of our present inquiry; but, as we have already dealt with some of the more important aspects of this question, we would now redirect our readers to what we have stated with regard to the preparation of such drinks from a sanitary point of view, and to Messrs. Barnett & Foster's stand in the Western Gallery of the Exhibition.

3. *Plant Waters.*—In tropical forests, many plants have the power of collecting and storing water in their tissues, which is often a boon to the parched explorer. The well-known Traveller's Tree affords copious draughts of cool fresh water on being pierced.* The grateful juice of the Cocoanut palm fruit affords a beverage which in quantity is sufficient to allay thirst, and, in palatable quality, excels the most delicious of artificial drinks. The cut inflorescences, in their estivation, of both the Cocoanut and the graceful Palmira, yield a delightfully refreshing nectar, which, however, is prone to ferment very speedily, and is then commonly called "toddy" by the natives of India. All these waters are of the nature of elaborated saps, but yet from their abundance in regions where water is scarce or polluted, are of sufficient importance to demand some attention here. Other plants with succulent stems, leaves, fruits, &c., are not to be classed with the above, since they are incapable of satisfying thirst, and moreover, their very existence presupposes an ample supply of wholesome water.

4. *Sewage* may be defined as the concentrated refuse of communities of human beings. In towns such as Manchester, where excrementitious waste products are utilised, and are not permitted to enter the drains, sewage is comparatively harmless; but in districts like London, in spite of every care, the pollution of rivers from such sources often assumes a most dangerous aspect. Royal Commissions, Metropolitan Boards, and Houses of Parliament all seem to be ineffectual to cope with impending evils; the first points

* The munificent gift of Miss North to Kew Gardens contains a series of beautiful paintings of tropical plants. Amongst the most noteworthy is the Traveller's Tree (*Ravenala Madagascariensis*), a striking example of the Banana tribe (*Musaceæ*). It may here be observed that the large expanded leaves, with their grooved midribs, afford channels for conveying the rain-water to sheathed recesses at their bases. The water thus collected remains fresh and limpid, and may be obtained by piercing through the attached ends of the soft, loosely-textured petioles.

out the dangerous ground, whilst the two last-named bodies remain inert, or, at least, expend an enormous sum of money per day on chloride of lime.* In the meantime Dr. Koch's comma-like cholera germ awaits but an opportunity for establishing itself in our midst. We cannot refrain from expressing our opinion that it is "passing strange" that all this misdirected expensive energy should exist, when numerous well-devised, inexpensive, nay *profitable* methods, for counteracting all ill-effects are easily available. It shall be our duty in future pages to give a detailed account of some of these.

We have already said enough about germs and their agency in producing chemical poisons or ferments, and upon decaying animal and vegetable structures in water to seriously alarm the more apprehensive of our readers. It is best, however, "to err on the side of safety," but we most emphatically disagree with "W. C. B.'s" address to our editorial fountain-head, which we requote here as an extraordinary sanitary curiosity :—

"W. C. B." demurs to the idea that a polluted river is necessarily unwholesome, as over and on the banks of one—"a mass of festering filth, chocolate in colour, molasses in consistency, and of stench simply indescribable"—many of his workpeople live, hale and hearty, as did he and a large family for fifteen years. Moreover, twenty cows, always well and thriving, drink this filth in preference to pure spring water.

To which our "E. F." aforesaid curtly replies :—"Just so; *de gustibus non est disputandum!*" † which, being freely translated, would sound very like the olden English saying, "There's no accounting for tastes, as the old woman said when she kissed her cow."

Nevertheless, organically polluted waters, of which sewage is a type, do undergo a process of natural purification. The organic matter consists chiefly of azotised substances and hydrocarbons; and the water, in its passage along rivers or through the soil, takes up a large proportion of oxygen, which in its turn reacts upon the former, converting them into useful nitrates; and upon the latter, causing them to give forth the equally valuable carbonic acid gas. But these processes are necessarily tardy, and, in the majority of cases, but imperfectly carried out. The water of rivers containing sewage is, moreover, not only prone to be temporarily unsuitable for domestic purposes, but it contains in addition chemical poisons, which result from the fermentative action of putrefactive agents, which no process of oxidation can ever eradicate. Whether these ferments are generated in sufficient quantity to render certain streams and rivers detrimental to the life of plants and fish, yet remains to be investigated; but we may safely argue from premises such as the above, that a prolonged discharge of sewage into rivers clearly points to a termination which must inevitably be disastrous to both plant and animal life.

We shall hereafter pass on to consider in detail the varieties of water suitable for specific purposes, the tests to be used in the determination of their respective values, and the means which have been adopted by recent inventors to meet all demands.

A Simple Sunshine Recorder.—Professor Herbert Macleod, of Cooper's Hill Engineering College, has devised a simple and effective sunshine recorder by merely placing a globular bottle of water (or water lens) in front of the lens of a camera in such a position that the focussed ray falls on a sheet of sensitised paper spread on the bottom of the camera box. A curved white line or band is produced on the paper as the sun revolves, and when clouds cross the sun the line stops.—*Engineering*. [I have often wondered that some such simple contrivance has not been devised before. The price at which so-called "sunshine-recorders" are sold is exorbitant. —Ed.]

* Cf. *Daily Telegraph*, July 16, 1884. † "Ut Supra," page 61.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p. 70.*)

"When they had ranked the heavens in the manner you tell me, pray what is the next question?" "The next," said I, "is the disposing the several parts of the universe, which the learned call making a system; but before I expound the first system, I would have you observe, we are all naturally like that madman at Athens,* who fancied all the ships were his that came into the Pyræum port. Nor is our folly less extravagant; we believe all things in nature designed for our use; and do but ask a philosopher, to what purpose there is that prodigious company of fixed stars, when a far less number would perform the service they do us? he answers coldly, they were made to please our sight. Upon this principle, they imagined the earth rested in the centre of the universe, while all the celestial bodies (which were made for it) took the pains to turn round to give light to it. They placed the moon above the earth, Mercury above the moon, after Venus the sun, Mars, Jupiter, Saturn; above all these they set the heaven of fixed stars, the earth was just in the middle of those circles which contain the planets; and the greater the circles were, they were the farther distant from the earth, and by consequence the farthest planets took up the most time in finishing their course, which in effect is true."

"But why," said the Marchioness, interrupting me, "do you dislike this system? It seems to me very clear and intelligible."

"However, Madam," said I, "I will make it plainer; for should I give it you as it came from Ptolemy its author, or some others who have since studied it, I should fright you, I fancy, instead of diverting you. Since the motions of the planets are not so regular, but that sometimes they go faster, sometimes slower, sometimes are nearer the earth, and sometimes farther from it;† the antients invented I know not how many orbs or circles involv'd one within another, which they thought would solve all objections: This confusion of circles was so great, that at that time, when they knew no better, a certain King of Castile, a great mathematician, but not much troubled with religion, said, 'That had God consulted him when he made the world, he would have told him how to have framed it better.' The saying was very atheistical, and no doubt the instructions he would have given the Almighty, was the suppressing those circles with which he had clogg'd the celestial motions, and the taking away two or three superfluous heavens which were plac'd above the fixed stars: for the philosophers, to explain the motion of the celestial bodies, had above the uppermost heaven (which we see) found another of crystal, to influence and give motion to the inferior heavens; and where-ever they heard of another motion, they presently clapp'd up a crystal heaven, which cost 'em nothing."

"But why must their heaven be of crystal," said the Marchioness; "would nothing else serve as well?"

"No, no," replied I, "nothing so well; for the light was to come thro' them, and yet they were to be solid. Aristotle

* The reasoning here closely resembles that which the modern student of the subject has to employ.—R. P.

† Sometimes advance and sometimes retrograde, he should have added.—R. P.

would have it so, he had found solidity to be one of their excellencies; and when he had once said it, no body would be so rude as to question it. But it seems there were comets much higher than the Philosophers expected, which, as they pass'd along, broke the crystal heavens, and confounded the universe: But to make the best of a bad market, they presently melted down their broken glass, and to Aristotle's confusion, made the heavens fluid: and by the observations of these latter ages it is now out of doubt, that Venus and Mercury turn round the sun, and not round the earth, according to the antient system, which is now every where exploded, and all the *ipse dixits* not worth a rush. But that which I am going to lay down, will solve all, and is so clear, that the King of Castile himself may spare his advice."

"Methinks," says the Marchioness, "your philosophy is a kind of outcry, where he that offers to do the work cheapest carries it from all the rest."

"'Tis very true," said I, "Nature is a great housewife; she always makes use of what costs least, let the difference be ever so inconsiderable; and yet this frugality is accompanied with an extraordinary magnificence, which shines through all her works—that is, she is magnificent in the design but frugal in the execution, and what can be more praiseworthy than a great design accomplished with a little expense? But in our ideas we turn things topsy-turvy, we place our thrift in the design, and are at ten times more charge in workmanship than it requires, which is very ridiculous."

"Imitate Nature, then," said she, "in your system, and give me as little trouble as you can to comprehend you."

"Fear it not, madam," said I, "we have done with our impertinences. Imagine, then, a German called Copernicus confounding everything, tearing in pieces the beloved circles of antiquity, and shattering their crystal heavens like so many glass windows. Seiz'd with the noble rage of astronomy, he snatches up the earth from the centre of the universe, sends her packing, and places the sun in the centre, to which it did more justly belong. The planets no longer turn round the earth, nor inclose it in the circles they describe; if they give us light it is but by chance, and as they meet us in their way. All now turns towards the sun, even the earth herself; and Copernicus, to punish the earth for her former laziness, makes her contribute all he can to the motion of the planets and heavens; and now, stripped of all the heavenly equipage with which she was so gloriously attended, she has nothing left her but the moon, which still turns about her."

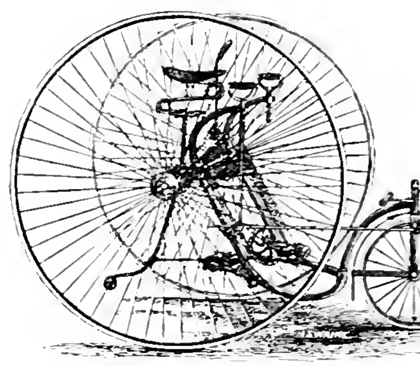
(*To be continued*).

THE TRICYCLES OF TO-DAY.

THE "ROYAL SALVO" No. II.

The makers of this justly-celebrated, double-driving, front-steering tricycle, the "Salvo,"—Messrs. Starley Bros.—can lay claim to the fact that the machine known as the "Coventry Lever" was the first type of tricycle ever made in this country, it being the invention of the late Mr. James Starley, who is rightly regarded as "the father of the iron steed"; and only quite recently the mechanics of Coventry, in appreciation of the immense service the founder of the present firm rendered to their native town by creating an industry which has amply recompensed them for the loss of their ribbon trade—for which Coventry was once so famous—have recently erected a monument to his memory.

Of course, not a single season has passed by without finding the machine greatly improved, and the "Royal Salvo" of to-day is a very different piece of mechanism from the progenitor of its race, which, by-the-bye, was a rear-steerer, having a large safety-wheel in front, which ran on the ground like the rear-wheel. The original machine bore the lengthy title of the "Salvo-Quadricycle." After a few experiments, however, it was found highly dangerous in descending hills at anything like a high speed, and, in consequence, was quickly altered to a front-steerer, in which form it has ever since been wisely allowed to remain.



The Royal Salvo Tricycle.

About four years ago, one of the firm had the honour of delivering in person two machines to no less a person than her Majesty herself at Osborne, her Isle of Wight residence, and with those machines she has since expressed the greatest satisfaction.

The "Royal Salvo" No. II. differs from the ordinary "Salvo" only as regards workmanship and weight, being a better-finished and considerably lighter machine than the latter, though built exactly on the same lines. The framework of the machine is constructed entirely of weldless steel-tubing. The front-steering wheel is supplied with Bown's ball-bearings, while roller ones are fitted to the two driving-wheels. The latter, I believe, are the oldest bearings which exist, and are unmistakably the best bearings made, being well-nigh indestructible, if only kept well-oiled and free from grit.

The steering-wheel in front renders a spill scarcely possible when ordinary caution is used.

It is well known that if a rider presses too hard on the pedals the front wheel will leave the ground. The back-stay of the "Salvo" prevents it from being lifted so far off the ground as to permit of the machine turning over backwards.

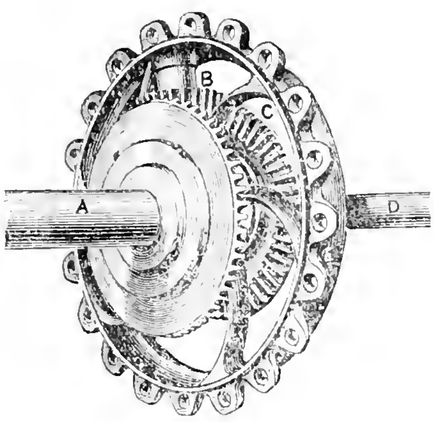
The lever band-brake fitted to the machine is as perfect as a brake can be, being far preferable to a tyre-brake, which is not only liable to pitch an inexperienced rider out if applied too suddenly, but may snap at any time when least expected, and with constant usage cannot fail in time to wear the tyre away or cause it to work loose.

No matter if the hill be as steep as a roof, there need be no fear of descending on the "Salvo," since the brake is sufficiently powerful to check the machine on any incline whatever, and at any speed. Neither need there be any fear of applying the brake promptly and vigorously—as, for instance, one is often compelled to do in the case of unexpectedly coming on children playing in the road, who invariably run in front of the machine, instead of out of its way.

One of the most pleasurable features of tricycling to my mind is descending hills at considerable speed, and on this machine the rider may do so at all times safely without being robbed of his pleasure by a constant dread of the brake snapping or not acting in some way in case of emergency.

The machine is also supplied with comfortable, rubber-clothed foot-rests, which, besides being a great luxury in riding down-hill, enable the rider on a good level road to take an additional rest by pedalling with alternate feet.

But the best feature of the machine is its patent automatic balance-gearing, an illustration of which is here given (through the kindness of Messrs. Starley Bros., of Coventry).



A.—Bevel tooth-wheel, fixed to the hub of one driving-wheel. B.—Crown-wheel. C.—Bevel-wheel fixed to shaft. D.—Main axle. E.—Chain-wheel.

The axle connecting the two large driving-wheels is telescopic, the central shaft from the right wheel working in a hollow tube from the left.

The chain-wheel works between two bevelled cog-wheels, one of which is attached to the hub of the right-hand driving-wheel, while the other is attached to the end of the hollow shaft that proceeds from the left hand.

Between the two cog-wheels works loosely the collar that forms the centre of the toothed chain-wheel, while on a rod which passes from the centre to the circumference of the chain-wheel works a small, loose cog-wheel, whose teeth are so bevelled as to work against the teeth of the other two cog-wheels.

While the machine is being driven in a straight course, the teeth of the little cog-wheel press evenly against the teeth of the other two cogs, and equal power is by this means imparted to both driving-wheels. But should one wheel be rotated more slowly than the other, as in turning corners or steering the machine completely round, the little cog or pinion-wheel glides freely over the face of the bevelled cogs that move the inner or slowly-rotating wheel, while it presses with more force against the cogs of the outer wheel, thus causing it to rotate with greater speed.

The great advantage of this simple mechanism is at once apparent in the facility it gives of turning sharp curves without the risk of the machine tilting over. It also can be worked backwards or forwards with equal effect. While at all times the machine, by the use of this gearing, is kept thoroughly under control. With reference to its luggage-carrying capability, there are few machines to surpass it, the amount of articles one can fasten to the detachable luggage-carrier behind being something prodigious.

It is in consequence a capital machine for an amateur photographer who wishes to take sufficient paraphernalia to photo any lovely bit of scenery he may meet with on his tour.

I advise those persons, however, who are above the average weight, or who live in a district where roads are bad, to ride an ordinary "Salvo," on account of its greater strength; whereas, on the other hand, for ladies, or those whose weight does not exceed 10 st., and who are fortunate enough to live in a neighbourhood of good level roads, with smooth surface, I strongly recommend their "Special Light Salvo."

With regard to height of wheels, I should recommend a 46-in., geared level, for those whose height does not exceed 5 ft. 9 in., and a 48-in., geared level, for those above this height.

Undoubtedly the "Royal Salvo" No. II. is one of the very best machines made. F.

EMBALMERS.

THOUGH in America embalming be on the increase and even bids fair to be one day popular, there can be no doubt that with us the practice does not gain ground.

We are a sensible rather than a sensitive people, and, unable to grasp any very definite reason for encouraging the art, we scarcely notice it. We have, in fact, no desire to have our dead, like our poor, always with us. But, nevertheless, there are in each year a certain number of cases of tolerably regular occurrence, and, to meet that demand, a small supply of practitioners, authorities on the subject, employed by the undertaker, who, as a rule, is the person first consulted.

Compared with the ancient, the modern method is rapid and simple; with the Egyptians, the process was a question of months, with us it is one almost of minutes.

Here it is, as practised by Dr. B. W. Richardson, the eminent authority on health, who has probably had a wider and longer experience than any other man in the country. "A large artery is exposed and opened, and into the vessel a hollow needle is inserted. The needle is firmly tied in its place. Through the needle a solution of chloride of zinc is injected slowly until it has found its way over every part. The principal art that is required in this process is to be very careful not to use too much force in driving the fluid into the tissues, and in not using too much fluid. The fluid which answers best is made as follows:—To two pints of water, at 50° Fahr., add chloride of zinc slowly, until the water just refuses to take up any more of the salt. Then add one pint of water more, and two pints of methylated spirit. The five pints so produced are a sufficient quantity for embalming an adult body. The solution can be injected quite cold, and it will find its way readily over the vessels. If expense be not considered, pure alcohol may be used instead of the methylated spirit.

The effect of the solution is shown by its making the surface of the skin white, firm, and, for a short time, slightly mottled." We have this eminent authority's permission to add that the latest improvement (a discovery of his own, and not yet published to the world) is that of injecting through the *optic foramen*, by the introduction of a long subcutaneous needle into the cavity of the cranium from behind the eyeball. This method, which will no doubt supersede all others, was discovered rather by accident than direct experiment, and dates from researches conducted by Dr. Richardson on the best modes of restoring animation after sudden dissolution from chloroform and other lethal substances. Thus, in original work it often happens that, in carrying out a design which has been most carefully projected, the original intention is not consummated, but some other result which was never thought of; and thus Columbus, in search of the golden lands of Marco Polo, accidentally lighted on the continent of America. It will be noted that in the modern system nothing of the ancient survives. There is no exenteration, no steeping in palm-wine, no filling of the cavities with myrrh and cassia, no swathing with bandages a thousand yards long, which, nowadays, the pilfering Bedouin use for clothes and sell for paper. Nor is there any need for the *περασχιστής*, that low-caste official, whose hateful duty it was to make the first incision, and who must needs have been as nimble of foot as he was quick of hand, since (all in Egypt being held in abomination who mutilated the dead), on the completion of the operation he had to make the best of his way into the country, pursued with sticks, stones, and curses. There, in a date-grove, he panted till the storm had blown over. He was the original, they say, of the familiar phrase *to cut and run*. Nor in our civilisation is the attendant expense in any degree as great. It ranges from 20 to 50 gs., varying with the circumstances of the survivors. Mr. Whiteley, whom we have consulted, will undertake an adult for £12. 10s., while the best workmanship of the Nile could not be secured for less than a talent, £243. 15s. In a sketch of this rapid character, in which we have striven to avoid as far as possible all unpleasant details and tiresome technicalities, there is necessarily much omitted that is historically interesting, though more perhaps to the student—if any such there be—than to the general reader. There is that Guinea tribe, for instance, who by some mysterious process reduce their relatives to a liquid condition and drink them down; and so, perhaps, have given rise to the saying that the society of certain individuals is refreshing. There is the desiccation practised by the Palmeritans, who put their friends aside in a chamber underground to dry, where they may still be seen in all the dreadful contortions of the process. There is Marshall's system of puncturing the surface of the body and brushing it over with acetic acid of the specific gravity of 1·048—"two days' application in this way will beautify any subject." There is the tadpole arrangement (though we cannot be sure that this has ever been applied to the human frame) by which a subject, suspended in water and left free to be acted upon by the suction-mouths of these little creatures, is in a short time stripped of all those parts which would otherwise decay. There are the natural mummies of the sands and of the bogs of Ireland and Scotland, and the lost travellers of the Alps, in a sense preserved by cold; and, not to be tedious, there is that buried secret of the Florentine physician Segato, by the exercise of which he could reduce the dead, Medusa-like, to stone. By this process of Segato's the head of the patriot Mazzini was, we believe, successfully treated, and still, no doubt, is in existence, the cherished treasure and pride of some Italian municipality; and though, as a means of preserving the dead, the method was never widely known or popular, yet it found its way into England; for we have been told, indeed, by the greatest living authority on mummies, that, many years ago, when present at a conversazione in London where several specimens of the Florentine's art were exhibited, he discovered among them a table inlaid, apparently with strange and curious marbles, but which on closer inspection resolved themselves into the interiors of dead friends.—*Cornhill Magazine.*

ELECTRO-PLATING.

IX.

By W. Slingo.

IT frequently happens that large statues are taken by the electrotyping process. Sometimes the object in view may be simply to copy one sculptured in marble, &c.; at other times a bronze statue may be the thing desired.

To attain such an object, one of two processes is generally adopted.

In the case of a plaster figure, the surface of the statue is saturated with linseed oil, and then allowed to dry. When quite dry, it is thoroughly plumbagoed, the surface presenting a uniform polished appearance. It is then placed in the solution, and a deposit is taken, the thickness varying with the size of the work. It must be sufficiently strong to be used as hereafter described. As intimated in the previous article, care is taken to insure a good deposit in the hollows by inserting small anodes in them, and keeping the main anode either a considerable distance away, or out of the bath altogether. Where this course is rendered impracticable by peculiarities or eccentricities in the shape of the mould, the anode is for a time placed at some distance from the cathode. This plan is in the main objectionable, and it is often found better to employ a current of high electromotive force at the commencement of the action. This, when using batteries, is easily done by introducing one or two extra cells "in series," and withdrawing them as soon as the mould has received a copper deposit all over it. When the coating has attained a sufficient thickness, the mould is withdrawn and the metal cut in halves, or in other convenient sections. The plaster is then sawn through, and afterwards extracted piece by piece until the whole internal copper surface is free. In this process the plaster model is thus sacrificed. When thoroughly cleaned, copper wires are soldered or otherwise attached to the external surfaces of the various copper sections. These surfaces are then "stopped off" with gutta-percha varnish, that is to say, they are coated with the varnish consisting of gutta-percha dissolved in bisulphide of carbon (CS_2) to insulate them, and so prevent deposition upon them when placed subsequently in the electrolytic bath. When thus provided externally, the internal surfaces are treated with turpentine, exposed to sulphuretted hydrogen fumes, or dipped in a weak solution of sulphide of potassium. The object of this treatment is, while it allows deposition to go on, to prevent the adhesion of such deposit to the original copper form. The copper sections having been treated in this manner, are again placed in the bath, and a good, substantial deposit is taken. When these positive sections are sufficiently thick, they are withdrawn from the solution, together with their previously-taken negative films, which are carefully stripped off, exposing clean and clear surfaces bearing an impression of every feature pertaining to the original plaster model. The sections are then trimmed, any superfluous pieces of metal being clipped or filed away. After this they are fitted and soldered together, and the joints bronzed over.

This method is largely employed where the work is required to be well done; but the extra expense involved in the sacrifice of the model, in taking two electrotyped impressions, &c., forms an important factor in determining upon the course to be adopted and the method to be employed. The method is, however, a safe one, and may be relied upon to give a first-class representation of the original figure. It was the one employed by Messrs. Elkington in producing their colossal statue of the Earl of Eglinton, 13½ ft. high, and weighing two tons. The capacity of the bath employed was 6,680 gallons. Another firm produced a work by this process weighing nearly three and a half tons.

Another process may be employed which does not involve the sacrifice of the model, and that is to take sectional plaster casts, and then, after saturating them with linseed oil and well coating their surfaces with plumbago, to place them in the bath, whence direct positive impressions may be taken, and treated in the ordinary way. The various sections are cleaned, fitted and soldered together, and the joints bronzed over. The casts need not necessarily be taken in plaster, wax or some other available substance answering almost equally well.

Bronzing is a branch of the subject to be dealt with presently; but before leaving the discussion of the typing processes as applied to large work—large, that is to say, in comparison with that with which we have next to deal—it may be as well if a few remarks are made upon the probable causes of failure and the steps that may be taken to avert a failure. It must be distinctly borne in mind that the perfect practice of every art is more or less the outcome of experience and experiment, and that, therefore, one can scarcely hope to turn out excellent work as the result of a first effort.

In the great majority of cases failure may be ascribed to an imperfect mould, or to an imperfect conducting surface. A great deal, of course, depends upon the condition of the bath and of the battery, but even when these are all that could be wished, difficulties and disasters present themselves which are attributable to one or other of the causes referred to. In the first place, every care should be taken to prevent "air-holes" forming between the mould and the original. In using gutta-percha the injunction to work it outwards from the centre and to apply a gradually-increasing pressure must not be lost sight of, and generally it may be said that to work from the centre is one of the readiest means of securing the absence of these holes. There are, however, times when even the greatest care is insufficient to insure immunity from this trouble, and when one can only hope that things have gone well. This is especially applicable when the object is so much under-cut as to involve the production of an elastic mould. The chief safeguard against air-holes in plaster moulds is to use a thin material and to aid its distribution with a hard brush or a small piece of wood. The brush should be transferred to a vessel containing water immediately after it has been used. Gutta-percha has the disadvantage of contracting on solidifying, and hence the necessity for the increasing pressure.

It follows from what has just been said that a careful and thorough scrutiny of the mould, prior to its being blackleaded, is imperative. Electrotyping is a faithful process, and shows up the blemishes of a model quite as prominently as the beauties. Being satisfied that the mould is good—that is, that it reflects perfectly the object we are desiring to copy—the next care is the blackleading. Only the best plumbago should be used, and care is necessary to reject any gritty particles that would be likely to scratch the mould or to impart their impress to the face of the electrotype. The plumbago must be rubbed on thoroughly and carefully, and nought should satisfy the worker short of a bright, polished surface, free from spots or specks. The appearance of holes in the copy is often due to an imperfection in the conducting surface. The plumbago should not be allowed to reach to the back of the mould or to any other undesirable point. Should it do so, the best plan is to cover up the excessive particles with varnish, oil, wax, or some such substance. Plumbago, however, cannot always be used, and then the best course open is to apply the phosphorous and silver process. As we shall see hereafter, this process is not always practicable, as the phosphorous is apt to render the copper surface more or less brittle. Where the mould is in considerable relief, the deeper parts require more careful attention as regards blackleading, &c., than the more prominent portions, because in the first place, the deepest parts of the mould become the highest in the copy, and therefore the most subjected to wear; and, in the second place, because the deeper portions are farthest from the anode, and therefore the path between such part and the anode is one of comparatively greater resistance.

Concerning the manipulation of the cell, there is little to say that has not been already said. The best materials should be used—they are far the cheapest in the end, and save one from interminable disappointment. Where Daniell cells are used, the copper that is deposited upon the negative plate forms the best anode for the bath that can be procured, because of its extreme purity. The bluestone, too, should be as pure as can be obtained. A very frequent impurity is iron, which may be easily detected by placing a small quantity of the solution in a test-glass, and then adding "an excess" of ammonia, that is, adding the solution of ammonia until the copper solution exhibits the alkaline property of rendering a piece of red litmus paper blue. Should there be any iron present, it will be deposited as a dark precipitate at the bottom of the glass. The copper solution becomes of a beautiful blue colour. Pin-holes are sometimes found in the copy, due generally to too strong a current or too feeble a solution, either of these circumstances causing the decomposition of the water, with the result that bubbles of hydrogen gas form on the negative plate (the mould). Sometimes, however, these holes may be due to bubbles of air which have adhered to the mould after its immersion. That bubbles do so adhere may be easily proved by placing a substance under water. Be it never so smooth, the smallest grain of foreign matter is prone to take with it an air-bubble, even if it be only a small one. It is usual, therefore, to wet the surface of the mould thoroughly before placing it in the bath. With small models this is easily done, although with large moulds of printing type it becomes a more difficult task. Then, again, there is the damage that may be effected by removing the mould before the deposition is completed. This, if avoidable, should rarely be done, and under no circumstances should the surface of the copy be touched with the hand, except under water. If the hand or the finger is at all dirty or greasy, there is considerable risk of its leaving a mark upon the mould, over which the copper fails to be deposited.

One of the greatest troubles attending the manipulation of the cell arises from the impurities inherent to all market-obtained copper, and precautions must be taken to prevent them from reaching the mould. Should they succeed in so doing, the probability is that they will seriously affect the deposition, giving it a dirty appearance, and often interfering with the texture. The impurities of commercial copper are very numerous, and equally varied in their proportions. They generally separate from the anode as it dissolves in the solution, and, falling to the bottom of the bath, accumulate there as dirt. This dirt has been analysed with, as might be expected, very various results. Max Duke, of Leuchtenberg, found a sample to contain tin to the extent of 33·5 per cent., copper 9·4, oxygen 24·82, antimony 9·22, arsenic 7·2, silver 4·45, sulphur 2·46, nickel 2·26, &c. The presence of this dirt forbids the immersion of the mould to the bottom of the bath. It should, in fact, be always well off the bottom. One of the objects in view in making a hole at the bottom of a hollow mould, such as the one referred to in the previous article when speaking of the elastic mould method, is to allow the flow of the liquid to wash out any dirt that may have fallen to the bottom, and which would otherwise injuriously affect the electrotype.

The temperature of the solution is another important, although apparently insignificant, detail. If it is too low the decomposition of the solution and the deposition of the metal are hindered. The temperature should never be allowed to fall below 60° Fahr., but, on the other hand, it should not get much above this point.

In the case of single-faced medallions and such-like objects, when the dimensions are small, the backing of lead may frequently be dispensed with, and a backing of shellac, pitch, or some such material substituted.

With this, I think I may safely leave this branch of the subject. Of course, in describing the process adopted in taking copies of large statues it was not my supposition that the amateur would attempt such work. My purpose was rather to make clear to him the fact that smaller and less ambitious tasks might be attempted with every prospect of success, and that with ordinary care excellent results might be accomplished. My next effort will be to explain the processes to be adopted in plating or typing leaves, flowers, insects, and other more or less delicate objects.

VENUS IN A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

THE glorious planet we are going to examine to-day surpasses, under certain circumstances, every object in the sky in lustre; and hence the poet in saying that,

> Hesperus that led
> The starry host rode brightest,

simply expressed a bald matter of scientific fact. About a month after she has attained what is called her greatest elongation east, or the same time before she acqures her greatest western elongation, she may be detected with the naked eye in the sunlit sky; and, when in the former phase, casts a very perceptible shadow at night upon any white surface. Her great brilliance under these conditions renders her the most severe test of the achromatism of a telescope that we possess; and an instrument must be perfect indeed that will exhibit an absolutely colourless image of her at this time.

In order that we may have an intelligent idea of what we are going to look at, it will be necessary to recall a few elementary facts in connection with the orbits of the Earth and Venus. Everybody (at least, everybody who will read these lines) knows that Venus goes round the Sun in an orbit inside our own; in other words, her mean distance from our mighty centre of light and heat is $66\frac{3}{4}$ millions of miles, while ours is $92\frac{1}{3}$ millions. She travels through this orbit in 224·7 days. Now, if we were standing still, she would go through all her phases in this period, and if she were in, say, inferior conjunction (*i.e.*, in a line between the Earth and the Sun) on any given day after 224·7 days, she would return to the same spot. But the Earth itself goes round the Sun in 365·26 days, of course in the same direction as Venus, so that what is called her synodic period (Greek *σύνοδος*, a meeting), or time elapsing between one meeting with the Earth and the next is really 583·92 days. For example, Venus was in inferior conjunction with the Sun at 2 a.m. on the 12th inst. Her next inferior conjunction will not happen until 7 p.m. on February 18th, 1886. Now, if we suppose her to be in inferior conjunction, and also in or near one of the nodes of her orbit, it is pretty evident that she will pass across the face of the Sun as viewed from the Earth, and we shall have a transit of Venus. With this phenomenon, however, we have but small concern here. It last happened on Dec. 6, 1882, and will not recur until June 7th, 2004, when the hand that pens these words and the eyes which rest upon them will alike be dust and ashes. If, though, the planet is far from her node at the time of inferior conjunction, then she passes above or below the Sun as seen by us. On the 12th of July she was nearly 5° south of the Sun's centre. Under these circumstances, as we shall presently see, while nearly the whole of her lighted face must be turned towards the Sun, yet an extremely narrow portion of her illuminated limb is perceptible. As she travels to the westward of the Sun after this as a morning star, more and more of the lighted part of her disc becomes visible; until she assumes the appearance of the Moon when in her first quarter; or, technically speaking, is "dichotomized." As will be seen by any one who will draw a diagram or plan of Venus's orbit, her diameter must appear the largest at the time of her inferior conjunction, and must diminish just as her illuminated surface increases. After attaining her greatest elongation west of the Sun (which can never exceed 47° 15′), the planet appears to begin to move back again, or from west to east, grows smaller and smaller, and when her disc is becoming fully illuminated, disappears behind the Sun in the glare of his light, as merely a rather big star. She is then said to be in superior conjunction. Emerging, after an interval, from his rays to the east of him, she becomes an evening star, and goes through all her phases in the reverse order, increasing in diameter as the area of her illuminated surface diminishes. Attaining her greatest eastern elongation, and then turning back as a rapidly-narrowing crescent, she finally returns to inferior conjunction again. This all being understood, we will, at last, go to the telescope.

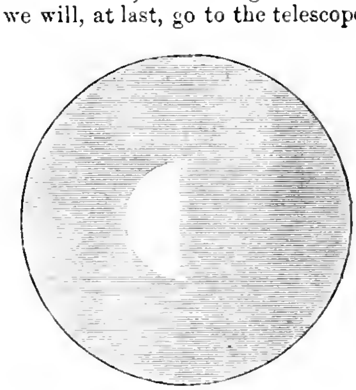


Fig. 1.—Venus, May 10, 1884. Power 160.

At 6 p.m., on May 2, Venus had attained her greatest elongation (45° 27′) east, and eight days later the drawing above was made, with a power of 160, in a 3-in. telescope. Now, two or three things will strike the observer who will carefully scrutinise this sketch. Perhaps the first will be the great brilliance of the illuminated limb of the planet, and the way in which this contrasts with the inner portion, or "terminator" (Knowledge, vol. iii., p. 222), shading off into the bright sky. The two little cusps, too, so sharp and bright, will certainly catch the eye, from the want of correspondence of their inner edges with the interior curve of the planet's lighted surface. All this seems indicative of a dense and extensive atmosphere surrounding Venus. One effect of the inner shading is worthy of note, and that is the effect it has in reducing the area of the planet which should be theoretically illuminated. If we draw a plan of the orbit of Venus we shall see that at her greatest elongation she ought geometrically to be dichotomised, *i.e.*, exactly half-full; but it will be seen that in reality she is rather less than this, the degradation of light towards the terminator being pretty rapid. Observers of repute have seen the terminator jagged and uneven, like that of the moon; but it is too much to expect of a 3-inch telescope that it should exhibit such difficult features as this. A blunting of one or both of the horns has also been perceived at times by various astronomers, both in this country and on the Continent. And, what is of considerable interest to the possessors of instruments of the size employed for the purpose of these papers, very faint dusky spots and bright patches have been perceived from time to time in telescopes of the most varying apertures; small ones showing these spots as well as, in fact better than, some of the larger instruments. This may possibly arise from the general glare of light in a large objective or mirror deadening the eye to such delicate details. It is by the aid of these spots, real or imaginary, that the hypothetical period of rotation of Venus has been determined.

But, however beautiful and curious the spectacle may be which is presented by Venus in quadrature, it will scarcely interest the student so much as his first view of her in inferior conjunction. Our succeeding figure exhibits the

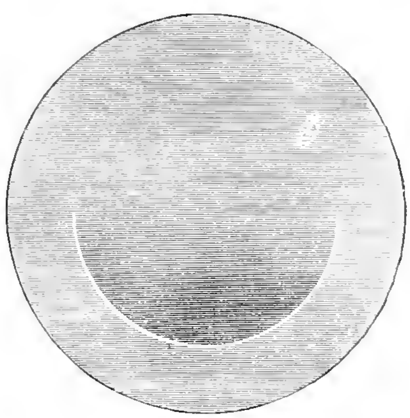


Fig. 2.—Venus in Inferior Conjunction, July 11th, 1884. Power 160.

planet as seen in the same instrument and with the same power as that employed to make our first sketch with. The contrast between these two aspects of Venus will arrest the attention at once. The comparatively small half-moon has become converted into a hair-like glittering semicircle of light, enclosing something which is certainly darker than the surrounding sky. The very abnormally hazy condition of the atmosphere which has now persisted for many months was against the perception of any very delicate gradations of shade, so that the whole of the dark body of Venus was invisible; but the effect, difficult or impossible to reproduce in a wood-cut, was that of a disc dark where embraced by the crescent of light, and fading into the light of the sky outside or beyond the cusps. On the occasion of former inferior conjunctions, the whole of the planet's dark limb has been unmistakably perceived. In order that it may be seen to the greatest advantage, a *very* small diaphragm should take the place of the ordinary one between the two lenses of the Huyghenian eye-piece. A blackened card disc with a fine hole made centrally in it with a red-hot needle, answers capitally. The hot needle burns the fringed edge of the perforation and leaves it clean and sharp. The smaller the hole, consistently with distinct vision, and the more sky light that is cut off, the sharper and better will the body of the planet appear. This little device will always be found useful when any body is to be viewed in bright sunlight.

There is a queer story—or, perhaps, it would be more correct to say a series of queer stories—with reference to various observations of a satellite or companion to Venus, situated always close to the planet, sometimes on one side of her, sometimes on the other, but always exhibiting a phase identical with her's. The most feasible explanation of this is that it has had its origin in each case in what is called, "a ghost" in the eye-piece, *i.e.*, in a reflection of the planet's image from the convex surface of the eye-lens on to the plane surface of the field-lens, and so back to the eye of the observer. An observation made by Short, the famous optician, in 1740, who did use two different telescopes, seems the only one to throw any legitimate doubt upon this explanation. M. Houzeau, the eminent Belgian astronomer, however, is so convinced of the objective reality of the various apparitions of this satellite that in *Ciel et Terre* for May 15th of the present year he gravely propounds the hypothesis that a little planet (which he provisionally names Neith) revolves round the sun in an orbit just exterior to that of Venus herself. Here there is an opportunity for the student to distinguish himself. He has only to watch Venus day and night until he picks up this attendant, to do so. Whether, though, he succeeds, or whether he fails in this attempt, he will find himself amply repaid for any amount of labour by the diversified but always beautiful appearance of the planet as she speeds on her path round the sun, and may find infinitely less profitable ways of spending his time than by the devotion of a daily half-hour to watching Venus in a Three-Inch Telescope.

BRITISH SEASIDE RESORTS,

FROM AN UNCONVENTIONAL POINT OF VIEW.

By Percy Russell.

II.

Taking all England, and making proportional allowance for inland as against sea-coast populations, it would probably be found that the line of shore between Cromer on the north-east and the Bill of Portland on the south-west, is the best-known, perhaps, of all the coast of England to the greatest number of people. If, *per contra*, we take the much more sinuous shore-line from Portland Bill by Start Point, Falmouth, the Lizard Head, the Land's End, and then northwards to the splendid estuary of the Severn, and thence to St. David's Head, that western headland of Pembrokeshire, we shall follow a coast-line that, except at a few points, is unknown in detail as it is unvisited by the multitude, but which includes some of the finest scenery of these islands, being in many cases a happy blending of the rugged grandeur of north-west Britain with the softness and almost the climate of Italy itself. The

Devonian heights extend southward to the Cornish highlands, that magnificent series of granite table-lands and hills terminating in the Land's End and in the volcanic rocks of Lizard Point. These highlands average from 800 to 1,300 ft. above the sea level, and from the ridge flow many short rivers through valleys rich with cornfields, orchards, and meadows. The combination of sublime with picturesque scenery is perfect, and on both sides of this peninsula the shore-line is bold, often grand, and constantly indented by beautiful bays guarded by imposing headlands.

Some parts of Cornwall, like Falmouth—the creation, in a shipping sense, of Sir Walter Raleigh—are popularly known to most persons. Here, indeed, may be seen what is in truth a strange sight under English skies—in the form of lemon and orange-trees which yield plenty of fruit growing against garden walls. As a whole, however, this strange peninsula is rather out of the ordinary range of the normal seeker for a seaside resort, and I will, therefore, rapidly and lightly touch on a few of its salient features.

St. Keverne, near the Lizard, with its quaint houses of unhewn stone, the joints being stopped by that remarkable china clay which is in such demand as a principal ingredient in manufacturing Staffordshire potteries, is one of many examples of the extremely picturesque places to be found in this remarkable region. Here grows the graceful white heath (*erica vagans*), marking out with its pure blossoms the conformation of the serpentine which, composed of silica and magnesia, characterises the remarkable metamorphic rocks of the Lizard. In some places the dark-green masses of crystallised serpentine give a strange aspect to the scene. In contrast to these rocky masses are the marl lands, the true gardens of Cornwall, yielding enormous crops of from eighty to ninety bushels of wheat to the acre, if we may credit local agriculturists. Along the shores the successive cliffs are marked by variety and grandeur. At Nare Point is a cavern 100 ft. long, having, by a singular juggle of some natural convulsion, an ancient beach converted into its roof. Here one looks down on a famous flat known as the Chynals Wollows, of some sixty acres, and lying so low that in heavy gales the sea rolls in and deposits a tribute of fine sand, in constant request for brass castings in the great foundries at Hayle.

The tamarisk hedges strike the stranger as something new. The twigs are reported to be possessed of tonic properties, and were once in high repute in the days of domestic herbal medicine. Cliffs, caves, strange fissures, and extraordinary monoliths are among the common things of this romantic shore, and here, in the eighteenth century, there was, for a considerable period, a squadron of six smuggling vessels, manned by 235 first-rate seamen, carrying 56 cannon, and maintaining for some years the command of these wild seas, notwithstanding all the King's cruisers could do.

This is but a patch of local colouring—a stray note in respect to the great and varied interest of these rugged shores. Penzance presents perhaps the most striking sight in the district. A mountain rises with ineffable grandeur from the midst of a lovely bay, beautiful in summer as Baiæ itself, which Horace, by-the-by, preferred, he said, to all other watering-places in the Roman world, and, shooting up with stern abruptness, culminates in one of the most noteworthy pinnacles of the county. The precipitous sides are in strong contrast to the fertile lands around, and from St. Michael's Mount is a magnificent prospect of the Channel. At Penzance you can command both the English and the entrance to the Bristol Channel. Here gigantic rocks are piled about mute witnesses of some tremendous forces at work when, this portion of the British Islands was roughly fashioned into its present form; here are the famous "Logging" or Loganstones—one of over a hundred tons being so delicately poised that it moves at a touch, and afar in the distance appears the Scilly archipelago. The island giving its name to the group is almost inaccessible, and only five or six of the islands are regularly inhabited. These were the Cassiterides, or, perhaps, the Hesperides of the ancients, and they abound in strange monolithic monuments. Tresco, which lies between Bryhher and St. Martin's, was granted by Athelstan to some monks in 936. St. Mary's, the largest member of the group, is quite a little kingdom in miniature. Hugh Town, the capital, is remarkable for the mingling of very old-fashioned with neat modern houses, and has an excellent pier, a post-office, and custom-house. In Tresco may be seen the vestiges of a tenth-century abbey, and of a camp traditionally assigned to Oliver Cromwell. Druidic remains — some real, and many, I suspect, fanciful—abound, and the geologist is certain here of a rich field for operation. On leaving the mainland to visit this singular cluster of rocky uplands—the highest points, no doubt, of an enormous submerged country—a splendid view is to be had of the Cornish coast formation here. In some instances, the promontories have a close resemblance to feudal castles. The thirty miles or so of sea between the Land's End and the Scilly Isles was once the famous Cornish champaign, and known as Lethowson, or Lyonesse, and is said traditionally to have included about a hundred and fifty churches. The landmarks of this submerged region are the Wolf Rock and the Seven Sisters—a cluster of cliffs whence fishermen of yore are said to have hooked up unmistakable evidences of a lost civilisation. Some persons may think this exaggeration, but in 1817, in a January storm, it was for some hours extremely doubtful whether the sea would not break right through the country to St. Ives, and thus reproduce in the Land's End another Scilly group.

As to the Scilly isles, some of the books I have consulted make them to number at most some forty or fifty, but other more trustworthy authorities reckon up full three hundred isles, islets, and rocks, scattered over an area of thirty square miles. Penimis, the head of the isles, is noticeable for its piled up granite blocks, forming walls, rude arches, and vast chambers, all the work of natural forces. There are caverns, covered galleries, and vaults hung with beautiful ferns, and enclosing crystal pools, while from the topmost blocks, the wild and lovely scene would be quite a revelation of land and seascape to thousands of persons who have seen nothing more striking than the Dover cliffs or Beachy Head.

One of the rocky marvels of these weird regions is the "Pulpit" rock, over which projects a vast granite coping, fifty feet long, and twelve broad. It looks unstable, but is secure enough, and may yet last for ages.

In these southern regions of England we have the wildness and much of the sublimity of the Scottish Highlands, mingled with and softened by a vegetation unknown in other zones of the island. At Penzance, the decomposed greenstone is marvellously fertile, and plants from Australia that will grow at Kew only under glass, here thrive out of doors. A perpetual southern spring reigns, but the nearness of the sea to all points of the land tempers what would be an oppressive heat at seasons; and even in "winter" the days are comparatively warm, and the sun is nearly always shining. The mines are, of course, a source of interest, but these hardly come within my present scope. Few, if any, counties of England present such examples of longevity among the inhabitants, and undoubtedly the purity of the atmosphere and the proximity of the sea to all points of the peninsula are in themselves highly hygienic conditions. The granite spine or ridge that divides the peninsula with its successive peaks—Brown Willy, 1,368 feet; Caradon Hill, 1,208 feet; Kit Hill, 1,067 feet; and Hensbarrow Beacon, 1,034 feet—help to complete the resemblance of Cornwall to a miniature Italy; and the fact that the Balm of Gilead—a species of tree flourishing in Arabia and Abyssinia—grows out of doors sufficiently establishes the softness of the climate. Marazion in particular, known as Market Jew, has special salubrity, being at the foot of a hill on St. Michael's Bay, and entirely sheltered from every cold wind. Marazion, by the way, is supposed to be the most ancient town in Cornwall, and is very near the famous Ictis, the great Tin Mart of ancient story.

Sweeping round northwards, and facing the Irish Sea, we find the Devonian heights on the one hand and the seaward ending of the Welsh mountains have, between them, formed a coast abounding in picturesque features and in noble scenery. Proceeding northwards along the Cornish coast, under the shelter of the high lands, we pass numerous points of interest like Padstow, Tintagell, and, reaching the Devonian shores, pass Bideford, on the banks of the Torridge, Barnstaple, and reach Ilfracombe, standing among picturesque and irregular hills, and having a harbour formed by veritable ramparts of rock. Here begin the special beauties of the Bristol Channel, the extension, in fact, of the magnificent estuary of the Severn. This is the grandest estuary of all Great Britain, and has a most irregular coast-line of 220 miles; and here may be seen tides that rise to heights ranging at Bristol from 35 ft. to 70 ft. at Chepstow. The phenomenon of the *bore* is also a special marine feature, and shows the ocean advancing like a wall of water, as much as nine feet above the normal level. It is this bore or tidal wave that rushes up the broad mouth of the Severn, which, by the way, at its junction with the Wye, presents one of the most famous water views of the kind in all England. On the north of the Bristol Channel, Glamorganshire (in Welsh, Gwlad Morgan) has a coast-line of full ninety miles, and includes the land of Gower, that remarkable peninsula projecting into the Bristol Channel with deeply indented and highly precipitous coast. Then comes the wild Caermarthen coast, the birthplace of Merlin, and having in Tenby what has been generally allowed to be one of the most beautiful and romantic places in these islands. It stands on a kind of promontory, and three miles away is Caldy Island, with many interesting archæological associations. The lodging-houses here are mostly on a high cliff, and the view across to Pembroke, on the shores of Milford Haven, is certainly unsurpassed for beauty. The grand approach to Pembroke is by water, and this enables its castle, which is justly ranked among the most splendid monuments of antiquity in South Wales, to be seen to advantage. The town principally stands on the ridge of a long rock. Under the chapel of the castle is the famous natural cavern known as the Wogan, which communicates with the harbour. One matter worthy of special note for the tourist is that in Pembrokeshire, originally settled by Flemish emigrants, English is generally spoken, and, indeed, this county has sometimes been called the Little England beyond Wales. Milford Haven is a truly wonderful expanse of sea, landlocked by steep hills, rich with vegetation and abounding in splendid views from all points of the compass. As a harbour, the Haven is hardly equalled in the world, and it is entirely protected from winds by its green girdle of hills. It is full seventeen miles by two or three. Proceeding onward by the coasts we reach St. David's, once a splendid, and still an interesting place. Off Whitsand Bay there are six singular islets, quaintly known as the Bishop and his Clerks. Next we reach Fishguard, and thence to Cardigan on the mouth of the Tyvi. This was anciently *Aberteif—i.e.*, the mouth of the Teif or Tivyi. The scenery here is highly romantic, and the coast-line is marked by rocks of great grandeur. It is worthy of note that this Welsh river is believed to have been the very last retreat of the British beaver. Cardigan Bay is a fine semi-circular bend, having a coast of nearly 111 miles, and being swept by a strong current from south to north, and obstructed by bars, it is rather dangerous for navigation. A great part of this grand bay is believed to have been formerly dry land, and had at least sixteen towns, and, tradition says, was entirely submerged during fearful storms in or about the year 520 A.D. This is decidedly a striking parallel to the submerged Lyonesse off the Land's End, of which I have spoken above. Cardiganshire, the great maritime county of West Wales, rests on the lower Silurian slates, and sends down from its rugged hills abrupt slopes to a steep beach. This county is remarkable for containing full twenty lakes or *llyns*, justly celebrated for their beauty, which is of the wild and even terrible order, and for its romantic waterfalls, particularly that known as the Rheidol Falls, and the Devil's Bridge. This is a single arch, crossing a chasm, and was diagonally erected by the monks of Ystrad Ffiur Abbey, near the source of the Tyvi, in the thirteenth century. The stream of the Mynach descends impetuously from mountains about five miles, and roars beneath the bridge at a depth of 114 feet. The total fall of the Mynach is no less than 322 feet. It was this county that gave, in 834, a king to all Wales; and throughout are many interesting remains of British and Roman camps, cairns, castles, and Druidical circles. Carnarvon is another of the romantic counties of Wales, and is traversed by the grandest mountains of South Britain. Here is the great Snowdonian range, culminating in Snowdon, 3,571 feet above the sea-level. The Menai Straits are well known for such features, of course, as appear in guide-books, and such glimpses of the special features as travellers to and from Ireland may obtain *in transitu*. Ample British and Celtic remains abound here to occupy the antiquary, but it is in Anglesea—which means, by the way, the Englishman's island, that the richest store of archæological and very ancient historic remains are to be found. This was the Mona of the Romans, and was the great stronghold of Druidical power. It has a coast-line of eighty miles, and possesses a milder climate than does the Welsh mainland, only it must be avoided in autumn, when the air is charged with very disagreeable mists. Beaumaris, with its ivy-clad castle, dating from Edward I., stands on a picturesque bay, and is a pleasant seaside resort in summer. From the Anglesea coast near the Tal y Moel ferry house, the town of Carnarvon, with the Menai Straits in the foreground and the lofty mountains of the Snowdonian range in the background, forms a picture of striking beauty. The Bay of Beaumaris is very sheltered and shallow, and at low water the Laven sands extend for miles. These, again, in parallelism to Cardigan Bay, once formed dry and inhabited land, and were inundated in the sixth century. In the churchyard of Abergele, a Caernarvonshire village, is a Welsh inscription, saying that there lies a man whose dwelling was three miles north, *i.e.*, where now roll the breakers of the Irish Sea. Another pretty conclusive evidence of the fact that a great strip of land was here entirely submerged arises from the fact that the boles of some vast oaks have been discovered during extraordinary low tides. The lofty mountains of Wales, broken by the Bristol Channel to reappear as the Devonian, and then the Cornish highlands gave in their hard declivities on the west a new coast-line, probably at some very remote period to this island; and but for the Cornish islands there can be little doubt but that the land's end south would have been furnished by Devonshire. A remarkable feature of Carnarvonshire is the promontory of Llyn, which juts out to sea, and includes many highly picturesque places, like Clynog, which, backed up by mountains, and with its houses half-hidden in refreshing foliage, presents the very perfection of a seaside resort where repose and natural beauties are the main desiderata. The principal town, however, on this remarkable promintory is Pwllheli. Some twenty-four miles away lies the Isle of Bardsey. Some portions of the coast are perpendicular, and others actually overhanging, producing a remarkable effect. Immense multitudes of birds build in the crevices of this cliff, and the collection of their eggs is quite a staple occupation. On the south-east Bardsey is accessible. In 1840 the population numbered just 84. It is remarkable that no kind of reptile has ever been seen in Bardsey, which is in Welsh known as the Refuge of the Saints. At the end of the promontory is a bay in which every ship once entering must be inevitably stranded, as, from whatever quarter blows the wind, the current always sets powerfully inwards, and among seamen on the coast this inhospitable and fatal bay is known vulgarly as Hell's Mouth.

(*To be continued*).

A CATASTROPHE AVERTED BY ELECTRIC WIRES.

THE *Scientific American* learns by a letter from Rev. H. C. Hovey, that the new drill hall of the State University, at Minneapolis, was struck by lightning on June 12, with attendant phenomena of interest. This building, locally known as the University Colosseum, stands on a bluff overlooking the Falls of St. Anthony, occupying the highest ground in the city. At 2 p.m. there were 1,000 children assembled on the stage, and about 3,000 persons in the audience. A thunder-storm arose, and while the children's choruses were going on, it was noticed that the series of electric lamps, fifteen in number, hanging from the dome, were lighted at each flash of lightning, going out again at once, and there was a sense of uneasiness pervading the people.

Suddenly there was a loud report, as if of heavy ordnance, balls of fire were distinctly seen through the large skylight, and following the electric wires away from the building. Subsequent examination showed that the lightning first struck the flag-staff surmounting the door, thence pierced an oaken beam to which the staff was fastened, the splinters, or the concussion, breaking the glass in the skylight. An iron rod conducted the fluid to the network of electric wires below, where the charge was divided, a portion being harmlessly distributed over the general circuit, and the remainder shattering several electric masts near the building.

A workman on the roof had his shoe torn off and his leg badly burned; and another person in proximity to one of the masts was temporarily paralysed. There was a panic imminent at first, as every one instinctively sprang to his feet and confused cries and shouts were uttered. Dr. Thomas, with great presence of mind, had his orchestra play, and Herr Scaria came forward and sang. Thus reassured, people either remained to hear the music, or quietly left the hall.

At night, an immense audience was present at the Colosseum to hear "The Creation," and quietly sat through another thunder-storm, seemingly satisfied that the electric wires were good lightning-rods. The lamps, however, worked fitfully, now blazing with startling brilliancy, and then going completely out, leaving the audience in total darkness, and then flashing up again. Meanwhile the music went on as if nothing unusual had occurred, both soloists and chorus being perfectly familiar with the score!

What drew the lightning was the metallic ball surmounting the tall flagstaff fifty feet from the wires. The staff and girder to which it was attached were wet, hence became conductors, carrying the fluid along to an iron bolt, beside which it passed through a heavy piece of timber, whence it leaped upon the electric wires, by means of which it escaped from the building. There is not the slightest doubt that the wires performed the duty of lightning-rods in this instance. Nor is there any doubt of the grave error of permitting a vast assembly to be gathered into a lofty, unprotected building on an eminence. The intensity of the current fused the fine wire circuit feeding the lamps, which accounted for the spasmodic working of the lamps, the wonder being that they should have worked at all after being subjected to such a strain.

Mr. Noyes, foreman of the Brush Company, tells an interesting experience. He was at work on the wires previous to the storm, and kept on after it burst, although aware of his danger. At the moment the building was struck he was splicing the wires directly above the central lamp, meanwhile taking every precaution possible under the circumstances. For a few minutes he lay unconscious, and then, regaining his senses, descended to the ground. He says that he did not feel any pain until he reached *terra firma*, when he suffered intensely in his right foot. On examination he found that the bolt had struck his leg below the knee, tearing the clothing to shreds, bursting open his stout boot from heel to toe, and blistering the flesh as if with a hot iron.

TRICYCLES IN VICTORIA.—The Postmaster-General of Victoria has it is said, decided to make a trial of the tricycle postal delivery system at Portland, Sale, and Ararat. If the plan should be successful, he will have it extended to other districts at an early date.

ELECTRIC LIGHTING IN LONDON.—The Board of Trade have decided to proceed at once to revoke no fewer than twenty-five of the provisional orders which were granted by them last year, and subsequently confirmed by Parliament, for the electric lighting of London and its suburbs. Of this number twenty-three are orders which were obtained by the Metropolitan Brush Electric Light and Power Company, which has since gone into liquidation. These orders relate to the electric lighting of Barnes, Mortlake, Bermondsey, Chelsea, Chiswick, Clerkenwell, Finchley, Greenwich, Hackney, Holborn, Hornsey, Islington, Limehouse, Poplar, Rotherhithe, St. George's-in-the-East, St. George the Martyr, portions of the parish of St. Giles, the parishes of St. Luke's, St. Olave, St. Saviour's, Southwark, Shoreditch, Whitechapel, and an order known as the Wandsworth order, which, however, relates to portions only of the parish of Clapham. Of the other two orders which will be revoked, one relates to the lighting of Kensington, and the other is an order granted to the Pilsen Joel Electric Lighting Company, with powers to light those portions of the parish of St. Giles not granted to the Metropolitan Brush Company. So far as London is concerned, the result, therefore, of the numerous electric-lighting orders which have been granted during the past two years, is that only eight now remain in force—namely, the St. James's and St. Martin's order, which, with the Hanover-square, Strand, and Victoria district orders, are now held by the Edison and Swan United Electric Lighting Company, the Hampstead order, granted to the Hampstead Electric Lighting Company, the St. Pancras order, granted to the Vestry, the order for the lighting of Fulham, which was granted only last May to the West Middlesex Electric Lighting Company, and the order, also granted in May last, to the West London Electric Lighting Company, for lighting portions of the parishes of St. George's, Hanover-square, St. James's, Westminster, and St. Martin-in-the-Fields. Of these eight orders, the first five have already had their time extended within which to comply with the provisions of the orders, and unless these provisions are complied with before October 15 next, the powers will be lost, unless a further extension of time is granted.

Reviews.

SOME BOOKS ON OUR TABLE.

Force and Matter. By Professor Ludwig Büchner, M.D. (London: Asher & Co. 1884.)—"Every scientific truth," said our great departed geologist, Sir Charles Lyell, "passes through three stages. In the first it is decried as absurd. Then it is said to be opposed to revealed religion. Finally, everybody knew it before." We are forcibly reminded of the verity and applicability of these words on opening the fourth English (translated from the fifteenth German) edition of the now famous "Kraft und Stoff," which, at its first appearance, twenty-nine years ago, met with such a chorus of virulent abuse from orthodox journals of every shade of thought; but which now would merely be held to push, perhaps rather to an extreme, views held by a large proportion of men of science in all civilised nations. The doctrine of the Conservation of Energy is now so firmly established that no one would seriously take the pains to attempt to controvert or deny it; and, starting from the premises of the immortality of matter and the equal immortality of force, Dr. Büchner essays to explain the entire phenomena of the visible universe upon strictly material principles, to the exclusion of any extra or supernatural agency whatever. In much that he says he would seem merely to have anticipated the irrefragably established facts of modern scientific research; while in other parts of his work it may, we think, be fairly said that his argument rests on assumptions for which adequate proof (in the existing state of our knowledge) is not offered. That every single thought, for example, is accompanied by an actual molecular change—or rearrangement—in the brain is as certain as any fact in physiology. It is, however, taking a very considerable stride to assert with our author that such molecular change or vibration *is* thought. It may not be unbelievable, but it is certainly inconceivable, that consciousness, reflection, and desire can be expressed in terms of motion; and without actual proof of the possibility of such expression, Dr. Büchner's final conclusions must drop to the ground. It is, of course, open to him or to his disciples to retort that where so much that he originally advanced has been shown to be absolutely true, every accession to human knowledge must tend to include a larger and larger proportion of what remains in the same category. This, however, is an argument whose fallacy may be shown by applying it to the contentions of certain people in connection with astrology, spiritualism, &c., and which need not detain us here. On one point there can be but little doubt or dispute—that a work which has passed through sixteen German, six French, four English, three Italian, and two Hungarian editions, and has been translated into thirteen living languages, must be eminently well worth reading, whether we agree with or dissent from its author's conclusions.

The Food Reform Magazine (London: National Food Reform Society.)—This is a vegetarian organ, seemingly devoted to the attempted conviction of mankind that their temporal salvation depends wholly upon their never touching a bit of meat. The whole thing is overdone to an extent which must repel every unprejudiced and impartial inquirer. We note, by the way, on the cover of this magazine an announcement that letters on "Vegetarianism" have been inserted in (*int. al.*) Knowledge; but we do *not* find any mention of the fact that Sir Henry Thompson, who had been publicly quoted by members of their society as an advocate of vegetarianism, publicly contradicted this false and dishonest impeachment on page 407 of our 1st Volume.

Lessons in Social Economy. By James Runtz. (London: Educational Supply Association).—Why Mr. Runtz has considered it necessary to dub his work "Social" Economy is by no means apparent. It is a treatise in a simple and apprehensible form on what every other writer on the subject, so far, has called political economy; and, as an introduction to that science (if it be a science) for the use of teachers in elementary schools, it leaves little to be desired. The tendency of modern elementary education would seem to be towards the loading of the wretched children's minds with a mass of heterogeneous subjects without the smallest thought or care whether they can be understood or assimilated. For earning the "grant," probably political economy is as useful—or useless—as many other things taught; and, admitting this, Mr. Runtz's book is a good and trustworthy one for the teacher's use.

An Epitome of History: Ancient, Mediæval, and Modern. By Carl Ploetz. Translated by Wm. H. Tillinghast. (London: Blackie & Son.)—Herr Ploetz has by no means mis-named his book in calling it an epitome, for he has packed what is practically a history of every nation in the civilised world within the limits of 564 pages. And yet, like all German work, his is done well and thoroughly, and the student who requires a conspectus of the life of any civilised nation at a given epoch will find it in these pages in a simple and convenient shape. While myth has not been excluded, the chronology is of the most orthodox description. The claims of the Chinese, the Ancient Egyptians, &c., to great antiquity are entirely pooh-pooh'd, and everything is smoothed down and squared off to fit in with the hypothesis of the supposed origin of mankind on the earth some 6,000 years ago. For the purpose, however, of such a work as that before us this is scarcely material, as it is only when we emerge from the region of legend into that of the contemporary chronicler that history—as such—possesses the slightest value to the student. The translator has not only done his immediate work well too, but has made considerable additions to the text; in fact the book, taking it altogether, is one of unquestionable value. It is supplied with a first-rate index, which will be appreciated by all who have occasion to consult it.

A Digest of English History, 1689—1760. By M. Gutteridge, B.A. (London: Relfe Brothers. 1884.) This little volume is really what it professes to be, and is something more than the mere cram-book into which so many recent epitomes of history have degenerated. This is doubtless due to the fact that Mr. Gutteridge deals only with a limited period in our national annals, and hence he is enabled to expand his narrative to an extent which renders it intelligible. He gives the leading characteristics of each of the great battles fought during the seventy-one years covered by his digest, and deals with other historical details in a way similarly adapted to impress them on the student's mind. He has produced a useful little book.

Text-book of Practical Solid or Descriptive Geometry. By David Allan Low. Part I. (London: Longmans, Green, & Co. 1884.)—Mr. Low has produced a little book of real value to the student of Architectural or Engineering drawing, containing a large number of problems and a corresponding number of illustrations. After stating each problem, he gives a general solution of it, and this is followed by its application to one or more examples, as the case may be, whose working is, as we have just hinted, always thoroughly elucidated by a diagram or diagrams. He claims no more than is due to him when he expresses the hope that his endeavour to meet the wants of both elementary and advanced students has been successful.

Half-hours at the Sea-side. By J. E. Taylor, Ph.D., F.L.S., F.G.S., &c. (London: W. H. Allen & Co. 1884.)—The holiday-maker, whose idea of a sea-side trip is comprised in the daily succession of the bath, the novel, and the promenade, need only open Dr. Taylor's work to see what a wealth of intellectual pleasure and recreation lies altogether outside of such stock devices for "killing time." There is no such rest, either for mind or body, as a total change of occupation; and more delightful occupation than the study of the myriad forms of life that people our shores it would be difficult or impossible to find. Beginning with a half-hour with the waves themselves, our author goes on to instruct us in the employment of the microscope, the construction and stocking of temporary aquaria, the use of the tow-net and dredge, the anatomy and physiology, manners and customs, of sea-weeds, sponges, sea-worms, corallines, jelly-fish, sea-anemones, sea mats and squirts, sea-urchins and star-fish, shell-fish, and crustacea. The reader who takes this book with him in his summer or autumn jaunt to the coast, will find that it will supply him with a perennial source of amusement. He who weak-mindedly omits to do so, will cut himself off from an incalculable amount of pleasure of the most novel and exciting kind.

Bringing it to Book is an advertisement of a Mr. Eglinton a (so-called) "Medium," which we decline to forward or further by taking any more notice of it. Professor Ray Lankester and Dr. Carpenter would be the fittest people to deal with this person in the outset, as Mr. Flowers, at Bow-street, would be at a subsequent stage of the proceedings.

THE FACE OF THE SKY.

From August 1 to August 15.

By F.R.A.S.

The usual daily watch for spots and faculæ will be kept upon the Sun. A picture of the Night Sky will be found in Map VIII. of "The Stars in their Seasons." Minima of the variable star Algol (Map I. of "The Stars in their Seasons") will occur at 2h. 35m. a.m. on Aug. 13, and at the more convenient hour of 11h. 23m. p.m. on Aug. 15. The reader should keep a careful watch on the sky during the nights of the 9th, 10th, and 11th (notably on that of the 10th) for that marvellous shower of shooting stars which has been familiar from classical antiquity; and mediævally designated "St. Lawrence's Tears," is now known more philosophically as the "Perseids," from the fact of all their paths appearing to radiate from a point in the Constellation Perseus ("The Stars in their Seasons," Map I.). These bodies were shown conclusively by Schiaparelli to be travelling in the orbit of a comet (2) which appeared in 1862. Moonlight will interfere to some extent, though not to a great one, with their observation this year. Mercury is an evening star, and may just possibly be picked up close to the horizon after sunset during the fortnight over which our notes extend. Venus is a morning star, and a most brilliant object she is in the eastern sky before sunrise; in fact, by a device akin to that explained on p. 421 of Vol. V., she may be found, and easily seen with the naked eye in bright sunshine, about the time when these notes terminate. No other planets are at present visible. The Moon enters her last quarter at eight minutes past three in the early morning of the 14th, so that the first two or three days of August will probably suit the ordinary observer best for examining her in the telescope. She will occult three stars at convenient hours during the next fourteen days. The first is BAC. 6292, a sixth magnitude one, which on the 3rd will disappear at the Moon's dark limb at 7h. 32m. p.m., at an angle of 139° from her vertex; reappearing at her bright limb at a vertical angle of 190° at 8h. 4m. Then, on the 14th, another sixth magnitude star, 63 Tauri, will disappear at the bright limb of the Moon fifty minutes after midnight, at a vertical angle of 49°. It will reappear at the dark limb at 1h. 45m. the next morning, at an angle from the vertex of the Moon of 253°. On the same night (the 14th) BAC. 1351, a star of the sixth and a-half magnitude, will disappear at the bright limb eight minutes later than 63 Tauri at an angle of 12° from the vertex; but it will reappear sooner, *i.e.*, at 1h. 34m. a.m. on the 15th, at the dark limb, at a vertical angle of 290°. The moon is in Ophiuchus when these notes begin, but at 6 a.m. on the 3rd enter Sagittarius. Hence at 6 p.m. on the 5th she passes into the N.W. portion of Capricornus; there she remains until 10 a.m. on the 6th, when she crosses into Aquarius; traversing Aquarius it is the same hour on the 9th ere she enters Pisces. Her passage across this great constellation occupies her until 10 a.m. on the 12th, at which time she crosses into Aries. She leaves Aries at 2h. 30m. a.m. on the 14th for Taurus; she is still in Taurus when our notes terminate.

Miscellanea.

There is an article on "Scintillation," by M. Ch. Moutigny in the number of *Ciel et Terre*, for July 15, containing an account of the naked-eye observations of that phenomenon by M. Ch. Dufour. It should be read by all interested in the curious subject to which it refers.

Accident from Lightning.—It is stated that on Wednesday, the 16th inst., during a storm, a house in the village of Chantemerle, Geneva, was struck by lightning and set on fire. There being no water available to extinguish the flames the fire spread, and the whole village was reduced to ashes.

Steam Ploughing in the West.—Recently, at Fargo, Dakota, a traction engine drew eight ploughs, turning a sod 4 in. thick as even and well as could be done by horse-power, and at a rate of over twenty-five acres per day. The cost of steam-ploughing is rated at about 1 dol. per acre as against 3 dols. per acre by horse-power.—*Engineering.*

Bessemer Steel.—The production of Bessemer steel in the principal countries of the world last year is estimated at 4,852,956 tons. This total was made up as follows: Great Britain, 1,553,380 tons; United States of America, 1,119,576 tons; Germany, 955,000 tons; France, 440,000 tons; Belgium, 220,000 tons; Sweden, 50,000 tons; Russia, 340,000 tons; and Austria, 175,000 tons.

Wednesday's *Standard* says:—"Litigation in respect to patent rights has hitherto impeded the development of electric railways. The Patent Office has now decided in favour of S. D. Field against Edison and Siemens. The first railway was opened at Cleveland, Ohio, on Saturday, and others are expected to be constructed now in quick succession."

The *Railway Review* says:—Buffalo claims to have the tallest telegraph-pole in the world. The Western Union put up one measuring 70 feet, and thought thereby to cut the Baltimore and Ohio off from getting its wire to its office, but the Baltimore and Ohio got a pole 90 feet high, 8 inches at the tip, and set it up within 5 feet of the Western Union pole, so that the two now point to heaven in parallel lines, with the Baltimore and Ohio a trifle ahead.

A sulphur deposit exists at Djemsa, Suez, in a perfectly rainless desert on the African coast, very near the sea, and constituting a hill 600 ft. high, whose sides are blasted down as in quarrying stone. Some 200 Arabs, employed under French engineers, succeed in mining ten tons a day. A similar deposit occurs at Ronga, 500 miles from Suez, also near the coast of the African continent, which differs only in being buried under other strata, so that mining is necessary.

During a slight thunderstorm which passed over the Lake district on Saturday morning last, the corning house at the Black Beck Powder Mills, near Ulverston, was struck by lightning. A terrible explosion ensued, completely wrecking the building, and instantaneously killing three men who were inside. Another man was standing outside the corning house, and the flames from the explosion set fire to his clothing, but by throwing himself into an adjoining brook he escaped with a severe scorching.

Facts concerning Vaccination.—At a meeting of the Vaccination Officers' Association, held on Saturday last, a cordial vote of thanks was given to the National Health Society for issuing their pamphlet entitled "Facts concerning Vaccination." The Association expressed their appreciation of the "thoughtful kindness which prompted the society to assist the vaccination officers of the Metropolis in the discharge of their often difficult duties." We are informed that the pamphlet in question has now been distributed from house to house in most of the districts in the Metropolis where small-pox is epidemic, and that the demand for it still continues. Something like 150,000 copies have already been issued since the present epidemic began.

The *Standard* says:—"The Midland Railway Company having decided to offer premiums for the best-kept station gardens throughout their system, a kind of Renaissance may be looked for in this branch of horticulture. Other companies are not unlikely to follow suit, and if flowers and fruit are to be objects of competition among station-masters and porters, paint and paper, draughtless waiting-rooms, and a constant regard for the comfort of their passengers may, ere long, be among the objects in which chairmen and directors will struggle to excel. In encouraging their servants to beautify their wayside premises, the Midland authorities are taking an excellent means to increase their business, by encouraging passengers to travel by a line where the carriages are good, the stations pretty, and everybody ready to oblige."

Six Months' Failures (in the States).—The failures for the six months ending July 1 are reported by R. G. Dun & Co. to number 5,510, as compared with 4,637 in the first six months of 1883. The liabilities amount to $124,000,000, as compared with $66,000,000 in 1883. That the failures which have occurred are largely confined to speculative quarters is shown by the fact that the average indebtedness of the parties failing in the last six months is $38,000 for each failure, as compared with $18,000 in the similar period of 1883. A higher average amount of liabilities has been reached in the last six months than ever before. The agency claims that the legitimate business of the country suffered no serious result from these failures; that a condition of preparation for the panic had been reached, and that the balance of the year may witness a fairly profitable demand for merchandise, with results more satisfactory than the first six months have shown.—*Railway Review* (Chicago).

To those persons who are continually stating that there is no speed to be obtained—by *ordinary* riders—on the tricycle, we commend the following facts. A N.L.T.C. rider—who does not claim to be a "scorcher" (in any sense of the word), but merely a *bonâ-fide* ordinary rider, who has a vocation to follow—and who follows it—but yet has the enthusiasm and good sense (like thousands of others) to devote what spare time he has to the wheel—rode, this week, from Theydon Bois to the East of London in 1 hour 30 min., *including* 10 min. stoppage at the Wilfrid Lawson Coffee Tavern. Distance, 15 miles by Thompson's cyclometer, clocked by one of Bennett's chronometers. All hills *en route*—including Buckhurst Hill, which is very loose and rough—were ridden both up and down, and the brake not once used. Machine used was a *bonâ-fide* level-geared 48 in. "Coventry Rotary" roadster. The journey down, in the heat of the day, occupied 1 h. 50 m., including stoppages. He had been suffering two days previously, and his M.D. ordered him to take out-door exercise, and this was how he took it; it is needless to say he is now quite well.—*The Tricyclist.*

The Hudson's Bay Route.—A report on the opening and closing of navigation at York Factory on the west coast of Hudson's Bay, with observations extending from 1828 to 1880, has been communicated by Mr. W. Woods to the Hudson's Bay Company. The latest recorded date of open water in spring is June 1, the earliest closing of navigation November 3. The earliest recorded date of opening was May 4, the latest day of closing, December 9. There is, therefore, some six months of open water on the average in the bay itself, but the communication with the bay and the Atlantic can only take place through Hudson's Straits, and this passage is only clear in July, August, and September, with probably a part of October. Further information on this head is much needed, and it is satisfactory to learn that Hudson's Bay is shortly to be properly surveyed, for the question of its navigability is a most important one to the settlers of Manitoba and the Saskatchewan, since they can ship their exports for Europe by this shorter route, instead of by the Red River and the St. Lawrence.—*Engineering.*

M. Pasteur's Experiments on Dogs.—The series of tests which, at M. Pasteur's own suggestion, were to be made with a view to confirming his theory of protective vaccination by attenuated hydrophobic virus, have now been partially completed; and the result is a complete justification of the faith of those who had confidence in M. Pasteur's statements. So far, fifty-seven dogs have been made subjects of experiment under the supervision of a commission appointed by the French Government, and under conditions arranged between the latter and the illustrious discoverer himself. Of these fifty-seven dogs, nineteen were already afflicted with hydrophobia; and of the remaining thirty-eight, one-half had been previously vaccinated with the attenuated virus. All the thirty-eight were then bitten by the nineteen rabid animals, and the result watched. This completely confirmed the truth of M. Pasteur's assumption of protective power on behalf of the cultivated vaccine matter, for every unvaccinated dog was speedily attacked with unmistakable symptoms of rabies, ending in death; whereas the protected dogs were unaffected by the injuries they had received, and are still in perfect health. In order, however, to make certainty positive, these nineteen dogs will be kept under observation for a full year, when, if they still remain healthy, it is assumed that sufficient proof of their being protected will be given.—*The Medical Press and Circular.*

The Utilisation of the Niagara Falls.—At a recent meeting of the American Association of Civil Engineers, Mr. Benjamin Rhodes described what had been done, and what might be done, towards the utilisation of Niagara for electrical purposes. He said:—"The power of Niagara can be estimated very approximately. The average flow of the river according to many careful measurements is 275,000 cubic feet per second. The fall in the river through the rapids immediately above the fall is 65 feet. The height of the falls is 165 feet, making a total of 230 feet; thus we have for the whole power 7,000,000 horse-power. To utilise this amount of power by water-wheels, generate electrical currents, and transmit to various cities within 500 miles, would necessitate a plant representing at least 5,000,000,000 dols. Such figures as these give some idea of the enormous amount of power here in reserve." He states that on the Canadian side the entire use of the falls is represented by a small over-shot wheel, which propels a pump furnishing a meagre supply of water to the adjoining village. On the American side there are five separate raceways, developing in all 800 to 1,000 horse-power. After describing the hydraulic canal, the greatest power now in use at Niagara, he says:—"Further developments of power at Niagara may be made at little expense. The hydraulic canal can be deepened and widened, and wheels may be set under greater heads, the total amount thus made available here being equal to the necessities of many years. It may safely be said that the use of Niagara has just begun. Low water is unknown; troubles from ice are slight; hours of use are not limited to eight or ten, but 24 hours in the day, and 365 days in the year, and unlimited power is ready, making this the most reliable, as it is the grandest, water-power in the world."

At a recent meeting of the American Society of Civil Engineers, observations upon the temperatures of the earth as shown by deep mines were presented by Messrs. Hamilton Smith, jun., and Edward B. Dorsey. At the new Almaden quicksilver mine at California, at a depth of about 600 ft., the temperature was very high—some 115 deg.—but in the deepest part of the same mine, 1,800 ft. below the surface and 500 ft. below sea-level, the temperature is very pleasant, probably less than 80 deg. At the Eureka mines in California, the air 1,200 ft. below the surface appears nearly as cool as 100 ft. below the surface. Mr. E. B. Dorsey said that the mines on the Comstock vein, Nevada, were exceptionally hot. At depths of 1,500 ft. to 2,000 ft., the thermometer placed in a fresh-drilled hole will show 130 deg. Very large bodies of water have run for years at 155 deg., and smaller bodies at 170 deg. The temperature of the air is kept down to 110 deg. by forcing in fresh air cooled over ice. Captain Wheeler, United States Engineers, estimated the heat extracted annually from the Comstock, by means of the water pumped out and cold air forced in, as equal to that generated by the combustion of 55,560 tons of anthracite coal or 97,700 cords of wood. Observations were then given upon temperature at every 100 ft. in the Forman shaft of the Overman mine, running from 53 deg. at a depth of 100 ft. to 121·2 deg. at a depth of 2,300 ft. The temperature increased:—100 ft. to 1,000 ft. deep, increase 1 deg. in 29 ft.; 100 ft. to 1,800 ft. deep, increase 1 deg. in 30·5 ft.; 100 ft. to 2,300 ft. deep, increase 1 deg. in 32·3 ft. A table was presented giving the temperatures of a large number of deep mines, tunnels, and artesian wells. The two coolest mines or tunnels are in limestone—namely, Chanarcillo mines and Mont Cenis tunnel, and the two hottest are in trachyte and the "coal measures"—viz., the Comstock mines in trachyte and the South Balgray in the "coal measures." Mr. Dorsey considered that experience showed that limestone was the coolest formation.

In reply to numerous letters and communications addressed to the office of Knowledge, *its Editor begs to announce that he has now concluded his Lecturing Tour, and has, in fact, definitely ceased to lecture altogether. Should he (which is very doubtful) at any future time resume his lectures on Astronomy, due and ample notice will be given of such resumption in these columns.*

"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

SOLAR GLOW.

[1350]—In connection with Capt. Noble's letter (1344, p. 77), it may be also of interest to mention that the solar glow is a striking object here in the north-west quarter of the heavens on any tolerably clear evening at about an hour and a-half after sunset; and likewise in the north-east before sunrise. The colour of the meteor is not quite white, but seems to be slightly tinged with yellow. R. Phillips.

Northam, Bideford, July 26, 1884.

LIGHTNING—VISIBLE LUMINOUS TRACK OF A METEOR.

[1351]—The record of Thunderstorms which appeared in your issue of 25th instant induces me to send you these few lines, not so much for the purpose of telling you that one passed over my house on July 4 (during which one tree was struck in the front lawn, another within twenty paces of the hall door, and another about a quarter of a mile in the rear), as to remark that, in my humble opinion, the conclusion arrived at some time ago in your columns—that, because the *duration* of a flash of lightning is but about a millionth part of a second, therefore the eye cannot detect its *direction*—is an erroneous one. For not only have I seen lightning descend from the clouds, and dart from cloud to cloud, but also ascend out of the ground; the explanation of which facts, as contrasted with the aforesaid conclusion, appears to me to be very simple, viz., that the electric spark (which, owing to its velocity, appears as a flash) must subtend some angle while passing through the air, which angle is necessarily reproduced in miniature on the retina, the consequence being that the optic nerve conveys to the brain, *in exact sequence*, the impressions made upon its terminal ramifications.

I further wish you would kindly ask your readers whether any of them recollect having observed the track of a meteor remaining visible long after the meteor itself had vanished, as I did on one occasion for about half an hour? Also, can you explain the "quare and quomodo" of such an unusual occurrence? W. A.

July 26, 1884.

[I have myself seen lightning ascend from the earth to a cloud: and hear that this phenomenon was witnessed by a well-known contributor during a heavy storm, on Thursday, the 24th ult.—Ed.]

LIGHTNING.

[1352]—I am surprised that none of your correspondents have referred to the copy of the photograph of a flash of lightning, which appeared in yours of the 4th inst., and which is certainly quite unlike the conventional lightning-flash as it appears in paintings, &c. I only recollect once getting a good side-view of a thunderstorm. I was looking on at a cricket-match in the Phenix Park, Dublin, and the storm took place in the neighbourhood of Kingstown. It is some years since, but I cannot fix the precise date. I saw a large number of lightning-flashes, all of which strikingly resembled the photograph in question, though in some cases the lines were, I think, a little more wavy In both cases the breadth of the flash was very perceptible, and I should expect to hear that the area of its section was considerable. Nevertheless, when the earth is struck by lightning the surface of contact appears to be very small. Possibly the flashes which I saw and that which was photographed by Mr. Gurley presented exceptional characteristics. Perhaps some of your readers could throw some light on this subject.—I remain, W. H. S. Monck.

13, Belvedere-place, Dublin, July 26, 1884.

PARTRIDGES: THEIR LOVE OF YOUNG.

[1353]—One morning here, after a heavy thunderstorm during the night, accompanied by deluges of rain and a great fall in temperature, the keepers came upon a family of partridges, all dead—the parent birds crouching close together in the grass, their nine little ones between them, pressed as closely as possible to their sides, the inside wing of each parent bird extended, wing over wing, making a double roof for the protection of their family, and in this position these devoted birds had perished, trying to the last to save their young ones at the cost of their own lives. The men who found them seemed quite impressed, and said "It was a pretty picture!" M. J. C.

Swigell House, Northumberland, July 23rd.

OVERHEAD WIRES.

[1354]—Let me say a few words about overhead wires, the danger from which I think may be easily obviated.

At present the posts to which the wires are fastened are placed on the *ridge* of the roof.

Let *additional* posts be placed on the *eave* in the street-front of the building on each side of the street, and directly opposite to each other.

I assume the distance betwixt these posts across the street would be sixty-five feet, and the height of the building and post together from the ground ninety feet. If so, and the wire broke off, *even close* from the post, it would swing twenty-five feet *above the traffic in the street*, and could not, therefore, interfere with it.

The *posts* could be made longer or shorter, so as in all cases a difference of twenty to twenty-five feet should be obtained.

J. W. Busk.

DIVISIBILITY BY SEVEN.

[1355]—When a vulgar fraction whose denominator is 7 is reduced to a decimal fraction, its equivalent is a repetend consisting of six figures, in which, when extended indefinitely, the 7th, 13th, 19th, &c., figures are repetitions of the first, and if the first figure be added to the 4th, 10th, or 16th, &c., figures, the sum is = unity or $\frac{9}{9}$. The 1st figure may, for convenience, be called the complement of the 4th, 10th, or 16th, &c.

Now, if a number be divided into terms of three figures each, and marked 0, 1, 2, 3, &c., from the right, it is evident from the above that any even term divided by 7 will have the same remainder, whether it is taken at its abstract or its local value; also, that any odd term divided by 7 will, taken at abstract value, have a remainder which is the complement of the remainder when the same term is taken at its local value. Take the following example:—

Terms. 2. 1. 0.

$$246,474,585 \div 7 = 35,210,655\tfrac{2}{7}$$

or

Local value	$216,000,000 \div 7 =$	$35,142,857\frac{1}{7}$
"	$474,000 \div 7 =$	$67,714\frac{2}{7}$
"	$585 \div 7 =$	$83\frac{4}{7}$
		$35,210,655\frac{2}{7}$

Abstract Value.

$246 \div 7 = 35\frac{1}{7}$ true fraction.
$474 \div 7 = 67\frac{5}{7}$ complement of true fraction.
$585 \div 7 = 83\frac{4}{7}$ true fraction.

Taking local values, the remainders are $\frac{1}{7}$, $\frac{2}{7}$, $\frac{4}{7}$, whose sum gives the true fraction. Taking abstract values, the remainders are $\frac{1}{7}$, $\frac{5}{7}$, $\frac{4}{7}$, and the true fraction is to be obtained from them thus, $\frac{1}{7} - \frac{5}{7} + \frac{4}{7} = 0$; for the same fractional result is obtained whether we add $\frac{2}{7}$ to a quantity or subtract $\frac{5}{7}$ from it, since the difference between the two results must be ($\frac{2}{7} + \frac{5}{7} =$) unity. If, therefore, the even terms be called plus and the odd terms minus, and if their sum be divisible by 7 without a remainder, then the whole number is also so divisible. If there be a remainder, it will either be the true remainder or its complement, according as the sum of the plus terms is greater or less than that of the minus terms.

The extreme left-hand term may consist of less than three figures. WILLIAM SINGERS.

LETTERS RECEIVED AND SHORT ANSWERS.

J. GREEVZ FISHER. Forgive me. I do not "discountenance improvements in spelling because reformers are not unanimous," but because I regard the orthography in which is enshrined the noble diction of Shakespeare, Milton, Pope, Addison, Macaulay, and Tennyson as quite good enough for me. As to the destruction of all traces of the etymology of words by "fonetic vagariz," I need say nothing to any philologist. I am much more disposed to sympathise with you in your protest against the meaningless limitations of the halfpenny postage.—HECTOR. The so-called "storm-glasses" are simply glass tubes (*not* air-tight) filled with a solution of camphor, nitrate of potash, and sal ammoniac. They are hygrometers, if they are anything, but both light and temperature affect them. For any scientific purpose they are worthless.—WM. WILSON, M.A., LL.D. Accepting Colenso's example as one illustrating Common Measure, you are obviously right in what you say as to his definition.—D. WINSTANLEY dreamt on July 8th that his ex-sweetheart came to say "good-bye" on the very morning on which (as he subsequently discovered) she was married to some one else. He also dreamt, on the 14th, a medical man but slightly known to him died on the floor of his (Mr. W.'s) bedroom. This gentleman *did* die, in his own bed, early the next morning. My correspondent goes on to suggest that certain sorts of suppers may "yield prophetic dreams," which is too much for me.—EDWARD F. HOERALE. Without yourself taking the trouble to attend any course of lectures, you will, I think, find in Weinhold's "Introduction of Experimental Physics" ample material for such instruction as you propose to impart; and you might even take the successive chapters of "Facts Around Us"—a little book published by Stanford's—as the basis of a series of lectures to them. I cannot possibly make an appointment for an interview, nor undertake to see any one personally in connection with matters discussed in these columns.—THOMAS MACLEAN. Does it ever strike you that I have scores—not to say hundreds—of correspondents to deal with, and that in the tremendous pressure which exists upon an editor's time, it is quite possible (and even excusable) for him to overlook papers among those which descend in shoals on his devoted head? I have not communicated your notions to Messrs. Browning and Wenham. You must do so yourself if you wish them brought before those gentlemen.—WILLIAM WORSLEY. I do not print the letter on cholera which you send, inasmuch as it contains internal evidence that the "Rev. Dr." who penned it is ignorant of the very rudiments of physiology and pathology.—AN EXILE, while protesting against the selection of Ireland as an illustration of a country sunk in the lowest depths of superstition, points out, not wholly without reason, that past misgovernment may be to some extent held to be at the bottom of such a deplorable state of things.—OXFORD asks this "question": Is it possible to obtain 360 different positions of the letters *a, b, c, d, e, f*, by means of the following two methods of transposition only, (i) $\frac{a,\ b,\ c,\ d,\ e,\ f}{a,\ d,\ b,\ f,\ c,\ e}$ and (ii) $\frac{a,\ b,\ c,\ d,\ e,\ f}{f,\ d,\ a,\ e,\ b,\ c}$, the last position being *a, b, c, d, e, f*? We commend this to readers with plenty of idle time on their hands.—EDWARD S. HANSON points out that the "Design for a Parlour Organ," which we extracted from the *Scientific American* on p. 58, was copied from the *Building News* into the *English Mechanic* of March 28 last, and was appropriated by the American paper without any acknowledgment at all. Thanks for your details anent the English translation of Fontenelle.—E. D. WARRING. When a man submits his views for publication, he, *ipso facto*, invites criticism upon them. You surely wanted my candid opinion of yours, and not an utterly insincere compliment.—FRED. JACKMAN. Will you kindly read the paragraph at the bottom of the first column on p. 62, where it is definitely stated that I have given up lecturing altogether?—KEMUS. I am unfortunately unable to give the address of the Cremation Society. Perhaps some reader of KNOWLEDGE will kindly do so.—J. H. HAYWARD. I am, I regret to say, out of town.—ST. E. You can scarcely do better than get the "Human Physiology," by Dr. W. B. Carpenter.—EYE-WITNESS. I do not think that either of my works which you name would render you more assistance than those which you possess. "The Stars in their Seasons" is a reprint of the maps which appeared monthly in Vols. I. and II. of KNOWLEDGE. If you merely want the old constellation figures, get the "Six Star Maps on the Gnomonic Projection," now published by Letts's, but originally issued many years ago by S.D.U.K.

Our Mathematical Column.

EASY LESSONS IN CO-ORDINATE GEOMETRY.

By RICHARD A. PROCTOR.

PROBLEMS ON THE STRAIGHT LINE.

We proceed to discuss the equations to lines fulfilling given conditions, and also to examine some problems with which it is necessary the student should be familiar.

61. PROP.—*To determine the form of the equation to a straight line passing through a given point.*

Let $x^1\ y^1$ be the co-ordinates of the given point. Now we have already seen that the equation to a straight line passing through $x^1\ y^1$, and inclined at an angle whose tangent is m to the axis of x is

$$y - y^1 = m\ (x - x^1) \qquad \text{(i)}$$

We might have obtained this equation as follows:—Let the equation to the required line be

$$y = mx + c \qquad \text{(ii)}$$

then, since the line passes through the point $x^1\ y^1$, equation (i) must be satisfied when x^1 is written for x, and y^1 for y; therefore

$$y^1 = mx^1 + c \qquad \text{(iii)}$$

And subtracting (iii) from (ii) we clearly obtain equation (i). This amounts to the elimination of c between equations (ii) and (iii). Instead of eliminating c we might have eliminated m; thus, substituting for m in (ii) the value given by equation (iii) we get

$$y = \frac{y^1 - c}{x^1} \cdot x + c$$

this represents a straight line passing through the point $x^1\ y^1$ and having an intercept c on the axis of x.

The equation will clearly assume different forms according to the condition we suppose the straight line to fulfil besides passing through the given point. We shall now consider the equations of lines fulfilling such conditions. It is well to note in passing, however, that whatever form of equation to the straight line be adopted in place of equation (ii), we obtain when the constant term is eliminated by subtraction, an equation of the form

$$x - x^1 + l\ (y - y^1) = 0$$

Thus if in place of (ii) we take the equation

$$\frac{x}{a} + \frac{y}{b} = 1$$

we get in place of (iii)

$$\frac{x^1}{a} + \frac{y^1}{b} = 1$$

or subtracting

$$\frac{x - x^1}{a} + \frac{y - y^1}{b} = 0$$

similarly from the equation

$$x \cos \alpha + y \sin \alpha = p$$

we should obtain

$$(x - x^1) \cos \alpha + (y - y^1) \sin \alpha = 0$$

and finally from the equation

$$\mathrm{A}\ x + \mathrm{B}\ y + \mathrm{C} = 0$$

we should obtain

$$\mathrm{A}\ (x - x^1) + \mathrm{B}\ (y - y^1) = 0.$$

It is important that the student should note these results. They show that in this particular case a relation subsists which we shall presently show to hold generally. The equations

$$x - x^1 = 0, \text{ and } y - y^1 = 0$$

represent lines whose intersection determines the point $x^1\ y^1$, and it appears that the equation formed by combining these two equations into a single equation of the forms

$$x - x^1 + \text{a const.}\ (y - y^1) = 0,$$

represents a straight line through the intersection of the lines represented by the two equations so combined.

62. PROP.—*To determine the equation to a straight line passing through two points.*

Let $x_1\ y_1$ be the co-ordinates of one of the given points, $x_2\ y_2$ those of the other. Then it follows from the preceding article that the equation of a straight line through $x_1\ y_1$ is of the form

$$y - y_1 = m\ (x - x_1) \qquad \text{(i)}$$

where m is the tangent of the angle which the straight line makes with the axis of x. If the straight line represented by (i) passes through the point $x_2\ y_2$ (i) must be satisfied when x_2 is written for x and y_2 for y, thus

$$y_2 - y_1 = m\ (x_2 - x_1)$$

that is

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

substituting this value of m in (i) we obtain the required equation, viz.,

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}\ (x - x_1) \qquad \text{(ii)}$$

an equation which may be written in the easily remembered form

$$\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$$

COR.—We may write (ii) in the form

$$y(x_2 - x_1) + y_1(x - x_2) + y_2(x_1 - x) = 0 \qquad \text{(iii)}$$

This amounts to the statement that if $x\ y$ be the co-ordinates of any point on the line through x_1y_1 and x_2y_2, then the area of the triangle formed by joining the points x_1y_1, x_2y_2 and $x\ y$ is zero,—a consideration from which we might have deduced the equation required.

Since (iii) may be written

$$x(y_1 - y_2) + y(x_2 - x_1) + x_1y_2 - y_1x_2 = 0$$

the intercepts on the axes of x and y are

$$\frac{x_2y_1 - x_1y_2}{y_1 - y_2} \quad \text{and} \quad \frac{x_2y_1 - x_1y_2}{x_1 - x_2}$$

(*To be continued.*)

Our Chess Column.

BY MEPHISTO.

SELECTED PROBLEMS.

No. 120.

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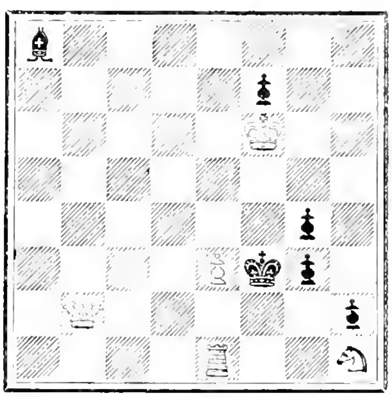
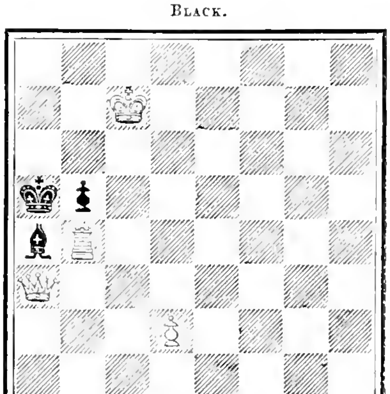


WHITE.

White to play and mate in two moves.

No. 121.

BLACK.



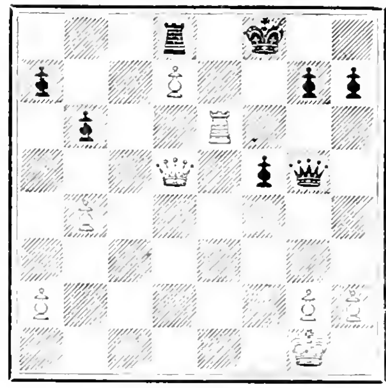
WHITE.

Reprinted from p. 80 on account of misprint.
White to play and mate in two moves.

Ending from actual play.

Amateur.

BLACK.



WHITE.

Mr. Waters.

White to play and win.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

GEO. W. THOMPSON.—You are quite right; we ought to have published the reply to Black's defence of Kt to Bsq—that is, Kt × P in Carpenter's problem.

E. W. YOUNG.—Regret to say problems not suitable.

W.—You say that you would *cheerfully* have played 50. P × BP in the ending given in KNOWLEDGE of July 18, expecting 50. P × RP 51. P to B5, when, I am afraid, on Black playing K to Q4, you would have become rather sad. No doubt we have seen the problem, but cannot recollect it. Is it not unsound?

WALTER.—We reprint the position correctly.

Correct solutions received from M. T. Hooton, Chas. T. Wilbraham, G. W. Thompson, Uncle John, C. T. G., The Owl.

THE *Norwood Review* says that a new Chess Club in in course of formation; it will assemble in a locality near the station, and will begin in September next.

CONTENTS OF No. 143.

SPECIAL NOTICE.

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AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, AUG. 8, 1884.

CONTENTS OF No. 115.

THE MORALITY OF HAPPINESS.

By THOMAS FOSTER.

[By an odd coincidence, the editor of KNOWLEDGE and I, Five of Clubs and the author of "How to Get Strong," crossed the Atlantic at one and the same time, in the steamship *City of Rome*. My own voyage has caused some delay in the appearance of my closing paper, promised for several weeks since. I was unable to complete it, as I had hoped, before leaving England. But I believe that the time which I have been able to give to the consideration of that general view of my subject which now alone remains to be presented has not been thrown away.—T. F.]

CLOSING REMARKS.

IT remains only now that I should consider the general conclusions toward which our discussion of the subject of happiness as a guide to conduct may appear to have led us.

Let me note, yet once more, that those have entirely misapprehended the whole drift of this series of papers who imagine, as many still seem to do, that my subject has been the morality of being happy, the propriety of seeking after happiness. The mistake appears so absurd, when the nature of the reasoning I have advanced is considered, that it would seem hardly worth while to correct it, seeing that no one who could fall into such a mistake could (one would imagine) in the least profit by any explanation or correction. Yet the mistake has been made by several who are clearly not devoid of capacity alike to render and to receive a reason. I have therefore felt bound to correct it as far as possible, and, as several letters recently received show that the error is still entertained, I have now to correct it afresh. Let me explain, then, that the object of these papers has been to show what sort of moral law is likely to arise, and what law appears actually to have arisen and to be in progress of formation, when the guide of conduct is the increase of happiness,—individual happiness, and the happiness of those around us, with due regard to the proper apportionment of altruistic and egoistic happiness. I have not examined such questions as, What is happiness? What kind of happiness is worthiest? and so forth. I have taken, as included in the term "happiness," all the various forms of pleasurable emotion of which the human race is susceptible, while all the various forms of painful emotion to which we are exposed have come naturally into consideration as all involving greater or less diminution of happiness. With the development of the human race, or of any part of the human race, in one direction or in another (for development is multiform), we find that ideas about pleasure and pain become modified in various ways. And it has been a special part of our subject to consider how the lower forms of pleasure, those related first to the physical gratification of self, and next those related specially to self, but otherwise of higher type, give place gradually to the higher gratifications arising from altruistic relations. But, apart from such considerations, our whole inquiry has been into the development of conduct by the natural operation of those laws which influence the development of happiness.

In passing I would, however, note that the law of conduct thus considered is by no means that abstraction which has been called "the happiness of the greater number," according to which each person is to regard himself and to be regarded as one, while the rest, being many, are to be regarded as of very much greater importance. This abstraction has not and never had any value whatever, as a rule of conduct, either in a man's self or in his relation to others. Even if we can adopt any meaning for the word happiness as thus used, it will be found that no rational way of apportioning the happiness thus regarded as a sort of common property can be conceived. If the law instead of being an abstraction were real and could be definitely applied, it could result only in this, that each person, being but one, should utterly neglect his individual welfare in favour of the general happiness, and, as it can be readily seen that no benefits he might receive from those around him (obeying, we may assume, the same law) could possibly compensate for the direct and immediate effects of this complete self-obnegation, it *follows* that a community of persons obeying this law would be a community of miserable beings; so that obedience to this law for obtaining general happiness would in reality insure universal misery.

Taking concrete instead of abstract happiness as the guide of conduct, we recognise far different results. We see that, though there must of necessity be a compromise between egoistic satisfactions and altruistic cares, the compromise need by no means imply antagonism. Regard for the welfare of others, though in its inception more or less of an effort, becomes more and more spontaneous as social relations develop. After spontaneity has been attained, altruistic actions involve more and more of egoistic satisfaction. Conversely, the care of self, which in the earlier stages of social development appears to involve more or less of disregard for the interests of others, becomes more and more altruistic in its effect as society advances. Thus also we recognise the answer to what at first might seem a difficulty, viz., that with the improvement of social relations the opportunity for altruistic actions might seem likely to steadily diminish. We see that the domain available for altruistic actions changes in position rather than in extent; nay, that such change of extent as actually accrues is toward increase. In a society where, owing to the steady improvement of the relation between egoistic and altruistic interests, the number of those depending for their happiness or even for their existence on altruistic cares has steadily diminished, the number of those who are the subject of altruistic emotions will as steadily have increased. Sympathy becomes more widely extended, its development becomes surer and more rapid, as its operation becomes more pleasurable, and a change of this sort cannot but take place as occasions for directly altruistic actions, such as arise out of pain and suffering, become less frequent.

With increased spontaneity in altruistic actions, more pleasurable feelings in the discharge of altruistic duties, and a wider range for altruistic emotions, will inevitably come such an evolution of conduct as must tend greatly to increase the well-being of the community. The care of self will be felt as a duty to others; due care of others will become a source of gratification to self. Society will be simply, on an enlarged scale and in a more varied form, such a community as might be formed by a number of kindly, well-meaning persons, of good capacity and pleasing manners, brought together for purposes of travel, research, or pleasure. In such a community it would be felt that each person's first duty was to take due care of self, first as just to himself, and secondly (yet chiefly) as a duty to the rest of the community. But it would also be felt by each member of such a community that he must be careful of the interests of others, ready to be of use to any other members of the community who required assistance such as he could give individually, or to combine with others where the assistance of several might seem to be required. Picture the relations of such a community, all of good-will, kindly, and anxious that the business of the community should go on so as to give pleasure to all, and it will be at once seen how little there is of actual selfishness in due care of self, how such care may be, nay, must be, a duty owed to all the rest; while, on the other hand, it will become clear also how each member of such a community is interested in the existence among all of a kindly interest on the part of each in the well-being of the rest. The social body, whether we consider the family, or the gathering of families into communities, or the collection of communities into nations, or the multitude of nations which form the population of the earth, may be regarded as an aggregate which should be pervaded by such ideas as are found essential for the comfort and happiness of gatherings casually brought together. The due subordination of self to others in certain relations, and of others to self in relations not less important, which is found in all such gatherings on a small scale and of comparatively uniform character—as in the passengers on an ocean-steamship, the members of a company of travellers, the fellows of a scientific expedition, or even a pleasure party—is what is necessary for the well-being of the body social: and out of this necessity, instinctively recognised, and exercising its influence steadily in the process of the evolution of races, nations, and the human family as a whole, seem to have sprung all those duties between man and man, between race and race, and between nation and nation, which form the present code of social morals, and will hereafter—developed and improved—form the moral code of perfected man. "What now, in even the highest natures," as the great teacher of our day says, "is occasional and feeble may be expected with further evolution to become habitual and strong; and what now characterises the exceptionally high may be expected eventually to characterise all. For that which the best human nature is capable of is within the reach of human nature at large."

"That these conclusions," Mr. Spencer goes on to say, "will meet with any considerable acceptance is improbable. Neither with current ideas nor with current sentiments are they sufficiently congruous. Such a view will not be agreeable to those who lament the spreading disbelief in eternal damnation; nor to those who follow the apostle of brute force in thinking that because the rule of the strong hand was once good it is good for all time; nor to those whose reverence for one who told them to put up the sword is shown by using the sword to spread his doctrine among heathens." From ten thousand teachers of a religion of love who are silent when a nation is moved by the religion of hate will come no sign of assent; nor from those priestly law-givers who, "far from urging the extreme precept of the Master they pretend to follow, to turn the other cheek when one is smitten, vote for acting on the principle, Strike lest ye be struck. Nor will any approval be felt by legislators who, after praying to be forgiven their trespasses as they forgive the trespasses of others, forthwith decide to attack those who have not trespassed against them. But though men who profess Christianity and practice Paganism can feel no sympathy with such a view, there are some, classed as antagonists to the current creed, who may not think it absurd to believe that a rationalised version of its ethical principles will eventually be acted upon."

Finally, I would ask those who have followed me thus far to note how all the duties we have considered, both egoistic duties and altruistic ones, may be seen with advantage from a different point of view and in a changed aspect, though unchanged in reality. We are in the habit of regarding the study of moral laws always from the personal side, and nearly all teachers in such matters (one might almost say all) view the subject in this way, since, even when laying down a code of morals, they present each law as it appeals to the reason and should affect the conduct of the individual. But it should be remembered that a moral law which commends to each man a particular line of conduct, is a law which, if accepted and followed by all, influences each man by the effect it produces on all the rest. Thus, a rule of conduct seemingly egoistic, and really egoistic as affecting the individual, becomes, in any society which accepts and obeys it, purely altruistic in its effect; while, *per contra*, a law seemingly altruistic in terms becomes purely egoistic in influence. If, instead of indicating a due regard for self and a proper subordination of self to others, our study of the morality of happiness had indicated as best for the community a series of duties directed solely to the benefit of self, yet the adoption of such a moral code by all men would be altogether unselfish, seeing that it would mean the forsaking of all right or title to help or sympathy from others; and others are many, while self is but one. If, on the other hand, we had found a system of perfect altruism commending itself as best, the acceptance of such a system would be no sacrificing of self to others, but would mean the acceptance of the principle that every one else was bound to assist in all his ways and wishes the accepter of this seemingly altruistic code—to sympathise with him in all his sorrows, and to care for him far more than for themselves. We have not been led to recognise any such abnegation of self on the one hand, or regard for self alone on the other hand, as desirable; but, in such degree as we have seen a regard for self to be desirable, we have in reality been led to the recognition of the rights of others (since each self is another to all others), while, in such degree as we have seen that each should consider not only the rights but the requirements of others, we have been led in reality to the recognition of the rights of each man to the assistance and sympathy of his fellows.

THE SEA HORIZON.

By Richard A. Proctor.

It is amusing to note how ignorant many ordinary seamen and nearly all sea travellers are of such matters as the distance of the sea horizon, the way in which a ship's place at sea is determined, and other such matters—which all seamen might be expected to understand, and most persons of decent education might be expected to have learned something about at school. Ask a sailor how far off a ship may be, which is hull down, and he will give you an opinion based entirely on his knowledge of the ship's probable size, and on the distinctness with which he sees her. This opinion is often pretty near the truth; but it may be preposterously wrong if his idea of the ship's real size is very incorrect, and is sometimes quite wrong even when he knows her size somewhat accurately. Any notion that the distance may be very precisely inferred from the relative position of the hull and the horizon line seems not to enter the average sailor's head. During my last journey across the Atlantic we had several curious illustrations of this. For instance, on one occasion a steamer was passing at such a distance as to be nearly hull down. From her character it was known that the portion of her hull concealed was about 12 feet in height, while it was equally well known that the eye of an observer standing on the saloon-passengers' deck on the *City of Rome* was about 30 feet above the water-level. A sailor, asked (by way of experiment) how far off the steamer was, answered, "Six or seven miles." "But she is nearly hull down," some one said to him. "I didn't say she warn't, as I knows on," was the quaint but stupid reply. Now, it might be supposed to be a generally-known fact that even as seen from the deck of one of the ordinary Atlantic steamers, the horizon is fully six miles away, the height of the eye being about 18 or 20 feet, and that for the concealed portion of the other ship's hull a distance of four or five miles more must be allowed: so that the man's mistake was a gross one. And several other cases of a similar kind occurred during my seven days' journey from Queenstown to New York.

The rules for determining the distances of objects at sea, when the height of the observer's eye and the height of the concealed part of the remote object above the sea-level are both known, are exceedingly simple, and should be well known to all. Geometrically, the dip of the sea surface is eight inches for a mile, four times this for two miles, nine times for three miles, and so forth: the amount being obtained by squaring the number of miles and taking so many times eight inches. But, in reality, we are concerned only with the optical depression, which is somewhat less, because the line of sight to the horizon is slightly curved (the concavity of the curve being turned downwards). Instead of eight inches for a mile, the optical depression is about six inches at sea, where the real horizon can be observed. But, substituting six inches for eight, the rule is as above given. Six inches being half-a-foot, we obtain the number of six-inch lengths in the height of an observer's eye by doubling the number of feet in that height; the square root of this number of six-inch lengths gives the number of miles in the distance of the sea horizon. Thus, suppose the eye of the observer to be eighteen feet above the sea level; then we double eighteen, getting thirty-six, the square root of which is 6; hence the horizon lies at a distance of six miles as seen from an elevation of 18 feet. For a height of 30 feet, which is about that of the eye of an observer on the best deck of the *City of Rome*, we double 30, getting 60, the square root of which is 7·7; hence, as seen from that deck the horizon lies at a distance of 7 7-10 miles. If the depth of the part of a distant ship's hull below the horizon is known, the distance of that ship *beyond the horizon* is obtained in the same way. Thus, suppose the depth of the part concealed to be 12 feet, then we take the square root of twice 12, or 24, giving 4·9, showing that that ship's distance beyond the horizon is 4 9-10 miles. Hence, if a ship is seen so far hull down, from the hull of the *City of Rome*, we infer that its distance is 4 9-10 miles beyond the distance of the horison, which we have seen to be 7 7-10 miles—giving for that ship's distance 12 3-5 miles. And with like ease may all such cases be dealt with.—*Newcastle Weekly Chronicle.*

THE SENSE OF TASTE.

By Grant Allen.

Animals eat, and, broadly speaking, one may say that a better popular definition of what is most essential to the idea of an animal as opposed to a plant could hardly be found than this habit of eating. In all the higher animals, at least, to eat implies a mouth—a special organ for the reception and often for the trituration of the natural food. This mouth is usually supplied with a tongue or discriminative service, the object of which is to enable the animal at once to distinguish between food that is good for it and food that is useless or positively injurious. The sense by which the animal thus discriminates between possible and impossible foodstuffs is called the sense of taste.

The lowest animals hardly need a sense of taste at all, at least in the developed form here contemplated; all is fish that comes to their net; they swallow and, if possible, digest every bit of organic matter they happen to come across in the course of their aimless peregrinations. Or, rather, they swallow whatever is smaller than themselves, and get swallowed by whatever is larger. Still, even in these lowest depths of animal evolution, we get in a very simple and undeveloped form some first faint foreshadowing of the faculty which becomes specialised later on into the sense of taste. When floating jelly-bag meets floating plantlet or floating jelly-speck under the microscope, it makes an effort to envelope the edible morsel all round with its own matter. But when it meets mineral bodies or uneatable things generally, it either does not try to envelope them at all, or if it coats them for a moment it soon rejects them as of no practical use for its own purposes. These simplest rudimentary animals, besides being all mouth and all stomach, are also all nerve and all sense-organ. Every part of them seems to possess in some feeble manner the power of discriminating between what is food and what is useless.

In the higher animals, side by side with the evolution of a definite mouth, jaws, teeth, stomach, and digestive and assimilative mechanism generally, the power of discriminating food has been specialised and localised in the tongue, at the very front of the alimentary canal. In each species of animal, natural selection has ensured that the nerves of the tongue should correctly in the main inform the animal what food-stuffs were desirable for it, and what were undesirable. Clearly if it were conceivable that a race of animals should be so constituted that it liked poisons and disliked nutritious substances, that race must rapidly die out and leave no survivors. On the other hand, just in proportion as a race finds the indications of its sense of taste in harmony with the physiological effects of things swallowed in that proportion must it tend (other things equal) to prosper in life, and to hand on its own discriminative powers to later generations.

In the human species the gustatory tract has been divided by Prof. Bain into three regions, each of which has its own special and proper functions to perform in the economy of tasting. The tip of the tongue is mostly supplied with nerves which are really rather nerves of touch than nerves of taste, and which are cognisant for the most part of pungent, acrid, or saline bodies. Obviously this arrangement conduces to the greatest safety of the mouth and stomach. The very first thing we want to know about any substance which we think of swallowing is whether it is immediately destructive of the bodily tissues. Now, the nerves of touch distributed to the tip of the tongue instantly inform us on this important primary question. In tasting an unknown substance, indeed, we all of us instinctively try it beforehand by touching it very lightly with the tip of the tongue. If it is caustic, like vitriol, or pungent, like cayenne and mustard, or fiery, like spirits of wine, or warping, like borax or alum, the tip of the tongue instantaneously warns us that it is not a fitting substance to be swallowed wholesale. This chemical sensibility of the nerves of the tongue is only a modified form of the general chemical sensibility of the whole body. Mustard, made into a plaster, acts on the skin very much as it acts on the tongue, only less rapidly and less specifically. The warping effect of alkalies can be felt on any part of the body, and the fiery character of alcohol faintly affects the nerves of touch in the same manner as the nerves of taste. In short, the sensitiveness of the tongue in this respect is only an intensified form of the common sensitiveness of nerves generally.

When a substance has passed the first examination with the tip of the tongue, and has been pronounced harmless, it is handed over to the middle region, supplied with the nerves of taste proper. It is the special function of these nerves to discriminate between sweet and bitter objects, as well as between various tasty substances which we know distinctively as flavours. On the whole, it is clear that human beings like sweets, that the tongue responds favourably to the class of foods which contain sugar as a principal element. The reason for this strongly-marked preference is probably to be found in the ancestral fruit-eating habits of our race. To our early arboreal progenitors fruits were, of course, almost the only sweet objects known; they had as yet no sugar factories, and they doubtless seldom tasted even honey in the honey-comb. Hence it was natural that the presence of sugar should come to be the instinctive test, as it were, for the edibility of whatever object they happened to come across. In our modern artificial condition, where we use sugar to excess, and often in too concentrated forms, taste alone no longer acts as a safe guide; as children we eat too many sweetmeats, and in adult life we have no digestions: but that is only because we have altered the natural conditions, and have separated the sugar from the other wholesome food with which it is usually combined under its original circumstances. On the other hand, almost all bitter substances in the vegetable world are known to be poisonous, and our repugnance to bitter tastes is thus due to the registered experience of countless generations of early human or pre-human ancestors.

The third and lowest region of the tongue is the one cognisant of pleasures and pains in immediate sympathy with the stomach. The feelings we experience in this part of our throats can scarcely be properly described as tastes; they are best characterised, in Professor Bain's well-chosen language, as Relishes and Disgusts. When we have begun to chew a piece of wholesome beef-steak in healthy hunger, we are conscious of a certain pleasurable sensation as it reaches the back of the tongue which induces us to persevere with the action of swallowing, and finally commit it to the digestive apparatus. On the other hand, when we take a dose of cod-liver oil, we are conscious, at the same stage in the proceedings, of a certain physical repulsion to the act of swallowing it; something seems to rise up instinctively in the throat which warns us that cod-liver oil is a remarkably difficult substance to digest and assimilate. The sensations thus experienced are purely premonitory of the effect of the food taken upon the stomach. Accordingly, they vary much, according to our state of health or appetite. However seasick we may be, pungent things are still pungent to us, acid things acid, bitter things bitter, and sweet things sweet. But meat, fat, oils, and so forth, produce effects very different from their ordinary results. The tastes discriminated by the lower part of the tongue are all of this character; and the things which find it most difficult to pass the final examination here are tainted or putrid meats, very rich or buttery dishes, and other indigestible or bilious substances.

Thus we may say roughly that the threshold of the mouth warns us against whatever will prove absolutely destructive to the tissues generally; the central region distinguishes between what is ordinary human food, and what is poisonous or otherwise deleterious when taken internally; and the lower portion of the tongue and throat pronounces finally upon the digestibility and fitness for the stomach (in its passing condition) of the food which has successfully passed the two earlier preliminary examinations.

THE ORIGIN OF SILK.

If we put any trust in tradition, says an English journal, there is a legend that Tchin, the eldest son of Japhet, father of the Asiatic race, taught his children the art of preparing silk, as well as the arts of painting and sculpture. Be this as it may, it is certain that, about 3,000 years before the Christian era, a Chinese book, the "Ghou-King," described silken cords, which were stretched upon a musical instrument invented by the Emperor Fo-Hi. One of his successors, Chin Nong, reputed inventor of the plough, explained to his contemporaries what beautiful stuffs could be obtained by cultivation of the mulberry tree, and about the year B.C. 2600 an empress, to whom a grateful posterity assigned a place in a celestial constellation, perfected the art of unravelling the cocoon and weaving. From that time silk culture had its principal seat near the northern portion of the Yellow River, in the province of Chan-Tong. There was produced silk for the Royal household. Yellow was the chosen colour for the emperor, empress, and prince imperial; violet for the other wives of the emperor, blue for distinguished officers, red for those less conspicuous, and black for everyone else. In the book of rites, "Li-Ki," the ceremonies performed at the harvest are carefully described. Even the empress did not disdain to gather the leaves of the mulberry with her own dainty fingers, and watched over the rearing of the busy toilers of the cocoon.

For a long time this invaluable industry remained the exclusive property of the Chinese empire, but about the third century before the Christian era a military expedition from China bore the results of its civilisation to the startled Occident. Silk became known in Persia and India, and was at last brought to Europe. The soldiers of Crassus, B.C. 56, saw silken standards among the Parthians, and a few years later an immense velarium of silk protected the spectators in the Roman circus from the rays of the sun. From this time the Romans were always provided with the beautiful textures which were the admiration of their legions. Yet silk was still the privileged possession of the rich, and in the time of Aurelian, who flourished in the third century, was worth about forty times its present value. The enormous price, when considered with the fact that there was at that time no commerce between Rome and the Orient, goes far towards explaining the great hoarding of treasure and jewellery which has since that time gone on in India.

There is a dispute between tradition and history as to the period when the genuine cocoon was brought from China to Europe. How was the vigilance of Celestials thwarted, since exportation of the silkworm from the Flowery Kingdom was forbidden under the severest penalties? One account states that in A.D. 552, two monks sent to Kothan by Justinian, succeeded in bearing away their booty concealed in a stalk of bamboo. The legend says that once upon a time, when Kothan did not yet possess the precious bombyx, the King of one of the provinces sought and obtained a daughter of the Chinese Emperor in marriage. Before quitting her native land she hid seeds of the mulberry and silkworms' eggs in her hair, where it would escape the vigilance of the Customs officers on the frontier. When she reached her new home she planted the seeds of the mulberry in order that suitable nourishment might be provided in the leaf for the worms.—*The Dyer and Calico Printer.*

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS

By Edward Clodd.

VI.

To the savage mind no other explanation of illness is possible than that it is due to the exit of one's own spirit or to the intrusion of a stronger one, whether of revengeful man or animal. An old Dacotah, whose son had sore eyes, said that nearly thirty years before, when the latter was a boy, he fastened a pin to a stick and speared a minnow with it, and it was strange that after so long a time the fish should come to seek revenge. When an Indian is attacked by any wild beast, he believes that the avenging Kenaima has transferred his spirit to the animal which seizes him, and if he has even a toothache, of which more presently, then the Kenaima has insinuated himself in the shape of a worm. The tribal chief among the Brazilian natives acts as doctor, and when he visits the sick, he asks what animal the patient has offended, and if no cure is effected, the convenient explanation is at hand that the right animal has not been found. At the death of Iron Arms, a noted North American Indian warrior, it was said that he died because the doctor had made a mistake, thinking that a prairie-dog had entered him when it was a mud-hen. The more abnormal and striking phases of disease manifest when a man is writhing under intense agony, as if torn and twisted by some fiendish living thing, or when in delirium he raves and starts, or when thrown down in epilepsy he struggles convulsively, or when he shivers in an ague, or when in more violent forms of madness he seems endowed with superhuman strength; the various symptoms attending hysteria; each and all support that theory of spirit-influence which survives among advanced races in referring disease to supernatural causes. For the ancient theories of a Divine government under which disease is the expression of the anger of the gods, and medicine the token of their healing mercy; and the current notions that any epidemic or pestilence is a visitation of God, are identical in character, however improved in feature, with the barbaric belief illustrated above: and in the ages when belief in the devil as one walking to and fro upon the earth was rampant, he especially was regarded as bringer of both bane and antidote. "He may," says an old writer, "inflict diseases, which is an effect he may occasion *applicando activa passivis* (by applying actives to passives), and by the same means he may likewise cure . . . . and not only may he cure diseases laid on by himself, as Wierus observes, but even natural diseases, since he knows the natural causes and the origin of even those better than the physicians can, who are not present when diseases are contracted, and who, *being younger than he*, must have less experience." In Lancashire folk-lore "casting out the ague" was but another name for "casting out the devil"; in the Arabic language the words for epilepsy and possession by demons are the same; and in such phrases as a man being "beside himself," "transported," "out of his mind," or in the converse, as when it is said in the parable of the prodigal son, "he came to himself"; in the words ecstasy, which means a displacement or removal of the soul, and catalepsy, a seizing of the body by some external power, we have language preserving the primitive ideas of an intruding or departing spirit. Such minor actions as gaping and sneezing confirm the belief. The philosophy of the latter, as Mr. Gill remarks in his "Myths and Songs of the South Pacific," is that the spirit having gone travelling about, its return to the body is naturally attended with some difficulty and excitement, occasioning a tingling and enlivening sensation all over the body. And the like explanation lies at the root of the mass of customs attendant on sneezing, and of the superstitions generated by it, which extend through the world.

Williams tells us that among the Fijians, when any one faints or dies, their spirit, it is said, may sometimes be brought back by calling after it, and occasionally the ludicrous scene is witnessed of a stout man lying at full length and bawling out lustily for the return of his soul. So in China, when a child is lying dangerously ill, its mother will go outside into the garden and call its name, in the hope of bringing back the wandering spirit. But for all the ills that flesh is heir to—from hiccupping to madness, from toothache to broken limbs—the patient seldom dares to doctor himself; neither the etiquette of the ordained medicine-man nor the orthodox therapeutics favour that show of independence. The methods adopted by the faculty vary in detail, but they are ruled by a single assumption. When a Chinaman is dying, and the soul is believed to be already out of the body, a relative holds up his coat on a bamboo stick, and a Taoist priest seeks by incantations to bring back the truant soul so that it may re-enter the sick man. Among the Six Nations the Indians sought to discover the intruder by gathering a quantity of ashes and scattering them in the cabin where the sick person was lying. A similar recipe for tracking demons is given in the Talmud; but, as more nearly bearing on the Indian practice, a Polish custom mentioned by Grimm* may be quoted. When the white folk torment a sick man, a friend walks round him carrying a sieveful of ashes on his back, and lets the ashes run out till the floor round the bed is covered with them. The next morning all the lines in the ashes are counted, and the result told to a wise woman, who prescribes accordingly. A favourite mode of treatment is blowing upon or sucking the diseased organ, and deception is no infrequent resort when the sorcerer secretes thorns or fishbones, beetles or worms, in his mouth, and then pretends that he has extracted them. Cranz says that the Eskimaux old women appear to suck from a swollen leg scraps of leather or a parcel of hair which they have previously crammed into their mouths, and in Australia the same dodge is practised, when the sorcerer makes believe that he has drawn out a piece of bone from the affected part. That toothache is due to a worm, is a belief which exists throughout Europe

* "Teut. Mythol.," 1165.

and Asia, and from the Orkneys to New Zealand. Shakespeare refers to it in "Much Ado about Nothing," act iii., sc. 2:—

> *Don Pedro.* What! sigh for the toothache?
> *Leonato.* Where is but a humour or a worm.

and instances are current of this superstition being acted upon in rural districts, whilst in China the itinerant dentist conceals a worm in the stick which he applies to the aching tooth, and on the stick being gently tapped, the worm wriggles out to the satisfaction of the sufferer. But among barbaric races the treatment is ordinarily the reverse of soothing. Here and there the virtues of some plant have been discovered by accident, and, whilst exalted into a deity in its native home, it has become, like cinchona, a priceless boon to the fever-stricken all over the world; but, speaking broadly, the medicine-man is no Melampus, winning the secret of their healing balm from herb and tree. Nor has he much faith in magic or charm compared to his faith in noise, in incantations, with their accompanying hideous grimaces and gestures, and their deafening yells with clang of instrument to drown the sufferer's groans and chase away the demon. Not unfrequently, when the patient is kept without food so as to starve out the in-dwelling enemy, or when the body is pommelled and squeezed to force him out, the remedy helps the disease! An illustration or two from a great mass at command must suffice. Among the Mapuches the sorcerer adopts the canonical howls and grimaces. Making himself as horrible-looking as he can, he begins beating a drum and working himself into a frenzy until he falls to the ground with his breast working convulsively. As soon as he falls, a number of young men outside the hut, who are there to help him in frightening the disease-bringing spirit out of the patient, add their defiant yells, and dash at full speed, with lighted torches, against the hut. If this does not succeed, and the patient dies, the result is attributed to witchcraft. When a Pawnee chief had some ribs and an arm broken, the medicine-men danced round him, and raised their voices from murmurous chants to howls, accompanying the music (?) by blows upon the wounded man's breast to banish the bad spirit. In olden time this rough-and-tumble business of blows, to which immersion was added, was applied to lunatics in these islands. And, in fact, until some local paper narrates a current superstition, we seldom awaken to the fact how widely the theological explanation of diseases and the empirical choice of remedies still obtains, each being survivals of barbaric theory and practice.

The savage who has more faith, as a curative, in plants that grow on burial-places, and the civilised, who ascribes special healing power to turf and dew from a saint's grave, differ no whit in kind; and so ingrained was the medicinal belief in virtue inhering in fragments of the dead, that not even the satire of "Reynard the Fox," telling how the wolf was cured of his earache, and the hare of his fever, the moment that they lay down on the grave of the martyred hen, could give quietus to the notion that grated skulls and sacramental shillings were specifics for the healing of the faithful.

This reference to like practices reminds us how belief in the action of invisible agencies has passed into the practice of confession among advanced races outside Christendom, as in Mexico and Peru. The Roman Catholic priests were not less astonished at finding this in vogue on their arrival in South America than the good Father Huc when, on reaching Tibet, he found shaven monks wearing rosaries, worshipping relics, using holy water, and a grand Lama decked in mitre, cope, and cross.* But, as the Italian proverb has it, the world is one country and "we have all one human heart," so that the confessional has the like explanation in east as in west. If the disease be the work of an offended deity or of an avenging spirit, let the wrongdoer admit his fault, and trust to him who is credited with influence with the unseen to exorcise the intruder.

THE EARTH'S SHAPE AND MOTIONS.†

By Richard A. Proctor.

INTRODUCTION.

In many works of astronomy the subject of the earth's figure and motions is dealt with at greater or less length; the general principles on which modern views are founded are exhibited with sufficient clearness; and a number of facts quite sufficient to establish the justice of modern theories are quoted in illustration. But it has always seemed to me that the way in which such matters are commonly presented, is open to objection. Either from a desire to simplify the subject, or for some other reasons, the facts are stated in a general way, which is in reality much more perplexing to the beginner than an exact statement would be, besides being open to cavil and objection. The full force of the observational or experimental evidence on which modern views have been founded, is lost to the student, when the results are stated without a careful reference to quantity and measure. The impression is too commonly left, that those inexact and unsatisfactory results are in reality all that astronomers have been able to gather; and when it is seen that such results admit of being explained in other ways, doubts naturally spring up as to the exactness of modern astronomy.

This would be less important, were it not that there is a class of persons very ready to profit by this state of things. Knowing perfectly well that the world is always more ready for novelty, than to hear the details of real scientific progress, these persons invent hypotheses of greater or less ingenuity, which appear to be consistent enough with the relations described in books on astronomy. These hypotheses they further recommend to the public notice by garbled extracts from the works of known authors, or by apocryphal experiments. Secure of a large audience for their absurdities, they little regard the contempt which all well-informed persons bestow on them. They invite controversy, confident that no student of science, who considers his own reputation, will enter the lists with them, and safe also (even if such an improbable event should occur) in the certainty that by a few verbal evasions they will be able to avoid the appearance of defeat.

There is also another class of persons equally anxious to promulgate new theories, but not absolutely dishonest. Among the thousand who, having read the ordinary popular works on astronomy, remain unconscious of the exactness of modern science, there are necessarily some who mistake their want of apprehension for exceptional ability. Such persons, especially if they are troubled by the *cacoethes scribendi*, promulgate new theories with a surprising fecundity. Scarcely a month passes that a work involving some new absurdities does not pass through the press. And these books find purchasers who are at least

* "Voilà autant de rapports que les Bouddhistes ont avec nous," adds the traveller, for hinting at which analogies between Buddhists and Catholics the Pope put his book on the Index.

† The papers which follow are revised versions of a series which appeared seventeen years since in the *English Mechanic*.

as likely to adopt the new views as to retain their confidence in the modern system of astronomy.

I would not have it understood that the present series of papers is in any way intended as an answer to the paradoxists—whether of the honest or of the dishonest school. To enter into controversy with these writers would be not only a foolish, but a wrong thing to do. It would imply that modern astronomy, and—which is more important—the professors of modern astronomy, require to be defended. The task would also be necessarily a vain one, since the honest paradoxist cannot, and the dishonest paradoxist will not see the futility of their arguments. Nor does either class, indeed, deserve to be answered, since even the honest paradoxist—though otherwise to be commiserated—yet merits condemnation for professing to teach matters which he has not mastered, and so leading others astray.

It is for the benefit of those who really wish to know something of the grounds on which the modern system of astronomy rests, that I pen these papers. I wish to indicate the way in which the various parts of the evidence dovetail into each other, and to show how observed facts are accounted for, not merely in a general way, but in measure and quantity—the only true test of a theory. Lastly, I may find occasion in passing to notice some of those absurd hypotheses which now, as at any time since Newton's day, find supporters and believers.

A large part of the evidence I shall present to the reader is such as he can himself abundantly verify ; but necessarily, a very large part remains which has to be taken on trust. I cannot call upon readers to take sail for the southern hemisphere and make such and such measurements or observations. I cannot ask them to devote a whole life to the study of practical astronomy, that they may be able to make those exact and delicate instrumental observations on which modern astronomy in large part depends. Nor can I insist that every one of my readers shall master the higher branches of mathematics so thoroughly that, if need were, he could follow Adams and Leverrier through all the intricate calculations by which they have extended our knowledge of the structure of the universe.

On many points, therefore, I shall have to confine myself to giving as clear and exact a statement of what is or of what has been done as I can, without being able to give evidence which can be tested, or of showing in all cases how such and such facts have been determined. In all such cases I shall have to claim the reader's trust, to ask him to believe in the exactness and honesty of modern astronomical work. Now so much has been heard from the paradoxists of the cliquism of astronomers, of their determination to uphold a false system at all costs, and of other such matters, that many have been led (absurd as it may seem), to feel doubts as to the bare honesty of the professors of modern astronomy. To all such I would say, judge astronomers in this respect as you would judge other men if you had occasion to question their honesty of purpose. Ask whether it is for the interest of astronomers to uphold a false system. Consider whether it is in accordance with what we know of human nature, that they should combine to laud the names of a Newton, a Copernicus, or a Kepler, in defiance of truth and justice.

On the first point it is easy to find an answer. The whole system of modern astronomy depends for support on the exactness with which it records or anticipates the celestial movements. Certain processes are applied for this purpose, which satisfactorily accomplish all that is required. These processes might be continued without change, though the whole system on which they were founded should be abandoned. Thus the single end and aim of practical astronomy, that purpose for which our observatories are founded, and our astronomical staff salaried, could be accomplished as well as at present, though Newton were proclaimed a charlatan, and Copernicus a cheat. So far then we see nothing to lead to the suppression of the truth, if the truth really required the overthrow of modern theories.

On the second point we can found a yet stronger claim for the confidence of our readers in the work of astronomers. Newton and Copernicus are long since dead. They can extend no patronage to the astronomer in return for the respect and admiration with which he speaks of them. To suppose that Airy, or the Herschels, Adams, Leverrier, or Hind, would praise Newton for a theory which they knew to be false, is not only to give them very little credit for honesty, it is to assert that they are blind to their own interest. If an unknown man, indeed, were to assert that Newton and Kepler were mistaken in their theories, we should, of course, pay no attention. But if Mr. Hind, for example, were to announce such a belief, he would be heard with respectful attention, and if (to conceive the inconceivable) he could establish the justice of his view, he would immediately rank high above the highest in the long list of eminent astronomers. So of any of the others I have named. On this second ground, therefore—that it is not in accordance with what is known of human nature for any man, still less for a set of men, to praise another (long since dead) for false theories, when he himself might acquire like or higher praise by overthrowing them—I confidently claim from my readers the acceptance of the results of all those observations, measurements, or experiments which have been made by modern astronomers.

The method I propose to adopt in the forthcoming pages is the same that I employed in the first chapter of my treatise on Saturn, and is in great part new. I shall show how a person wholly unacquainted with modern astronomy, might have the true relations of the earth exhibited to him in a series of simple observations. The particular order I shall select for presenting those relations might be departed from, since the subject is one which admits of a considerable variety of treatment. Other methods have, indeed, suggested themselves to me, but I believe that, on the whole, the one I have adopted is that best calculated to present the subject in a clear and satisfactory manner, within such limits as are here available.

(To be continued.)

THE ELECTRO-MAGNET.

By W. Slingo.

(Continued from p. 69.)

I AM anxious to keep clear of formulæ as far as I can, but at the same time to impart as much information as possible concerning the electro-magnet and the principles governing its structure. The two very simple equations at the end of the previous article may facilitate matters very materially. It was shown that with a coil of the relatively thick wire a current was produced, having a a strength of 1·3 ampères, and that when the diameter of the wire was reduced to one half, so as to get twice the number of turns, the current strength was reduced to ·4 ampère, or less than one-third of that attainable with the thicker wire. One of the laws of electro-magnetism is that the strength of an electro-magnet is proportional to the strength of the current. This is only true when the number of turns is the same, because each time the current circulates round the iron core it exerts its electro-magnetic effect. This law has therefore to be taken in conjunction with another, declaring that "The strength of an electro-magnet is proportional to the number of turns of wire." Regarding these two laws together, it is clear that the thick wire coil has the greater effect, because, while there are twice the number of turns of the thin as compared with the thick wire, there may be said to be three times the current circulating through the thick as compared with the thin wire. Were the two currents made equal by modifying the battery power, then the thin wire would be twice as effective as the other. On the other hand, if while the conditions of the thin coil remained constant, the thick wire could by any means be made to encircle the core twice as often (the current being kept constant) then the threefold current circulating in the thick wire would exert three times the magnetising influence upon the core.

Even these laws, however, are not always applicable, because there is a limit to which iron or any other substance is capable of being magnetised, and the fact of there being such a limit implies that the above laws may only be regarded as applicable when the effect to be produced is considerably below this limit, which is called the "saturation point."

It was just now stated the magnetic strength varies in proportion to the number of turns. Supposing that the iron core were covered, and that no room could be found for another turn, how are we to increase that number? It might be done by coiling a wire over the previously wound coil, but what about the direction? It is evident that if we send a current round the core through a left-handed helix (as in Fig. 1), so as to make the end N a north-pole, and then send a current through an outer coil in such a manner as would induce a south-pole at N, then no polarity will be manifested unless the inducing force of one helix exceeds that of the other, in which case the magnetism induced will be a measure of the difference between these forces.

It is, however, very easy to calculate the inductive effect that would be produced by any particular coil of wire. Suppose, for example, that we are dealing with the arrangement depicted in Fig. 1, and that we wind a second left-handed helix over the core, then join a wire from the S end of the inner coil to the N end of the outer one, so that the current is made to travel in the direction indicated by the arrows through each coil in succession. Neglecting the slight increase in the length of wire involved in winding one coil over another, we shall get an external circuit having twice the resistance of the inner coil or (with the two cells).

$$\frac{E}{R+r} = \frac{4}{2+2} = 1$$

The current is thus 1 ampère as compared with 1·3, but as it passes twice as often round the core, it may be said to have an inducing power of 2 as compared with 1·3 exerted by the single coil. Here, then, an advantage is clearly gained.

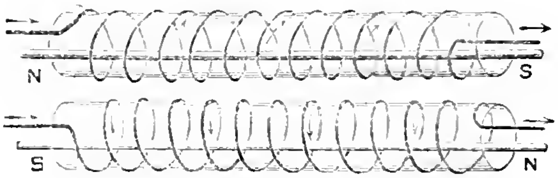
Supposing, however, that instead of connecting the two coils in series, we join them in parallel circuit—that is, by connecting the two N ends together, and likewise the two S ends. Then the current will divide at N, and, the resistance of the coils being identical, the current will divide equally, to re-unite at S. But the *joint* resistance of two equal wires is only half that of one of them, or their conductivity (the reciprocal of resistance) will be doubled. This principle has been more than once enlarged upon, so it need not further take up time here. The simple equation becomes

$$\frac{4}{\frac{1}{2}+2} = 1{\cdot}6.$$

1·6 ampères do not, however, go through each coil, but the current halving itself at N becomes only ·8 in each. Manifestly, then, a current of ·8 ampère through a certain number of turns can only have the same effect as a current of 1·6 ampères through half that number of turns.

In other words, the effect produced is the same as would result from a single coil having the same number of turns as before, but with twice the conductivity or half the resistance. This could not be obtained with the same kind of wire, because to have half the conductivity it would require twice the weight of metal. Of course, it would be possible to gain this end by using rectangular wire whose thickness in one direction is equal to the diameter of the original round wire. But even then the trouble involved would not be recompensed by the gain in inducing power, which, as pointed out, is only 1·6 as compared with 1·3.

Under the circumstances, then, the best effect is produced when the current is made to traverse the coils successively. But, on the other hand, to wind a number of individual layers, and then to connect them by longitudinal lengths of wire is out of the question, more especially as the desired effect may be more easily produced without such an arrangement.



Figs. 1 and 2.

By examining Figs. 1 and 2, the method to be employed may be readily made clear. Let us start with a layer wound, as shown in Fig. 1—that is as a left-handed helix—and let the current travel from left to right, or from N. to S. Now it has been stated (and Fig. 2 will illustrate it) that a current passing through a right-handed helix induced a north at its exit. Suppose, then, that instead of travelling from left to right, the current pursues the opposite direction, or from right to left. Then the end marked N becomes a south pole, and the end marked S a north pole. The effect thus produced is the same as that resulting from left to right through a left-handed helix. If a right-handed helix be wound over a left-handed one, and the adjacent extremities, say on the right-hand side, be connected together, then the current will pass from left to right through a left-handed, and from right to left through a right-handed, helix, when the inducing effect of each coil will harmonise, and a north pole will be produced on the left-hand side, and a south pole on the other (as in Fig. 1).

It is scarcely necessary to say that the resistance of a wire is not affected by the direction of winding, consequently the current flowing will be

$$\frac{4}{2+2} = 1$$

which (as may be gathered from what has been said above) will produce a magnetising force of 2 as compared with 1·3 resulting from either of the coils used singly. If the student takes a piece of wire or string in his hand and winds it round a rod so as to make a left-handed helix, and when he reaches the end of the rod continue the winding back to the other end without bending the wire back on itself, he will find that the second layer becomes a right-handed helix. If, furthermore, on finishing the second layer, he winds back again for a third layer, he will find that this is a left-handed helix. So, continuously winding, he generates left and right-handed helices alternately. Every layer, therefore, supposing a current to traverse such series of coils, tends to produce a north pole at one end and a south pole at the other. This is the principle involved in the construction of electro magnets.

Before dilating upon the size and length of wire for any particular coil, let us turn our attention to the practical details of construction. It may, in the first place, be stated that, generally speaking, the best effects are produced when the length of the core is six times its diameter. Its surface should be as even as possible, not absolutely smooth, but free from marked irregularities. If such irregularities are present, they are likely to cut through or wear away the cotton or silk, whichever it may be, that is used for insulating the wire. If, again, the current is one of exceptionally high electro-motive force, there will be a considerable risk of its passing from the wire to the core, rejoining the coil at some other point. It is almost superfluous to say that when it behaves in this way, the coil might as well be absent for all the good it is capable of doing. Where any of these dangers are present the iron should either be coated with a layer of shellac varnish (made by dissolving good shellac in methylated spirit), or closely covered with paper which has been saturated with melted paraffin wax. Either of these courses will, in the great majority of cases, be sufficient to prevent the current taking a short path through the iron. The wire should be well insulated with cotton or silk, and wound as closely and regularly as possible. When the first layer is finished it should, more particularly if the wire is cotton-covered, and currents of high E.M.F. are to be used, be immersed in a bath of melted paraffin wax, and insulation is further assured by covering the layer of wire with a piece of paraffined paper. This will not want tying on or securing by extraneous means, but may be quite as effectually fixed by winding it round tightly, and then with the aid of a hot poker, or other piece of iron, heating one edge of the paper over the other. The hot iron melts the wax, which, on cooling, holds the paper firmly. The second layer may then be applied and treated in identically the same manner as the first. Layer should then succeed layer until their entire thickness equals the diameter of the core; or, in other words, until the diameter of the coil measures three times that of the core. The length of the coil will then be twice its diameter. It will be apparent that, to get the greatest possible number of layers on, so as to come within these dimensions, the space occupied by the insulating material must be as small as is practicable. An electro magnet is then produced, care being taken, obviously, to leave free sufficient wire at the ends of the coils for purposes of connection.

Electro-magnets are very powerful, much more so than ordinary permanent steel-magnets, and are capable of producing marvellous effects. The shape of the magnet may be just whatever the experimentalist pleases, remembering, of course, that the simpler the shape the more easily will it be wound. The effects produced by magnets of equal length with equal quantities of wire are not by any means identical. Even in simple straight bar-magnets, a number of different effects may be produced, and Professors Ayrton and Perry have published particulars of very interesting experiments on this point, with which, however, as the allotted space is filled, we must deal a fortnight hence.

(To be continued.)

It is a sad commentary on the danger of railroading to limbs, to say nothing of the disaster to life, that the *Toledo Railroader*, the organ of the railway employés, contains the advertisements of nine different manufacturers of artificial limbs.

THE CAPTURE THEORY OF COMETS.*

By Richard A. Proctor.

We start from the conception that all comets originally entered our solar system from without. They came, says Heis. Schiaparelli, and others, who have advanced the Capture Theory, from out of interstellar space. Now, it is no valid objection to this view that it gives us no idea how cometary matter came to exist in interstellar space, for in all inquiries into the past condition of the celestial bodies we must always come short of their actual origin. Thus, in considering the past of our solar system we may start from a chaotic vaporous state, or from a past condition in the form of cosmical dust, or from a condition in which the vaporous and the dust-like forms are combined; but if we are asked whence came the vapour or the cosmic dust we are obliged to admit that we cannot tell. If, hereafter, we should be able to say that it came from such and such changes in a quantity of various forms of matter, which we may represent by X, Y, and Z, we should still be unable to say how X, Y, and Z came into existence. So that I make no serious exception against the supposed origin of comets on the ground that it really leaves very much to be explained. Interstellar space is a convenient place to which to assign the origin of bodies so mysterious as comets. *Cela exprime beaucoup de choses.* Almost anything might happen in regions of which we know so little, or, rather, of which we know absolutely nothing.

Yet it may be worth while to remark that, on the whole, the interstellar regions are less likely to be the regions whence comets originally came to visit suns and sun systems, than to be regions whither comets strayed after leaving originally the neighbourhood of solar systems. The most probable idea about the interstellar spaces is that they are the most vacuous regions within the range of the sidereal system. The mere circumstance that comets came from out of them affords no better reason for regarding them as the original home of comets, than the circumstance that comets pass from the solar system into these interstellar spaces affords for rejecting that assumption. There is, in fact, simply no reason whatever for imagining that the place where comets came into existence is the vast unknown region around the solar system which we call interstellar space. Most comets come to us from thence; as many comets are travelling into that unknown region as are coming out of it. To form an opinion about the origin of comets from no better evidence than their last journey (out of millions, very likely) can afford, would be as absurd as for a day-fly to reason that the river flowing past the home of his race came out of the sky because a few drops of rain came thence.

Suppose, however, we admit that in interplanetary space there have been in the past, and still exist, such flights of meteoric matter as the theory we are considering assumes. Let us grant them, also, such motion as may save them from what otherwise would inevitably be their fate, viz., a process of direct indrawing towards the nearest sun, and consequently destruction (with mischief probably to his orb), after a period of time which must be regarded as utterly insignificant compared with the time intervals measuring the duration of a solar system.

It follows, then, that each flight of meteors would in the long run draw near some sun, without, however, rushing directly upon him; and sweeping round his globe upon such path as chanced to result from the combination of its original movement and its attractive influence, would pass

* From an article on the "Origin of Comets," in the *North American Review.*

out again into interstellar space. This might happen tens, hundreds, thousands, or even millions of times, a comet either sweeping in a long elliptical orbit with enormous periods of revolution, around one sun; or, if its velocity were slightly greater than that supposition implies, rushing first round one sun, then out into the depths of space to visit another sun, then to yet another, and so on, flitting from sun to sun for ever, or until the kind of disturbance in which the holders of the theory we are considering believe, had changed this kind of motion into actual orbital circuit.*

In either case the minimum velocity with which a comet would be moving, when at any given distance from our sun, would be determinable within a few yards per second. It is well known that the velocity with which a body travelling to the sun from an infinite distance (though one cannot, of course, conceive such a movement) would reach the sun, would not exceed by a foot per second the velocity with which a body would reach him after travelling from the distance of the nearest fixed star. So, also, the velocities of bodies moving in orbits reaching half as far from the sun as the distance of the nearest star, would be the same within a foot or so per second as the velocities with which bodies coming to the sun from infinity would reach the same distance from him. If such bodies had originally a great inherent velocity, of course they would reach any given distance from the sun with much greater velocity. But this would not affect our estimate of the least velocity at that distance. Thus we know what the giant planets to which has been attributed the final capture of those comets which now form a part of the solar system, had to do. We can tell the precise velocity in miles per second, or, at least, the minimum velocity, with which our imagined meteoric flight would cross the orbit of Neptume, or Uranus, or Saturn, or Jupiter, as the case might be, before its capture. We know, in the case of each comet supposed to have been captured, the precise velocity of the comet at the distance of the planet which captured it,—its special planet-master. The difference is the amount of velocity which the capturing planet had to take away in order to effect the supposed capture.

Observe that we are here on sure ground, if the theory is sound. It is certain that a comet in coming from remote interstellar space to the solar system would have at the distance, say, of Jupiter, a certain velocity. It is certain that a comet now travelling in a particular orbit, approaching at one point very near to the orbit of Jupiter, has at Jupiter's distance a certain velocity, very much smaller. Hence, it is certain that, if Jupiter captured that comet by disturbing it as it approached him on the last of its many free visits to the sun, the giant planet must have deprived the comet of so many miles per second of its former velocity. All we have to do is to find out how the planet could do this; in other words, how near the comet must have approached the planet to be thus effectively disturbed.

These columns are not suited for the close and exact discussion of the case of any particular comet. I have elsewhere (in a paper which appeared in the "Proceedings" of the Astronomical Society) given the details for certain cases which have been regarded as among the most satisfactory illustrations of the comet-capturing ways of the giant planets, and have shown that the theory is in those cases, and therefore in all, absolutely untenable, though so resolutely held. Still it may be well here to consider an illustrative general case—the simplest that can be taken, and also the most effective, because the conditions are, in reality, much more favourable than they are in any known case.

Imagine a flight of meteors to travel from interstellar space toward the sun until it reaches the distance of Jupiter, and that when at that distance it chances to pass very close to the orbit of Jupiter, and at a time when Jupiter himself is very near the place where the meteor flight crosses his track. Observe that the chances against each one of these contingencies are enormous. If we conceive a sphere around the sun, girdled by Jupiter's orbit, the meteor flight in its course sunwards might traverse the surface of that sphere (or, which is the same thing, might traverse the part of its course where it is at the same distance as Jupiter from the sun) anywhere, and we are supposing that it traverses that surface close to a particular girdling circle (technically a "great circle" of the sphere). Suppose that by "close" we mean within a million miles; then the imaginary girdle of the sphere through which the meteor flight must pass to fulfil the required conditions is two millions of miles broad. The sphere itself has a diameter of some nine hundred and sixty millions of miles, and by a well-known property of the sphere,* its surface is four hundred and eighty times greater than that of the girdling strip. The chance is but one in four hundred and eighty than any meteor flight coming from interstellar space toward the sun will be within a million miles of Jupiter's orbit when at Jupiter's distance from the sun. Then Jupiter's path has a circuit of more than three thousand millions of miles. Thus the chance that at the moment of the meteor flight's passing the orbit, Jupiter will be within a million miles on either side of the place of passage, is as two in three thousand, or one in one thousand five hundred. But the chances that both these relations hold is only as one in one thousand and five hundred multiplied by four hundred and eighty, or as one in more than seven hundred thonsand. Thus, assuming—though the case is otherwise—that a million miles would be an approach near enough for capture, still only one meteor flight out of seven hundred thousand which come from outer space could be captured by Jupiter.

This, however, is but the mere beginning. We may admit that millions of times as many comets or meteor flights approach our system as the planets have captured; and if so, we need recognise no special force in any such considerations as have just been presented. I have only advanced them to suggest the conditions which are, as it were, essential for the process of comet capturing by a giant planet.

(To be continued).

* I have here considered only two kinds of cometic orbit, the elliptic and the hyperbolic; for a true parabolic orbit would be as unlikely, or rather as impossible, as a truly circular orbit among the planets.

* The property is this: that the surface of a sphere exceeds the surface of a girdling strip, such as we are considering, in the same degree (if the strip is relatively narrow) that the diameter of the sphere exceeds the breadth of the strip.

MIND IN MAN AND BRUTE.†

By George J. Romanes.

If it is true "The proper study of mankind is man," assuredly the study of nature has never before reached a territory of thought so important in all its aspects as that which, in our own generation, it is now for the first time approaching. After centuries of intellectual conquest in all regions of the phenomenal universe, man has at last begun to find that he may apply in a new and most unex-

† From an article on "Man and Brute," in the *North American Review*.

pected manner the age of antiquity, "Know thyself." For he has begun to perceive a strong probability, if not an actual certainty, that his own living nature is identical in kind with the nature of all other life, and that even the most amazing side of that nature—nay, the most amazing of all things within the reach of his knowledge—the human mind itself, is but the topmost inflorescence of one mighty growth, whose roots and stem and many branches are sunk in the abyss of planetary time.

The problem, therefore, which in this generation has now, for the first time, been presented to human thought, is the problem of how this thought itself has come to be. A question of the deepest importance to every system of philosophy has been raised by the study of biology, and it is the question whether the mind of man is essentially the same as the mind of the lower animals, or, having had, either wholly or in part, some other mode of origin, is essentially distinct, differing not only in degree, but in kind, from all other types of physical existence.

First, then, let us consider the question on purely *à priori* ground. The process of organic and of mental evolution has been assumed to be continuous throughout the whole region of life and of mind, with the one exception of the mind of man. On grounds of a very large analogy, therefore, we should deem it antecedently improbable that the process of evolution, elsewhere so uniform and ubiquitous, should be interrupted at its terminal phase; and I think that, looking to the very large extent of the analogy, this antecedent presumption is really so considerable that it could only be fairly counterbalanced by some very cogent and unmistakable facts, showing a difference between animal and human psychology so distinctive as to render it in the nature of the case virtually impossible that one could ever have graduated into the other. This I posit as the first consideration.

Next, still restricting ourselves to the *à priori* aspect of the matter, it is unquestionable that human psychology in the case of every individual human being presents to actual observation a process of gradual development, or evolution, extending from infancy to manhood: and that in this process, which begins at a zero level of mental life and may culminate in genius, there is nowhere and never observable a sudden leap of progress, such as the passage of one order of psychical being into another distinct in kind might reasonably be expected to show. Therefore, it is a matter of observable fact that, whether or not human intelligence differs from animal in kind, it certainly admits of gradual development from a zero level; and to this we must add that, so long as it is passing through the lower phases of that development, it assuredly ascends through a scale of mental faculties which are *pari passu* identical with those that are permanently presented by the psychological species of the animal kingdom. These facts, which I present as a second consideration, tend still further, and I think most strongly, to increase the force of the antecedent presumption against the process of evolution having been discontinuous in the region of mind.

Again, it is likewise a matter of actual observation, that in the history of our race, as recorded in documents, traditions, antiquarian remains, and flint implements, the intelligence of the race has been subject to a steady process of gradual development—a general fact which admits of any amount of special corroboration by comparing the psychology of existing savages, where the process of evolution in the past has not been so rapid or has in part been arrested, with that of civilised man. This is the last consideration that I shall adduce of the *à priori* kind, and its force consists in the fact of its proving that if the process of mental evolution was interrupted between the anthropoid apes and primitive man, it must again have recommenced with primitive man, and since then have continued as uninterruptedly in the human species as it previously did in the animal species. This, to say the least, upon the face of the indisputable facts, or from a merely antecedent point of view, appears to me a highly improbable supposition. At all events, it certainly is not the kind of supposition which men of science are disposed to regard with favour elsewhere: for a long and arduous experience has taught men of science that the most helpful kind of supposition which they can bring with them into their investigations of nature is that kind of supposition which recognizes in nature the principle of continuity.

Taking, then, all these *à priori* considerations together, they must, in my opinion, be fairly held to make out a very strong *primâ facie* case in favour of the view that there has been no interruption of the developmental process in the course of psychological history, but that the mind of man, like the mind of animals—and, indeed, like everything else in organic nature—has been evolved. For these considerations show, not only that on analogical grounds any such interruption must be held as in itself improbable; but, also, that the human mind unquestionably admits of having been slowly evolved from the zero level, seeing that in every individual case, and during many past millenniums in the history of our species, the human mind actually does and has undergone the process in question.

In order to overthrow so immense a presumption as is thus erected on *à priori* grounds, the psychologist must fairly be called upon to supply some very powerful considerations of an *à posteriori* kind, tending to show that there is something in the constitution of the human mind which renders it impossible, or, at all events, exceedingly difficult, to imagine that it can have a genetic relation to mind of lower orders.

NATURAL GAS FUEL AT PITTSBURG.

AT the recent meeting of the American Society of Mechanical Engineers at Pittsburg, the report of the committee appointed to investigate the whole subject of natural gas was made, and many interesting particulars, we read, were given.

Though Pittsburg is within reach of three or four prolific localities, and gas has been used for many years, it is but recently that any organised effort has been made to use it on a large scale. Already there are 150 companies chartered in the State, representing over 2,000,000 dols.: and gas is brought from eight to twenty-five miles for use in the city. Five-inch mains are being followed by 8-inch, new wells are being bored, and the time when Pittsburg shall become a smokeless city may not be far distant. Though the gas is used under a pressure of a few ounces, the pressures at the wells run from 50 to 125 pounds; this is due to the friction in the mains, five pounds being allowed for each mile. If the flow be shut off the pressure runs up much higher, and great difficulty has been experienced in making tight joints; cast iron is too porous, and ordinary pipe-threads do not fit well enough. A number of new coupling devices were exhibited, in some of which a lead packing was used. No allowance for expansion need be made, as the gas maintains an even temperature of about 45° Fah. When gas is allowed to burn freely at the mouth of a well, the cold produced by the expansion is such that ice has been projected through the flames.

The gas is used in all kinds of furnaces for making steam iron, glass, &c.; and electric light carbons, and the finest lampblack for printing inks is made from it; but it is used with suicidal wastefulness, which causes anxiety, as many wells give out in less than five years. The report looks to its economic and safe control. For household use, it might otherwise be dangerous, and such use has commenced, though no practicable method of deodorising it has been found. Being composed largely (96 per cent.) of marsh gas, its value as a heating agent is high, and its density is about half that of air. One pound (23·5 cubic feet) of gas has a theoretical evaporating power of 24 lb. of water, 20 lb. having been actually evaporated. The best method of burning it is not generally known; experiments with injector burners show that they do not suck in sufficient air for complete combustion, and the best results have been from numerous jets in contact with the whole heating surface of the boiler. The value of the gas, as compared by evaporation tests with coal at \$1.40 per ton, is only 8 cents per thousand feet (which suggests that even our ordinary gas companies make profits), but its use is immensely more convenient; no stacks are needed, and the furnace reduces to a simple non-conducting chamber. The gas has just been turned on to the city waterworks. On the first day's excursion numerous furnaces were seen running with gas blown in through rough, $\frac{1}{8}$ in. nozzles; and two or three lines of 5-in. pipe lay on the surface of the railway embankment.

A gas well has lately been opened within the city limits, at a depth of 1,600 feet, on the property of Mr. Westinghouse.

THE TARANTULA OF SOUTHERN CALIFORNIA.

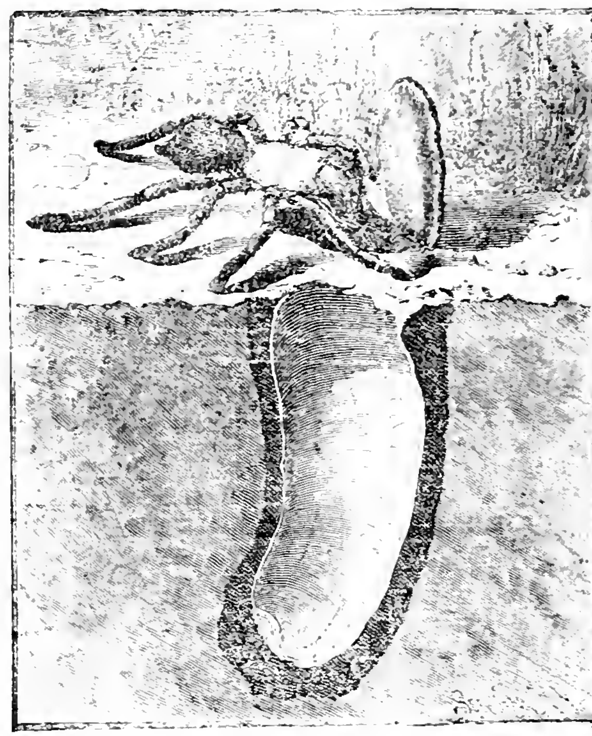
UGLY, vicious, energetic, and to a certain degree poisonous, are the spiders that infest the southern part of California, and yet when closely studied they present many peculiar characteristics, both in regard to their structure and habits. Among the most valued trophies tourists carry away with them from the coast are neat cards adorned with these animals, and a case containing the nest so arranged as to show its wonderful trap-door and the delicate lining of the interior. The adobe ranches are full of these strange little habitations, and some of the sunny valleys among the foot hills are literally strewn with the small tunnels, capped with the almost invisible door. Our engraving shows the tarantula (*Mygale hentzii*) as he is about to enter his abode, both being full size.

The general appearance of the tarantula is very clearly shown in the engraving. The legs are larger, and are not furnished with so long and dense a growth of hair as are the specimens found in other sections of the south-western States. The back is covered very thickly with extremely fine short hair; the back and the outer joints of the legs are of a light brown colour, the remainder being of a deeper shade. The forward part of the head is divided, and each division terminates in a sharp, downwardly curved, and jet black horn or hook.

The tarantula pounces upon his prey, and thrusting in the hooks most securely holds his victim. It is seldom met in the daytime, preferring to seek its food during the night, returning to its nest in the early morning. Although pugnacious when cornered, he will not seek a fight, and is more anxious to escape than the stranger whom he chances to meet.

This tarantula is justly celebrated for the architectural skill he displays and for the luxurious comfort of his dwelling. Having selected a suitable site, he digs a hole varying from four to eighteen inches in depth, and just large enough around to admit him easily, although it is puzzling to conceive how he ever gets his long, ungainly, and many-jointed legs comfortably disposed in so small a space.

The walls are carefully smoothed, and are completely covered with an exceedingly fine fabric of his own manufacture. The top of this tunnel is slightly flared, and in this widened part is fitted the door, which is hinged at one side so that it may be easily lifted. The inside of the door is finely finished, and covered with a web similar to that on the side. The tarantula knows that this door is not heavy enough to ensure a tight fit when it is dropped, so he makes a small handle near the centre of the under side by which he pulls the door closely down, thereby insuring a joint that most effectually excludes all dampness from his abode. The handle is a strong web, the two ends of which are attached to the door at points about one-sixteenth of an inch apart. The outside of the door is placed about at the level of the ground, and is so nearly the same colour as the surrounding



soil that it can be discovered only after the most careful search. The joint of the door is so well made and the colours are so nearly alike that it is almost impossible to ascertain upon which side the hinge is placed, except by raising the door. The framing of the door seems to be a coarse, strong web, which is extended at one side to form the hinge, and which is bonded with earth to give it the requisite stiffness. The hinge is about three eighths of an inch wide, and acts as a spring to shut the door immediately after the owner's exit. For the tarantula and nest from which our engraving was made, we are indebted to the courtesy of Mr. H. J. Finger, of Santa Barbara, Cal.—*Scientific American.*

Remedy for Toothache.—Melt two parts of spermaceti or wax and dissolve in it two parts of chloral hydrate and one part of carbolic acid. Dip pieces of cotton into the mixture and let it cool. For use, detach a small quantity, soften it with a gentle heat, and press it into the hollow tooth.—*Rundsch. f. Pharm.*

ATTITUDES AFTER DEATH.

By C. E. Brown-Séquard.*

Among the phenomena sometimes noticed at the hour of death there is one that offers a peculiar interest, and which, up to recent times, has remained a mystery. This phenomenon appears especially, but not exclusively, after a sudden death due either to wounds received upon the field of battle or elsewhere, or to other causes, but almost always when there has been an intense excitement, and often also when great bodily fatigue has preceded the last moment of life. The principal feature of this curious fact is the persistence after death of the expression of the face or of certain attitudes of the limbs or body, or of both. Such persistence exhibits itself clearly in certain cases; for example, when, despite the sudden cessation of life, a limb that is raised does not drop, or when the body of a man standing, or seated on horseback, does not fall over.

In order to clearly understand the terms of the problem to be solved in reference to this phenomenon, it is absolutely necessary to know (1) that our attitudes and facial expression depend upon a contraction of our muscles due to an influence of the nervous centres, and (2) that such influence necessarily ceasing at the instant of death, a relaxation must also necessarily occur in all the muscles that were contracted, unless some other agency at once replaces that which has disappeared and causes the same physical state to persist that formerly existed therein.

The question, then, is this: What is the agency that, as soon as the faculty of volition vanishes, takes the place of the latter, or at least produces in the muscles an organic state that prevents all relaxation?

* *La Nature.*

The object of this article is to answer this question, and to show that the cause or agency to be discovered is not the sudden appearance of that state of muscular stiffness known by the name of *rigor mortis* or *cadaveric rigidity*, but that such agency is found in a peculiar action of the nervous centres that manifests itself a little before or at the instant of death. One of the most striking examples of the strange fact that I am about to study was observed by Dr. Rossbach, of Wurzburg, upon the battlefield o Beaumont, near Sedan, in 1870. He found the corpse of a soldier half-sitting, half reclining, upon the ground, and delicately holding a tin cup between his thumb and forefinger, and directing it toward a mouth that was wanting. The poor man had, while in this position, been killed by a cannon-ball that took off his head and all of his face except the lower jaw. The body and arms at the instant of death had suddenly taken on a rigidity that caused them to afterward remain in the position that they were in when the head was removed. Twenty-four hours had elapsed since the battle, when Dr. Rossbach found the body in this state. (See engraving.)

In the first work of any importance in which this subject has been treated of, Dr. Chenu relates that a French military surgeon, Dr. Perrier, was greatly surprised upon going over the battle-field of Alma, the day succeeding the terrible conflict, to see that many corpses of Russian soldiers had attitudes and expressions of countenance like those of living persons. Some of these corpses had the different expressions that characterize anguish, suffering, or despair. Others, on the contrary, had the appearance of greater calmness and resignation.

One case particularly attracted the doctor's attention, where the body lay stretched out upon the ground, the knees bent, the hands clasped and lifted in the air, and the head thrown back, as if death had come upon the individual while he was reciting a prayer. In addition, many other persons who have visited battlefields immediately after a conflict tell us that they observe numbers of corpses that were still holding their guns or sabres. Some seemed to be biting their cartridges, while others, still upon horseback, continued to preserve the attitude they had at the moment of death. These phenomena have been studied with special attention by Dr. Armand at Magenta, by Baron Larrey at Solferino, and by Dr. Bandin at Inkermann.

I owe to the kindness of Dr. S. Weir Mitchell a knowledge of an excellent memoir by Dr. John Brinton, of Philadelphia, upon the "Rigidity which Accompanies Sudden or Violent Death"—a work in which the question under consideration is studied with the greatest care. Speaking of the field of battle of Antietam, Dr. Brinton says that he counted forty corpses over a space of from forty to fifty yards square, and he gives us the following picture of what he observed in this place.

"Several of these corpses were lying in extraordinary attitudes, some with their arms lifted and rigid, and others with their legs drawn up toward the trunk, and stiff. With others, in quite large number, the trunk was curved forward and also rigid. In a word, these attitudes were not those of the state of relaxation produced by death, but rather those of an apparently active character, doubtless due to a final muscular act at the very moment of the extinction of life—a spasmodic act that had left the muscles stiff and inflexible. Death, in the majority of these cases, had been caused by wounds made in the breast; and, less frequently, by balls that had traversed the head or abdomen. In the latter cases there had been considerable hemorrhage, as was proved by the pools of blood of dark colour near the sides of the bodies. This inspection was made thirty-six hours after death, or still later."

The following three cases related by Dr. Brinton (which were furnished to him by friends, are very remarkable:—

A detachment of United States soldiers, foraging around Goldsborough, N.C., came suddenly upon a small band of Southern troopers who had dismounted. These latter immediately jumped into their saddles, and all scampered away except one, after being exposed to one round of fire. The soldier who did not escape was sitting upright, one foot in his stirrup. In his left hand he held the bridle and the horse's mane, while his right hand grasped the barrel of his rifle, near the muzzle, the stock of the gun resting on the ground. The horseman's head was turned toward his right shoulder, apparently watching the approach of the assailing party. Some of the soldiers of the latter were preparing to fire again, when their officer ordered them to desist, and to go and make the defiant man a prisoner. The latter, upon being ordered to surrender, made no answer. When he was approached and examined, it was found that he was dead and rigid in the singular attitude that we have just described. It took a considerable effort to force his left hand to release the horse's mane and to remove the rifle from his right hand. When the body was laid upon the ground, the limbs preserved the same position and the same inflexibility. This man had been struck by two balls fired from Springfield rifles. One of these had entered to the right of the vertebral column, and had made its exit from the body near the region of the heart. It had left its track upon the side of the saddle, and had then dropped to the ground. The other ball had entered through the right temple, and its point of exit could not be found. The horse had remained quiet, as he was fastened by a halter.

The following is another incident: At the battle of Williamsburg, Dr. T. B. Reed examined the body of a United States Zouave who had received a ball in the forehead just as he was climbing over a low fence. He, likewise, had preserved the last attitude of his life. One of his legs was half over the fence, while his body still remained behind. One hand, which was partially closed, was raised level with his forehead, with the palm forward, as if to preserve himself against some imminent danger.

Dr. Henry Stillé relates that, while seated upon a freight car on the Nashville and Chattanooga Railroad, he saw a brakeman instantly killed by a ball which struck him between the eyes, a mortal wound that was given by a guerilla who lay in ambush in a forest through which the train was passing. The man thus killed was tightening the brake when he received the ball. After his death his body remained fixed, the arms extended and stiff on the handwheel of the brake. The pipe which he was smoking remained fastened between his teeth. The rigidity was so perfect, and his hands were so tightly closed, that it was scarcely possible to free the corpse and make it let go its hold.

A maintenance of the last attitude may occur under circumstances other than a sudden death produced by lesions of the brain, heart, or lungs, although an injury to an organ of great importance to life is the most frequent cause of the phenomena. Dr. Brinton has observed it after wounds made in the abdomen, and Dr. Armand, in a single case, through a wound of the thigh.

Yet this phenomenon does not manifest itself exclusively in cases where death results from wounds. It was observed in a horrible accident that happened at London in 1867, when forty-one persons, skating upon Regent's Park Reservoir, perished through the sudden giving way of the ice. The following extract from *The Times* concerning this event is full of interest:—

"The attitude of the majority of the persons who were taken from the water has given rise to numerous discussions in the medical journals. In almost all cases the arms were raised, and sometimes the elbows were pressed against the sides. In other cases the elbows formed a right angle, and projected as in the act of skating. It may be concluded that these unfortunates were resting upon the ice with their arms, not daring to use their hands, and that when, on becoming exhausted, they died, it was not through asphyxia, but rather through the action of cold and fright: and this would explain why they preserved the position in which they were found."

Dr. Taylor had already mentioned the case of an individual who had for a long time held his arms extended to avoid being drowned, and in whom, after death, these limbs were found stiffened out in the same position.

It seems that carbonic acid is capable of producing that special rigidity of the muscles that maintains the trunk and limbs in the attitude that the last act of the will has caused them to assume.

In 1832 Dr. Von Graefe saw, in the grotto of Pyrmont, the corpse of a young man who had voluntarily put an end to his days by exposing himself to the carbonic acid gas that fills this cavern. The body was found half-seated upon the ground. One of the hands supported the head, as if the young man had desired to avoid touching the wall, against which the upper part of his body rested. The trunk was bent toward the right. The attitude of the body had the appearance of a person asleep and reposing peacefully.

How shall we explain this curious series of facts? We know that sooner or later there supervenes a stiffness (called *cadaveric* or *post mortem rigidity*) in all the limbs and all other parts of the body where there are muscles. Is not the stiffness that occurs on the battle-field, and sometimes elsewhere, immediately after death, merely a cadaveric rigidity that has come on suddenly? Those who know the law that I have established concerning the rapidity or retardation of cadaveric rigidity after death (see my Croonian Lecture before the Royal Society of London, 1861) will find it evident that in the majority of the cases of preservation of attitude after death that I have just mentioned, the circumstances were very favourable for the prompt appearance of *post mortem* rigidity. Yet, even the cases placed under the most favourable circumstances, death could not have come on quickly enough to permit of the preservation of an *ante mortem* attitude. This is a sufficient reason to assure us that the fact that we have to explain is not due to the sudden intervention of cadaveric rigidity. But how, then, shall we explain this fact?

Some experiments that I cannot here give the details of have shown me that it is a fixed contraction—a tonic, persistent, muscular action which then occurs, similar to that which it replaces, and which existed during life. At the very moment that death comes on, this fixed or tonic contraction occurs. It is an act of life, but the last one. I have sometimes seen this contraction exhibit itself and then disappear, and it was not till later that the true cadaveric rigidity supervened.

Death, in man as in animals, takes place in two ways that differ radically from each other. On the one hand, it may supervene suddenly, either through the influence of excitement or that of a wound or blow, or, again, through the following causes:—The impression produced by submersion in cold water, or in almost icy water, and the impression produced sometimes, in persons who are eminently nervous, by the least lesion affecting certain parts of the body. In this kind of death there may not be even the least vital manifestation after the last sigh, except a feeble action of the heart that soon disappears. All the cerebral faculties give way suddenly—consciousness, intelligence, the will, the perceptive faculties, sensorial and sensitive impressions, and respiratory motions all disappear at once. There is no *agony*, and none of that struggle that usually precedes death. The body suddenly loses its temperature, and cadaveric rigidity comes late, and lasts considerably.

In the other kind of death, which is the one that we usually observe, there is, on the contrary, a genuine struggle in the still living organism, especially when life is ending through the effect of certain wounds or of a great hæmorrhage, or as a consequence of a complete and sudden deprivation of respiration. The heart in such a case beats violently, the efforts made to breathe are extremely energetic, consciousness and the cerebral faculties may keep up for a short space of time, and after this great agitation or general convulsions occur. The temperature of the body rises, and this increase may still continue for some little time after the last effort made to breathe. Cadaveric rigidity appears early, but never immediately.

My experiments and the details of the cases that I have related show that the persistence of the last attitude does not occur in all cases of death belonging to the first of the two types just described; but facts indicate that this singular phenomenon occurs only in cases of death that belong to this type.

In one of the conclusions of Dr. Brinton's excellent memoir, he says that in the cases of persistence of attitude that have been observed upon the battle-field, and that he describes, death had probably been instantaneous, without being accompanied with convulsions or agony.

It results from the facts that I have studied in this paper, and from the experiments that I have done nothing more than allude to: (1) that the preservation after death of the attitudes of life, and of the facial expression, does not depend upon the sudden appearance of what is called cadaveric or *post mortem* rigidity, but upon the production of a vital act of rigidity or tonic contraction, like the fixed spasm that we often see in hysterical or paralytic persons; and (2) that a number of causes of death, acting without the ordinary agony, may produce that strange phenomenon which is characterised by a persistence after death of the attitude and facial expression that existed at the moment of the last sigh.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p. 88.*)

"FAIR and softly," says the Marchioness, "I fancy you yourself are seized with the noble fury of astronomy; a little less rapture, and I shall understand you the better. The sun, you say, is in the center of the Universe, and is immovable. What follows next?"

"It is Mercury," said I; "he turns round the sun, so that the sun is the center of the circle wherein Mercury moves. Above Mercury is Venus, who turns also round the sun: after comes the earth, which, being placed higher than Mercury and Venus, makes a greater circle round the sun than either of them. At last come Mars, Jupiter, and Saturn, in the same order I name 'em, so that Saturn has the greatest circle round the sun, which is the reason he is longer in making his revolution than any of the other planets."

"You have forgot the moon," said the Marchioness.

"We shall quickly find her again," said I; "the moon turns round the earth, and does not leave her, but as the earth advances in the circle which she describes about the sun, and if the moon turns round the sun, it is because she will not quit the earth."

"I understand you," said she, "and I love the moon for staying with us when all the other planets abandon us; nay, I fear your German would have willingly taken her away too if he could, for in all his proceedings I find he had a great spite to the earth."

"'Twas well done of him," said I, "to abate the vanity of mankind, who had taken up the best place in the universe, and it pleases me to see the earth in the crouds of the planets."

"Sure," said she, "you do not think their vanity extends itself so far as astronomy! Do you believe you have humbled me, in telling me the earth goes round the sun? For my part, I do not think myself at all the worse for it."

"I confess," said I, "Madam, I believe a fair lady would be much more concerned for her place at a ball, than for her rank in the Universe: and the precedence of two planets will not make half such a noise in the world as that of two ambassadors. However, the same inclination which reigns at a ceremony governs in a system; and if you love the uppermost place in the one, the philosopher desires the center in the other; he flatters himself that all things were made for him, and insensibly believes a matter of pure speculation to be a point of interest."

"This is a calumny," said she, "you have invented against mankind; why did they receive this system if it was so erroneous?"

"I know not," said I; "but I am sure Copernicus himself distrusted the success of his opinion. He was a long time before he would venture to publish it, nor had he done it then without the importunity of his friends. But do you know what became of him? The very day they brought him the first printed sheet of his book he died. He foresaw he should never be able to reconcile all the contradictions, and, therefore, very wisely slipt out of the way."

"I would be just to all the world," said the Marchioness, "but 'tis hard to fancy we move and yet see we do not change our place. We find ourselves in the morning where we lay down at night. Perhaps you will tell me the whole earth moves."

"Yes, certainly," said I; "it is the same case as if you fell asleep in a boat upon the river, when you awake you find yourself in the same place and the same situation in respect to all the parts of the boat."

"'Tis true," she reply'd; "but here's a great difference; when I awake I find another shore, and that shews me my boat hath changed place; but 'tis not the same with the earth. I find all things as I left 'em."

"No, no," said I; "there is another shore too. You know that beyond the circles of the planets are fixed stars; there is our shore. I am upon the earth, and the earth makes a great circle round the sun. I look for the centre of the circle, and see the sun there; then I direct my sight beyond the sun in a right line, and should certainly discover the fixed stars which answer to the sun, but that the light of the sun effaces 'em. But at night I easily perceive the stars which correspond with him in the day, which is exactly the same thing; if the earth did not change its place in the circle where it is, I should see the sun always against the same fixed stars; but when the earth does change its place, the sun must answer to other stars; and there again is your shore, which is always changing. And seeing the earth makes her circle in a year, I see the sun likewise in the space of a year answer successively to the whole circle of the fixed stars, which circle is called the Zodiac. I will draw you the figure of it, if you please, on the sand."

"'Tis no matter," said she. "I can do well enough without it; besides, it will give an air of learning to my park, which I would not have in it. For I have heard of a certain philosopher, who, being shipwreck'd and cast upon an unknown island, seeing several mathematical figures traced on the sea-shore, cry'd out to those that followed him, 'Courage, my companions, the isle is inhabited; behold the footsteps of men:' but you may spare your figures; such footsteps are not decent here."

"I confess, madam," said I, "the footsteps of lovers would better become this place; that is, your name and cypher carv'd on the trees by your adorers."

"Tell not me," said she, "of lovers and adorers; I am for my beloved sun and planets. But how comes it to pass that the sun, as to the fixed stars, compleats his course but in a year, and yet goes over our heads every day."

"Did you never," reply'd I, "observe a bowl on the Green? It runs towards the Jack, and at the same time turns very often round itself, so that the parts which were above are below, and those which were below are above; just so it is with the earth, at the same time that she advances on the circle, which in a year's space she makes round the sun, in twenty-four hours she turns round herself; so that in twenty-four hours every part of the earth loses the sun,* and recovers him again, and as it turns towards the sun, it seems to rise; and as it turns from him, it seems to fall."

"It is very pleasant," said she, "that the earth must take all upon herself, and the sun do nothing. And when the moon, the other planets, and the fixed stars seem to go over our heads every twenty-four hours, you'll say that, too, is only fancy?"

"Mere fancy," said I, "which proceeds from the same cause; for the planets compleat their courses round the sun at unequal times, according to their unequal distances; and that which we see to day answers to a certain point of the Zodiac, or circle of the fixed stars, we see to-morrow answer to another point, because it is advanced on its own circle, as well as we are advanced upon ours. We move, and the planets move too, which must make a great alteration; so that what seems irregular in the planets, proceeds only from our motion, when, in truth, they are all very regular."

"I will suppose 'em so," said the Marchioness; "but I would not have their regularity put the earth to so great trouble; methinks you exact too much activity from so ponderous a mass."

"But," said I, "had you rather that the sun and all the stars, which are vast great bodies, should in twenty-four hours travel such an infinity of miles, and make so prodigious a tour as they needs must, if the earth did not turn round itself every twenty-four hours?"

"Oh," said she, "the sun and the stars are all fire, their motion is not very difficult; but the earth, I fancy, is a little unwieldy."

"That signifies nothing," I replied; "for what do you think of a first rate ship, which carries near 150 guns, and above 3,000 men, besides great loads of merchandise? yet you see one puff of wind sets her a-sailing, because the water is liquid, and, being easily separated, very little resists the motion of the ship. So the earth, though never so weighty, is as easily borne up by the celestial matter, which is a thousand times more fluid than the water,* and fills all that great space where the planets float; for where would you have the earth fastened to resist the motion of the celestial matter, and not be driven by it? You may as well fancy a little block of wood can withstand the current of a river."

* This, of course, is inexact; being only true at the time of the vernal or autumnal equinox. But it is nearly true of the habitable parts of the earth.—R. P.

* All the reasoning here relates to the system of Vortices.—R. P.

THE INTERNATIONAL HEALTH EXHIBITION.

XI.—WATER AND WATER-SUPPLIES—(*continued*).

WE have now placed before our readers the chief types of water that are commonly derived from both natural and artificial sources. It yet remains to be seen whether any of those crude products are directly available, and how we are to deal with such as are not so, in order to render them fit for domestic purposes, and valuable in various industries and arts.

In the household, the water in this, and all countries with temperate climates, is derived from many different origins. In considering the problem before us, we shall take, as an example, a model tenement provided with every possible convenience and variety of supply; we shall then be able to indicate how the wants of special cases are to be provided for by referring to some particular section of our hypothetically perfect mansion. Imagine, too, that to this abode there is attached a series of typical workshops, each concerned with some special manufacturing process, and that the entire system is furnished with (1) winter reservoirs for the utilisation of snow and ice; (2) tanks for the collection of rain-water, which may be subject to all kinds of impurity; (3) a lake-water supply, prone to peaty contamination; (4) a source of soft-water derived from upland surface drainage, *e.g.*, the non-calcareous parts of the Coal Measures and the Millstone Grit; (5) a hard-water supply, from a district like that of the basin of the Thames; (6) pump-water from a well on the premises; (7) sea-water.

Domestic requirements would entail a supply of water for the garden, the kitchen, the laundry, the bath-room, and the table; and for each of these it is desirable to procure suitable water from the most ready source, with a minimum of labour and expense. All the waste waters of the household, such as those directly derived from the surface drainage, the kitchen sink, side-gutters, &c., may be conveniently stored in a special brick or stoneware reservoir at the end of a garden, and there treated as required for the irrigation of flower-beds, lawns, and vegetable plots. Of course, in closely-crowded street-houses such waters cannot be utilised, and should therefore find a ready escape into the general sewerage. In like manner, the waste drainage from each factory ought to be stored in some suitable receptacle, where it can be freed from harmful products ere it is allowed to be discharged into streams, rivers, or the soil.

The storage of snow and ice in winter reservoirs has never been generally adopted because of the labour which such a procedure would necessitate if carried out on a large scale; yet we think that there is scope here for country residents to direct some attention to processes which would secure them an ample supply of exceptionally pure water during the colder months of the year. In a paper recently read at the Society of Arts Water-Supply Conference, held in the Exhibition buildings,* Mr. Baldwin Latham records the opinion of Pliny that some prefer "snow-water before that which cometh down in showers, and the water of ice dissolved before the other of melted snow;" and that the rain, snow, and ice, are all lighter than those which spring out of the earth, and ice amongst the rest far lighter than any water in proportion. He also states that, as the result of an extensive series of experiments, upon the degree of purity of frozen waters, which he carried out some years ago: "that the act of freezing may be carried to such an extent as to produce in the remaining water a precipitation of the salts in solution, but ice frozen upon very superficial water was found very liable to have the impurities frozen in it which adhered to the under sides of the ice, and which became embedded in it by subsequent freezing; but water which has been largely deprived of air by boiling or exposure upon being frozen, if perfectly crystalline, will produce absolutely pure water. Several patents have been taken out with a view to freezing sea-water, so as to furnish a supply of fresh water on board ship, but such processes will not compete, from an economical point of view, with the process of distillation."

It is advisable in the case of waters derived from snow and ice, that they should be kept in vessels of stoneware, or other material not liable to be acted upon by the water. There are very many waters which are looked upon as objectionable, because they are too soft for storage in the leaden pipes and cisterns with which the water companies are wont to supply the public. A few days ago, one of our correspondents addressed us with respect to the water-supply of his district. It happened at a period not far distant, that the water became foul through the accession of sewage, and the typhoid germ accordingly grew and multiplied in its strength to an alarming degree. Steps were taken to remedy the evil, when fresh cause for serious apprehension broke out in their midst. The water-supply, derived from the upland drainage of the Coal Measures and the Millstone Grit, was particularly pure and soft, and, as misfortune would have it, also peculiarly avid of lead. Now, we are all aware that it is not the water itself which attacks the lead, for soft waters dissolve metals because they contain, or very soon appropriate various acids and gases, which react upon the metals. Organic substances, especially such humus, ulmic, or other acids, as are likely to accrue from upland surface drainage, act very powerfully on lead. Oxygen, nitrous and nitric acids, all chlorides, and quicklime, also form soluble poisons with lead. The nitrite of ammonia is said to be peculiarly active when it comes into contact with lead; and all these matters are apt to obtain in soft waters. Their presence in small quantities suffices to cause serious metallic contamination; $\frac{1}{100}$th of a grain in a gallon of water may be regarded as an irritant poison. Only $\frac{1}{10}$th of a grain per gallon was discovered in the water which had such evil effects upon the family of Louis Philippe in exile at Claremont, and ended fatally in the case of Vatout, the celebrated librarian. Carbonic acid does not form soluble salts with lead unless in great excess; and the carbonates, sulphates, and particularly the phosphates of lime and magnesia and alkaline phosphates are comparatively harmless (Frankland). Other metals are seldom used for the construction of water-holders; we may, however, mention that injurious effects may arise from zinc, copper, or iron impurities. Tin is sometimes used as a wash over soft iron (so-called "block-tin"), or lead, but is scarcely of any avail, since the decomposition of that metal may not be perceptible, and yet permit of an ingress of the soluble lead or other poison. Tin salts themselves, if taken in moderately large doses,* act as irritant poisons; but, of course, in such cases, which are not at all likely to happen, detection is quite easy.

We have thus dwelt upon the metallic contamination of water, because it is a vexed question to those who are concerned with the supply of water in non-calcareous districts. Such waters may be treated in either of two ways:—they may be hardened to the extent of about five or six degrees by the addition of lime, or the lead must be got rid of in some way or another. The first-mentioned process is, perhaps, the most valuable, since it brings the water to a more generally useful condition from a domestic point of view. The incorporation of a little lime not only prevents the water from taking up lead by appropriating those reagents which act upon the metal, but it also renders the water more suitable for drinking. We may here state that our correspondent has found that the use of the very soft waters of his parish is detrimental to the healthy condition of that most important apparatus in the digestive economy—a thoroughly sound set of teeth; he has, moreover, been in the habit of recommending, in his lectures to the people, the use of oatmeal porridge, especially amongst the young, and we here embrace the opportunity to direct the attention of our readers to his excellent and most wholesome advice, which is, indeed, but an endorsement of the system which has been adopted unconsciously, as the outcome of practical experience, amongst the Scottish Highlanders from times immemorial.

The elimination of lead from poisoned waters by

* "Softening of Water," by Baldwin Latham, M.I.C.E., F.G.S., &c., read July 25, 1884, p. 7.

* Eighteen to twenty-four grains of the chloride given to dogs killed them with symptoms of violent vomiting and general depression in from one to three days. Two grains injected in the blood-vascular system caused death with pronounced tetanus in fifteen minutes, and peculiar tanned post-mortem appearance of the coats of the stomach.

chemical filtration will be considered in due course when we come to describe some of the contrivances which we have carefully tested in the Exhibition. It seems desirable, however, that leaden pipes, as such, should not be used, and we therefore suggest that the metal might be coated in some way with a siliceous or earthenware glaze, after having been suitably shaped to meet the wants of aquiferous apparatus. It is a subject of such importance, and is brought home to us so forcibly by the many disastrous occurrences of poisonous contamination and the spread of zymotic disease, that we consider it our bounden duty to call the attention of practical workers to the difficulty. We would strongly recommend experiments in this direction to the notice of Messrs. Doulton & Co., of Lambeth.

The uncertainty of an adequate supply of rain-water is a most serious drawback to manufactures in general; but even on a small scale the collection of rain is most desirable. Such water in London alone would save a large annual expenditure for soap used in cleansing operations; and in all towns where the water is naturally very hard rain-water reservoirs must be looked upon as a boon. It occurs, however, that wherever they have hitherto been introduced, as in the Midland counties of England, they are wofully neglected, and come to be, in time, little else than the accumulated liquid filth of roof-drainage.

In the East-central Gallery B, of the Exhibition, devoted to "Water-supply and Purification," Stand 416 has been delegated to Mr. C. G. Roberts, of Haslemere, Surrey, for his "Patent Rain-Water Separator." Fig. 19 shows where

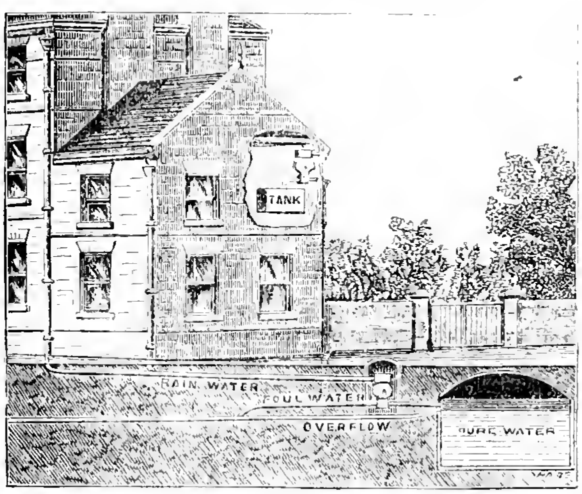


Fig. 19.

this instrument ought to be placed in relation to the system of roof-pipes, etc., of a house; and how provision can be made for the efficient storage of the practically pure water. This innovation so thoroughly fulfils what it has been designed to accomplish, and is moreover so useful an adjunct to every modern dwelling, that we deem it worthy of something more than a passing notice in these pages. It is in reality what it pretends to be, a "water separator," and not a filter; inasmuch as through its action the impure water is rejected and permitted to run to waste, whilst the clear water, deprived of even minute suspended solids is forced to pass to the storage tank or other receptacle.

The water thus secured is well adapted to the wants of the kitchen, laundry, for purposes of ablution and manufacturing processes, and, when filtered, for drinking. The first portion of the rainfall passes into a preliminary box called a strainer, where all the coarser impurities, such as leaves, twigs, &c., are detained, and can be readily removed. From thence the water passes into the first compartment of the separator, through which it flows into the waste-pipe for foul water. After a sufficient time, the rain, which is now considerably purified, owing to the cleansed state of the roof, &c., collects in the second compartment of the separator, which, in consequence, cants or is overturned, so that the future discharge is directed to the pure water reservoir-pipe, as shown in the subjoined explanatory section (Fig. 20).

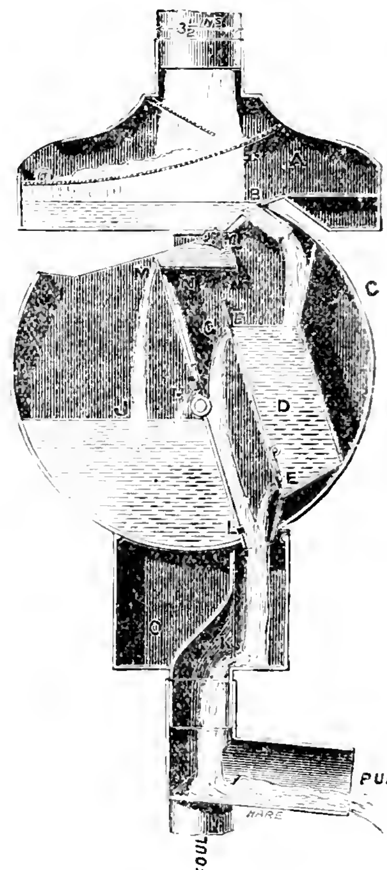


Fig. 20. Section of separator No. 2A in action. Pure water passing to storage. Detailed description of apparatus:—A. Removable strainer with perforated plate to prevent rubbish passing into the separator. B. Outlet for water to pass to separator. C. separator balanced on pivot. D. Small compartment into which the rain-water first falls. E. Small hole fitted with washer proportioned to size of roof. F. Larger hole to take the overflow from D during moderate rain. G. Discharge pipe. In a storm the water fills the compartment D and flows over the top of this pipe. H. Small holes at back of G between compartments. When the rainfall exceeds the discharging capacity of hole E the water rises in compartment D and passing through holes H slowly fills compartment J. When the height of water in J overbalances the separator, it is canted (as shown in drawing) and the water (by that time pure) directed by the discharge-pipe G into the storage-pipe K. L, small hole at bottom of compartment J. M M, auxiliary pipe for keeping compartment J full after the separator is canted when the rain is leaving off, so that the last drop of rain may be stored. By raising the slide N, a third and fourth hole can be opened at H; this will cause the compartment J to fill more rapidly. The whole of the water passes through the discharge-pipe G which conveys it into the waste-pipe O so long as it remains uncanted. The length of time it remains in this position, running the water to waste, is regulated by the slide N to suit the smokiness of the locality. The dotted lines down the centre indicate the position of the iron frame to which the apparatus is attached, provided with holes for fixing to the wall.

Editorial Gossip.

There is no problem in Social Science more nearly affecting the individual citizen than that of assuring the security of his person and the preservation of his liberty. Two cases which have recently been prominently reported in the newspapers seem to point to the fact that the existing law fails very conspicuously to protect either personal liberty, or to afford immunity from wanton and murderous attack.

The first one is that of Mrs. Weldon, which discloses a condition of things that are a simple scandal to our legislation. From what has been brought to light in the High Court of Justice during the past few weeks, it would seem that there is nothing to prevent any person from going to the proprietor of a private lunatic asylum and intimating that he has reason to suspect that the reader of these lines is out of his, or her, mind; nor such proprietor from proceeding with a relation of his own, obtaining access to the said reader under a false pretence, and putting fishing questions for the purpose of establishing that he, or she, is insane. Further, that, having done so, this mad-house keeper may, under the existing law, send two private friends from his own table to certify to the lunacy of the unfortunate reader aforesaid, and upon their certificate lock him, or her, up in his asylum as long as ever it pays him to do so! Surely this discloses a state of things so terrible as to call for searching and immediate reform. No more righteous verdict than that in the case of Weldon *v.* Semple was probably ever delivered; and common-sense Englishmen will only deplore that a decision so conspicuously come to solely on the merits of the case, should stand in the slightest danger of reversal from any of those technical legal quibbles which find their sole defenders in the lawyers who batten on them. *The* remedy for the iniquitous state of things revealed would seem to be the immediate abolition by statute of all private lunatic asylums whatsoever in the United Kingdom.

And if Mrs. Weldon's case illustrates the very precarious tenure upon which we all hold our personal liberty, the shooting by burglars of those two most gallant policemen, Garner and Snell, at Hoxton, equally serves to indicate how the security of the person is sacrificed to sickly and maudlin sentimentality. After the attempted murder of the police constable Chamberlain in the same neighbourhood in June, common sense would have dictated that policemen on night duty there should have been armed. But, oh dear no! They might conceivably under such circumstances have sent a bullet through one of those idols of the Home Office, a ticket-of-leave man, before he had time to fire upon and, perchance, kill them—and that would have been so very shocking! The bull-dog courage, the splendid British pluck which prompted P.C.'s 429 G and 462 G—defenceless, but for a wretched 18-in. ash stick each—to face two murderous ruffians armed with deadly weapons, which they used without hesitation, may well cause a pang of grief and shame to strike everyone who reflects upon the cant and ineptitude which leaves such brave men helpless. A suggestion has been made that armed burglars, when convicted, should have flogging added to their sentences; but, meantime, the death of half-a-dozen of these vermin at the hands of the defenders of the law would do more to stop their nefarious profession than a hundred sentences of a hundred lashes each. Depend upon it, when an armed attack upon the police meant a ·455 bullet through the assailant, "the enterprising burglar" would "cease to burgle" forthwith.

Our Paradox Column.

As an example of the pseudo-science with which the unfortunate readers of the *Christian Globe* are fed, we extract the following two paragraphs:—

"So, after all, the 'Man in the moon' is not fiction, but a real flesh-and-blood reality like ourselves. Our little folks, at any rate, will learn the fact with a sense of delight, for all of us in our childhood's days felt a sort of sympathy for the poor old gentleman, condemned, according to the tradition implicitely believed in, to wander about from one year's end to another with his bundle of fagots on his back for gathering firewood on the Sabboth. 'At the astronomical observatory of Berlin,' says a translation from Nya Pressen Helsingfor, 'a discovery has lately been made which, without doubt, will cause the greatest sensation, not only amongst the adepts in science, but even amongst the most learned. Professor Blendmann, in that city, has found, beyond a doubt, that our old friend, the moon, is not a mere lantern which kindly furnishes light for the loving youth and gas companies of our planet, but the abode of living, intelligent beings, for which he is prepared to furnish proofs most convincing. The question has agitated humanity from time immemorial, and has been the object of the greatest interest. But the opinions have always differed very widely, and no two minds held one and the same.'"

"During the last few decades, however, the idea of life on the moon has been held up to ridicule, and totally scorned by men of learning. But, nevertheless, it has now been proved to be correct. By pure accident, Dr. Blendmann found that the observations of the moon gave but very unsatisfactory results, owing to the intensity of the light power of the moon's atmosphere, which is so strong that it affects the correctness of the observations in a very high degree. He then conceived the idea to make the object-glass of the refractor less sensitive to the rays of light, and for this purpose he darkened it with the smoke of camphor. It took months of experimenting before he succeeded in finding his right degree of obscurity of the glass, and when finally found he then with the refractor took a very accurate photo of the moon's surface. This he placed in a sun microscope, which gave the picture a diameter of 55½ feet. The revelation was most startling. It perfectly overturned all hitherto entertained ideas of the moon's surface. Those level plains which formerly were held to be oceans of water proved to be verdant fields, and what formerly were considered mountains turned out as deserts of sand and oceans of water. Towns and habitations of all kinds were plainly discernible, as well—*mirabile dictu*—as signs of industry and traffic. The learned professor's study and observations of old Luna will be repeated every full moon when the sky is clear."

We have heard of Auwers, Förster, Knorre, and Tietjen as astronomers at Berlin, but strongly suspect that "Professor Blendmann" is a species of astronomical "Mrs. Harris." The whole thing reads like a very clumsy reproduction of the famous lunar hoax of which the details will be found in "Myths and Marvels of Astronomy."

Miscellanea.

The Eucalyptus and Water Supply.—Baron Von Mueller has, it is stated, sent to the Victorian Water-supply Department a long report as to the powers of the eucalyptus tree to absorb water, and to condense into water the moisture in the air. He speaks highly of the remarkable powers of these trees in this direction as well established, and urges judicious tree-planting as an auxiliary measure for maintaining and augmenting the water-supply.

At a recent meeting of the Paris Academy of Sciences, an account was read of a deposit of saltpetre in the neighbourhood of Cochabamba, Bolivia, by M. Sace. An analysis of this vast deposit, which is large enough to supply the whole of the world with nitrate of potash, yields the following results:—Nitrate of potash, 60·70; borax, with traces of salt and water, 30·70; organic substances, 8·60; total, 100·00. The author concludes that the saltpetre is the result of the decomposition of an enormous deposit of fossil animal remains.

Overhead Wires in London.—According to Sir H. Tyler, no less than 230 overhead wires may be counted beween the Royal Exchange and St. Michael's Church, Cornhill, and 200, more or less, between the Mansion House and Queen-street, the latter being stretched across Queen Victoria-street. A few days since he called the attention of the Secretary of the Local Government Board to these figures. In his reply, this gentleman pointed out, that out of the 230 only six belonged to the Post-office, and of the 200, only four.

A test has been made of balancing a straightedge three feet long and weighing thirteen pounds on a human hair. It was placed on another straightedge, and the hair introduced between the two faces near the centre. The upper one was moved on the hair as a roller until the proper point was reached, when it remained balanced perfectly, so that light could be plainly seen the entire length of the straightedge between the two surfaces, except where the hair separated them at the middle of their length.—*Scientific American.*

From the annual report of the Metropolitan Board of Works for 1883 it appears that the staff of the London Fire Brigade consists of 670 men. The number of firemen employed on the several watches kept up throughout the metropolis is at present 108 by day, and 253 by night, making a total of 361 in every 24 hours; the remaining men are available for general work at fires. The number of calls for fires, or supposed fires, received during the year was 2,630. Of these 337 were false alarms, 149 proved to be only chimney alarms, and 2,144 were calls for fires, of which 184 resulted in serious damage, and 1,960 in slight damage. The fires of 1883, compared with those of 1882, show an increase of 218; and, compared with the average of the last ten years, an increase of 446.

Use of Disinfectants in Paris.—Experiments in the disinfecting of rooms have been carried on in a Paris hospital, and many have witnessed the experiments conducted by Drs. Pasteur and Dujardin-Beaumetz. At present two systems are under discussion—the use of the liquid sulphurous anhydride and the simple burning of sulphur. At first the sulphur would not burn, and the acid, though it told on the litmus test-papers, did not kill the microbes which M. Pasteur had left in the room. Now, however, by pouring a little alcohol over the sulphur, it has been made to burn very successfully, and by using a larger quantity of the disinfectant, whether in a liquid or a solid state, the microbes were killed. Both the rooms measured 98 cubic mètres, and 2 kilos. of sulphur had to be burnt before the living organisms left in the room were destroyed. This is about the same amount which long experience in England has proved to be necessary.

"Let Knowledge grow from more to more."—Alfred Tennyson.

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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No communications are answered by post, even though stamped and directed envelope be enclosed.

VENUS IN A THREE-INCH TELESCOPE.

[1356]—I should like to ask readers of my paper on p. 92, to float a pale wash of Indian ink over the inner (the upright or right-hand) edge of Venus as shown in the woodcut (Fig. 1.) on that page, so as to cause it to melt, as it were, into the surrounding sky. The engraver has removed the shading from it, and erroneously left it too sharp and bright.

A Fellow of the Royal Astronomical Society.

MIND AND BRAIN.

[1357]—Your very fair critique on Büchner's "Force and Matter" contains one remark on which you will, perhaps, permit me to say a word—viz., that it is inconceivable "that thought, &c., *is* motion in matter." To me this seems to follow clearly; for if it is proved that no motion of brain-matter, no thought, is a truth—and Haeckel, Hurohke, Vogt, and other eminent scientists clearly say so—it appears to me *very* conceivable and reasonable to say that thought is a mode of motion of the molecules of the brain.

The more perfect the brain the more complicated these movements, the deeper the thoughts, seems to follow as a matter of logic.

From the simple movements of attraction and repulsion, the loves and hates of matter, it is conceivable to me to trace the gradual development of thought movements *pari passu* with the physical development of the human brain in course of evolution through immense periods. F. W. H.

[I may be as obtuse as F. W. H. appears to consider that the Reviewer of Büchner's work is, but I confess that I fail to see that because (as is indubitable) no thought occurs—or can occur—without motion of brain matter—ergo—such motion is itself thought. No tune was, or conceivably ever could be, played upon an organ without the movement of the keys, bellows, &c., but it would appear an old mode of reasoning to predicate that such movement was the tune itself.—Ed.]

FLORAL PARASITISM.

[1358]—During the past spring I have had a fine specimen of *Orobanche minor* make its appearance in a flower-pot containing a double pink geranium, and placed at a window in a sitting-room.

When it had finished flowering I examined the root. It had firmly engrafted itself on the root of its host, which had made but little growth, and no recent roots at all.

Is it not unusual for *orobanche* to establish itself on such a plant as a geranium? Wm. H. Allen.

[The *orobanchaceæ* are all parasitical on the roots of plants; but they mostly attach themselves to wild ones. Yours does seem rather a singular instance.—Ed.]

LETTERS RECEIVED AND SHORT ANSWERS.

Nigel Doble.—A 4-in. object-glass of 66 in. focus ought to suit your purpose. You understand, of course, that for the eye-pieces of which I gave the details on page 79 to give the magnifying powers set against them, it is imperative that they should be employed with an objective of that focal length. Any alteration in that respect would involve a corresponding alteration in their respective powers of amplification. I neither can nor will recommend tradesmen. The firm you mention only sell—they do not make—object-glasses.—A. Roberts. See what you can do with λ Ophiuchi. This is a *very* severe test for an instrument of the size of yours. τ in the same constellation is, I am afraid, just beyond your instrumental capabilities. Try too the double-double star ϵ^1 and ϵ^2 Lyræ, and see how many stars you can make out between the two pairs.—G. H. Robertson inquires what is the chemical composition of the substance called "Essence d'Orient" used in the manufacture of artificial pearls. Can any of our readers inform him? I suppose he does not mean the powdered bleak or minnow scales with which glass beads are internally coated to imitate pearls?—Anonymous (Bradford). Thanks for the cutting from *Le Temps* containing M. Cotteau's essay on the Krakatoa eruption. It tells in the picturesque French fashion what has appeared in print in other forms over and over again.—John Branch sends me a letter from "Enquirer" with reference to Spiritualism, which is very much too long for insertion. Some years since, impressed to a certain extent by the blatant assertions of so-called "Spiritualists," I investigated the question thoroughly for my own satisfaction; and am hence in a position to reply to, at all events, some of "Enquirer's" queries. Imprimis, neither furniture nor anything else ever moves unless it is pushed or lifted by human agency. In the next place, the whole of the race of mediums (save a very small percentage, indeed, who are insane) are arrant rascals; who, as I have said before in these columns, ought, one and all, to be prosecuted under 5 Geo. IV., c. 83, s. 4. And lastly, do not let "Enquirer" delude himself with the belief that he will be suffered to conduct any experiments in a scientific (to say nothing of a common-sense) fashion. If the "Spiritualists" forming the "circle," find out that he is sceptical, and likely to detect the vile cheat who trades upon the holiest feelings of our nature by pretending to communicate with our loved dead ones, he is told that "his influences are antagonistic," and that he must shift his place in the circle, &c., and so he is wedged in between people who take exceedingly good care that he is in no position to lay hold of the medium himself, that medium's paper tube, or anything else that may be "floating" about in the dark. I declare that I have sat in a sort of dumb wonder at the fatuous and idiotic manner in which believers have gone two-thirds of the way to meet the imposture of the medium, when I have been present at a *séance*, the indifferently-performed conjuring tricks of such mediums having been received by these *gobe-mouches* as the veritable acts of beings from another sphere! I have said before, though, and must here repeat, that I cannot have the valuable space of Knowledge wasted in the discussion of an imposture which is simply a disgrace to the boasted intellectual advancement of the nineteenth century.—Fides. I regret to say that I am ignorant of the correspondence class to which you refer. It was apparently a private adventure, possessing no official character whatever.—Sydney Pocklington. To give the objects described as observed with a three-inch telescope, as seen in a two-inch one, would be simply to show them a very little smaller, and not quite so well-defined; the closest separable double stars, for example, in the large instrument merging into misshapen single ones in the smaller telescope. It would be the veriest waste of space.—An Anonymous Correspondent sends us the *Times* obituary for July 29, as containing this coincidence:—"On the 25th inst., at Delverton-road, Manor-place, Walworth, John *Lightning* Morgue, aged 75," and "On the 26th July, after three years' suffering, Margaret, wife of Captain George *Thunder*, aged 31." These names are sufficiently uncommon to read oddly in such connection.—A Constant Reader. I have nothing to add to what I said about Professor Loisette's system in No. 117. You must hence judge of its applicability to your own case. If by "Abstract English History," you mean a cram-book, I can recommend none such. Dr. Wm. Smith's "Smaller English History," though, ought to answer your purpose. Stewart's "Modern Geography," too, published by Oliver & Boyd, will give you a sound grounding in the subject of which it treats.—H. Francis. Your "Coincidence" is of too doubtful a character to warrant me in wasting space by its insertion. You will see your extracts from the *Christian Globe* elsewhere. There is not a trace either of air or water upon the Lunar surface. Did the latter exist, its evaporation must, perforce, form clouds. Of course, the Moon appears inverted as viewed from the Southern hemisphere, *i.e.*, when we are looking at, say, the "Metropolitan Crater" Tycho, in England with the naked eye, it appears to be at the bottom of the Moon; while, as viewed from New Zealand, it is at the top. Your difficulty about what you call the "axial inclination" of the Moon, arises wholly from the fact that her diurnal path is not parallel to the horizon. For a cognate reason the Great Cross in the Constellation Cygnus rises in these latitudes horizontally and sets perpendicularly.—J. Murray has had an octagonal tin reflector made, and finds that it gives a number of dim blotches of light when a candle is placed 20 inches from its centre. This, he seems to conceive, affords some sort of explanation of Sunspots! Like the lamented Artemus Ward, however, "I don't see where the larfture comes in myself."—Excelsior. The *Sidereal Messenger* is published at the Carleton College Observatory, Northfield, Minn., U.S. I do not know whether either of the American publishers in London would be able to obtain a single number for you. It is a subscription serial.—Mars. Newcomb's "Popular Astronomy" is an admirable book. By all means get it.—Algernon Bray. The words which you quote were used in connection with the enormous amount of painstaking work bestowed upon the production of the magic cube. I willingly repeat them in connection with the specimen which you send me. You will perhaps give me credit for knowing how much—or how little—*mathematical* difficulty is attendant on such calculations. "X.'s" cube contains once each number from 1 to 1,331 inclusive.—R. E. O'Callaghan asks me to correct the statement on p. 97 that the National Food Reform Society is a Vegetarian Association; inasmuch as it permits the use of eggs, milk, cheese, and butter. Possibly the reviewer may have been misled by the short manifesto of the society, which heads all its publications: "National Food Reform Society." — Objects: "To circulate useful information regarding healthful, cheap, and natural articles of diet: to promote thrift in food—temperance in eating—and the use of grains, fruits, nuts, and other products of the vegetable kingdom as essential articles of diet: and to advocate abstinence from flesh of mammals, birds, and fish:" and it may also be that the eggs, milk, cheese, and butter, part of its programme, was not prominently insisted upon (even if there was a single syllable about it) in the "Magazine" noticed.—R. F. H. To answer your queries in detail here would be impossible. The pole star at the date of the erection of the Great Pyramid was *a* Draconis, and *not* Orion, as you imagine. The pole of the heavens in these latitudes is the point towards which the northern end of the earth's axis is directed. Now, the polar radius of the earth describes a cone in space in the course of 25694·8 years, or, putting it another way, the pole of the equator revolves round the pole of the ecliptic in that time. Hence the pole star for the time being will be that star most nearly vertical over the north pole of the earth. To the rest of your questions you will find categorical replies in my "Universe of Stars," published by Longmans & Co. I may add, by the bye, that the companion to Polaris has preserved sensibly the same distance from its primary ever since its discovery, but that it seems to be moving very slowly round that primary in a direction opposite to that of the hands of a watch.

Our Mathematical Column.

NOTES ON EUCLID'S SECOND BOOK.

By Richard A. Proctor.

(Continued from p. 80.)

Prop. 11.—*To produce a given straight line* (A B) *so that the rectangle contained by the whole line thus produced and the given straight line may be equal to the square on the part produced.*

Produce A B to C and D, making B C equal to C D equal to A B. Divide C D in E so that the rectangle C D, D E may be equal to the square on C E. Then the rectangle A E, A B shall be equal to the square on B E.

For the square on B E is equal to the squares on B C, C E, together with twice the rectangle B C, C E; that is, to the square on A B, the rectangle C D, D E (*const*), and twice the rectangle A B, C E; that is, to the rectangle contained by A B, and the line made up of A B, D E, and twice C E. But the sum of these lines is equal to A B, C D, and C E together, that is, to A B, B C, and C E, or to A E. Hence the square on B E is equal to the rectangle A E, A B.

Props. 11 and 11. correspond to the two solutions of the quadratic

$$a\,(a-x)=x^2$$

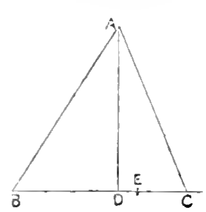
which results as the analytical expression of the relation in Prop. 11, when A B is made equal to a, and the smaller section of A B equal to x.

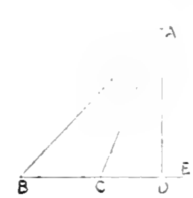
Props. 12 and 13 are important in solving geometrical problems of a certain class, though Euclid himself makes no use of these propositions. Each has a *general* and also an *exact* converse theorem. The general theorem converse to Prop. 12 is this:—*If the square on one side of a triangle is greater than the sum of the squares on the other two sides, these two sides contain an obtuse angle.* The proof is simple: the angle contained by the two sides must either be acute, right, or obtuse. If it were acute, then by Euc. X., Bk. II., 13, the squares on the sides containing this angle would together be greater than the square on the remaining side, but they are not greater; if it were right, the squares on the sides containing this angle would together be equal to the square on the remaining side; but they are not equal to this square. Therefore the angle is obtuse.

And in like manner may be proved the theorem converse to Prop. 13, viz.,—*If the square on one side of a triangle be greater than the sum of the squares on the remaining sides these sides contain an acute angle.*

These two props. may be referred to as Euc. II., Props. 12 and 13, *gen. conv.*

The exact converse theorem to Prop. 12 is this,—*If* A C B *be an obtuse angle, and* B C *be produced to* D, *so that the squares on* B C *and* A C *with twice the rectangle* B C, C D *are equal to the square on* A B, *then* A D *is perpendicular to* B D. This property is often useful, as is the corresponding property converse to Prop. 13, viz.,—*If* A B C *be an acute angle and a point* D *is taken in* B C (*produced if necessary*), *such*





that the squares on A B *and* B C *together exceed the square on* A C *by twice the rectangle* B C, B D, *then* A D *is perpendicular to* B D. The proof in either case is easy, for in the first case, if the foot of the perpendicular from A on B C produced, fell otherwise than at D—at E suppose, it can be readily shown to follow from Prop. 12 that C D is equal to C E, which is absurd: and similarly in the second case we can show (if E is the foot of the perpendicular from A) that B E is equal to B D.

These propositions may be referred to as Euc. Bk. II., Props. 12, 13, *ex. conv.*

Our Chess Column.

BY MEPHISTO.

PROBLEM, No. 122.

BY T. SIMMONDS.

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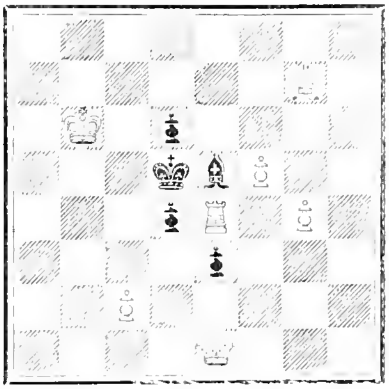


WHITE.

White to play and mate in three moves.

SOLUTION OF PROBLEM, p. 80.

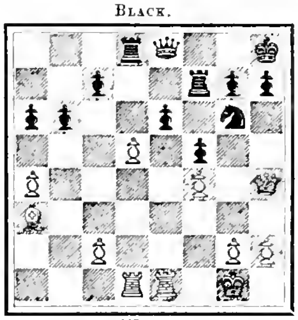
1. P to Q3	1. P takes P
2. R to B 4	2. K takes R
3. B to K6 (mate).	
	If 2. Kt takes R
3. B to Kt7 (mate).	

One of three games played blindfold by Mr. GUNSBERG on the 29th of July at the residence of Dr. J. Hunt.

White. E. Dale.	Black. Gunsberg.
1. P to K4	P to K4
2. Kt to KB3	Kt to KB3
3. Kt to QB3	Kt to QB3 (*a*)
4. B to Kt5	P to QR3
5. B to R4	B to B4 (*b*)
6. Kt × KP	Kt × Kt (*c*)
7. P to Q4	B to QKt5 (*d*)
8. P × Kt	Kt × P
9. Q to Q4	B × Kt (ch)
10. P × B	Kt to Kt4
11. Castles (*e*)	Kt to K3
12. Q to KKt4	Castles
13. B to Kt3	K to R sq. (*f*)
14. P to QR4	P to KB4 (*g*)
15. Q to Kt3	P to QKt3 (*h*)
16. B to QR3	R to B2 (*i*)
17. QR to Q sq.	Q to K sq.
18. P to KB4	B to Kt2
19. B to Q5	B to B3 (*j*)
20. P to B4	R to Q sq.
21. Q to KR4(*k*)	B × B (*l*)
22. P × B	Kt to B sq.
23. P to K6	P × P
24. KR to K sq.	Kt to Kt3 (*m*)

Position after Black's 24th move.

BLACK.



WHITE.

White. E. Dale.	Black. Gunsberg.
25. Q × R (*n*)	Q × Q
26. P × P	R to B sq. (*o*)
27. P to K7 !	Q to B sq. (*p*)
28. P × R (ch)	Kt × P
29. B to K7	Kt to Q2
30. R to K5(*q*)	P to Kt3
31. R to Q5	Resigns.

NOTES.

(*a*) If it was Black's intention to avoid the complications arising out of the Ruy Lopez, by playing the Russian Defence, then he ought to have continued with 3. B to Kt5; to this, White's best reply seems to be 4. Kt takes P (for if 4. P to Q3 then P to Q4), B takes Kt. 5. QP takes B, Kt takes P. 6. B to Q3, Kt to B3. 7. Castles, Castles with an even game. The move in the text transforms the opening into a four Knights' game.

(*b*) Some German analysts consider 5. B to K2 to be Black's best reply. If White now or in his previous move plays B takes Kt, then QP takes Kt; Kt takes P, Kt takes P; Kt takes Kt, Q to Q5; and Black can equalise the game. In reply to B to K2, White might play 6. P to Q3, P to KKt4. 7. B to Kt3, P to Q3, &c.

(*c*) There is no advantage to be gained by B takes P (ch), for although compelled to play K to Kt sq., later on White will obtain a strong centre by P to Q4, and, subsequently, a good development.

(*d*) There is not much satisfaction to be got from 7. B to Q3, as given by the books, as White comes very strong with 8. P to KB4, Kt to Kt3. 9. P to K5, B to K2. 10. P to B5, &c.

(*e*) Here 11. B to R3 appears to be very strong.

(*f*) Black's proper reply was 13. P to Q4, threatening Kt to B4, and to exchange the B for the Kt, after which a draw is certain; if P takes P *en passent*, Q takes P, and White has no perceptible advantage.

(*g*) 14. P to KB3 was admissible.

(*h*) Seeking to place the QB, but that leaves the QP weak.

(*i*) 16. R to K sq. might have answered better, but Black's position is weak.

(*j*) B takes B was the correct reply, and after R takes B, Black, although having a cramped game, would have been able to defend himself.

(*k*) A very good move, White threatens B takes Kt, and neither the P nor the Q could then retake.

(*l*) Anything but that. Black might have retired his QR to Kt sq.

(*m*) Black had a satisfactory reply in 24. R to B3, *i.e.*

23.	R to B3		
24. P takes P	R takes R	or, B takes Kt	Q takes B
25. R takes R	R takes P	P takes P	R takes R, &c.

leaving Black with the better game for the ending.

(*n*) This move is as ingenious as it is sound. Mr. Dale has on more than one occasion shown that he is capable of playing in first-rate style.

(*o*) If Q moves, P takes R, and the R threatens mate.

(*p*) If 27. Kt takes P. 28. R takes Q, R takes R. 29. B takes Kt, remaining with two Pawns against the B, perhaps Black's best course.

(*q*) If 30. Kt takes R, then P takes Kt, first followed by R to Q8.

"THE CHESS-PLAYERS NOTE-BOOK."*

We were very pleased with this little book, which is well got up, and contains Diagrams, Letters for sending solutions, Game records, and tables for noting down results. There is a very good shilling's-worth in this useful little book of 150 pages.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Minasoto.—The K must never be in check.

T. Simmonds.—Ending received with thanks.

Correct solutions received, Problem, p. 80:—J. K. Milne—A. W. Overton. Problem No. 120: C. T. G., E. Ridgway, George Gonge, Donna, T. Simmonds, John Watson, Uncle John, Minasoto, A. J. Howard. Problem No. 121: The Owl, A. J. Howard, Minasoto, S. B. C., Uncle John, John Watson, Geo. Thompson, T. Simmonds, C. T. G., Donna, George Gouge, E. Ridgway, J. K. Milne. Ending, p. 102: C. T. G., G. Thompson, John Watson.

* Rhodes Marriott, 95, Clifton-street, Manchester.

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Contents of No. 146.

PLEASANT HOURS WITH THE MICROSCOPE.

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

THERE is a remarkable group of small insects interesting to the microscopist on account of their beauty and their strangeness, and interesting, also, in a bad sense, to the agriculturist and the gardener on account of their destructive habits. They belong to the Order Thysanoptera, or Fringe-wings, characterised by "four wings, alike, narrow, membranous, neither folded nor reticulated, with long ciliæ, laid horizontally along the back when at rest." Westwood, in his "Introduction to the Modern Classification of Insects," cites Haliday, the first important English observer,* and, in the main, agrees with his description of the mouth parts of these creatures, which, he says, "though constructed" in the mandibulated and palpigerous form, unite into a short conical sucker, which does not extend beyond the anterior coxæ." Curtis, in "Farm Insects," specially describes the species which injures corn (*T. cerealium*), and speaks of the trophi or mouth-parts uniting to form a short beak. Duncan, in his pretty book, "Transformations of Insects," founded upon Emile Blanchard, speaks of this species "*nibbling* the protecting envelopes of the grain"—a thing they could only do if they had mandibles constructed for biting, which is not the case. Westwood, although not detecting the principal feeding organ of these insects, judiciously said: "It appears doubtful whether the action, even of the maxillæ, can be transverse, or whether the insect can be said to bite its food."

The kind common in greenhouses is rather more than one-fifteenth of an inch long in its adult stage, exclusive of its antennæ. Its appearance, when considerably magnified, is shown in Fig. 1. To the naked eye, the full-grown specimen looks black, with white gauzy wings; but when mounted in Canada balsam, and seen with transmitted light, the colours are shades of brown, some much lighter than others, which may be a matter of age. Dark-ground illumination, and a magnification of about 50 linear, makes them objects of great beauty. Each segment of the little creature is decorated with an elegant network pattern. The antennæ are formed of segments like slender vases, the foot of one in the cup of another, and terminate like the top joints of a fishing-rod, the tip being exceedingly fine. Westwood says the number of joints varies from five to nine, in consequence of the terminal joints being more or less firmly soldered together. Fig. 5 shows the appearance of this organ highly magnified. The eyes are large and coarsely granulated, and there are ordinarily three ocelli.

* "Entomological Magazine," Vols. III. and IV.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Description of Figures. Fig. 5.

Fig. 1.—Greenhouse Thrip, highly magnified.
Fig. 2.—Rostrum. This is generally seen straight. The sketch is from one slightly curved, showing it is flexible.
Fig. 3.—Outline of maxillary palp.
Fig. 4.—Outline of labial palp.
Fig. 5.—Outline of antenna, drawn on a large scale, as a smaller one would not show the proportion the fine tip bears to the stouter parts.

Curtis says: "Every one must be acquainted with a little black insect, which alights on the face in hot weather, causing an intolerable irritation with its bladder-tipt feet, throwing up its head and twisting about its tail to expand or close its beautifully-fringed wings." The writer has not experienced this annoyance, which may be perpetrated by *T. cerealium*. The greenhouse sort, though common on wild flowers as well as those of indoor growth, does not behave in that way. Most probably the mouths of all the species are constructed upon a closely similar pattern: but it is the greenhouse plague that is figured here. The mouth parts are very difficult to make a complete display of, but, capable of projection in advance of the "short-beak" of various writers, comes the long, flexible rostrum shown in Fig. 2. The writer thinks it is furnished with two or three very slender setæ, but leaves this for further inquiry. This organ, when at rest, lies in the middle of the "short beak," and unless projected forward is easily confounded with it. It seems capable of a lateral motion. All the mouth-organs commence at the lower part of the head. The "short beak" extends to the first coxæ, and the rostrum can be thrust beyond it. Fig. 3 is a maxillary palp, and Fig. 4 a labial one. Two slender "horny, setiform mandibles," as figured by Westwood, have sharp and probably piercing tips. In one mounted specimen two fine rapier-shaped instruments are thrust forward in advance of the rostrum, only the tip of which projects a little beyond the "short beak." Are they maxillæ? To see the rostrum, which has escaped the notice of so many observers, the head of the insect should be pushed off by pressing it *forwards* with a fine needle. This will probably cause the rostrum and some other parts to be seen extending *backwards*. If the first attempt is not successful, the process should be repeated till the end is accomplished. The larva and pupa much resemble the perfect insect, but they are yellow and very transparent. They reach the imago state through a succession of moultings. Their mouth organs seem like those of the adult, and if a few of the larger ones are mounted in thin Canada balsam some are pretty sure to exhibit the rostrum and some of the other mouth parts. In the head of the pupa several long muscular bands to work the mouth-parts are very interesting to view with powers of 200 and upwards. The mandibles and maxillæ are of transparent glassy aspect; the rostrum is brown and chitinous, deepening in tint towards the tip. When the whole of this organ is seen, it corresponds to a gun with the barrel at an angle with the much curved stock. Not having succeeded in displaying the whole of the mouth organs in their natural position, naming them is uncertain, except as regards the rostrum, which clearly belongs to the Haustellate or Sucking insects, and not to the Mandibulate or Biting ones.

Their modes of doing mischief are twofold. Firstly, by piercing leaves or other objects of attack, and sucking out the plant juices; and, in the second place, by depositing their excrement in the form of black globules as stiff as tar. Vines and fuchsias are favourite objects of attack. The adults seem to like the upper side of the leaves best, and the little yellow babies and juveniles affect the under side. The latter are so transparent as readily to show the contents of their intestines, and it is curious how soon their digestive processes turn the green leaf matter into the black mess which kills the part it is deposited upon. The insects may be seen moving about with balls of this stuff at the end of their tails. The adults, when disturbed at their work on the leaves, never use their wings in order to escape, but can run pretty quickly.

When they get into cucumber or melon frames they are very destructive, and troublesome to get rid of. They can stand a wonderful lot of tobacco-smoking, and most of the vaunted insecticides are of little use. With pot-plants, the best thing is to wash them off with yellow soap, or, better still, with Gishurst Compound, which is a sulphur soap.

The damage done by these little pests is always serious if they get into any frame or house, and the species that attacks farm crops is terribly injurious. Curtis quotes Halliday to the effect that in 1805 they destroyed one-third of the wheat crop in the richest part of Piedmont, and in the same year they caused similar losses to the British farmer. Olives, peaches, melons, and potatoes are assailed by some of the tribe. In attacking wheat, rye, &c., they are found between the interior valve of the corolla and the grain, causing the latter to shrink, or be *pungled*, as they call it in Suffolk. In one case an orange-coloured powder was noticed in the grains that had been attacked, and was taken for the insect's excrement, which is not at all like it. Probably the yellow powder was one of the rust fungi.*

In preparing these objects for the microscope some should be mounted whole in thin balsam. To display the wings, the abdomen should be pushed off, and the head, thorax, and wings treated in the same way. What to do with the head has already been explained. The feet do not exhibit the bladder-like endings at all well in balsam. Probably some fluid would do better, but they are very difficult to make out. Before balsaming the whole insect, it is well to soak it for an hour or two in a drop of carbolic acid, which helps to make the balsam penetrate, and adds to the transparency of the preparation.

THE CAPTURE THEORY OF COMETS.

By Richard A. Proctor.

(*Continued from page* 112.)

ARRIVED at Jupiter's distance from the sun, the meteor flight from interstellar space will have a velocity of about eleven miles per second. Now let us inquire what its velocity must be reduced to in order that it may thenceforth be compelled to travel in a circle around the sun. As a matter of fact, all the members of Jupiter's comet-family travel in orbits whose remotest parts are near Jupiter's orbit, and to give a comet such an orbit as one of these much more must be done in the way of reducing velocity than is necessary merely to make the meteor flight from outer space travel thenceforth in a circle at Jupiter's mean distance. We are taking, in fact, a very unfavourable case for our argument. Still, the velocity must be reduced, even in this case, by nearly three-tenths, or by more than three miles per second.

Now Jupiter's power to withdraw velocity from a body in his neighbourhood is measured by his power to impart velocity. In fact, both processes are but different forms of the same kind of work. Precisely as we say that the sun can communicate a velocity of three hundred and eighty-two miles per second to a body approaching him from interstellar distances, and that therefore the sun can withdraw such velocity from a body leaving his surface at that rate, and eventually bring such a body to rest out yonder in interstellar space, so can we make a corresponding statement for any planet,—Jupiter or Saturn, the Earth, our Moon, and even for the least of all, the asteroidal family (supposing only the mass and size known). In the case of Jupiter, for instance, we find that the utmost velocity he can impart to a body reaching him from external space is about thirty-six miles per second. That, at least, is the velocity with which such a body would reach the visible surface of the planet. What the velocity might be with which the real surface, far down below the visible envelope of clouds, would be reached, we do not know,—not knowing where that surface lies. In the case of our own earth, the

* Dr. Cooke's "Microscopic Fungi" is a good popular introduction to the study of rust, smut, &c.

velocity with which a body would reach the surface, if brought thither solely by the earth's action from interstellar space, would be a little over seven miles per second, or more than twenty-seven times greater than the velocity of the swiftest cannon-ball.

But while Jupiter—to keep for the moment to our giant planet—has thus, theoretically, the power of giving or taking away a velocity of thirty-six miles per second, he is not practically able to do anything of the sort. He is not left to draw matter to himself, or to act on the recession of matter from himself, alone. The bodies which come near to him from outer space have been drawn by solar might within that distance from the sun, and almost the whole velocity they there possess is sun-imparted. We have seen what it is—some eleven miles per second. Now manifestly this greatly affects Jupiter's power of imparting or withdrawing velocity. Both processes require time, and it is clearly impossible for Jupiter to produce anything like the same effect on a body rushing past him with a sun-imparted velocity of eleven miles per second as he would produce on a body left undisturbed to his own attraction. Jupiter's action at any moment is the same whether the body is moving or at rest; but the number of movements is very much reduced owing to the swift rush of the body past the planet. To use the old-fashioned expression of the first students of gravitation (an expression which has always seemed to me amusingly quaint) the solicitations of Jupiter's attractive force are as urgent on a swiftly rushing body as on one at rest; but if a body will not stay to hearken to them, much less effect must be produced. In all this part of my reasoning, I may remark, I am not pleading a cause, but indicating what every student of celestial dynamics knows.

We may fairly regard twenty-five miles per second as the utmost velocity that Jupiter can impart or take from any body coming out of interplanetary space past him, as close as such a body can pass without being actually captured. Moreover, in every possible case, Jupiter can only abstract or add a small portion of this amount; for this reason, simply, that in every possible case there will be first an action of one kind (abstraction or addition of velocity), and afterward an action of the opposite kind (addition or abstraction respectively). It will be but the difference between these effects, in most cases very nearly equal, which will actually tell on the body's future period of revolution around the sun.* This makes an enormous reduction on Jupiter's potency to modify cometic revolution. Certainly ten miles per second is a very full estimate of the velocity he can abstract or add in the case of a body passing quite close to his apparent surface.

But even this may seem ample. Seeing that a loss of three miles or so per second would cause a body which had reached Jupiter's distance from the sun, after a journey from out of interplanetary space, to travel in the same period around the sun as Jupiter himself, and since we seem to recognise a power in Jupiter to abstract ten miles per second, it would seem as though Jupiter's capturing power were in fact demonstrated.

But while, to begin with, the close approach required for this capturing power to exist is something very different from that approach within a million miles which I before considered, there is a much more important difficulty to be considered, in the circumstance that we have thus far dealt with Jupiter's capturing power on one body, not on a flight of bodies, such as a comet approaching from interstellar space is held to be, according to the theory I am discussing. Let us take the former point, though the least important, first.

At Jupiter's apparent surface the actual maximum velocity which the planet could give to a body approaching from a practically infinite distance would be about thirty-six miles per second, and we reduced the actual maximum effect on a body passing Jupiter very close, under such conditions as actually prevail in the solar system, to ten miles per second. Let us see what would be the corresponding numbers in the case of a body passing within a million miles of him, remembering that even that would carry such a body right through Jupiter's system of satellites, the span of that system being about four and a half millions of miles. Since a distance of one million miles exceeds the distance of Jupiter's surface from his centre nearly twenty-five times, it follows (I need not explain why: mathematicians will know, and for non-mathematicians the explanations would be tedious and difficult) that the velocities which Jupiter can give or abstract at the greater distance would all be reduced to little more than one-fifth those determined for Jupiter's surface. So, instead of ten miles per second, we should get but two miles per second, as the greatest Jupiter could abstract from a body approaching him within a million miles. And this would not be sufficient reduction to make such a body travel thenceforth in Jupiter's period, still less in one of the much shorter periods observed throughout what has been called Jupiter's comet-family.

But the other difficulty is altogether more serious. A comet approaches Jupiter, on the theory we are dealing with,—and indeed the same may be assumed on any theory,—as a flight of scattered bodies. Either this flight is so close as to be in effect, because of mutual attractions, a single body, or it is not. If it is, the flight will not be broken up by Jupiter's action; and, if not so broken up, will remain for ever after a united family. But if, as is more in accordance with observed facts, the cometic flight is so large that the attraction of the flight, as a whole, on the separate members, can be overcome by Jupiter's action, then not only will the flight be broken up, but the orbits given to different members of it by Jupiter's disturbing action will be widely different. Suppose, for example, the extent of the flight to be such that the parts coming nearest to Jupiter approach his centre within fifty thousand miles (a very close approach, indeed, to his surface), while those parts which are remotest from him at the time when the flight, as a whole, is nearest, came only within sixty thousand miles from his centre. Then, in round figures, the reduction of velocity of the nearer members of the flight will be greater than the reduction for the farther members, as six exceeds five. Supposing, for argument's sake, the former reduction to be three miles per second, as it must be to make those members of the flight travel thenceforth in Jupiter's period round the sun, then the reduction for the outermost members would be but three and a half miles per second; or thenceforth one set of meteors formerly belonging to the comet would have at Jupiter's distance a velocity of eight miles per second (eleven less three), while another set would have a velocity of eight and a half miles per second (eleven less two and a half) at that distance. This means that thenceforth the mean distance of the latter set from the sun would exceed the mean distance of the former set about as nine exceeds eight.* Since the former set would thenceforth be

* As distinguished from the orbit. The orbit might be largely affected even in a case where the velocity at Jupiter's distance remained absolutely unchanged; but in this case the period of revolution would remain the same.

* The simple law is, that for two bodies having different velocities at the same distance from the sun, the mean distances from him differ as the square of those velocities. Now, the square of eight and a half is seventy-two and a quarter; that of eight is sixty-four.

travelling at Jupiter's distance, or about 5·2 times the earth's, the latter set would be travelling at a mean distance greater by one-eighth of this, or ·65 of the earth's distance, say some sixty millions of miles. The latter set would be at their nearest to the sun when at Jupiter's distance, would pass sixty millions of miles farther away to their mean distance, and as much farther away still at their greatest distance. Practically, then, even in this case, as favourable for capture as can be well imagined, the capture, though effected, would result in spreading out the comet, which had arrived as a compact flight of meteors ten thousand miles only in span, over a region one hundred and twenty millions of miles broad. It is hardly necessary to say that nothing like this is observed in the case of any member of Jupiter's comet-family. We know that along their track meteors are strewn to distances which, in some cases, may well exceed even the enormous distance just named; but they lie along the track, not ranging more than a few hundred thousand miles on either side from the path of the comet's head. This means that the orbit of every single meteor of such a system has, practically, the same mean distance from the sun.

The difficulty last considered is simply fatal to the theory that the comets forming what have been called the comet-families of the giant planets were captured by those orbs in the way imagined by Heis, Schiaparelli, and others.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XL.—COUNT RUMFORD'S SUBSTITUTE FOR TEA.

TAKE eight parts by weight (say ounces) of meal (Rumford says "wheat or rye-meal," and I add, or oatmeal), and one part of butter. Melt the butter in a clean *iron* frying-pan, and when thus melted sprinkle the meal into it; stir the whole briskly with a broad wooden spoon or spatula till the butter has disappeared and the meal is of an uniform brown colour like roasted coffee, great care being taken to prevent burning on the bottom of the pan. About half an ounce of this roasted meal boiled in a pint of water, and seasoned with salt, pepper, and vinegar, forms "burnt soup," much used by the wood-cutters of Bavaria, who work in the mountains far away from any habitations. Their provisions for a week (the time they commonly remain in the mountains) consist of a large loaf of rye bread (which, as it does not so soon grow dry and stale as wheaten bread is always preferred to it); a linen bag, containing a small quantity of roasted meal, prepared as above; another small bag of salt, and a small wooden box containing some pounded black pepper; and sometimes, but not often, a small bottle of vinegar; but *black pepper* is an ingredient never omitted. The rye bread, which eaten alone or with cold water would be very hard fare, is rendered palatable and satisfactory, Rumford thinks also more wholesome and nutritious, by the help of a bowl of hot soup, so easily prepared from the roasted meal. He tells us that this is not only used by the wood-cutters, but that it is also the common breakfast of the Bavarian peasant, and adds that "it is infinitely preferable, in all respects, to that most pernicious wash, *tea*, with which the lower classes of the inhabitants of this island drench their stomachs and ruin their constitutions." He adds that, "when tea is taken with a sufficient quantity of sugar and good cream, and with a large quantity of bread-and-butter, or with toast and boiled eggs, and, above all, *when it is not drank too hot*, it is certainly less unwholesome; but a simple infusion of this drug, drank boiling hot, as the poor usually take it, is certainly a poison, which, though it is sometimes slow in its operation, never fails to produce fatal effects, even in the strongest constitutions, where the free use of it is continued for a considerable length of time.'"

This may appear to many a very strong condemnation of their favourite beverage; nevertheless, I am satisfied that it is perfectly sound. This is not an opinion hastily adopted, but a conclusion based upon many observations, extending over a long period of years, and confirmed by experiments made upon myself.

The *Pall Mall Gazette* of Aug. 7 says:—"There is balm for tea-drinkers in one of Mr. Mattieu Williams's 'Science Notes' in the *Gentleman's Magazine*." This is true to a certain extent. I referred to the Chinese as habitual drinkers of boiled water, and suggest that this may explain their comparative immunity from cholera, where all the other conditions for a raging epidemic are fulfilled. It is the boiling of the water, not the infusion of tea-leaves therein, to which I attribute the destruction of the germs of infection.

In the note which follows, I proposed an infusion of fried or toasted bread-crumbs, oatmeal, maize, wheat, barley, malt, &c., as a substitute for the tea, the deep colour of the infusion (poured off from the grounds in this case) serving to certify the boiling of the water. Rumford's burnt soup, taken habitually at breakfast or other meals, would answer the same purpose, with the further advantage to poor people of being, to a certain extent, a nutritious soup as well as a beverage. All that is nutritous in porter is in this, minus the alcoholic drug and its vile companion, the fusel oil.

The experience of every confirmed tea-drinker, when soundly interpreted, supplies condemnation of the beverage; the plea commonly and blindly urged on its behalf being, when understood, an eloquent expression of such condemnation. "It is so refreshing"; "I am fit for nothing when tea-time comes round until I have had my tea, and then I am fit for anything." The "fit for nothing" state comes on at five p.m., when the drug is taken at the orthodox time, or even in the early morning, in the case of those who are accustomed to have a cup of tea brought to their bedside before rising. With blindness still more profound, some will plead for tea by telling that by its aid one can sit up all night long at brain-work without feeling sleepy, provided ample supplies of the infusion are taken from time to time.

It is unquestionably true that such may be done; that the tea-drinker is languid and weary at tea-time, whatever be the hour, and that the refreshment produced by "the cup that cheers" and is *said* not to inebriate, is almost instantaneous.

What is the true significance of these facts?

The refreshment is certainly not due to nutrition, not to the rebuilding of any worn-out or exhausted organic tissue. The total quantity of material conveyed from the tea-leaves into the water is ridiculously too small for the performance of any such nutritive function; and besides this, the action is far too rapid, there is not sufficient time for the conversion of even that minute quantity into organised working tissue. The action cannot be that of a food, but is purely and simply that of a stimulating or irritant drug, acting directly and abnormally on the nervous system.

The five o'clock lassitude and craving is neither more nor less than the reaction induced by the habitual abnormal stimulation; or otherwise, and quite fairly, stated, it is the outward symptom of a diseased condition of brain produced by the action of a drug; it may be but a mild form of disease, but it is truly a disease nevertheless.

The active principle which produces this result is the crystalline alkaloid, the *theine*, a compound belonging to the same class as strychnine and a number of similar vegetable poisons. These, when diluted, act medicinally, that is, produce disturbance of normal functions as the tea does, and, like theine, most of them act specially on the nervous system; when concentrated they are dreadful poisons, very small doses producing death.

The non-tea-drinker does not suffer any of these five o'clock symptoms, and, if otherwise in sound health, remains in steady working condition until his day's work is ended and the time for rest and sleep arrives. But the habitual victim of any kind of drug or disturber of normal functions acquires a diseased condition, displayed by the loss of vitality or other deviation from normal condition, which is temporarily relieved by the usual dose of the drug, but only in such wise as to generate a renewed craving. I include in this general statement all the vice-drugs (to coin a general name), such as alcohol, opium, tobacco (whether smoked, chewed, or snuffed), arsenic, haschisch, betel-nut, coca-leef, thorn-apple, Siberian fungus, maté, &c., all of which are excessively "refreshing" to their victims, and of which the use may be, and has been, defended by the same arguments as those used by the advocates of habitual tea-drinking.

Speaking generally, the reaction or residual effect of these on the system is nearly the opposite of that of their immediate effect, and thus larger and larger doses are demanded to bring the system to its normal condition. The non-tea-drinker or moderate drinker is kept awake by a cup of tea or coffee taken late at night, while the hard drinker of these beverages scarcely feels any effect, especially if accustomed to take it at that time.

The practice of taking tea or coffee by students, in order to work at night, is downright madness, especially when preparing for an examination. More than half of the cases of break-down, loss of memory, fainting, &c., which occur during severe examinations, and far more frequently than is commonly known, are due to this.

I frequently hear of promising students who have thus failed; and, on inquiry, have learned—in almost every instance—that the victim has previously drugged himself with tea or coffee. Sleep is the rest of the brain: to rob the hard-worked brain of its necessary rest is cerebral suicide.

My old friend, the late Thomas Wright, was a victim of this terrible folly. He undertook the translation of the "Life of Julius Cæsar," by Napoleon III., and to do it in a cruelly short time. He fulfilled his contract by sitting up several nights successively by the aid of strong tea or coffee (I forget which). I saw him shortly afterwards. In a few weeks he had aged alarmingly, had become quite bald, his brain gave way and never recovered. There was but little difference between his age and mine, and but for this dreadful cerebral strain, rendered possible only by the alkaloid (for otherwise he would have fallen to sleep over his work, and thereby saved his life) he might still be amusing and instructing thousands of readers by fresh volumes of popularised archæological research.

I need scarcely add that all I have said above applies to coffee as to tea, though not so seriously *in this country*. The active alkaloid is the same in both, but tea contains weight for weight about three times as much as coffee. In this country we commonly use about 50 per cent. more coffee than tea to each given measure of water, and thus get about half as much alkaloid. On the continent they use about double our quantity (this is the true secret of "Coffee as in France"), and thus produce as potent an infusion as our tea.

I need scarcely add that the above remarks are exclusively applied to the *habitual* use of these stimulants. As medicines, used occasionally and judiciously, they are invaluable, provided always that they are not used as ordinary beverages. In Italy, Greece, and some parts of the East it is customary when anybody feels ill with indefinite symptoms to send to the druggist for a dose of tea. From what I have seen of its action on non-tea-drinkers it appears to be specially potent in arresting the premonitory symptoms of fever, the fever headache, &c.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from page 47.*)

We may fitly conclude our few remarks upon lenses by a description of the methods adopted to find their foci, which the amateur will often find very useful. First, in the case of a convex lens of any considerable size, a cardboard disc may be fitted at the end of a straightedge accurately graduated into feet, inches, and tenths of an inch, at right angles to its length. This arrangement is then taken out into the sunshine, and the lens whose focal length is to be measured is slid along the straightedge rigidly parallel to the screen, until a sharp and distinct image of the sun is formed upon the latter. The distance between the point where the middle of the edge of the lens rests on the straightedge and the screen may then be taken off the scale by mere inspection. Or, suppose that we wish to find the focus of our lens when sunlight is not available. We place a lighted candle at the end of a graduated scale of inches and parts, and so connect the lens with the scale that it may always have its axis parallel with the edge of the scale as it slides along it. A card disc, or screen, must also be made to slide along the scale so as to be in a line with the light and the lens, the light being manifestly on one side of the lens and the card on the other. Both the lens and the card must now be shifted backwards and forwards until the *least* distance between the light and the card is found, at which a sharp image of the candle is depicted on the latter. Then, if we measure this least distance accurately, it is four times the focal length of the lens. An ingenious modification of this method devised by the Rev. Prebendary Webb, and applicable to the measurement of the foci of the smallest lenses, is illustrated in Fig. 22, in which K N is a

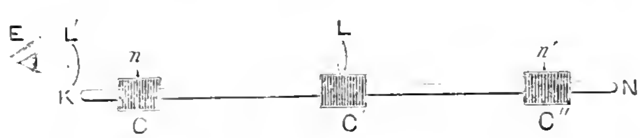


Fig. 22.

knitting-needle, along which three perforated corks, C, C', C'', slide. To the one in the middle, C', the lens, L, whose focus is to be measured, is attached in a vertical position, with its axis parallel to K N; while in each of the two others is stuck a piece of an ordinary sewing-needle, n, n', point uppermost, and of such a length that a line joining the two points p shall pass, as nearly as can be managed, through the centre of the lens, L. Now, as in our previous experiment, the corks are moved backwards and forwards until the inverted image of the needle-point, n', formed by the lens is seen coincident, and equally distinct, with the point of the needle, n, when both are viewed through a pretty strong magnifier, L', by the eye at E. If this condition of things obtains when the needle-points are sensibly equidistant on each side of the lens (and we must shift them about until they are), then, if we take the distance between them very accurately—preferably with compasses and a finely-divided scale—this, as before, will be four times the focal length of the lens for parallel rays. And while on the subject of the measurement of the focus of lenses, we may just mention a simple way in which that of an equi-concave lens may be ascertained; a kind of determination which sometimes puzzles the beginner. Blacken one side of the lens whose focus you wish to find, and draw a diametrical line across the black backing. On this line make two dots, about the twentieth of an inch in diameter, and equidistant from the centre (or, what is of course the same thing, from the edges) of the lens. Now, hold your lens square to the Sun's rays with its unblacked face turned towards him, and place a card screen, as nearly parallel as may be to the face of the lens to receive the resulting image. Measure very carefully the distance apart of the spots on your lens, and shift the screen about until their images are exactly *twice* this distance apart; then will the distance between the screen and the lens be the virtual focus of the latter.

While we are on the subject of measurement, and before proceeding to the consideration of the structure of the human eye, and of the phenomena of vision, we may say something on the very interesting subject of photometry, or the measurement of the relative amounts of light emitted by various sources of it. We see lamps advertised which are guaranteed to give the light of sixteen or twenty candles, as the case may be. How can we find out for ourselves whether this quantity of light really is emitted by any given flame or not? The principle on which this is done will be apparent from Fig. 23,

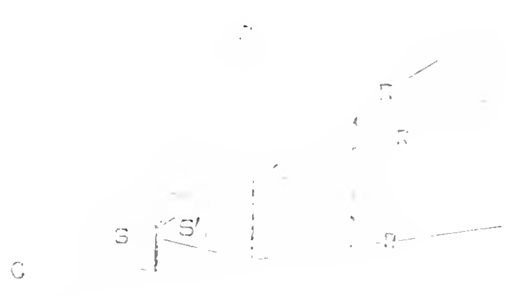


Fig. 23.

wherein C is the flame of a candle, from which rays CR, CR', &c., are radiating. If now we place a piece of cardboard, S, one foot square, at S, a distance of 2 ft. from the candle, C, a glance at our figure will show that its shadow will just cover an area of four square feet (*i.e.* two feet high and two feet wide), and so on. Or, putting it in another way, if we removed the first screen, S, altogether, the light falling on an equal area of another screen, S', at twice the distance would only be one-quarter as intense as that lighting the nearer screen. At three times the distance, S'', the candle would only give one-ninth of the light it does at distance unity; upon an equal area four times as far off, one-sixteenth, and so on. And this we may express in the form of the following law: the intensity of light is inversely proportional to the square of the distance of the illuminated surface from the source of it. Hence a very little thought will show that when two sources of light produce equal intensities of illumination at different distances, their illuminating powers must be in the ratio of the squares of their distances from the illuminated surface. This supplies us with a ready means of measuring the intensity of any given light. For we may adopt Rumford's method, illustrated in Fig. 24.

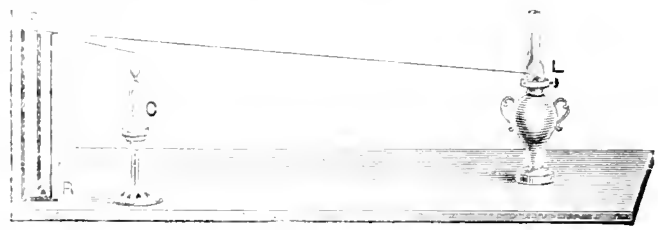


Fig. 24.

In this figure S represents a white card screen, in front of which stands a rod about as thick as an ordinary drawing pencil. It will be seen that each of the two lights to be compared casts a shadow of the rod, and each light illuminates the shadow cast by the other. Let us suppose now that our candle, C, is one foot from the screen; then if, on moving the lamp, L, to a distance of four feet from the screen, the two shadows appear identical in depth, the lamp really must give sixteen times the light of the candle. It will be quite evident that had it given a precisely similar shadow to that caused by the candle when removed to a distance of five feet, it must have emitted light of twenty-five-candle power, and so on. Bunsen's photometer is, if possible, more simple still in construction, consisting, as it does, mainly of a sheet of white paper with a grease spot on it. This, of course, lets more light through it than the rest of the paper. Hence, if it be illuminated more strongly from behind, it will appear to be bright on a dark ground. If the front surface be the more strongly lighted, it will seem to be dark upon a light ground; while, if absolutely equally illuminated on both sides, it will disappear as a spot, and be merged in the general surface of the paper. In employing this simple device a sheet of white paper should be stretched on a frame, and the lights, whose relative intensity is to be measured, placed one on each side of it at the height of the spot; then they are moved about until the spot disappears, and, such disappearance being complete, the distances of the lights are measured from the screen, the squaring of those distances as before giving the comparative intensities of the lights. One practical word of caution is needed here as to the method of making the grease-spot, as oil would create one of which it would be very difficult to cause the disappearance. The best plan is to let a drop or two of stearine fall on to the paper from a burning candle, and when it has cooled scrape the superfluous stearine off the paper with a pen-knife. Then the stearined spot should be placed in a fold or two of blotting-paper, and ironed with a hot iron until it becomes of the proper strength. This the reader must ascertain for himself by direct experiment. The two common forms of photometer which we have just described will amply serve to illustrate the principle on which such measurements are made, and will afford the student both amusement and instruction. Into the great subject of celestial photometry we cannot here enter, our object being, as we have before stated, to describe optical experiments which can be performed without the aid of any elaborate or costly apparatus, and with materials within the reach of everybody.

The *Medical Press and Circular* says:—One of the effects of the cholera scare is the sudden increase in market prices of all kinds of disinfectants. Opium, too, has gone up twenty-five per cent., and sulphate of morphine has likewise advanced. We hear that the demand is so great from France that one well-known English house cannot manufacture carbolic acid sufficiently fast to meet it.

THE HISTORY OF A LIGHTNING FLASH.

By W. Slingo.

Lately we have all felt, I doubt not, a considerable amount of interest in the various phenomena attending this summer's unusually heavy thunderstorms, accompanied, as they have been, by vivid lightning discharges of a more or less hurtful nature. The list of disasters published in Knowledge, No. 143, might be very materially augmented were we to record such damage as has been wrought since that list was compiled.

There is not, I suppose, in the mind of any intelligent man at the present day a doubt as to the electrical origin of a lightning flash. The questions to be considered are rather whence comes the electricity? and in what way is the thunderstorm brought about? In attempting to answer these questions, sight must not be lost of the fact that the very nature of electricity is in itself almost sufficient to baffle any effort put forth to ascertain from lightning, as such, its whence and its whither.

It is possible, however, with the aid of our knowledge of static electricity, to arrive at hypotheses of a more than chimerical nature. In the first place, that our sphere is a more or less electrified body is generally admitted. More than this, it is demonstrated that the different parts of the earth's surface and its enveloping atmosphere are variously charged. As a consequence of these varying charges, there is a constant series of currents flowing through the various parts of the earth, which show themselves in such telegraph-wires as may lie in the direction followed by the currents. Such currents are known as earth-currents, and present phenomena of a highly interesting nature. But, apart from these electrical manifestations, there is generally a difference of electrical condition between the various parts of the earth's surface and those portions of the atmosphere adjacent to or above them. Inasmuch as air is one of the very best insulators, this difference of condition (or potential) in any particular region is in most cases incapable of being neutralised or equilibriated by an electric flow. Consequently the air remains more or less continually charged. With these points admitted as facts, the question arises, Whence this electricity? There have been very many and various opinions expressed as to the cause of terrestrial electricity, but far the greater portions of such theories lack fundamental probability, and indicate causes which cannot be regarded as sufficiently extensive or operative to produce such tremendous effects as are occasionally witnessed. I take it that we may safely regard the evolution of electricity as one of the ways in which force exhibits itself, that, in other words, when work is performed electricity may result. When two bodies are rubbed together, electricity is produced, so also is it when two connected metals are immersed in water and one of them is dissolved, or when one of the junctions of two metals is raised to a higher temperature than the other junction. I will go further than this, so far, in fact, as to maintain that there is reasonable ground for supposing that every movement, whether it be of the mass or amongst the constituent particles, is attended by a change of electrical distribution, and if this is true it may easily be conceived that inasmuch as motion is the rule of the universe, there must be a constant series of electrical changes. Now, these changes do not all operate in one direction, nor are they all of similar character, whence it is that not only are there earth currents of feeble electro-motive force, but that this E M F is constantly varying, and that, furthermore, electricity of high E M F is to be met with in various parts of the atmosphere.

With earth currents we have here very little to do. The rotation of the earth is in itself sufficient to generate small currents, and the fact that they vary in strength at regular periods of the day and of the year enforces the suggestion that the sun exerts considerable electrical influence on the earth. Letting it be granted, however, that the earth is variously charged, how comes it that the air is also charged, and with electricity of greater tension than that of the earth itself? It was pointed out by Sir W. Grove that if the extremities of a piece of platinum wire be placed in a candle-flame, one at the bottom and the other near the top, an electric current will flow through the wire, indicating the presence of electricity. If an electrified body be heated, the electricity escapes more rapidly as the temperature rises. If a vessel of water be electrified, and the water then converted into steam, the electric charge will be rapidly dissipated. If a vessel containing water be electrified, and the water allowed to escape drop by drop, electricity will escape with each drop, and the vessel will soon be discharged. We regard it as an established fact that the earth has always a greater or less charge; whence it is safe to assume that in the process of evaporation which is going on all over the surface of the globe, more particularly in equatorial regions, every particle of water, as it rises into the air, carries with it its portion, however minute that portion may be, of the earth's electric charge. This small charge distributes itself over the surface of the aqueous particle, and the vapour rises higher and higher until it reaches that point above which the air is too rare to support it. It then flows away laterally, and as it approaches colder regions, gets denser, sinking lower and nearer to the earth's surface. The aqueous particles becoming reduced in size, the extent of their surfaces is proportionately reduced. It follows that as the particles and their surfaces are reduced, the charge is confined to a smaller surface, and attains, therefore, a greater "surface density," or, in simpler language, a greater amount of electricity per unit of surface. Electricity, as above set forth, is in what is known as the "static" condition (to distinguish it from electricity which is being transferred in the form of a current), when it has the property of "repelling itself" to the utmost limits of any conductor upon which it may be confined. This will account for the charge finding its way to the surface of the water particles, and will furthermore account for the greater density of the charge as the particle gets smaller and has the extent of its surface rapidly diminished. It may be mentioned that the surface of a sphere varies as the cube of its radius. Returning to the discussion of the state of affairs existing when the particles have reached their highest position in the atmosphere, we may imagine that they set themselves off on journeys towards either the north or the south pole. As they pass from the hotter to the colder regions, a number of particles coalesce; these again combine with others on the road until the vapour becomes visible as cloud. The increased density implies increased weight, and the cloud particles, as they sail pole-wards, descend towards the surface of the earth. Assuming that a spherical form is maintained throughout, the condensation of a number of particles implies a considerable reduction of surface. Thus, the contents of two spheres vary as the cubes of their radii, or eight (the cube of 2) drops on combining will form a drop twice the radius of one of the original drops. We may safely conceive hundreds and thousands of such combinations to take place until a cloud mass is formed, in which the constituent parts are more or less in contact, and, therefore, behave electrically as a single conductor of irregular surface, upon which is accumulated all the electricity that was previously distributed over the surfaces of the millions of particles that now compose it.

The tendency of an electric charge upon the surface of a conductor is to take upon itself a position in which it may approach nearest to an equal and opposite charge, or, if possible, to attain neutrality. If, then, a cloud has a charge, and there is no other cloud above or near it, the charge *induces* on the adjacent earth surface, electricity of the opposite kind. Thus, assuming the cloud to be charged with positive electricity, the subjacent earth will be in the negative state. The two electricities* exert a strong tendency to combine or to produce neutrality, whence there is a species of stress applied to the intervening air. Possibly the cloud will be drawn bodily towards the earth more or less rapidly, according as the charge is great or small. Or, on the other hand, the cloud may roll on for leagues, carrying its influence with it, so that the various portions of the earth underneath become successively charged and discharged as the cloud progresses on its journey.

Should the cloud be near the earth, or should it be very highly charged, the tension of the two electricities may be so great as to overcome the resistance of the intervening air; and if this resistance should prove too weak, what happens? How does the discharge show itself? It takes place in the form of a lightning flash, and passing from the one surface to the other—or, may be, simultaneously from both—produces neutrality more or less complete.

There has recently been a little discussion in these pages on the subject of lightning, some having stated that they discerned the discharge to take place upwards—that is, from the earth towards the cloud. I will not venture so far as to say whether or not the direction of the discharge is discernible; possibly the flash may sometimes be long enough to enable one to tell; but I have never so seen it, and have always looked upon the eye as a deceitful member —very. "The lightning flash itself never lasts more than $\frac{1}{100000}$ of a second." It is, however, just as likely that a discharge may travel upwards as downwards. What controls the discharge? Does the quality of the charge?—that is to say, is the positive or the negative more prone to break disruptively through the insulating medium? Investigations with Geissler's and other tubes containing highly rarefied gases have made it tolerably clear that there is a greater "tearing away" influence at the negative than at the positive pole, and if two equal balls, containing one a positive and the other a negative charge, be equally heated, the negative is more readily dissipated than the positive. But, so far as we at present know, this question enters into the discussion scarcely, if at all. Our knowledge seems rather to point to the substances upon which the charges are collected. The self-repellent nature of electricity compels it to manifest itself at the more prominent parts of the surface, the level being forsaken for the point. The tension of the charge, or its tendency to fly-off, is proportionately increased. And if at a given moment the tension attains a certain intensity, the discharge follows, emanating from the surface which offers the greatest facilities for escape. The earth is generally flatter than the cloud, whence, in all probability, the discharge more frequently originates with the cloud.

Should a lightning flash strike the earth and produce direct neutrality, it is possible that no damage will result, although this again is not always certain, because when the cloud-charge acts inductively upon the earth it produces the opposite (say negative) charge on the nearer parts, the similar (or positive) state is also produced at some place more or less distant. Sometimes this "freed" positive (which, by the way, accumulates gradually and physiologically imperceptibly) is collected at some portion of the earth's surface. When the negative is neutralised by the discharge, the freed positive is no longer confined to a particular region, but tends to dissipate itself, and a shock may be felt more or less severely by any person within the region. Or, again, a similar shock may be experienced by a person standing within the negative zone on the neutralisation of the charge.

I may take the opportunity here to mention a highly interesting and instructive incident observed on local telegraph circuits during a thunderstorm. The storm may be taking place at some distance from the point of observation. The electrified cloud induces the opposite charge beneath it, the similar charge being repelled. It is noticeable that the needle of a galvanometer, starting from the middle position, goes gradually over to one side, eventually indicating a considerable deflection. Suddenly, owing apparently to a lightning discharge some distance away, the force which caused the deflection is withdrawn, and the needle rebounds with great violence to the opposite side. In a short time, the cloud becoming again charged on its under surface, and recommencing its inductive effect upon the subjacent earth, the needle starts again, and goes through the same series of movements, a violent counterthrow following every flash of lightning.

If we can so far control our imagination, we may conceive the earth to be one large insulated conductor, susceptible to every influence around it. If, then, the earth, as a mass of matter, behaves as above indicated, there is no plausible reason for declining to regard any other large conducting mass in a similar light, and, as a body capable of being subjected more or less completely to the various impulses affecting the earth. In other words, a large mass of conducting material, partially or perfectly insulated is, during a thunderstorm, in considerable danger. With this portion of the subject I shall, however, deal more fully when discussing the merits of lightning protectors.

Lightning discharges do not take place between cloud and earth only, but also, and perhaps more frequently, between two oppositely-charged clouds. We then get atmospheric lightning, the flash often extending for miles. This form of lightning is harmless, and in all probability what we see is only a reflection of the discharge. The oft-told tale of the lightning flying in at the window, across the room, and out of the door, or up the chimney, is all moonshine, and before dealing with lightning-protectors I intend to expose some of the fallacies concerning lightning. Were the discharge to pass through a house it would infallibly leave more decided traces and do more damage than simply scaring a superstitious old lady now and again. Many people are often and unnecessarily frightened during a thunder-storm, but it may be safely predicted that a person under a roof is infinitely safer than one who is standing alone on level ground, and making himself a prominence inviting a discharge. Rain almost invariably accompanies the discharge, and the roof and sides of the house being wet, they form a more or less perfect channel of escape should a flash strike the building.

* We may speak of two electricities or two electric states without necessarily implying adherence either to the single or the double "fluid" theory. Whether electricity be of two kinds or no, the fact remains that there are two conditions, and all the features of this paper may be explained with equal facility by the supporters of either hypothesis.

Glass-making in Italy.—Colle de Val d' Elsa contains one of the most important glass-works in Italy. The value of the annual production amounts to 2,500,000 lire; its sale extends over all Italy, but more especially in the Roman, Tuscan, and Piedmontese provinces

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

(Continued from page 109.)

CHAPTER I.—THE DAILY MOTION OF THE SUN.

THE first impression which the aspect of the earth and sky gives to the observer is that the earth is a vast plain over which the sky extends in the form of a dome. I propose in the present chapter to consider the lessons which may be learned from the most easily recognised of all the forms of motion which this dome presents to our contemplation.

Each day we see the sun rise towards the east, pass to the highest point of his path in the south, and then set towards the west.*

Now the diurnal motion of the sun is far more instructive than is commonly thought. To say merely that the sun rises towards the east and sets towards the west, is to mention nothing which can teach the real significance of the motion. For we might see an object apparently rise towards the east, culminate in the south, and then set in the west, while the real character of its motion was totally different from the sun's, and due to causes of another sort. It is the rate of the sun's motion and the figure of his apparent path which are so instructive. I will describe some simple observations which will show this.

Here in England, when the sun rises nearly in the east and sets nearly in the west—in other words, in spring and autumn—he attains in the south a height of about $38\frac{1}{2}$ deg. Suppose, then, that we fix a rod in such a position that it will be square to a plane passing through the east and west point, and also through the highest point of the sun's path. In other words, let it have the position indicated in the figure, where N S represents the north and south line, E W the east and west line, O L (Fig. 1) the direction of the sun at noon, in spring or autumn, and O P the rod, which points towards the north, but is inclined

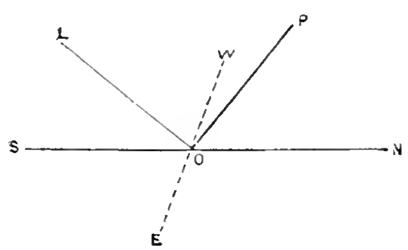


Fig. 1.

$51\frac{1}{2}$ deg. to the horizon ($51\frac{1}{2}$ being the angle, which with $38\frac{1}{2}$ deg. makes up a right angle).

Now to the rod O P let the observer attach a cross-wire L K N at right angles to the rod, and another cross wire, K M, at right angles both to the rod and to L N; and let L K, K M, and K N be made equal. Then bend a strip of card or paper into a semicircular shape, and attach it, as shown in the figure, to the ends of the wire.

Set the rod in the sunlight in the position shown in Fig. 2, and so that the wire L K N may point east and west; no great exactness is required in this last respect.

Now at any hour observe where the shadow of O P falls on the strip of paper, as at R, and put a pencil-mark there. Half an hour later repeat the observation, and set another mark where the shadow now falls. Do this from half-hour to half-hour, or at shorter or longer intervals, as may be most convenient, only the successive intervals must be all equal, and carefully timed. Finally, remove the strip of paper, straighten it, and measure the spaces between successive marks. These will be found exactly equal.

Fig. 2.

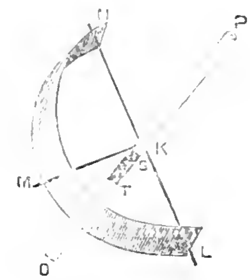


Fig. 3.

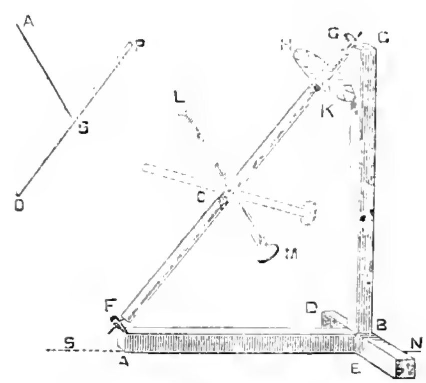
In describing this experiment I have for convenience spoken of a day in spring or autumn; because this gave the readiest way of showing how the position of O P was to be determined. But this position once fixed (in other words O P set up in such a way as to point towards the north at an angle of $51\frac{1}{2}$ deg.) the same experiment can be tried on any day of the year with precisely the same result.

We have now learned an important truth about the rate of the sun's motion; we know that if a plane were taken always through O P and the sun, this plane would revolve uniformly on O P as an axis. But we want to know further what the shape of the curve traversed by the sun may be. This is easily accomplished by the same simple instrument. We have only to turn the rod O P on its axis, keeping its direction unchanged, until the circular strip has its centre towards the south, as shown in Fig. 3.

Then note where the shadow of the strip falls on the rod, as at S T; *it will be found that the position of the shadow remains unchanged throughout the day.*

Now, what does this result teach us? The following illustration will show:—

Suppose we attach to O P (Fig. 4) a straight rod A S, in



Figs. 4 and 5.

such a position that the point S coincides with the shadow of the upper rim of the paper strip, while S A just touches that rim. (The strip is removed from the figure for the sake of distinctness.) Then, since the sun's rays towards O P, crossing the top of the paper strip, fall at S, we can, by merely turning O P round on its axis without changing its position, make S A point exactly at the sun. And as

* I say towards the east and towards the west, for, as a rule, the sun does not rise exactly in the east nor set exactly in the west, and it is worth noticing in passing that in no place has the sun, since the world began, ever risen exactly in the east and set exactly in the west on one and the same day.

this is true at any part of the day, we can make S A follow the sun by simply turning O P *uniformly* (remembering what we have already learned about the rate of the sun's motion) on its axis.

Here, then, we have the simplest conceivable account of the sun's diurnal motion, we have a fixed axis O P pointing towards the north and inclined at an angle of 51½ degs. to the horizon. We have a straight rod S A, projecting from O P at a fixed angle determined for each day, by experiment; and by merely rotating O P uniformly on its axis, we can make S A point towards the sun all through the day.

We can now combine what we have learned in an instructive instrument which any handy person can construct with the utmost ease, and which will afford the most satisfactory information concerning the sun's daily motion.

A B, B C, Fig. 5, are two rods forming a right angle, and of such length that a line from C to A may be inclined 51½ deg. to A B. D E is a cross-rod for supporting A B C in an upright position. F G is a rod revolving easily in the pivot-holes at F and G. H K is a circle of card or other material, marked round its circumference with degree divisions. L M is a rod turning round on a pivot at O (the dotted figure shows the nature of its motion,) and bearing a small card circle M.

The instrument must be set upright, A B pointing due north and south, as shown. Then turn the rod F G on its axis, until L M can be made to point to the sun. It will be easy to know when this is the case by observing that when L M is pointing directly towards the sun, there will be no shadow of L M on the paper circle M. (The pivot on which L M turns should be so placed as to keep L M an inch or so from G F, and should also be perceptibly smaller in diameter than L M. When this is attended to it is easy to direct L M towards the sun by observing its shadow, and *making* this shadow disappear.)

The instrument is now ready for use. We note the division on the card H K which falls opposite the mark at K on the rod B C. Half-an-hour later, say, we inspect the instrument, and we find that L M now throws a shadow on the card M. We turn F G round on its axis until this shadow disappears. We find that this happens without our having occasion to shift L M, and we notice also that the card circle H K has to be turned through an angle of 7½ deg. At the end of another half-hour the same motion has to be repeated. And the same happens whatever day of the year it may be.

Now one day's observation of the sun with such an instrument teaches us this first important fact:—If E S P W represents the dome of the heavens, K L N the sun's diurnal path, O P a point towards the north 51½ deg. above the horizon; then every point of K L N is equally distant from P, *for the main axis of our instrument pointed throughout towards P, and the cross-rod, which we made to point to the sun, was inclined throughout at a fixed angle with that main axis.*

If, then, the sun's apparent motion were due to a real motion of his in a circle, that circle must have the inclined position K L M.

Again we have learned that the diurnal motion of the sun is either really uniform, or is apparent and due to some uniform motion of our earth's.

Again we have learned that our earth is not an infinitely wide plane, but that the sun rises from beyond the earth's limits on the east, and sets beyond the earth's limits on the west. For having found that our instrument follows the sun from the time of his rising fairly above the horizon, all through the day, until he approaches the horizon again in the west—by merely giving a certain uniform rotation to the axis F G, we are justified in assuming that there is no break in the continuity of this motion at sunset, but that by turning the axis round *after* the sun has disappeared, at the same rate at which we have moved it during the day, it will still point to his place. Now, doing this, we find the rod L M pointing below the horizon after

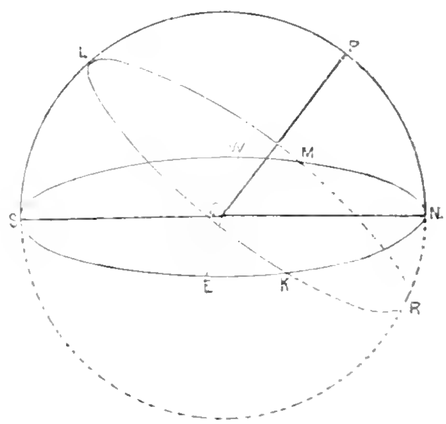


Fig. 6.

sunset. Further, by continuing the motion we find the rod L M pointing lower and lower until near midnight, when it is directed due north, and downwards, as towards R, in Fig. 6; then gradually it rises towards the east, and when it again becomes horizontal we find it pointing directly towards the rising sun.

(*To be continued.*)

THE ENTOMOLOGY OF A POND.

(*Continued.*)

By E. A. Butler.

LEAVING now the middle depths, which have detained us so long, and continuing our descent, we reach the

Bottom of the Pond.

The bottom of a pond can hardly be considered a particularly attractive abode, at least so far as appearances are concerned, and if one remembers its usual composition it will appear even less desirable as a home. Here is collected a fine mud, composed of the remains of all sorts of rubbish that is continually being rained down from the watery heights above. It is, as it were, the dust-bin, the cesspool, and the cemetery of the pond. Dust blown in from time to time by high winds, fragments of plants broken from aquatic vegetation, dead leaves and bits of stick fallen from the trees on the banks, the excrement of the insect and other inhabitants, together with fragments left from their repasts, empty shells of all sorts of water-snails, cast skins of larvæ, the dead bodies of the multitudinous aquatic population (and the mortality in a thickly populated pond must be considerable) together with those of worms and other terrestrial creatures that have had the misfortune to fall in and be drowned—these are some of the materials that, besides the mere earthy matter, help to form the ever-increasing mud at the bottom. There are, however, multitudes of minute creatures constantly at work on this refuse matter, dividing it up, and transforming the dead and effete materials into the living tissues of their own bodies, and thereby reducing the ultimate waste substance to a much smaller bulk, and rendering it innocuous to a degree that might at first seem impossible. Half buried in this mud, or slowly crawling over its surface, are the lurking monsters of entomological pond life, the majority of which belong to two orders we have hitherto scarcely noticed, the Neuroptera and Trichoptera, the former containing the dragon flies, and the latter the caddis flies. We will, however, first consider certain bugs which haunt these parts.

They are known as water scorpions, and two species inhabit this country, one commonly found in almost every pond, the other of much less frequent occurrence. They have, of course, no connection with the true scorpions, which are not insects at all, but eight-legged creatures belonging to the class containing spiders and mites. The water scorpions, too, unlike their terrestrial namesakes, are not venomous. The first, and much the less common, is

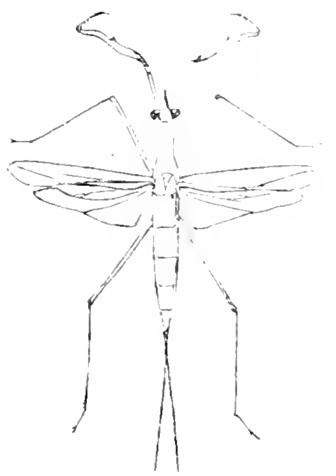


Fig. 1.—Ranatra linearis (reduced).

a long, narrow insect, called *Ranatra linearis* (Fig. 1). On account of its habit of frequently lurking in an inclined position amongst the water weeds, often only a little below the surface, this creature belongs less to the fauna of the bottom than its common relative. Still, they are best treated of together. It is of a brownish colour, except the upper surface of the abdomen, which is scarlet, but this is concealed when the insect is in the water, being made apparent only when the wings are expanded, and then it is quite astonishing to see what a beautiful creature the apparently uninteresting object becomes. The head is small, but the eyes exceedingly prominent, as is often the case with aquatic insects, and the beak short and sharp, not bent underneath, but projecting in front like an extremely acute nose. Both thorax and abdomen are elongated to an enormous extent; indeed, the insect, with a length of an inch and a-half from tip of snout to end of abdomen, has its greatest breadth no more than one-sixth of an inch. The upper pair of wings, while almost as long as the abdomen, are each only about half its width, but the hinder pair are considerably broader, and have to be carefully folded up before they can be stowed away under their narrow covers. These hind wings are beautifully delicate and transparent, similar, indeed, to those of the Corixidæ before referred to. But when we have reached the tip of the abdomen, we have by no means got to the end of the insect; from this point there extend two long bristle-like organs, about an inch in length, which project straight behind like a stiff tail; they are tubular, and communicate at their base with the tracheal system, and are, of course, respiratory in function. The legs are long and slender; the first pair are not used for progression, but for seizing prey, and it is these in front, and the respiratory filaments behind, that give the creature whatever resemblance it may have to a scorpion, although the similarity to that venomous animal is not nearly so exact as in the other species to be considered presently. The front legs are most remarkable objects, and will well repay a careful study. To understand clearly their peculiarities, we must first refer to the general plan of an insect's leg (Fig. 2).

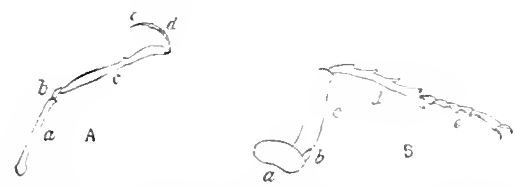


Fig. 2.—(A) Fore-leg of Ranatra; (B) Leg of Stag-beetle. *a*. Coxa; *b*. Trochanter; *c*. Femur; *d*. Tibia; *e*. Tarsus.

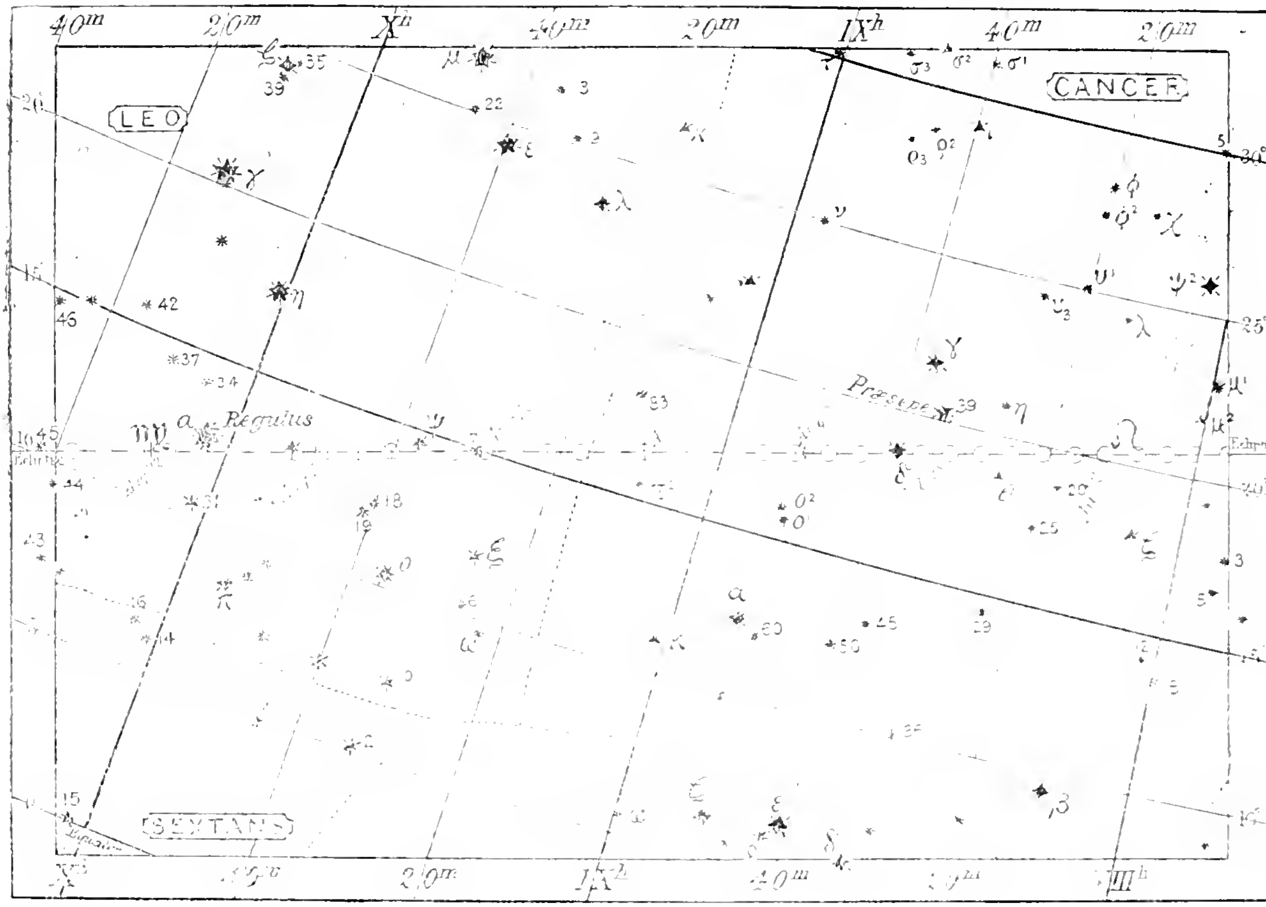
There is first a joint, usually comparatively small, and more or less globular, called the *coxa*, by which the leg is articulated to the body, and which is usually invisible from above. Succeeding this is a small triangular joint, called the *trochanter*, squeezed in, as it were, between the coxa and the next joint, and looking as if added, as an afterthought, to fill up a gap. Then follows, attached to the side of the trochanter, the first long piece of the leg, the thigh, or *femur*, then another long piece, the shank, or *tibia*, and lastly the *tarsus*, or foot, which is composed of from two to five joints, and usually terminated by a pair of claws.

Now let us take one of Ranatra's fore-legs and compare it with this plan. First we find a long joint, which extends far beyond the head, but still. from its being that which articulates the leg to the thorax, we know it must be the coxa, though it protrudes so far that we may easily at first mistake it for the thigh. Then there is the trochanter, a little larger and more conspicuous than usual, and this is succeeded by a long piece slightly curved at the further end, and with a tooth a little beyond the middle; this, of course, is the femur. After this there is a short, sickle-shaped part, less than half the length of the femur, and looking like a great claw; it is able to be folded back upon the inner edge of the femur, along which a narrow groove, serrated at the edges, is excavated to receive it, and then its tip just reaches the above-named tooth. This sickle-shaped part consists of both tibia and tarsus, the latter of which is very small and has no claws. It will thus appear that the leg proper is, as it were, spliced on to the end of a long handle, the elongated coxa, an arrangement the effect of which is to give the limb much greater freedom of motion and a much wider sweep, and thus to enable it to levy tribute over a much more extended area. So peculiar is the plan of these limbs that it is no wonder that many persons have been puzzled to understand them.

We must leave the habits of Ranatra for consideration in the next paper.

(*To be continued.*)

The French Electrical Power Storage Company.—Vice-Chancellor Bacon made an order on Saturday week for the winding-up of this Company on the petition of the Faure Electric Accumulator Company. It was stated in court that the proceeding was rendered necessary by the frauds of M. Phillippart, whose name has been so intimately associated with electric lighting and accumulators.



Day Sign for the Month.

ZODIACAL MAPS.

By Richard A. Proctor.

WE give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p. 118.*)

"BUT pray," said she, "how can the earth with all its weight, be borne up by your celestial matter, which must be very light, because it is so fluid?"

"It does not argue," said I, "that what is most fluid is most light: for what think you of the great ship I mentioned just now, which with all its burden is yet lighter than the water it floats on?"

"I will have nothing to do with that great ship," said she, with some warmth, "and I begin to apprehend myself in some danger on such a whirligig as you have made of the earth."

"There is no danger," replied I; "but, madam, if you are afraid, we will have the earth supported by four elephants, as the Indians believe it."

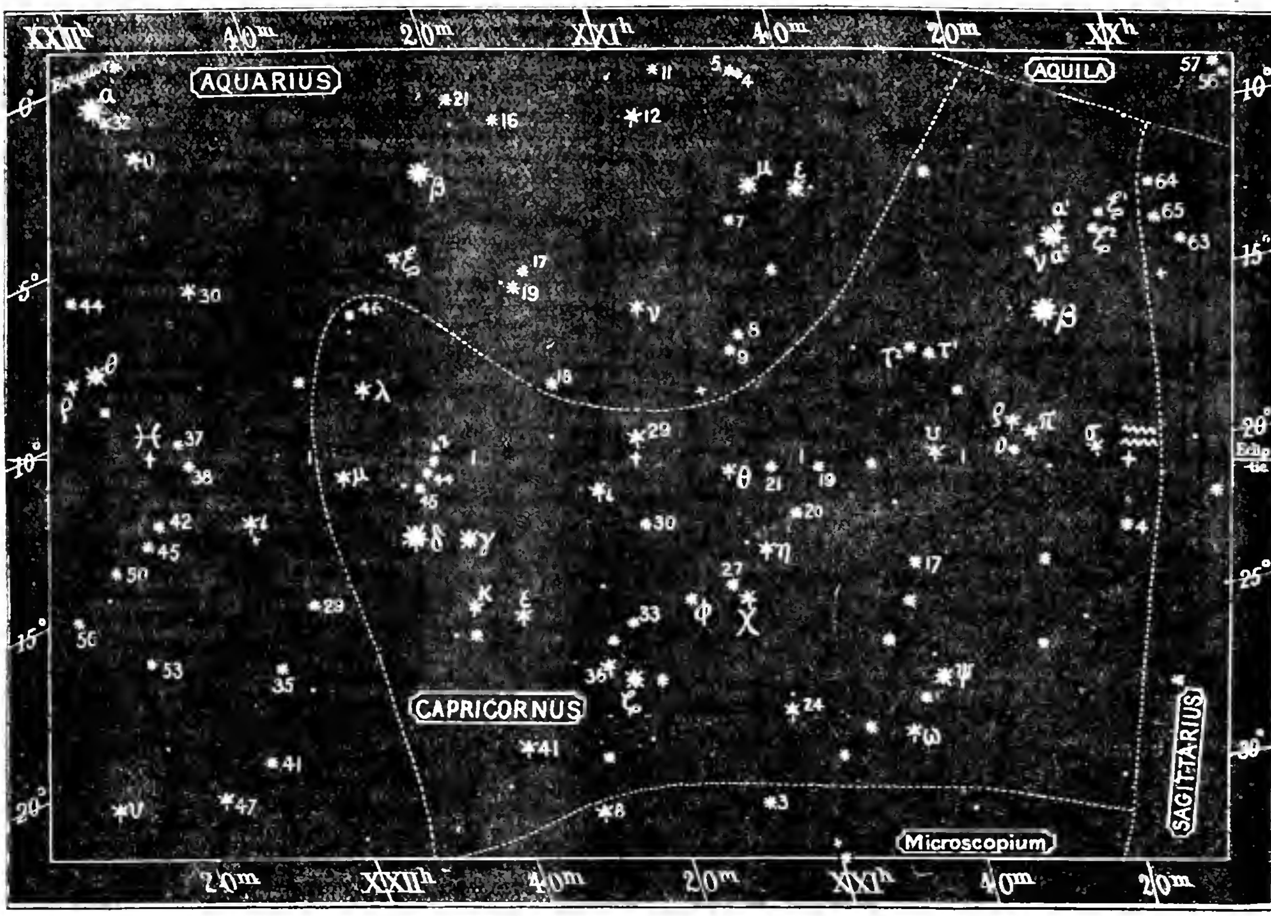
"Hey-day," cry'd she, "here's another system; however, I love those people for taking care of themselves; they have a good foundation to trust to, while you Copernicans are a little too venturous with the celestial matter: and yet I fancy, if the Indians thought the earth in the least danger of sinking, they would double their number of elephants."

"They would do well," said I, laughing at her fancy, "who would sleep in fear? and if you have occasion for 'em to-night, we will put as many as you please in our system; we can take 'em away again by degrees, as you grow better confirm'd."

"I do not think 'em very necessary," said she; "I have courage enough to turn."

"You shall turn with pleasure, madam," said I, "and shall find delightful ideas in this system: For example, sometimes I fancy myself suspended in the air, without any motion, while the earth turns round me in twenty-four hours; I see I know not how many different faces pass under me, some white, some black, and some tawny; sometimes I see hats, and sometimes turbans; now heads with hair, and then shav'd heads; here I see cities with steeples, others with spires and crescents, others with towers of porcelain, and anon great countreys with nothing but cottages: here I see vast oceans, and there most horrible deserts: In short, I discover the infinite variety which is upon the surface of the earth."

"I confess," said she, "twenty-four hours would thus be



Night Sign for e Month

very well bestow'd, so we were in the same place where we are now: I do not mean in the Park; but we will suppose ourselves in the air, other people continually passing by, who take up our place, and at the end of twenty-four hours we return to it again."

"Copernicus himself," said I, "could not have comprehended it better. First, then, we see some of our neighbours passing by us, up to the ears in politics, yet settling their nation no better than we do the world in the moon; then follows a great sea, perhaps a fleet of ships, perhaps a mackrel-boat, no matter whether; then come some of the Iroquois going to eat a prisoner for their breakfast, who seems as little concerned as his devourers; after, appear the women of the land of Jesse, who 'spend all their time in dressing their husband's dinners and suppers, and painting their lips and eyebrows blue, only to please the greatest brutes in the world; then the fair Circassians, who give all their love to the first comer, except a little they reserve for their husbands; then the Tartars going to steal concubines for the Turks and Persians; and at last our own dear countrymen, it may be in some points as ridiculous as the best of 'em."

"It is very pleasant," said the Marchioness "but to imagine what you tell me; tho' if I were above, and saw all this, I would have the liberty to hasten or retard the motion of the earth, according as the objects pleas'd me more or less; and I assure you I should quickly send packing the politicians and man-eaters, but should have a great curiosity for the fair Circassians, for methinks they have a custom very particular. But I have a difficulty to clear, and you must be serious. As the earth moves, the air changes every moment, so we breathe the air of another country."

"Not at all," replied I, "for the air which encompasses the earth does not extend above a certain height, perhaps twenty leagues; it follows us, and turns with us. Have you not seen the work of a silkworm, the shells in which those little animals imprison themselves, and weave with so much art? they are made of a silk very close, but are covered with a down very slack and soft: so the earth, which is solid, is covered from the surface twenty leagues upwards with a kind of down, which is the air, and like the shell of the silkworm turns at the same time. Beyond the air is the celestial matter, incomparably more pure and subtle, and much more agitated than the air."

"Your comparison," said she, "is somewhat mean, and yet what wonders are wrought, what wars, what changes in this little shell."

"'Tis true," I replied, "but nature takes no notice of such little particular motions, but drives us along with the general motion as if she were at bowls."

"Methinks," said she, "'tis very ridiculous to be upon a thing that turns, and yet not be well assured that it does turn; and to tell you the truth, I begin to distrust the reasons you give why we should not be sensible of the motion of the earth; for is it possible there should not some little mark be left by which we might perceive it?"

"All motions," said I, "the more common and natural they are, are the less perceptible: and this holds true even in morality. The motion of self-love is so natural to us, that for the most part we are not sensible of it, and we believe we act by other principles."

"You are moralising," said she, "to a question of natural philosophy: But 'tis enough for the first time; let us now go home, and meet here again to-morrow, you with your systems, and I with my ignorance."

In returning to the Castle, that I might say all I could on the subject, I told her of a third system, invented by Tycho Brahé, who had fixed the earth in the centre of the world, turned the sun round the earth, and the rest of the planets round the sun: for since the new discoveries, there was no way left to have the planets turn round the earth. But the Marchioness, who had a quick apprehension, said, she thought it was too affected, among so many great bodies, to exempt the earth only from turning round the sun; that it was improper to make the sun turn round the earth, when all the planets turn round the sun: and that tho' this system was to prove the immobility of the earth, yet she thought it very improbable. So we resolv'd to stick to Copernicus, whose opinion we thought most uniform, probable, and diverting. In short, the simplicity of his system convinces us, and the boldness of it surprises with pleasure.

(To be continued.)

REMARKABLE STORMS IN BELGIUM.

A NUMBER of very remarkable storms occurred in Belgium in July, 1884, and the following account is taken from reports made to the Observatory at Brussels. On the 4th, at Lamorteau, near Virton, from 2h. 34m. to 5h. 22m. p.m., there was a storm wind, and during eighteen minutes a great fall of hail, making the fields look as if thickly covered with snow. The hailstones were at first the size of nuts, and then of large peas. At Thirimont, near Beaumont, on the 5th, the hail was the largest ever known there. The stones had sharp angles, and did great damage to crops. The storm did not extend beyond a radius of 1,500 mètres. On the 13th, at Bruges, during a severe storm, the sky looked as if instead of clouds there were vast eddies of smoke from a huge fire, reflecting flames. The movements of the lower clouds increased in rapidity, the wind rose to a hurricane, and snapped great branches off the trees. Transparent hailstones fell for five or six minutes, the size of small nuts. At Maldegem, east of Bruges, almost at the same time, there was a deluge of rain mingled with pieces of ice from 25 to 40 millimètres in diameter (1 inch to 1½). They were round, lenticular, and angular, striking the ground with extraordinary force. A waterspout passed within 3,000 mètres, destroying hundreds of trees. At Ostend, on the same day, some hailstones were as big as pigeons' eggs and some as big as fowls' eggs. One of these, when cut in the direction of its longest diameter, exhibited a nucleus, surrounded with successive layers, alternately transparent and opaque. The surface was very irregular, with clear protuberances. At Haesrode, near Louvain, at 2.30, on the 13th, a small white cloud appeared and suddenly discharged hailstones as big as eggs, one weighing over 8 oz. They varied in shape—oval, hemispherical, triangular, and some spinous, like a prickly pear. This storm only lasted three or four minutes, and only extended over the small space of from half a mètre to a mètre! At Hechtil (Limbourg), on the same date, hailstones fell over 3 inches in diameter.

During the storm of July 13, Baron van Ertborn, at Aartselear, near Antwerp, examined with a telescope a large cloud 50 deg. above the horizon, and saw that it was formed of seven superposed layers, the lower ones eddying and moving quickest. Curved flashes of lightning darted from one layer to another. On July 17, near Arlon, pieces of ice fell 3 to 3½ inches in diameter, breaking glass, killing poultry, and cutting fruit-trees. Storms of this kind are said to be very rare in Belgium. S.

THE INTERNATIONAL HEALTH EXHIBITION.

XII.—WATER AND WATER-SUPPLIES—*(continued)*.

THE description of Mr. Roberts's "Rain-Water Separator," given in our last communication, is an apt introduction to the subject of water-purifying appliances, which we now propose to deal with. In the "East Central Gallery B," may be seen, in active operation, all the forms of apparatus that are of any value in the present enlightened day, when Darwin's great law of the "survival of the fittest" holds its sway more powerfully than ever. The plan we have chosen to adopt in our remarks upon the inventions here displayed, is to place before our readers a descriptive account of the *types* that have been resorted to in gaining certain desired ends, rather than a serial discourse upon the relative merits of the various patents. In illustration of these principles, we shall select the most suitable examples at our disposal, so that our series of reviews shall embody a digest of the highest possible value for those who wish to exercise their own discretion in the choice of what we deem to be one of the most essential requisites in every household—a good filter.

Type I.—As a natural sequence of the rain-water separator, which is adapted to procure a supply of good soft water suitable for all domestic purposes, save drinking,* we would draw attention here to "Stall 420," and the "Grant Revolving Ball Water Filter," the value of which lies in the fact that a tolerably pure water, such as that derived from a Roberts Separator, or delivered to town and suburban dwellings by water companies, may be rendered fit for drinking in an incredibly short space of time. It is, without doubt, the best rapid water filter for the above-mentioned sources of supply; it can be fastened on to any existing water-pipe with the utmost ease; may be as readily cleansed and re-charged with the filtering medium; and, when "turned on full," there is but a slight, almost inappreciable, diminution in the rapidity of flow from the tap. We can safely recommend this filter to the notice of those who desire to have an unlimited supply of good, pure water always readily available, more especially in the kitchen; and to convince our readers of its practical utility, we cannot do better than give an outline of its general anatomy. So far as we are aware, this type of filter stands alone—it has not yet been copied; in one particular, however, it may be placed amongst the so-called high-pressure filters.

The "Grant Revolving Ball Water Filter" consists of a spherical metallic case, the smallest manufactured size of which, for domestic purposes, is about 2 inches in diameter, and under pressure from the tap diminishes the ordinary rate of delivery by about only 20 per cent. Within the case there is a hollow metal ball, designed to hold the filtering medium (granular animal charcoal), and every drop of water which passes into the mechanism is forced

* In making this proviso, we desire it to be understood that, in most cases, the rain-water obtained through the use of the Roberts "Separator," may be also used for drinking; but it is well to purify it still further by efficient filtration, so as to render the result doubly secure.

to percolate through the filter. This is secured by a washer, which forms a tight joint around the ball. The water may be permitted to pass through unfiltered along the passage B B, Fig. 21; but when the packed handle C is revolved so as to bring the filter into operation, the water

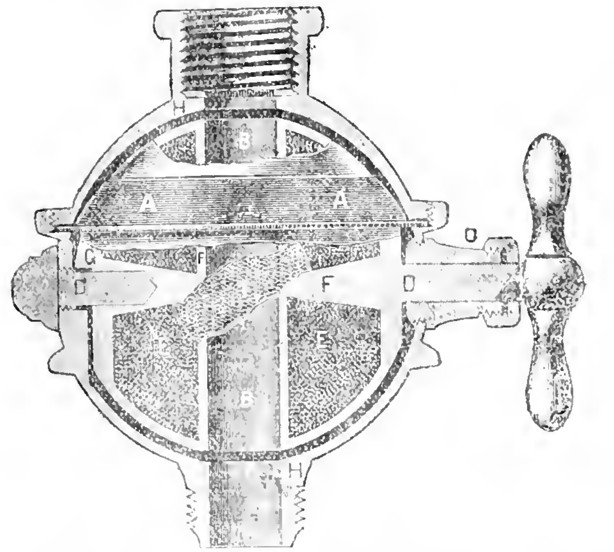


Fig. 21.—Sectional view of "*The Grant Revolving Ball Filter.*" A A, patent cup and joint washer, packed by pressure of water; B B, direct way for water through ball *without filtering*; C, packed handle to revolve ball; D D, bearings upon which ball revolves; E E, animal bone, charcoal, or filtering medium: F F, bars inside of ball upon which the water strikes when filtering, preventing drilling of charcoal; H H, shell containing ball; I, section of wire screen or sieve which holds charcoal into the ball, and through which water passes when filtering.

strikes upon the bars FF, thus breaking its initial force, and causing it to spread over the whole body, whence it finds its way through the charcoal with an equalised pressure, thereby securing perfect filtration with a minimal disturbance. The matters which accumulate in the filter may be removed by a simple revolution of the ball, and the entire system thus cleansed in a few seconds. An objection to this method of cleansing is, that it is at most only approximately effective, but that is all that is really necessary in a filter of this kind; and, moreover, should the objector be unusually fastidious, he may, at the worst, remove the charcoal, wash it thoroughly, and return it to its receptacle, or supply its place with a fresh charge, which is easily done at but a nominal expense. The entire apparatus is inexpensive, portable, almost indestructible, effective, and even elegant; it speaks very highly for the ingenuity of its transatlantic inventor. The carbon recommended for use is in a sufficiently fine state of division to act as a thorough mechanical strainer; it also acts chemically, if we are to judge from analyses of the filtrate.

TYPE II.—Although we strongly object to the old-fashioned "block" principle in filters, we are constrained to admit that there are some of them which it would be unjust to leave unnoticed, since they achieve results which place them amongst the best of modern inventions. Of these, "Doulton's Manganous Carbon Filters" deserve a special notice; they may be seen and tested in the western annexe of their Pavilion in the "Central Gallery."

Before we proceed to describe the action of these filters, we desire to draw attention to one of the most important features in the construction of filter-cases which is strikingly exemplified in Messrs. Doulton's patent. These are the only filters extant where anything of the kind has been adopted. Fig. 22 will help us to explain more clearly than any written description alone, how every drop of filtered water becomes available, and is prevented from getting stale by the gentle slope of the floor of the reservoir to the tap, which is situated below the level of that floor. In most filters this item is generally overlooked, with the consequence that the lowest stratum of water may lie unused within the reservoir of the filter sufficiently long to become either mawkish or positively harmful through the accidental introduction of aërial germs, which usually gravitate to the bottom of the water. To this class belong certain forms of the minuter *Algæ* and *Rotifera*, not to speak of *Bacteria*, which in their totality may, and almost always do, produce, in about ten or twelve days, an undesirable adherent slimy layer at the bottom and lower sides of the reservoir.

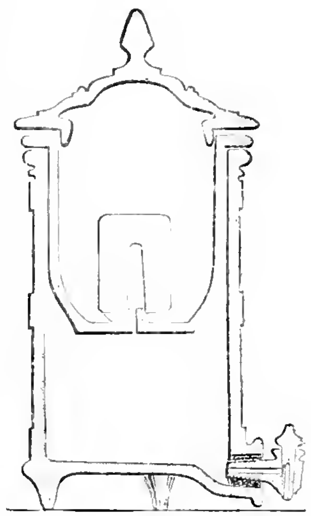


Fig. 22.

This state of affairs may be observed in the form of filter-case shown at Fig. 23, where the position of the tap necessitates a constant remnant of unusable water, which has therefore to be cleansed out periodically. As the majority of filters now in use are all modelled upon the type of Fig. 23, we would here offer our practical advice to such of our readers as may possess filters of this sort, which is:—To be careful to thoroughly wash out the reservoir at least once a week; this will be sufficient to insure them against the possible sources of contamination to which we have alluded.

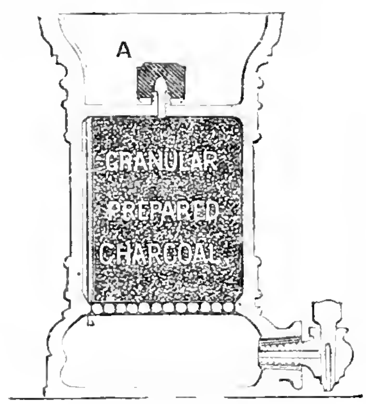


Fig. 23.

Another praiseworthy fact about Doulton's filters is that their taps are made of stoneware, and hence are not liable to the inevitable corrosion, to which metal taps are subject, which, if not positively dangerous, are at least objectionable on the score of cleanliness.

We would, of course, expect to find elegantly-shaped and beautifully-decorated filters at Messrs. Doulton's, nor are we doomed to disappointment. Apart from strict utility there is an indescribable charm about an artistically finished production, such as that represented at Fig. 24, which raises it above the commonplace, to rank amongst the things that are to be desired.

Fig. 24.

THE GREELY EXPEDITION.

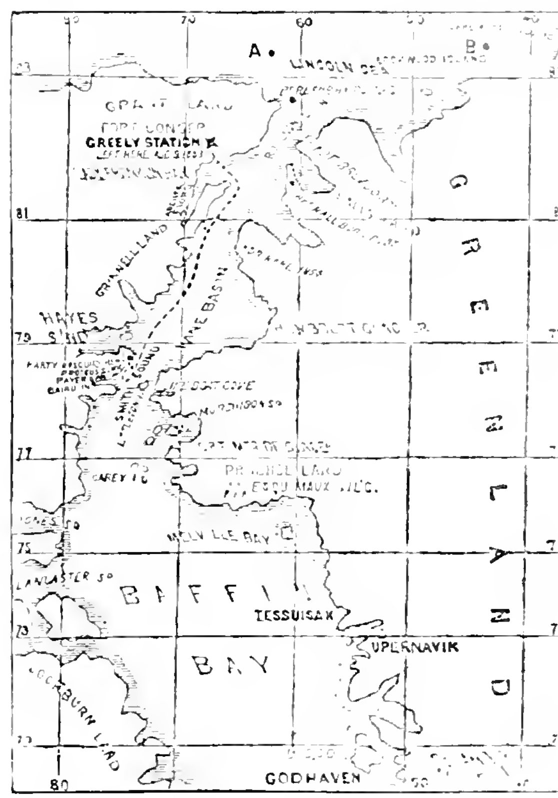
IT was August 18, 1881, that the officers and crew of the *Proteus* bade good-bye to Lieutenant Greely and his little band, twenty-five in all, leaving them in camp, as an advance guard of explorers, in a high northern latitude. The exploration in which they were engaged was not one for the advancement of material aims or the ambition of governments to enlarge their dominions—it was one solely in the interest of science, to widen the domain of knowledge, and help us to better know the laws which affect the conditions of life and growth on this planet, as well as to throw light, if possible, on that great field of research, so largely speculative, in which we are seeking to find out something of the universe. It was not until June 22, 1884, a little more than two years and ten months after the party had been left on the shores of Lady Franklin Bay, that seven of them, the only living members of the original band, were relieved of their long vigil by the appearance of the vessels of the government expedition under Commander Schley. Seventeen of the others had died of starvation, one was drowned while sealing to obtain food, and of those found alive one died subsequently from the amputation of limbs made necessary by frost bite, so that only six of the original twenty-five remained alive to reach home again.

The story of the expedition, the plans of the scientific bodies and Arctic explorers which led up to it—in connection with several other observation posts around the pole—as well as the futile efforts of 1882 and 1883 to reach and relieve the colony at Lady Franklin Bay, have often been told. It was the understanding when the station was established—subject to the discretion of Lieutenant Greely, as circumstances might affect the situation—that if government relief did not reach the station during the summer of 1882, the party would endeavour to work its way southward in the summer of 1883 as far as Cape Sabine, or make its quarters on the west coast as far south as might be practicable, and yet within the possibility of being reached by a relief expedition, but that the route would be on or along the west coast, and not on the Greenland side. In accordance with this idea Lieutenant Greely abandoned his quarters at Fort Conger, on Lady Franklin Bay, August 9, 1883, and reached Baird Inlet, near Cape Sabine, September 29, with the entire party wel up to that time. Great difficulty was experienced in getting to that point, with the instruments and records of observations, and as large a supply of provisions as it was possible to convey. He was obliged to abandon all his boats, and was adrift for thirty days on the ice in Smith's Sound, the party finally making its way across an almost impassable field of ice hummocks to a landing just north of Cape Sabine, where a permanent camp was established October 21.

Here the party found that a very insufficient supply of provisions had been left, while some of those thus obtained had been left by Sir George Nares as long back as 1875, and were, of course, much damaged. It was known that supplies had been left on Littleton's Island, almost opposite Cape Sabine, on the east side of Smith's Sound; but the channel did not close all the winter on account of violent gales and strong currents, and there was no means of reaching the food that was so near. The party was immediately put on short rations, but on May 14, 1884, the last regular food was issued. After this the men were forced to live on boiled sealskin strips from their sealskin clothing, lichens, and shrimps, game having failed, despite daily hunting, from early in February.

One had died in January, 1884—the first death of the party—then five died in April, four in May, and seven in June, up to the 22nd, when the rescue was made, and when, according to Commander Schley, "forty-eight hours' delay in reaching them would have been fatal to all." Too high praise cannot be accorded to Commander Schley for the energy with which he pushed north so early in the season, fighting his way almost inch by inch through the ice: but it will be remembered with a feeling of sadness, if not of severe reprobation, that three United States vessels, the *Yantic*, the *Proteus*, and the *Neptune*, had visited the near locality of Greely's fatal camping-ground, during the summers of 1882 and 1883, with ample provisions, and came home again without leaving there the supplies that would have prevented these men from starving.

It is too early to say what will be the probable value of the information obtained by this expedition. Up to the fall of 1883 its success seems to have been all that could have been desired by its promoters, and in the journey southward copies were brought of meteorological, tidal, astronomical, magnetic, pendulum, and other observations, although some photographs, Esquimaux relics, and other things were necessarily left behind. It is probable, however, that Lieut. Greely made all the observations required



by the International Conference at Hamburg, under whose directions the various circumpolar stations were established, and that substantially all such records have been saved. The distinguishing work of the expedition—that which will perhaps give it most fame—is thus announced by Lieut. Greely: "For the first time in three centuries England yields the honor of the furthest north," which had previously been 83° 20′, but was marked at 83° 24′ by Lieut. Lockwood, of the Greely expedition, on May 13, 1882. The point of observation was named Lockwood Island, where, "from an elevation of 2,000 feet, they saw no land north or north-west." To the east and north-east of Lady Franklin Bay the party undoubtedly made the best survey yet accomplished of northern Greenland, and, by observation of what seemed to be a distant headland, located it as Cape Robert Lincoln, in latitude 83° 35', longitude 38° west of Greenwich.

At B, in our map, is shown Lockwood Island, the highest northern latitude yet reached, and from whence the observation was made, while A marks the highest point attained by Commander Markham, the most successful British explorer in 1876. In a subsequent endeavour to go still farther north, the party was turned back by open water, and, as Greely's report says, "barely escaped drifting into the Polar Ocean."

There are many other newly-named places, and some material changes will have to be made in the maps of regions hitherto incorrectly laid out, along the west shore of Kane Basin and Kennedy Channel, and in the configuration of Grinnell Land, and the north shores of Grant Land and Greenland. Arctic geography will thus, doubtless, be greatly amended, but whether the results attained will prove sufficient compensation for the loss of life of the brave men who were sacrificed is a query which many people will think most unsatisfactorily answered.—*Scientific American.*

Reviews.

SOME BOOKS ON OUR TABLE.

An Introduction to Mental Philosophy, on the Inductive Method. By J. D. Morell, A.M., LL.D. (London: W. Stewart & Co.) As an introduction to the study of psychology, at once scientific and popular, it would be difficult to find a work better adapted to its avowed purpose than that whose title heads this notice. While omitting nothing essential to a complete theory of the nature and modes of action of the human mind, it is yet commendably free from that redundance of verbiage which unfortunately distinguishes so many works on mental science; though while as succinct as need be, it never degenerates into baldness, or slurs over a difficulty for want of detail in the argument adduced to meet it. Dr. Morell begins *ab initio* with the primordial forms of mental activity, and, proceeding through the nature and development of perception, and subsequently of ideas, traces the logical processes of the human mind from the latter. In subsequent divisions of his work he necessarily deals with human reason, the development of the will, and the feelings generally; concluding with an appendix of very numerous examination papers in mental and moral science set for degrees in the London University. The reader who has been taught to regard everything in the shape of metaphysical or psychological disquisition as essentially dreary will undeceive himself very agreeably by the perusal of Dr. Morell's book; while the student more familiar with mental science may read such chapters as those on belief and on the freedom of the will by no means without profit. The work has one solitary defect, which we trust to see supplied in the next edition—it has no index.

Manual of the Mosses of North America. By Leo Lesquereux and Thos. P. James. (London: Trübner & Co. 1884.)—To every practical bryologist this wonderful specimen of patient and enduring labour of Messrs. Lesquereux and James will be welcome, containing as it does a detailed description of something like nine hundred species of the mosses found on the American continent; in fact, presenting a practically exhaustive account of every one so far known there. It is illustrated with six beautiful plates, crowded with figures, illustrating the genera; and must be indispensable to every one interested in the lowly type of vegetable organisms with which it so ably deals.

How to Foretell the Weather with the Pocket Spectroscope. By F. W. Cory. (London: Chatto & Windus. 1884.)—In or about the year 1872 Professor Piazzi Smyth, the Scottish Astronomer Royal, discovered that when moisture was present in the air a band or shading appeared in the spectrum of the light of the sky, on the less refrangible side of the well-known D, or sodium, lines. The result of a series of observations induced him to believe that the spectroscope might thus be employed as a hygrometer, or, speaking more rigidly, a hygroscope, to foretell the advent of rain; and, impressed with this idea, he published his discovery to the world. The matter was taken up in England by Mr. Rand-Capron and a few others, but very considerable difference of opinion seems to have prevailed as to the value of the method; and, during the autumn of 1882, the columns of the *Times* were the scene of a pretty lively conflict of opinion on this subject. Mr. Cory, however, appears to have given the spectroscope a pretty fair trial as a means of forecasting rain, and claims to have been quite successful in his vaticinations. To all who wish to follow his footsteps, his little book may be commended; as he gives the plainest possible directions for the use of the instrument to predict rain, illustrated in a way which renders his descriptions almost equivalent to personal instruction. The method is worth a trial, at any rate.

Editorial Gossip.

The devotees of the science or art, or whatever it is, of "Philately" may be interested to learn that up to the end of the year 1883 two hundred and three countries, states, &c., and twelve private companies had issued adhesive postage-stamps. Of these, sixty-nine have also issued envelopes, and one hundred and seven, post-cards. Between 1840 and Dec. 31, 1860, 2,400 stamps of sorts were issued. From 1861 to December, 1870, sixty-six new countries were added, and the stamps rose in number to about 6,400, an increase of 4,000 in ten years. In the next decade forty-nine new countries were added to the list, and another 4,000 was added to the number of adhesive stamps. Finally, the number of stamps which, up to Dec. 31, 1880, was about 10,400, had advanced to about 12,000 in the succeeding three years, or at the rate of more than 500 a year; so that if the same rate of progression should continue, by December, 1890, 16,000 varieties of postage-stamp will be in existence. When I read all this in the pages of Messrs. Alfred Smith & Co.'s *Monthly Circular*, I tremble to think of the sorts and sizes of Stamp Albums that it will be incumbent on the collector of five or six years hence to keep. A moderately complete collection will require a perambulator, at the least, for its transport from place to place; while a really full one will scarcely be movable in anything short of a donkey-cart.

I have just obtained what is expressively known as "a wrinkle" from a wholesale price-list of a distiller which has fallen (no matter how) into my hands. That it was never intended to be seen by any mortal eyes outside of "the trade" goes without saying. In this highly-instructive document I find, under the head of "Spirit Flavours," "the attention of consumers in Australia and India" (we needn't say anything about England) "is particularly called to these very useful and excellent flavours. One pound of either of these essences to fifty gallons of plain spirit" (let us suppose potato spirit) "will make immediately a fine brandy or old tom, &c., without the use of a still.—See *Lancet* report." This is followed by a list of prices of these "flavours," and then follows a similar one of "Wine Aromas." A cheerful look-out all this presents, upon my word! The confiding traveller calls at his inn for some old brandy, and they make it in the bar while he is waiting. He orders a pint of claret or port, and straightway he is served with some that has been two and a half minutes in bottle! After the perusal of this price-list, I have come to the conclusion that in the case of no articles of consumption whatever is the motto *Caveat Emptor* more needful to be attended to than in that of (so-called) wines and spirits.

Quem Deus vult perdere dementat prius. Towards the end of last year public attention was prominently directed to a "Dr. Samuel Kinns, F.R.A.S.," who, after proclaiming his crass ignorance of science in a book called "Moses and Geology"—or by some such title—set forth, a blind leader of the blind, to lecture on the Harmony of the Bible with Science and History. He claimed to have the sanction and support of, *inter alios*, members of the staff of the British Museum, but this was promptly denied and repudiated by more than one leading member of that staff themselves. "Dr." Kinns's sciolism and ridiculous blunders were thereupon so thoroughly exposed that I, among the vast majority of English men of science, fondly hoped that we had heard the last of him. Now, to my unbounded surprise, I find it stated in the newspapers that "Lord Shaftesbury, the Bishop of Bath and Wells, the Lord Mayor, Rabbi Ascher, and other influential gentlemen" have sent a preposterous resolution to the press, affirming that "eminent men connected with our highest scientific institutions" have borne "public testimony to the accuracy of Dr. Kinns's work, 'Moses and Geology,'" . . . and so on, and so forth. In the face of this manifesto, I think that *real* scientific men have a distinct right to demand that my Lords Shaftesbury, A. C. Hervey, and R. N. Fowler, together with the Rabbi Ascher and Co., shall furnish the names of those "eminent men connected with our highest scientific institutions" to whom they so vaguely refer. Surely the right honourable and noble Lords and the Reverend Rabbi do not ask the British public to accept *their* dictum on a question of science? I write strongly, because I feel strongly, on this question. Myself a Fellow of the Astronomical Society, I do not even know Dr. Kinns by sight, but I have an abiding conviction that such books and lectures as his do more fatal mischief to religion than all the efforts of Messrs. Aveling and Bradlaugh put together. "Let" says the old proverb, "sleeping dogs lie." Dr. Kinns and his rubbish had practically vanished from public view. If, however, he is to be dragged forward again, and made a pseudo-hero and martyr by such most ill-advised friends as the Mansion House Committee, we may not impossibly hear of a counter series of lectures to his, exposing his ignorance, and laying bare his fallacious results. It strikes me with very considerable force, that orthodoxy will come off decidedly "second-best" in such an encounter, unless it can secure some very much more competent champion than the "F.R.A.S." who thought that the Sun could continue visible, by abnormal refraction, above the *western* horizon, after he had risen in the east!!!

In the current number of the *Asclepiad*, there is a paper (presumably by its Editor, Dr. B. W. Richardson, F.R.S.), on "Euthanasia for the lower creation," in which the author advocates the administration of some anæsthetic, preferably carbonic oxide, to narcotise sheep, lambs, calves, and smaller animals, prior to handing them over to the slaughterer. He does not propose to interfere with the present method of killing oxen, in which I think he shows his wisdom; inasmuch as it seems impossible to conceive any more rapid and effective a means of producing insensibility than the use of a properly-wielded pole-axe.

I am sincerely glad to see that the fine collection of works of art now brought together at St. Helen's is open on Sundays. The suicidal policy which simply leaves the working man his choice between Church and the Beershop must at no very distant date yield to the more rational system of affording him the means of elevating and refining his mind, and so weaning him from gross and sensual pleasures.

Our contemporary, *Society*, writing apropos of the gallantry of the two constables shot by the Hoxton burglar, makes the excellent suggestion that an Order for Civil Courage should be instituted, akin to the Victoria Cross already given for conspicuous personal bravery in the field. It would be a pleasant greeting for Garner and Snell, on their discharge from the hospital, to have such a "C. C." pinned to their breasts.

"Some gorgeous sunlight effects," says the *Standard*, "have been observed over the Yorkshire wolds for several nights past. The sky has been one mass of richly-blended colours, commencing at the horizon with a broad belt of deep yellow light, and then tier above tier of orange and purple, the latter colour predominating in horizontal streaks, whilst the sky above was flooded with a magnificent glow from the setting sun." I wonder whether any of the members of the Krakatoa Committee of the Royal Society have been "kicking up a dust" in the East Riding within the last week or two?

THE FACE OF THE SKY.

From August 15th to August 29th.

By F.R.A.S.

The Sun will, as usual, be examined on every clear day for the spots and faculæ which continue to appear on his disc. The August night sky will be found delineated in Map VIII. of "The Stars in their Seasons." A minimum of Algol ("The Stars in their Seasons," Map I.) will occur at 8h. 12m. p.m. on August 18th. Mercury is an Evening Star, and attains his greatest elongation east of the Sun (27° 16′) at 5 p.m. on the 23rd. Unfortunately at this time he only sets about half an hour after the Sun, so that the chances of detecting him with the naked eye are very small. Venus is a Morning Star throughout the month, and is at her greatest brilliancy on the 17th. About this time she may be picked up perfectly well by the naked eye near the time of her passage over the meridian. This occurs at 9h. 20m. a.m. on the 17th, and something like a couple of minutes sooner on each succeeding morning. At this time she looks, in the telescope, like the Moon when she is about four days old. As far as the remainder of the planets are concerned, the night sky is a blank. As the Moon is new on the night of the 20th, and does not enter her first quarter until 42 minutes past 3 o'clock in the afternoon of the 28th, she will only be visible for the purpose of the ordinary observer during about the last three or four days to which these notes have reference. She will only occult one star in the course of the fortnight, and that at an hour (2h. 24m. a.m.) at which very few whom we address will care to be on the watch for the phenomenon. The Moon is in Taurus all day to-day, and until 2 o'clock to-morrow afternoon, when she will enter the northern part of Orion; which, however, she will quit for Gemini about 1 a.m. on the 17th. She is travelling through Gemini until 8 a.m. on the 18th, at which hour she crosses into Cancer. At 4 o'clock in the early morning of the

20th she enters Leo; passing across which constellation she descends into Sextans at 5 a.m. on the 21st, only, however, to quit it and re-enter Leo at 7 p.m. on the same day. At 8 o'clock the next evening she finally leaves Leo for Virgo, her passage across which occupies until 3 a.m. on the 26th. Then she enters Libra, where she continues until 4 a.m. on the 28th, crossing at that hour the boundary into the narrow northern strip of Scorpio. At 3 o'clock the same afternoon she enters Ophiuchus, and is on the confines of that constellation and Sagittarius when these notes terminate.

Miscellanea.

The Solar Heat.—Mr. Slack writes from Ashdown Forest that on Thursday, August 7, he placed a black bulb vacuum thermometer in an open box on a layer of cotton-wool, and with the bulb resting on black cotton velvet. Exposure to full sunshine between 11 and 1 o'clock caused the mercury to rise to 159° Fahr. The shade temperature a few yards off was 78° Fahr., and the difference between wet and dry bulbs of Mason's hygrometer 9 Fahr. The air was remarkably still.

The National Health Society's Vaccination Pamphlet.—We are pleased to find that this admirable circular, the facts of which have been approved of by the Local Government Board, is being distributed energetically in the metropolis. Some such antidote to the unscrupulous and pernicious literature of anti-vaccination was required, and we trust it will be eagerly accepted by the masses, who require their convictions to be strengthened. We especially note the cordial manner in which the Vaccination Officers' Association has received the circular, looking upon it as they do in the light of strong moral support to them in their duties. Apropos of this subject, we might mention several interesting clinical details which come to us from one of the metropolitan small-pox hospitals. Four children of an anti-vaccinator were attacked with small-pox, three of them being unvaccinated, and one vaccinated after repeated penalties. Two of the unvaccinated died, and the third narrowly escaped with his life, losing an eye in the struggle, whilst the vaccinated child had an exceedingly mild attack, and was out of bed in a very few days. Again, the family of an anti-vaccinator consisted of himself, wife, four children under ten years, and an infant. The wife and infant were the only vaccinated ones, the latter being vaccinated under compulsion, and these escaped small-pox, the other five being admitted to hospital and suffering severely. Lastly, the chairman of a local branch of the Anti-Vaccination Society was lately admitted to hospital and died.—*Medical Press and Circular.*

Scientific Philanthropy.—Mr. Lee J. Vance writes in the *Popular Science Monthly*:—"The conscious aim of scientific philanthropy is in the first place to deal with the struggle of man with nature—is to help men to help themselves; secondly, its aim is to regulate the struggle of man with man—is to help men to understand and adapt themselves to the conditions of existence. It is commonly noticed that the individual who succeeds in his struggle with nature is apt to be successful in the good-natured struggle with his fellow-men. As Darwin proves, the intemperate suffer from a high rate of mortality and the extremely profligate leave few offspring. There is economy in this process of elimination whereby the transmission of the industrial vices is restricted, and in the competition of life the degraded members of society, unable to adapt themselves to the conditions imposed by physical and social environment, succumb before the rest of the population. The scientific idea of benevolence involves, first, the preparation of man to receive intelligently nature's stern discipline—that is, to help him avoid all the evils coming from disobedience of physical agencies, and also to aid him in grasping those great rewards, which, as Huxley says, nature scatters with as lavish a hand as her penalties. The philanthropist will show us that the hereditary vices which the parent establishes for his children and his children's children meet in the long run with certain punishment. If we could believe in the certainty of punishment, says Sir J. Lubbock, temptation, which is at the root of crime, would be cut away, and mankind would become more innocent. The penalties attached to the consumptive, scrofulous, or syphilitic in contracting marriage are sharp and sure—oft-times swift and merciless. Men sin from a mistaken idea of what constitute's to-day's pleasure and to-morrow's pain, and it is not pleasant to be reminded that a great deal of our suffering is due more to ancestral errors than to our own."

The practice of taking tea with a principal meal, or what is called a "meat tea," is not to be commended. Tea does not promote digestion of the food in the stomach, and especially is not adapted to accompany meat, but rather bread and farinaceous articles. "Meat teas," as a daily habit, are more likely to create dyspepsia than not. The proper time for tea is an hour or two after food, or when the stomach is empty. Although a certain period of rest, after a hearty meal, assists the process of digestion, digestion is impeded by continuous sleep, which is pretty certainly made uneasy and disturbed when the stomach has been recently charged with a full meal. Quiet and refreshing sleep is best secured when the wants of the system have been satisfied by a meal in great measure digested, and when the functions of the stomach need no longer be in full activity, but a long fast and repletion are alike hindrances to sleep. Great caution is needed in sitting down to the chief meal of the day, when both mind and body are exhausted by long-continued labour and abstinence. A rapid, hurried mode of eating should be avoided, especially if the repast commences with some solid dish. There are advantages in commencing with some light food, such as soup, or fish, in small quantities, not calling for the full powers of the stomach, whilst the gastric juice is not in full flow, and when the muscular powers of the stomach partake of the general enfeeblement of the system. It is frequently supposed to be undesirable to commence with fluids, and this is probably the case if any large amount be taken, but not otherwise, in the case of a nutritive fluid like soup, by the gentle stimulus of which the secretions of the stomach are called forth. It is certainly preferable to the glass of sherry or prefatory dram.—*From "Food and its Use in Health."* By Sir Risden Bennett, in *Cassell's Book of Health.*

"Let Knowledge grow from more to more."—Alfred Tennyson.

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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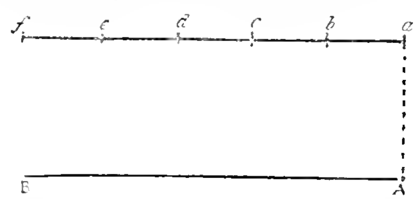
No communications are answered by post, even though stamped and directed envelope be enclosed.

FALSE PERSPECTIVE.

[1359]—I regret the appearance in your columns of the "flat cone" and the flourish about Zetetic Philosophy. My letter on certain errors to be found in most elementary books on perspective was not, I can assure you, intended to provoke this sort of thing.



Let a, b, c, d, &c., be a row of posts of equal height and equidistant from one another (ground plan), A, the position of an observer, A B being parallel to af, then the post at a will appear taller than that at b, the one at b higher than that at c, and so on, and that at f will, of course, seem shortest of all, *simply because it is the most distant.* For this reason the imaginary straight line upon which the posts stand, and the straight line bounding their summits *cannot*, I contend, be *parallel*. Again, the spaces $a\,b$, $b\,c$, $c\,d$, &c., will grow shorter and shorter as they recede from the eye. The geometrical proof of this is very obvious.

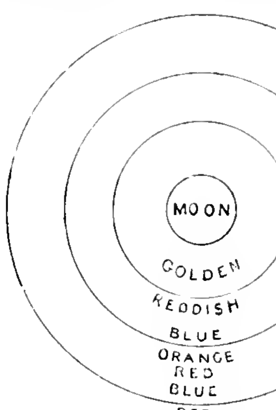
T. E. Jones.

A COINCIDENCE.

[1360]—Last week I was going in for an examination in Scripture, and, opening my Bible at random, my eye caught the words, "Then are the children free." I was struck by the expression and read it carefully over; the words haunted me, and, on receiving the printed paper of questions, the first words I again saw were. "Then are the children free." STUDENT.

LUNAR RAINBOW.

[1361]—The moon last night was quite a picture. When I left this room at a few minutes past 10 o'clock, I soon came into a street facing the moon; which, being near the full, its brightness naturally caused me to give it a look, when an exclamation of intense admiration escaped me "Oh! look at the moon!" This was addressed to my wife, who replied, "I noticed it when I came out." (This was an hour before.) So that it had lasted thus long, then. As I did not know the bearings of the street (by compass) and the thought coming into my mind that Mr. Proctor (despite his churlishness relative to my ideas respecting the apparent *size* of the moon and sun at setting[*]) shall know of this splendid lunar rainbow—I turned to look for the polar star, and finding it (which looking informed me that at least 270° of heaven's canopy was clear of mistiness, while the 90° remaining, in the centre of which was the moon, was the contrary), I turned me round, and ascertained that the moon was near southing, was, in fact, as nearly as I could guess, about S.S. East. When we stood on the bridge crossing the "Foss" we had a long view of this "Picture," in the water and in the sky. Perhaps you have seen in your time, on the pulpits in churches, a representation of the sun, gilt—well, sir, the colour of the circle which immediately surrounded the moon, and which was nearly as broad as the disc of the moon itself, was a rich colour; while that of the moon was a lighter golden hue—this golden circle gradually finished in an *auroral* tinge; then was succeeded by another circle, nearly as broad, of a blue kind, such as I cannot describe, too lovely in fact—this ending in a faint orange-red, was succeeded by another circle of a fainter blue, which seemed to have a reddish rim as well; to use a simile, which is very unsimilar, the whole had an appearance like to a St. Katherine's wheel (fireworks) thus:



Not being able to leave it yet awhile, I distinctly noticed that the golden circle next the moon had a motion, of two kinds—slightly bulging out more on the west side than the east side, and the whole in motion from one side to the other, while this rim nearest, being brightest, showed the other motion best, viz.: it seemed to enlarge and contract just like the pupil of the eye acted upon less or more light. When I reached home, a few minutes past 11 o'clock, it was still in its beauty. When I retired to bed, after reading through the Birmingham Demonstration speeches, I moved the window-blind aside, and that part of the sky where the moon was situated was as clear as the rest had been, and there sailed the moon in her naked majesty, being divested of every particle of the late lovely lunar rainbow. I give it this name in ignorance of a better or more correct one. During the course of many years I have several times witnessed this phenomenon, of a larger but fainter kind; but never with the rainbow colours so distinct and so plain. WALTER FREDERIC CURTIS.

MIND AND BRAIN.

[1362]—In my brief remarks on the review you gave of Mr. Büchner's "Force and Matter" I had certainly not the slightest intention to prefer a charge of "obtuseness" against the writer, but wished simply to give my own personal opinion, *quod valeat*, in order to show that the idea, that thought is a mode of motion of the molecules of the brain, is "conceivable" to certain minds, without in any way setting up any dogmatic assertion that it "must" be so. The comparison of an organ cannot hold, since the brain, or rather the molecules of the brain, like every other organ of "living" organisms, is self-acting. An electric instrument would be a better comparison: apply the current, or produce the necessary surroundings, and it begins to act; such, I think, is the brain, apply the stimulus and the brain begins to act, producing "thought." Huschke puts it in this way:—"There subsists the same relation between the thought and the electrical vibrations of the filaments of the brain as between colour and the vibration of ether." Of course there are other "authorities" who maintain that the mind it an entity domiciled in the brain, playing on it like on an organ.—Yours truly, F. W. H.

[Huschke's illustration seems to me to fail in this respect. There can be no reasonable doubt that colour has its origin in the different wave-lengths and rates of vibration in the ether; but these do not become *colour* until they have been transmitted through the eye and optic nerve to the brain. Set up an electrical vibration of the filaments of the brain, and try to express hope, ratiocination, or will, in terms of such vibration. That it may be the efficient and indispensable means of their production, is a very very very different thing to the allegation that it is the feelings and affections themselves.—ED.]

WHAT ALES IT?

[1363]—Bottled ale or beer *well-up* when poured into a tumbler gives more than enough of froth. A small piece of cheese in the glass checks *immediately* the froth.—Why? or How?—BOREAS.

LETTERS RECEIVED AND SHORT ANSWERS.

J. T. ROUTLEDGE. I have not read Professor Balfour Stewart's "Visible Universe," in the *Contemporary Review*, and am hence ignorant as to the nature of the arguments by which he sustains his allegations. If, as you seem to imply, he simply *asserts* that the waste—or seeming waste—of Energy in the Universe affords proof of the spiritual production of that Universe, than—be he "a person of authority in the scientific world" or not—he is talking nonsense. If we are going to admit the teleological argument at all into the discussion of any fact of nature, waste is evidence of absence of design and perfunctory workmanship; certainly not of provision and adaptation of means to ends.—F. M. BILLINGS. Received. I have nothing to add to my former reply. Mr. Clissold regards Swedenborg as inspired. I am absolutely certain he was insane. We cannot argue on common ground.—BECCABUNGA kindly sends the address of the Cremation Society for the benefit of "Kemus" (p. 101). Communications should be addressed to W. Eassie, Esq., C.E., 11, Argyle-street, Regent-street, London, W. My correspondent goes on to complain of the non-appearance of articles on Evolution in KNOWLEDGE. I fancied myself that Mr. Grant Allen's interesting articles, one and all, illustrated different phases of Evolution, but I suppose that I (in common with many thousands of readers) was mistaken.—J. F. C. takes exception to a statement on p. 76 with reference to imprisonment for debt, and points out how the most thoroughly dishonest debtors can, and do, under the existing law, snap their fingers at their creditors. In fact, that, so far from the unfortunate debtor being treated as a criminal, the scoundrel almost systematically escapes.—H. SIGGERS. Everything depends upon the branch of astronomy to which you propose to devote yourself. Ball's is, in every respect, an excellent book.—MAJOR GASCOYNE. The sole official statement of the results obtained from the last Transit of Venus which has been so far issued, is that of the Belgian ones by M. Houzeau, in Tome V. of the "Annales de l'Observatoire Royal de Bruxelles" for 1884. I need scarcely say that no English results have been yet published. May I invite your attention to the concluding sentence (in capital letters) of those which head the Correspondence column.—H. P. S. Not easy to introduce into a *scientific* journal.—M. J. C., having apparently heard of Fontenelle's treatise for the first time through these columns, took it up at random from among a lot of old books recently found in a cupboard at a friend's house.—J. PAXMAN. You will see from p. 103 that Mr. Proctor had started for America at the date for which your invitation was issued.—WM. HARRISON. Received with thanks.—IGNORAMUS. 1. There are three primary colours, red, green, and violet. 2. A complementary colour is that which when mixed with the one to which it is complementary gives white light. Blue and yellow are complementary colours, so are red and greenish-blue, orange and what is called cyan-blue, and greenish-yellow and violet. The complementary colour to pure green is purple. Note especially that I am speaking of *light* of different colours, not of pigments. The blue and yellow of our paint-boxes, for example,

* This is very courteous, soothing, and pleasing, and is probably designed to put the Editor into a good humour.

form green, and not white at all. 3. Flints are aggregations of silica round shells, sponges, echinites, &c., which died and sank to the bottom of the ocean which deposited the chalk. There were thermal springs then as now, and you know that hot water will dissolve more or less silica. 4. *Ciel et Terre* is published in Brussels on the 1st and 15th of each month in the pamphlet form. The subscription to it is 10 francs (*i.e.*, 8s. 4d.) a year, for which it is sent free by post.—Percy Greg has seen a table move "without human or mechanical agency." Scores of people heard a musical-box play, and instantly cease playing, at the word of command, in the presence of a vagabond called Monck; the box standing absolutely isolated and in full view in the middle of a table without any cloth on it, and Monck's hands being held by the persons sitting on each side of him. When this highly respectable "medium" subsequently found himself in a police court, the *modus operandi* of this quasi-miraculous phenomenon was exposed at once. If we were to attribute everything for what we wholly fail to find an explanation to the action of "disembodied intelligences," then surely must we credit Bautier, Frikell, Hermann, and Maskelyne and Cooke with very intimate communion indeed with another world.—J. Greevz Fisher sends me a letter pointing out—in effect, albeit, in slightly more euphemistic terms—how very foolish I am not to reform my spelling straightway. He accompanies this by some little tracts which I will read. When I am convinced by them that "Nolij" is a better form of writing the title of this journal than Knowledge, I will consult the Messrs. Wyman as to the policy of substituting the first form of heading for the existing one.—H. Wormald. A "singing mouse," poor little beast, has an inflammatory affection of its air passages.—G. A. Spottiswoode. This journal addresses students of every branch of science, and the article to which you take exception was one possessing great *physiological* interest. Knowledge in no sense enters into competition with such publications as *Little Folks* or *Aunt Judy's Magazine*.—Algernon Bray. Will you forward your address to the office of this paper, as a letter is lying here for you?—J. Elgie. (1) How can you expect a body shining, ex hypothesi, only by reflected light, and never departing by many seconds of arc from its primary, to be visible with any power, high or low, at the stupendous distance of Algol? (2) D'Arrest, in 1865, found a 10–11th Mag. Star somewhere near the place in Cassiopeia. The new star blazed out in Nov., 1572, and this was afterwards seen by Espin in 1878. (3) You can divide Castor with a power of 80 on a 2-inch object-glass. (4) I cannot say offhand how many physically double stars are now known, but there are certainly some hundreds.

Our Mathematical Column.

EASY LESSONS IN CO-ORDINATE GEOMETRY.

By Richard A. Proctor.

63. Prop.—*To determine the equation to a straight line parallel to a given straight line.*

Let the equation to the given straight line be

$$y = m\,x + c \qquad \text{(i)}$$

then since a straight line parallel to the given straight line must be inclined to the axis of x at the same angle, the equation required is

$$y = m\,x + c \qquad \text{(ii)}$$

an equation differing only in the constant term from equation (i).

It follows that the equation—

$$A\,x + B\,y + C = 0$$

represents a straight line parallel to the line whose equation is

$$A\,x + B\,y + C = 0$$

The equation to a straight line parallel to the straight line represented by the equation

$$\frac{x}{a} + \frac{y}{b} = 1$$

may be shown from the same consideration to be

$$\frac{x}{ra} + \frac{y}{rb} = 1$$

a relation which may readily be established independently; since it is obvious that the intercepts of two parallel lines on the axes of x and y must be respectively proportional.

64. Prop.—*To determine the co-ordinates of the point of intersection of two straight lines whose equations are given.*

Let the equation to the two given straight lines be

$$y = m_1 x + c_1 \quad \text{(i)} \quad \text{and} \quad y = m_2\,x + c_2 \quad \text{(ii)}$$

Solving these simultaneous equations, we obtain

$$x = \frac{c_1 - c_2}{m_2 - m_1} \qquad y = \frac{c_1 m_2 - c_2 m_1}{m_2 - m_1}.$$

Since both equations are satisfied when we give to x and y the above values, it follows that the point which has these co-ordinates is a point on both lines,—that is, is the point in which the two lines intersect.

If $m_2 = m$, the values above obtained for x and y are indefinitely great. This is the analytical expression of the relation that parallel lines never meet.

If the equations of the lines be given in the form

$$A_1 x + B_1 y + C_1 = 0 \quad \text{(i)} \quad \text{and} \quad A_2 x + B_2 y + C_2 = 0 \quad \text{(ii)}$$

we obtain

$$x = \frac{B_1 C_2 - B_2 C_1}{A_1 B_2 - A_2 B_1}, \text{ and } y = \frac{A_1 C_2 - A_2 C_1}{A_2 B_1 - A_1 B_2}$$

65. Prop.—*To determine the condition that three straight lines whose equations are given may pass through a point.*

Let the equations of the three lines be

$$y = m_1 x + c_1 \text{ (i)},\ y = m_2 x + c_2 \text{ (ii)}, \text{ and } y = m_3 x + c_3 \text{ (iii)}.$$

Then the x co-ordinate of the point of intersection of (i) and (ii) is $\frac{c_1 - c_2}{m_2 - m_1}$, and the x-co-ordinate of the point of intersection of (i) and (iii) is $\frac{c_1 - c_3}{m_3 - m_1}$. Hence, if (i) (ii) and (iii) meet at the same point we must clearly have

$$\frac{c_1 - c_2}{m_2 - m_1} = \frac{c_1 - c_3}{m_3 - m_1}$$

that is

$$c_1 m_3 - c_3 m_1 + c_3 m_2 - c_2 m_3 + c_2 m_1 - c_1 m_2 = 0 \qquad \text{(iv)}$$

In fact (iv) is the algebraical condition that the three equations (i) (ii) and (iii) may be equivalent to only two independent equations.

We know from algebra that if the three equations (i) (ii) (iii) are equivalent to only two independent equations, that is if condition (iv) hold, then when (i) (ii) and (iii) are multiplied respectively by the quantities $c_2 m_3 - c_3 m_2$, $c_3 m_1 - c_1 m_3$, and $c_1 m_2 - c_2 m_1$, and added together, both sides of the resulting equation vanish identically. Hence we obtain the following rule, which is frequently useful in practice. If three equations representing straight lines can be multiplied by such quantities that the sum of the resulting equations expresses identical equality, the straight lines represented by the three equations all pass through a single point.

66. Prop.—*To determine the form of the equation to a straight line passing through the intersection of two given straight lines.*

If these equations to the two straight lines are

$$A_1 x + B_1 y + C_1 = 0 \qquad \text{(i)}$$
$$A_2 x + B_2 y + C_2 = 0 \qquad \text{(ii)}$$

We may proceed to a full-length solution as follows:—

Solving (i) and (ii) we get for the point of intersection

$$x = \frac{B_1 C_2 - B_2 C_1}{A_1 B_2 - A_2 B_1} \text{ and } y = \frac{A_2 C_1 - A_1 C_2}{A_1 B_2 - A_2 B_1}$$

∴ by the equation to a straight line passing through the point of intersection of (i) and (ii) is of the form

$$A\left[x - \frac{A_2 C_1 - A_1 C_2}{A_1 B_2 - A_2 B_1}\right] + B\left[y - \frac{B_1 C_2 - B_2 C_1}{A_1 B_2 - A_2 B_1}\right] = 0 \qquad \text{(iii)}$$

$$\text{or } (A_1 B_2 - A_2 B_1)(A x + B y) + (B\,B_2 - A\,A_2) C_1 + (A A_1 - B B_1) C_2 = 0 \qquad \text{(iv)}$$

Now if we multiply (i) by $(B\,B_2 - A\,A_2)$ and (ii) by $(A\,A_1 - B B_1)$ and add, we get for the co-efficient of x

$$A_1 B\,B_2 - A\,A_1 A_2 + A\,A_1 A_2 - A_2 B\,B_1 = B(A_1 B_2 - A_2 B_1)$$

and for the co-efficient of y

$$B\,B_1 B_2 - A\,A_2 B_1 + A\,A_1 B_2 - B\,B_1 B_2 = A(A_1 B_2 - A_2 B_1)$$

or for the resulting equation the form (iv).

We might simply have proceeded thus

$$A_1 x + B_1 y + C_1 = 0 \qquad (1)$$
$$A_2 x + B_2 y + C_2 = 0 \qquad (2)$$

any equation of the form

$$l(A_1 x + B_1 y + C_1) + m(A_2 x + B_2 y + C_2) = 0 \qquad (3)$$

which is also obvious since whatever values of x and y satisfy (1) and (2) must also satisfy (3). It is also obvious that *every* equation to a line passing through the intersection of (1) and (2) can be put in the form **3**, seeing that the ratio B : A of the preceding article is the tangent of the angle made by a straight line through (i) (ii) with the axis of x, and as we have seen to give B and A suitable values, all we require is that the following equations shall hold.

$$l = B\,B_2 - A\,A_2$$
$$\text{and} \qquad m = A\,A_1 - B\,B_1$$

The method of the preceding article leads directly to the very valuable method of treating certain problems on the straight line called the Method of Abridged Notation. I do not here dwell upon it because any one who is likely to require much information on the subject would go to treatises where the methods of co-ordinate geometry are more fully dealt with than they can be here.

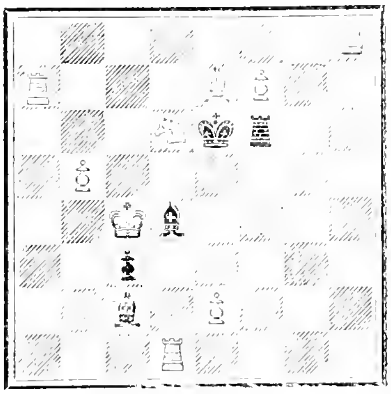
Our Chess Column.

By Mephisto.

PROBLEM, No. 123.

(Selected.)

Black.



White.

White to play and mate in two moves.

SOLUTIONS.

Problem No. 120, p. 102.

1. Q to Kt5	1. B to K5
2. Q to B sq. mate	
	1. ... to Kt7
2. Q to B5 mate.	

No. 121.

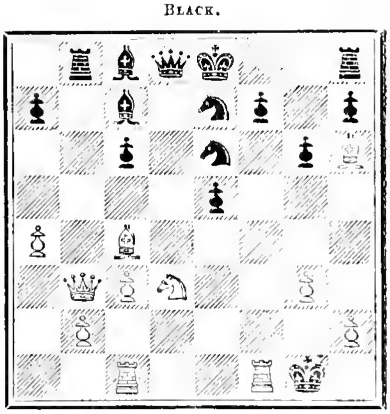
1. Q to Q3 and mate accordingly.

Ending p. 102

1. R to K8 (ch)	1. R × R
2. Q to Kt8 (ch)	2. K × Q
3. P × R mate	
	2. K to K2
3. P × R (Q) (ch) and wins	

ENDING FROM ACTUAL PLAY.

Black.



White.

1. B × Kt	1. R × Q
2. B × P (ch)	2. K to Q2
3. Kt to B5 (ch)	3. K to Q3
4. R to B6 (ch)	4. K × Kt
5. B to Q3 (ch)	5. Q to Q5
6. P × Q (ch)	6. K to Kt5
7. B to Q2 (ch)	7. K × P
8. R to R sq. (ch)	8. K to Kt4
9. B × R and White won	

GAME AT ODDS OF TWO KNIGHTS.

We publish the following amusing game as a curious example of of odds giving.

Remove the two White Knights.

1. P to K4	P to K4
2. P to Q4	P × P
3. B to B4	B to B4
4. P to QB3	P × P
5. Castles	P × P
6. B × P	Kt to KB3
7. P to K5	P to Q4

This move is often played, but not when the B is on Kt2; of course, receiving the odds, Black ventured something to exchange pieces.

8. P × Kt	P × B
9. R to K sq. (ch)	B to K3
10. P × P	R to Kt sq.
11. Q to R5	

White threatens R × B, also Q × B and Q × RP; the latter move especially would be dangerous.

B × P (ch)

Black was bound to lose a piece. K to Q2 would have been best, but B × P looked feasible.

12. K × B	Q to Q7 (ch)
13. K to Kt sq.	

An artful move

Q × B

Besides this likely-looking move, Black could have played K to K2, but White would maintain his attack.

14. R × B (ch)	K to Q sq.
15. R to Q sq. (ch)	K to B sq.

If Kt to Q2 then R × Kt (ch), and mates in four moves.

16. R to K8 (ch)	R × R
17. Q to B5 (ch)	R to K3
18. P to Kt8(R) (ch) and mate.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Joseph Farrar.—In the article on the Roy Lopez in Knowledge, p. 490, Black's move ought to read 9. Kt to K3.

G. Thompson, T. B. S., Chas. T. Wilbraham, M. T. Hooton. C. T. G.—In Problem No. 122, if 1. Q to K2, B to B3, and there is no mate.

Correct solutions received.—Problem p. 80, H. A. N.; No. 120, 121, A. W. Overton, M. T. Hooton, G. Thompson.

Contents of No. 145.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, AUG. 22, 1884.

CONTENTS OF No. 147.

SUNFLOWERS.

By Grant Allen.

IT is well to choose a text which everybody can easily verify for himself; and as hardly a house is now without a sunflower, I may as well choose that fashionable blossom as the subject for this morning's discourse. Take down one from the drawing-room mantel-shelf, and you will be able to follow for yourselves what I have to say to you. You had better choose a blossom in which the central florets have not yet begun to open, as you will then be able to find flowers in every stage of development.

The sunflower, I need hardly say, is a member of the composite family; and each head is not, of course, a single separate flower, but a whole collection of hundreds of golden bells. If you pull out one of these, you will find it consists of a yellow tubular flower, five-lobed above, and bulging broadly at its base. This flower surmounts a large seed, or rather fruit, with one or two wings at its top, which are all that now remain of the original calyx.

In the centre of the compound flower-head you will find a mass of unopened flower-buds, each one covered and protected by its own scaly bract. These bracts are the remnants of the little leaves which once grew under each blossom when the ancestors of the sunflower still possessed long spikes of flowers. But in course of time the composites learnt to flatten out their spike into a broad, disc-like head. Still, however, the bracts, in a much-dwarfed form, remained to separate the individual little bells; and in some cases, as in the sunflower, they have been utilised for a new purpose—namely, to protect the unopened flower-buds from insects which might otherwise eat them, or lay their eggs upon them. Many composites still retain the bracts; in others, and often in closely allied forms, they are wanting, having been gradually lost by disuse. There are none in the daisy or the dandelion.

Beyond this central region, where the buds are yet unopened, you will find two or three rows of newly-opened flowers, with all their lobes displayed, and with the little black stamens standing up conspicuously in their midst. These florets are in their first or male stage. If you open carefully with a needle the tube formed by the united stamens, you will find inside the little style, with its two branches still pressed closely together. The bee hovering over these florets in the first state, dusts himself over with pollen from the yellow tips of the anthers. This he afterwards carries away to fertilise the other florets.

Outside the rows of flowers in the first male state we come to some other and more crowded rows, which have reached the second or female condition. In them the style has grown longer, so as to overtop the now withered stamens. At the same time, its branches have opened outward, and now curl over gracefully, so as to expose their sensitive surfaces. If you look closely you can see, even with the naked eye, grains of pollen clinging to their surface.

Outside these female florets again come a few rows of fully-fertilised and over-blown blossoms, which are crowded together by pressure from within, and of which the bees and other visitors hardly take the slightest notice.

Lastly of all, on the very outside of the great compound flower-head, we reach the big expanded golden ray florets, which are, in fact, neuter members of this organised floral community. Their business is to make as large a display as possible, and so to attract insects to the fertile florets in the centre. If you pull out one of them carefully, you will find that it is tubular in its lower portion, but that the broad upper part is formed by the splitting open of the tube on the inner side. One may still observe faint traces of the original five lobes even in these very enlarged and distorted florets, especially at the tip, where they are often notched or divided. In some composites the expanded ray florets still keep their styles; but in the sunflower they have become wholly abortive. We may thus compare the compound head in some respects with a hive of bees containing females, males, and neuters.

It will be observed that the sunflower opens from without inward, and the bee who approaches it visits it in the same order. Thus he comes in contact first with the florets in the female stage on the outside, and dusts them over with pollen which he brought from the last head. He then proceeds to the inner rows of male florets, from which he unconsciously collects pollen to carry to some neighbouring plant. If either the sunflower or the bee reversed this proceeding, the result would be that the florets would get fertilised with pollen from their own brother flowers, the least desirable form of cross-fertilisation; but here, as elsewhere, natural selection has adapted the habits of the plant to those of its regular visitors, and has thus secured the best form of impregnation. Bees are particularly fond of the sunflower, and obtain from it large quantities both of pollen and honey.

The fruit of the sunflower has no feathery top or pappus to float it away like the dandelion and thistledown. It is too large and heavily stored with rich food-stuffs for the young plant to admit of that form of dispersion. So the calyx, instead of being transformed into a pappus, as in most other composites, here remains simple and cuplike. But the seed profits in the end by its richness in oil and other valuable stores, for the sunflower plant is thereby enabled to get that splendid start in life which makes it into one of the tallest and stoutest annuals of temperate climates. Very few species attain so immense a height in a single year. Probably, too, no other annual, except Indian corn, produces so large a number of so richly-stored seeds. It is this provision on the part of the mother-plant which allows them to reach so great a stature during a single short summer.

A STRANGE DISORDER.

A VERY curious disorder of the nervous system is described in the *Revue Scientifique* of August, being taken from the *Archives de Neurologie* for April of this year. It appears that, in the U.S. State of Maine there are some persons in apparent health except so far as relates to nervous excitability, which is excessive. The least irritation causes them to jump. They also feel compelled to execute anything they are ordered to do, and they repeat the command in a loud voice. Dr. Beard reports that one "jumper," as they are called, was sitting on a chair cutting tobacco. He went up to him, struck him suddenly on the shoulder, and said, "Throw it away!" He repeated the words in a voice of terror, and threw his knife, so that it stuck in a door opposite to him. Two other jumpers struck themselves violently on being told to do it.

This disorder appears to be hereditary. In one family Dr. Beard found the father, his son, and two little girls of four and seven affected by it; and in another case three brothers were its victims.

A similar complaint occurs in the Malay region of Asia, and it has been observed amongst various races, Tamils, Bengalese, Sikhs, and Nubians. The Malays call the patient a *latah*, a word of wide significance, applied to various degrees of nervous excitability. Mr. O'Brien states that when travelling in the Malay Peninsula he had as a servant a young Malay whom his comrades called a *latah*, though his conduct and conversation indicated nothing irrational. Four-and-twenty hours elapsed before his peculiarity was displayed. A signal fuse was then fired by way of rejoicing, and the doctor was about to ignite another when the young man pushed him violently on one side, seized the torch, lit the fuse, and fell to the ground face downwards, uttering a strange cry. The next day he seemed all right, but when the doctor waved his hand as an adieu on leaving the shore, he imitated the movements with frenzy. He also imitated him as he whistled a European tune.

On another occasion the doctor had introduced to him an old and highly respectable woman, with whom he talked for ten minutes without noticing anything abnormal. All of a sudden the person who brought her took off his coat, upon which she began to undress, and would soon have been quite naked, if he had not stopped her. She was furious against the man who incited her to this indecency, and while she was taking off her clothes, abused him as "an abandoned pig," and wanted him killed. Another case ended tragically. The cook of a steamer was *latah*, and one day was nursing a child, when a sailor came near him with a billet of wood in his arms. He rolled the wood on the top of an awning, and loosening it let the wood fall. The cook did the same with the child, and killed it. At Singapore another *latah*, seeing his mistress tear a letter and throw the pieces out of window, did the same with a bundle of new clothes he was carrying.

The disorder is not confined to warm climates. It is known in Siberia, and a case is mentioned of the pilot of a ship on the Ussar who could not refrain from imitating actions or noises made by the passengers to try him. The captain had a fall while clapping his hands, whereupon the pilot clapped his, and fell in the same way. The Russians call the complaint *miryachil*, and it is said to be common near Yakutsk in severe winters. S.

American Telegraphy.—There were 42,917 telegraph offices in the United States in 1882. The number of telegrams forwarded during the year was 40,581,177.

PARADOXISTS IN AMERICA.

By Richard A. Proctor.

ONE of the most remarkable features of American newspapers is the attention directed in them to men of the paradoxical turn of mind. Our Hampdens, Parallaxes, and Newton Crosslands ought to cross the Atlantic if they wish to receive the amount of attention which doubtless they consider their due. At Montreal lately there died a man named Vennor, who had posed as a weather prophet, with the usual amount of success, for several years. His predictions were quoted over the length and breadth of the United States, as well as of British America, and he was regarded (if we can judge from newspaper comments) as a veritable man of science by most Americans. The *Montreal Daily Witness* paid Montreal the left-handed compliment of describing Vennor as "her most celebrated citizen." In Kentucky, a few years ago, there was another charlatan, by the name of Professor Tice, who claimed similarly to be a weather-prophet, and showed an even more marked ignorance of real science in every line of his writing. His predictions were for a long time regarded with approval, although they showed no more than the usual proportion of successes to failures. He was successful as a lecturer, getting fees, in fact, which an English science-teacher of the soundest kind would certainly not command in the old country, nor secure in America unless he had done something which had attracted special attention there. After a while, "Professor" Tice found that his failures were becoming rather too prominent a feature in newspaper notices; so he made a bold stroke for public favour. He invented a planet to account for his failures—an intra-Mercurial planet, of course. He described how, observing the sun one September day, he saw a round spot, which at first he supposed to be only an ordinary sun-spot; but, seeing it was moving across the sun's face, he concluded it must be Mercury. (He had no idea how thoroughly he was thus exposing his ignorance—not, indeed, to the average American paragraphist—but to every one acquainted with the elements of that science in which he pretended to be most profound; a transit of Mercury in September would be as surprising a phenomenon to an astronomer as an eclipse of a crescent moon.) Finding after reference to an almanac that it was not Mercury, he concluded it must be Vulcan, the intra-Mercurial planet discovered by Lescarbault, if that veracious observer's account is to be believed. This idea being conceived, Tice was at once able—such is the force of genius—to assign the true period of Vulcan, so as to combine together Lescarbault's observation, his own, and all those failures of his which wanted a new planet for their interpretation. So ingeniously was this done, that it appeared, on examining "Professor" Tice's own most precious data, that when he saw Vulcan, that planet must have been seen through the sun. This was pointed out in a Louisville magazine, edited by a gentleman much less widely known throughout America than "Professor" Tice, but having the advantage of him in knowing a good deal about science, whereof the professor knew nothing. We heard less about Tice after that, though, doubtless, millions still put faith in him. And now, another of these charlatans has distinguished himself in such a way that American papers have spoken of him as one might speak of a new Newton, though every line he has written shows him to be ignorant of the veriest elements of science. Like Tice, this man—who rejoices in the name of Wiggins, and honours Ottawa by his presence

—has undertaken to predict weather. He terrifies all the unwiser folks in British America and the United States, and not a few who by no means regarded themselves as idiots, by announcing some year and a half since the destruction of every ship on the ocean by a mighty storm, which did not come when he did call for it. But latterly even newspaper paragraphists have noted that Mr. Wiggins's predictions have been unfortunate, to say the least. So, as Tice invented a new planet, and probably Wiggins thought another new planet would not be welcomed with enthusiasm, the weather prophet of Ottawa invented a new moon, not where M. Petit, of Marseilles, thought that another moon may perchance be travelling, to wit, nearer than the known moon, and lost nearly always in the earth's shadow, but far beyond the moon, and invisible because it has no atmosphere! I think the readers of this paper would hardly credit me if I were to tell them of all the silly things Mr. Wiggins said in the preposterous paper in which he announced the discovery of a second moon; but perhaps the most ludicrous notion was that the atmosphere of a planet plays an important part in enabling the planet to reflect sunlight, so that an orb without an atmosphere would not be visible at all. Another absurdity was the statement that Newton could not explain the perturbations of the moon's movements; but that with this outer moon everything could be fully explained—the inanity of which assertion may not be obvious to others, but is simply stupendous even to the humblest students of the lunar theory. It is not, however, the absurd nature of this man's ideas and reasoning that I care to dwell upon. The ways of paradoxers are tolerably well known, and Mr. Wiggins is neither better nor worse than the rest of them. What is really interesting, and I fear significant, is that in many American newspapers the nonsense of a Wiggins, a Tice, or a Vennor, is discussed as gravely as the work of a Draper, a Young, a Langley, or a Newcomb. In a country distinguished by the labours of such men as these, and a host of other steady workers in the fields of science—from men who rank with the best in Europe down to those whom form indeed the rank and file, but are nevertheless sound scientific students—the average newspaper paragraphist is so ignorant that he speaks of the inanities of men who, in the very nature of things, must either be knaves or fools, as though he were dealing with the thoughts of men of sense. They seem unaware of the fact that the mistakes of a Young or a Newcomb cannot be brought into comparison with the notions of even the least foolish (or knavish) among the paradoxers. A stranger taking up an American newspaper in which a man like Vennor is spoken of as "the most celebrated citizen of Montreal," or a Tice as "our distinguished weather prophet," in which a Wiggins, as recently in a paper published in Missouri, figures among the great men of the day, would never suspect, what is in reality the case, that America possesses mathematicians, astronomers, geologists, meteorologists, and chemists, who yield in skill and in the quality of their work to none in Europe.—*Newcastle Chronicle.*

An attempt is being made to obtain subscriptions for enlarging the buildings in Whitechapel of the Working Lads' Institute. These are to comprise Reading, Refreshment, and Class Rooms, Lecture Hall, Technical School, and Swimming Bath. All interested in the social and intellectual advancement of the working classes, who may feel the desirability of providing such counter attractions as are indicated above to street-corner betting and sotting in the public-house, can send their subscriptions to the treasurer, F. A. Bevan, Esq., 54, Lombard-street, E.C., or to the hon. sec., Henry Hill, Esq., jun., 38, Bow-lane, E.C.

TRICYCLES IN 1884.

By John Browning.

(Chairman of the London Tricycle Club.)

SMALL *VERSUS* LARGE WHEELS AND TWO-SPEED GEARINGS.

Though I have for some months written but little for Knowledge, I have been riding tricycles and experimenting with them continuously.

During this season, I have ridden only machines made to my own specifications. The whole of my machines now have wheels either 36 in. or 38 in. in diameter.

Here my experiments in reducing the size of the wheels must stop, for if the wheels were reduced in diameter only two or three inches more, my legs would not clear the axles, nor would my pedals clear the ground.

But, as far as my experience goes, I have found the reduction of my wheels to this extent an unmixed advantage. The machines are lighter, they are stronger, they are more portable, and they travel quicker or with greater ease. To my thinking, only one point worth considering has been urged against the use of small wheels—that is, that their employment would greatly increase vibration, particularly when they were highly geared. I have one machine geared up to 48 in., and another to 52 in. I cannot find that the vibration of these machines is greater than other machines I have been riding, which have wheels of 46 in. and 48 in. diameter, level-geared.

Mr. S. Salmon, who is deservedly considered an authority on tricycles, has had a machine built this year by Hirst, of Croydon, of the Coventry Rotary type, with a 38-in. driving-wheel, which weighs less than one pound to the inch. It is geared up to 57 inches, yet Mr. Salmon assures me that after three months' experience he prefers it to any other machine he has ridden. From this it is evident that small wheels can be adopted with advantage, even with high gearings.

The great obstacle to their introduction is the fact that manufacturers whose patterns have been designed for large-wheeled machines, and who have often a considerable stock of parts of machines and of large wheels by them, dissuade customers from having them, and frequently refuse to make them.

Also in the case of two-speed gearings, manufacturers have made the high speed agree with the diameter of the driving-wheels, and obtained the low speed by gearing down; thus, a machine with 50-inch wheels will run as 50, or when geared down, as 35 inches.

If, instead of this, a machine were made with wheels say 42 inches diameter, geared up to 50 inches and down to 35 inches, it would be stronger, faster, and about 20 lb. lighter.

The Crypto-Dynamic two-speed gearing has not, I believe, had such a success as was anticipated for it, and I notice that the patentees particularly recommended the use of large-wheeled machines. By doing so, I consider they have not given their invention a fair chance, but have stood in their own light, as, by adding weight in the form of a two-speed gearing, and also by increasing the weight of the machine by making it with large wheels, they neutralised the advantage of the gearing; in plain words, what they gave with one hand they took away with the other.

This point I am urging is of great importance just now, as so many manufacturers are bringing out two-speed gearings. Unless some maker of more originality than the rest will depart from the beaten track, we shall have this new and invaluable improvement in machines brought forward in an unsatisfactory form, and tested at a great disadvantage. The new two-speed, central-geared Sparkbrook is a well-planned and well-made machine, half spoilt by being constructed on the plan I have described. The Coventry Machinists have, however, introduced a new and very original two-speed machine, in which speed is obtained by gearing up above the size of the wheels, which is the correct principle. It would be unfair for me to leave this subject without saying that Messrs. Humber, Marriott, & Co., Singer & Co., and Starley & Sutton, make most of their machines with wheels from 40 in. to 44 in. diameter, and gear them up according to the requirements of their customers.

A very noteworthy fact in connection with the adoption of small wheels is the wonderful performance of the various safety bicycles, chiefly the Facile, the Sun and Planet, and the Kangaroo. Now, these machines have wheels ranging from 36 in. to 42 in. in diameter, yet their performances in point of speed and of long distances will bear favourable comparison with those of bicycles of the usual make, with wheels from 50 in. to 60 in. in diameter, though all the small bicycles have to contend with additional friction in extra moving parts. This is one of the most powerful, because it is the most practical, argument, I have yet found in favour of small wheels.

Having now had more than a year's experience of two-speed machines, and having three out of my five machines —viz., a Sterling, a Europa, and a Rucker, provided with two-speed gear, I say deliberately that I do not care in future to ride any tricycle that is not furnished with two-speed gearing.

Several correspondents have called my attention to the fact that while I have highly recommended the Sterling it is only a single driver. I have not overlooked that point, but I consider its merits as a most simple and efficient two-speed machine quite over-balance that single disadvantage. Sir John Herschel said, with regard to the correct figure of a curve for the mirror of a reflecting telescope, "that is a good curve which performs well," and I say that is a good form of machine which performs well, and that is the case with the Sterling.

Some objections have been raised against two-speed gearings on the ground of their complication, the uncertainty of their action, their liability to get out of order, and the increased friction they cause. My reply is that my Sterling has never, in the hundreds of reversals I have given it from speed to power, failed to act instantaneously, nor has it ever given me one moment's trouble. I can say the same of my Europa, so far as the speed and power gearing are concerned; and my friend, Mr. Grace, gives the same testimony as regards the Diana of the same makers; while the fact that my two-chain Rucker, with speed and power gear, is by far the fastest machine I have ridden, is a convincing proof that the amount of extra friction produced by the second revolving chain is of no material consequence, and may, in mathematical language, be neglected.

Very soon I propose to give Eades' new tricycle, the Emperor, a trial. This novel machine has bicycle steering, and is central-geared, and is open-fronted above the axle. I am prepared to find that it may require a little practice to develop its best qualities, and to give it, on account of its novelty, the time and attention necessary to form a fair opinion of its qualifications.

The Colonial Exhibition.—The Victorian Mining Department has decided to send to the Colonial Exhibition, which is to be held in London in 1886, a scientific and economic mineral collection representing the geological features of Victoria. A collection which was sent to Amsterdam will be used as a nucleus.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

(*Continued from page 134.*)

CHAPTER II.—THE DIURNAL MOTION OF THE STARS.*

HAVING satisfied himself respecting the character of the sun's diurnal motion, our observer, we will suppose, turns his attention to the celestial objects which make their appearance when the sun is below the horizon.

Among these the moon is the first to attract his attention. I do not propose, however, at present, to devote much space to the diurnal motion of the moon, which closely resembles that of the sun. It may be followed with the instrument represented by Fig. 5, p. 133, without any change whatever, either in the position of the instrument or in its construction. The only peculiarity which would be noticed would be, that the rate of the moon's motion, though uniform, is not exactly the same as that of the sun's motion, but somewhat slower.

The stars which seem scattered over the whole sky in unnumbered profusion, are the objects to which our observer is now supposed to turn his attention.

A very short time suffices to show that, in the east, stars are rising into view, while in the west stars are setting. More careful observation shows that all the stars visible to the eye are moving with greater or less speed. The stars which rise in the east pass over to the south, where they attain their greatest elevation; and their motion continuing, they pass down to the west, where they set. Stars which rise towards the south of east attain but a small elevation when due south, and set towards the south-west. Stars which rise towards the north of east attain a considerable elevation when due south, and set towards the north of west. Other stars are seen, which neither rise nor set; but appear to travel in circles around a point on the northern skies. And stars very near that point seem scarcely to move at all.

Such are the general features of the stellar diurnal motions; but our observer is now to inquire what are the exact paths which the stars appear to follow.

He might notice that a star rising in the east attains in the south about the same elevation as the sun when that luminary rises due east. He is led, therefore, to inquire whether the whole system of the stars may not be revolving (really, or in appearance,) after precisely the same law as he had observed in the case of the sun. The instrument which he has constructed to follow the solar diurnal motion (Chapter I., Fig. 5) will serve equally well to follow the sidereal motion, if this suspicion be correct; only the observer must be able to look along the rod L M at a star. He need not, however, remove the circular card at M. He may bore a hole through it, and place another card similarly pierced at the end L of the rod, so that the two holes may be directly opposite each other. If, however, the rod L M is a tube, he can look yet more conveniently at a star through this tube.

Thus provided, the observer directs L M to any star whatever, noticing what division of the card H falls opposite the opening in the upright B. At the end of half-an-hour (say) he again directs the tube towards the star. He finds that to do this he has only to turn the rod F G round on its axis, just as he had done in the case of the sun, and apparently through exactly the same angle. In reality the angle is slightly greater, a matter which will presently be noticed more at length. But the great point to be here

* The word diurnal in astronomy is not used as the converse of the word nocturnal, but is applicable to any motions observed during the twenty-four hours, from noon of one day to noon of the next.

noticed is, that every star in the heavens obeys the law of uniform rotation round the axis F G, precisely as the sun and moon had been observed to do.

This is indeed a most important discovery; and will be found, when we come to examine it, to be full of significance.

In the first place it is to be noted that if the stars were bright points on the inner surface of a vast sphere rotating uniformly around the earth, their motions would be precisely such as we have thus seen them to be. So that the notion entertained of old by Anaxagoras and his followers —that the stars are the heads of nails driven into the concave of a vast dome—however *bizarre* it may seem in the light of modern science, was founded at any rate on an observed relation.

Another notion, somewhat less fanciful, was equally consistent with observed appearances. If a vast spherical crystal shell surrounded the earth, and the stars were bright points fixed within the substance of this crystalline dome, but not necessarily at the same distance from the observer, then the observed diurnal motion of the stars would be accurately reproduced by the rotation of the crystalline shell about a fixed axis through its centre.

Let us carefully consider the points thus suggested. Let us take the case of one of those stars which never set.

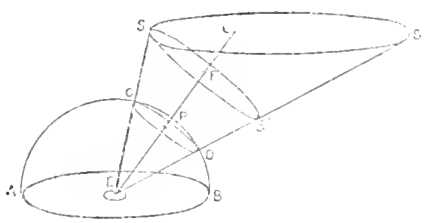


Fig. 1.

Suppose E (Fig. 1) to be a part of the earth's surface (we are supposed to know nothing as yet of the shape of the earth), and let A C B represent the imaginary dome of the heavens on which the stars seem to move. Let P be the point to which the axis of our instrument (F G, in Fig. 5 to Chapter I.) was directed throughout our observations. Further, let C D be the apparent path of a star.

Now our observations showed us the star going round and round in the circle C D, at a perfectly uniform rate. When we saw the star in direction O C, the star must have been somewhere along that line (produced if necessary). Suppose the star was at S. Now where was the star when it seemed to be at other parts of the circle C D? The line of sight went round and round O P, uniformly and keeping always inclined at the same angle to O P. It therefore described a conical surface of which O P was the axis. Now if our star travelled in S S′, *a circular section of this cone*, then the star motion really was as equable as it seemed, and the fixed axis O P (produced) passed through the centre of the star's motion at F. But if our star travelled in any other section (necessarily non-circular) as S *s*, then its motion was not equable, but obviously was slowest at S and swiftest at *s*. Also the fixed axis O P did not in this second case pass through the centre of the star's path, but through an eccentric point Q.

We see that the path S S′ explains observed appearances *simply*, while the path S *s* requires altogether artificial assumptions of varying motion around an eccentric axis.

But this is only a small part of the difficulties in which we become involved if we give to a star a diurnal motion (relatively to the earth) in any other but a circular path around the axis O P. The path S *s* lies wholly above the plane of the earth's surface at E where the observer is supposed to stand, and, in fact, I have made the oval S *s* parallel to A B, because that is the sort of path by which one of the paradoxists explains the diurnal celestial motions. When, however, we take the case of a star which rises and sets, we get a cone corresponding to S E S′, but having part of its surface *below* the plane A B; so that we have to conceive an oval path quite different to S *s*, not only as regards shape and centring, but in position also.

Even this, however, is not all. When we take the case of a star which rises due east and sets due west, the cone corresponding to S E S′ becomes a plane. We have, in fact, the case illustrated in Fig. 2, where *e* C *w* represents

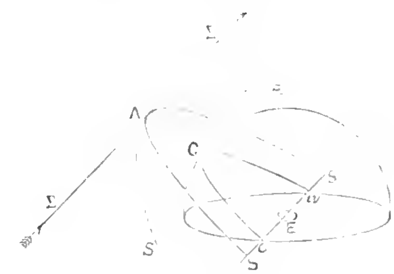


Fig. 2.

the apparent path of such a star on the heavens. Now, in this case, if the true path of the star (relatively to the observer at E) is not a circle (as that of which S A S′ is the half), uniformly described, it must either be some other curve *s* A *s′* in the same plane, *not* uniformly described, or if it belong to some other plane *as well* as the plane *e* C *w*, it must be a straight line as Σ A Σ'. For it cannot by any possibility lie out of the plane *e* C *w*, since the line of sight from E to the star is observed always to lie *in* that plane; therefore, if it belongs to another plane also, it must be on the intersection of two planes; and we know that two planes can only intersect on a straight line.*

When we see that so many artificial and incongruous assumptions have to be made if the apparent motions of the stars are to be explained in any other way, we can no longer feel any doubt that the simple explanation suggested by our observations is the correct one. We conclude, therefore, that the motions of all stars relatively to the earth, take place uniformly in circles having one line (E P of Fig. 1) as common axis.

As yet, however, we do not know whether the celestial sphere, carrying all its stars with it, rotates around the earth on this axis, or whether the earth rotates within the celestial sphere, on an axial line in the same direction. We must make excursions over the earth's surface to determine what the figure of the earth may be, before we can form a probable opinion on this point. And before we can feel absolutely certain we shall need yet other observations.

But first it will be necessary to somewhat extend our

* It may be noticed in passing that the sun's course when he rises due east is so very nearly coincident with the course of a star so rising, that the account just given is true appreciably for the sun also; so that if the sun really were travelling parallel to the earth's surface as conceived by one of the paradoxists, he would on March 22 or Sept. 23 (when he rises due east) be travelling in a straight line as Σ A Σ' with a variable velocity saving its least value when he was at A. How he should ever come back again after going off in the direction A Σ', until by the enormity of his distance he appeared close to the horizon (though, strangely enough, looking appreciably undiminished), we may leave to be settled by those who have flattened the earth.

observations of the heavens. Hitherto we have only considered the apparent motion of the sun during a single day, and that of the stars during a single night. We have to inquire whether there are any changes from day to day, and if so, what their character may be. It is clear that until we are certain what the aspect of the heavens by day or by night would be in the place whence we are to start on our excursions, we cannot rightly estimate the significance of the appearances presented in other places.

ELECTRO-PLATING.

X.

By W. Slingo.

TO the amateur or student, one of the most interesting branches of the electrolytic art is the deposition of a metallic film upon the skeleton of a leaf or upon a mould of one. At this point in this series of papers we ought rather to confine ourselves to the preparation of a mould and the deposition of copper upon it. For several reasons, however, it will be found better to take up and finally deal with the finer work that is involved in plating or typing small and delicate objects, such as leaves, insects, and other animal and vegetable matter.

To take an electrotype copy of a symmetrical two-sided animal, such as a herring or other fish, is not difficult. A rather stiff paste of plaster is prepared and poured on to a piece of greasy paper, fastened on a flat board—a rim being provided to prevent the plaster spreading. The fish, having been oiled to prevent adhesion, is laid on the plaster, and then gently pressed in until the lower half is, as it were, enveloped or hidden. The plaster is then allowed to dry until it is well set, although not quite hard, when the object is removed and the edges of the mould finished off with the aid of a knife. Two or three small holes are made in the level portion surrounding the figure. The mould is then brushed over with soap and water, and the fish replaced in its former position. A thin plaster paste is then prepared and poured over the fish and lower mould rather quickly. When quite set and thoroughly hardened, the two moulds, each representing one side of the fish, are easily separated, after which they are placed in an oven to dry. When dry they are treated in the ordinary way—that is to say, they are first saturated with molten wax, and the surfaces, so far as they present an image of the fish, are plumbagoed and connected to the negative electrode of the bath; leading wires are used if the fish, or whatever else the object may be, is thick, or, in other words, if the copy is to be a work in high relief. It would be possible to make arrangements for taking the copy in one piece, but it is preferable to take it in two pieces, and then filing, fitting, and soldering them together.

When the object to be copied is under-cut, or of such a shape as to render the use of plaster impossible—as in the case of, say, a mouse, the elastic-mould process is, as a practical necessity, resorted to. Of course, it would be possible to use plaster moulds, if we divide the copy into four instead of two pieces.

Leaves may be very faithfully and beautifully copied. To take the upper side, a plaster-of-paris paste is prepared, on which the back of the leaf is laid and gently pressed. Some little care is necessary here to ensure a good result. Air-holes must be filled up and the plaster, if necessary, helped into its place by means of a thin stick of wood. When thoroughly set and hard, plumbago is brushed over and melted wax is poured on until a layer of sufficient thickness is deposited. When cold, the wax is separated, coated with plumbago, and placed in the bath: a good electrotyped copy of the leaf results, if the work has been performed with sufficient care. Other substances than plaster may be used for imbedding purposes, such as clay or fine sand. Where, however, a soft substance is employed, it is advisable to make the leaf rigid by coating the back with a few layers of thin plaster, allowing each layer to dry before the successive one is applied. Substances which require pressure cannot be used for moulds, because the surface or shape of the object is liable to damage. Gutta-percha is therefore inapplicable.

The process for plating leaves, flowers, insects, &c., is an interesting one. The object to be coated is first dipped into a solution of phosphorus in bisulphide of carbon. A silver solution consisting of 1 dwt. of nitrate of silver dissolved in a pint of distilled water having been prepared, the object is immersed in it and kept in until the phosphorus has caused an entire coating of silver to be deposited, which will be evidenced by a uniform blackness. After washing in clean water, the silvered object is immersed in a solution of chloride of gold, again washed in clean water, and then allowed to dry. When dry, it is placed in the bath, and a thin copper deposit is taken. If bisulphide of carbon is not available, a silver coating may be obtained by dipping the object in the nitrate of silver solution, and then suspending it under a glass jar or receiver, closed at the top, in which a piece of phosphorus is being burned.

Another method is to grind in a mortar to a fine powder some nitrate of silver crystals, and shake up the powder with alcohol in a flask placed in warm water. One hundred parts of alcohol should take up about $2\frac{1}{4}$ parts of the nitrate. The object to be copper-plated is dipped in the solution, while warm, for a moment, and on withdrawing the alcohol is allowed to evaporate, the nitrate being left on the object. It is then placed in a vessel containing burning phosphorus, when the salt is reduced and the usual conducting coating is provided.

Skeletons of leaves may be treated in the same way as insects or flowers, and beautiful results obtained. The appearance may be further considerably improved by depositing a gold or silver film over the one of copper, of which, however, more anon. I must leave the amateur to work out any special design he may have in view, derived from combinations of leaves, skeletons, and insects, and I fancy that with a little application he may produce, with the aid of various metallic solutions, some remarkably pretty and attractive results.

It is, perhaps, worthy of mention, as an interesting fact rather than as an experiment to be repeated, that E. T. Noualhier and J. B. Prevost, in 1857, introduced a plan to "metallise soft surfaces," such as a human corpse. All the apertures, mouth nostrils, &c., were stopped with modellers' wax, and pulverised nitrate of silver was spread over the body with a brush. It was then placed in the bath, and a copper coating deposited, the "result being a metallic mummy."

The next subject to claim our attention will be the deposition of copper upon the baser metals, glass, &c.

The number of workmen employed in our dockyards at home increased from 1879 to 1884 from 16,381 to 18,849. The armoured building had been advanced from 7,427 tons in 1879-80 to 12,614 tons, as proposed in the Estimates for 1884-85. The expenditure on armoured building for 1883-84 and 1884-85 was actually doubled as compared with 1879-80. For the protection of our vast commerce in every part of the globe we maintain a fleet in commission with an aggregate displacement of 324,256 tons, as compared with 171,300 tons for the French. Our fleet in commission was more than double the tonnage of the French, but our mercantile marine was tenfold larger than theirs.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

VII.

In thus far illustrating the confusion inherent in the barbaric mind between what is and what is not external to itself, and the explanation which it consequently gives of such simple matters as a man's name and likeness, the explanation given of matters still dividing philosophers into opposite camps has been hardly indicated. The uniformity of this among the lower intelligence in every zone and age might surprise us, and we should be in bondage to the theory which explains it by assumption of primal intuitions of the race, were we not rejoicing in the freedom of the truth of the doctrine of the descent, or ascent, of man from an ape-like ancestry, and the resulting slow development of his psychical faculties, involving his accounting for motion in things around by the like personal life and will of which he is conscious in himself, and for his regarding the world of great and small alike as the home and haunt of spirits.

For the assumption underlying the savage explanation of such things as dreams and diseases involves a larger assumption—namely, that the spirit which acts thus arbitrarily, playing this game of hide-and-seek, now, as it were, caught up into Paradise, and now dodging its owner and worrying its enemy on earth—is, to quote Mr. Spencer's appropriate term, a man's *other self*. It is, at least, what the scientists call a working hypothesis; it is the only possible explanation which the uncultivated mind can give of what it has not the power to see is a subjective phenomenon. Odd and out-of-the-way events have happened to the dreamer; he has been to strange places and seen strange doings, but waking up, he knows that he is in the same wigwam where he lay down to sleep, and can be convinced by his squaw that he has not moved therefrom all night. Therefore it is the other self, this phantom-soul, which has been away for a time, seeing and taking part in things both new and old. We civilised folk, as Dr. Wendell Holmes remarks, not rarely find our personality doubled in our dreams, and do battle with ourselves, unconscious that we are our own antagonists. Dr. Johnson dreamed that he had a contest with an opponent and got the worst of it; of course, he found the argument for both! Tartini heard the Devil play a wonderful sonata, and lay entranced by the arch-fiend's execution. On waking, he seized his violin, and although he could not reproduce the actual succession of notes, he recovered sufficient impressions to compose his celebrated "Devil's Sonata." Obviously the Devil was no other than Tartini.

Thus the philosopher, to whom dreaming merely indicates a certain amount of uncontrolled mental activity, may satisfy himself; not thus can the savage, who cannot even think that he thinks, and to whom the phenomena of shadows, reflection, and echoes bring confirming evidence of the existence of his mysterious double. What else than a veritable entity can his shadow be to him? Its intangibility feeds his awe and wonder, and increases his bewilderment; its actions, ever corresponding with his own, make it, even more than its outline, a part of himself, the loss of which may be serious. Only when the light is withdrawn or intercepted does it cease to accompany, precede, or follow him, and to lengthen, shorten, or distort itself; whilst not he alone, but all things above and around, have this phantom attendant. The Choctaws believed that each man has an outside shadow, *shilombish*, and an inside shadow, *shilup*, both of which survive his decease. Among the Fijians a man's shadow is called the dark spirit, which goes to the unseen world, while the other spirit, which is his likeness reflected in water or a mirror, stays near the place where he dies. The Basutos are careful, when walking by a river, not to let their shadow fall on the water, lest a crocodile seize it, and harm the owner. Among the Algonquin Indians sickness is accounted for by the patient's shadow being unsettled or detached from the body; the Zulus say that a corpse cannot cast a shadow, and in the barbaric belief that its loss is baleful, we have the germ of the mediæval legends of shadowless men and of tales of which Chamisso's story of Peter Schlemihl is a type. The New England tribes called the soul *chemung*, the shadow, and in the Quiche and Eskimo languages, as also in the several dialects of Costa Rica, the same word expresses both ideas: while civilised speech indicates community of thought in the *skia* of the Greeks, the *manes* or *umbra* of the Romans, and the *shade* of our own tongue. Still more complete in the mimicry is the reflection of the body in water or mirror, the image repeating every gesture and adopting every colour, whilst in the echoes which forest and hillside fling back, the savage hears confirmation of his belief in the other self, as well as in the nearness of the spirit of the dead. The Sonora Indians say that departed souls dwell among the caves and nooks of the cliffs, and that the echoes are their voices, and in South Pacific myth echo is the first and parent fairy, to whom at Marquesas divine honours are still paid as the giver of food, and as she who "speaks to the worshippers out of the rocks." In Greek myth she is punished by Juno for diverting her attention whilst Jupiter flirts with the nymphs, and at last, pining in grief at her unrequited love for Narcissus, there remains nothing but her voice.

But what, in primitive conception, is the more specific nature of the other-self, and how does it make the passage from within to without, and *vice versâ?* Very early in man's history he must have wondered at the difference between a waking and a sleeping person, a living and a dead one, and sought wherein this consisted. There lay the body in the repose, more or less broken, of sleep, or in the undisturbed repose of the unawakening sleep; in the latter case with nothing tangible or visible gone, but that which was once "quick" and warm, which had spoken, moved, smiled, or frowned but a little while before, and which still came in dream or vision, was now cold and still.

It should here be remarked, in passing, that many savage races do not believe in death as a natural event, but regard it as differing from sleep only in the length of time that the spirit is absent from the body. No matter what anyone's age may be, if his death is not caused by wounds, it is attributed to magic, and the search for the sorcerer becomes a family duty, like the vendetta for other injuries. And the widespread myths which account for death have as their underlying idea the infraction of some law or custom, for which the offender pays the extreme penalty. And that personification of it which pervades barbaric thought, whilst undergoing many changes of form, yet retains its hold in popular conception as well as in poetry. Pictured as the messenger of Deity, the awful angel who sought the rebellious and impious, or who, in mission of tenderness, bore the soul to its home in the bosom of the Eternal, it was transformed and degraded by the grotesque fancy of a later time into a grim and dancing skeleton whetting his sickle for ingathering of the young and fair to their doom, or into the grinning skull and crossbones of Christian head-stones.

But to resume. Whilst shadows, reflections, and echoes, one and all seemed to satisfy the uncivilised mind as to the existence of the other-self, they gave no key to its nature, to what it is like. Obviously the difference between death and life lay in some unsubstantial or semi-substantial thing. Perhaps, thought some races, it lies in the blood, with the unchecked outflow of which death ensues, and the idea of this connection has not been confined to barbaric peoples. Perhaps, thought other races, it lies in the heart, which, say the Basutos, has gone out of anyone dead, but has returned when the sick have recovered. Among the Greeks some philosophers held that it was fire, which was extinct when the fuel of life was burnt out, or water, which would evaporate away. But, as language shows, it is with the *breath* that the other-self of the savage and the vital principle of the philosopher has been most widely identified. For it is the cessation of breathing which would in the long-run be noted as the unfailing accompaniment of death; and the condensing vapour, as it was exhaled, would confirm the existing theories of a shadowy and gaseous-like soul. In this, as the illustrations to be adduced from various languages will evidence, the continuity of idea which travels along the whole line of barbaric and learned speculation is unbroken.

THE WORKSHOP AT HOME.

By a Working Man.

I HAVE been asked by the Editor of this paper to give directions in its columns for the performance of some of those kinds of handicraft which may be practised by the amateur without assistance. I mean the construction of articles of household use, and furniture, in wood (both by the aid of ordinary joiners' tools and the lathe), and the making of simple apparatus in brass, &c., as well, in the last-named machine. I shall begin at the beginning, describe the tools to be employed, and their use, and tell the learner not only what to do, but—what is often of as much consequence—what not to do.

And my first piece of advice will be, "Don't buy a chest of tools." There are certain ones which are essential, which will be found in it; but, on the other hand, it is sure to contain others of comparatively infrequent use, while some which are certain to be wanted, sooner or later, will be conspicuous by their absence. Start with an outfit suitable to your purse, go to a first-class maker, like Buck, Churchill, Fenn, or Melhuish, or (if you are a wealthy man) to Holtzapffel, get just what you require, and add to your

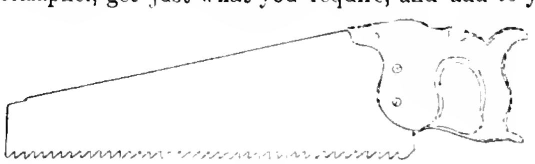


Fig. 1.

original collection as necessity arises. I shall come by-and-by to lathe tools; just now we will confine ourselves to those used by the carpenter or joiner.

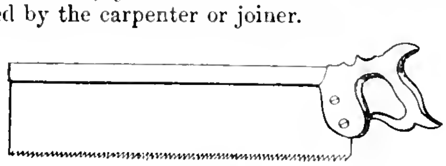


Fig. 2.

To begin with, we ought properly to have the three saws shown in the annexed figures; where Fig. 1 represents what is called a "hand-saw," for cutting planking the lengthways of the grain of the wood; Fig. 2, a "tenon-saw," for cutting across the grain; and Fig 3, a "bow" or "frame-saw," for sawing round curves. A very thin, narrow saw, sliding through a handle (or "pad"), and

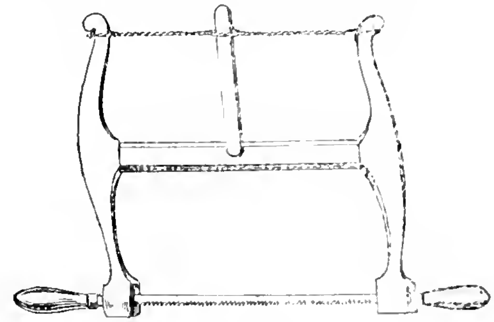


Fig. 3.

called a "keyhole-saw," will sometimes be found useful; but we can dispense with it for the present. Next, we shall require three planes, two of which are depicted in Figs. 4 and 5. Fig. 4 is known as a "jack-plane," and is

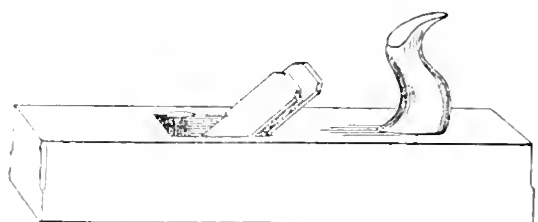


Fig. 4.

used for the first rough planing-up of wood as it comes from the timber merchant. A longer and "finer-set" form of this workmen call a "trying (by which is meant true-ing)

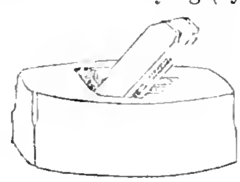


Fig. 5.

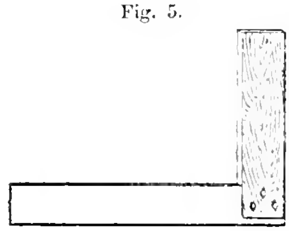


Fig. 6. Fig. 7. Fig. 8. Fig. 9.

plane." It is used to produce a perfectly flat surface; and Fig. 5 is a "smoothing-plane." In addition to this, there are "plough," "rabbeting" (or rebating), "side filister," "match," "grooving," "moulding," "beading," and divers other planes, to more than one of which I may have to return. Any one of these, though, if wanted for a special job, can be bought subsequently. Then we shall require at least four "firmer" chisels,"—1-in., $\frac{3}{4}$-in., $\frac{1}{2}$-in., and $\frac{1}{4}$-in.—(Fig. 6), and a couple of gouges, together with a wooden mallet, four gimlets, three bradawls, a hammer, a square (Fig. 7), a marking-gauge (Fig. 8), and a mortice-gauge (Fig. 9), a two-foot joint-rule, or else a yard measure, an oilstone, a glue-pot and brush, glue, screws and nails; Nettlefold's screws in cardboard boxes and the so-called "French" or wire-nails being the best for the amateur. The tools I have enumerated may be considered as essential. They will cost as nearly as may be £2. 8s. at a good shop. A carpenter's bench, too, is a great desideratum, but a very firm table will do for smaller jobs, especially if it is placed in the corner of a room so that one end and one side of it abut against the adjoining walls. The amateur who is about, though, to take up carpentering in earnest, had better buy a bench. A new one of sufficient size for ordinary amateur cabinet-making may be bought for five and forty shillings or so, but occasionally a second-hand one may be picked up for much less. Suppose, then, that the reader has provided himself with the tools mentioned above, the next thing will be to learn how to use them in an attempt upon a simple piece of work.

As a preliminary, though, even to this, it is essential that they should, one and all, be very sharp. No good or even decent work ever was done yet with blunt tools, or ever will be; so we had better begin at the very beginning by learning how to sharpen ours. Saw-sharpening the amateur had better not attempt—at all events, for some time to come. It is an art which requires a considerable

Fig. 10.

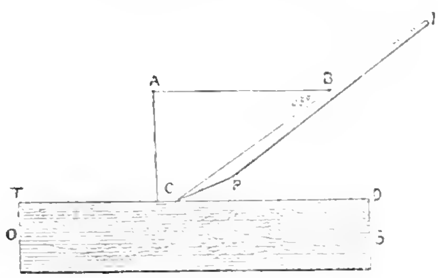


Fig. 11.

Fig. 12.

amount of practice; and, besides, he can get them sharpened and set for 3d. a piece; so that the game is really not worth the candle. Using the word "set" just now, reminds me to explain that a saw is set by bending its teeth alternately to the right and to the left of the plane of the saw; so that if we suppose the first, third, fifth, and seventh teeth to bend to the left, the second, fourth, sixth, and eighth, and so on, will be bent to the right. If the reader will turn a saw-edge upwards and look along it, he will see what I mean in an instant. His plane-irons and chisels, though, he must, perforce, sharpen himself. To get out a plane-iron, a long plane (like Fig. 4) should be knocked with a mallet on the front part of the top of it. In the case of the smoothing-plane (Fig. 5) the iron is released by striking the binder end of the plane. Having got our iron out, we shall find it present the appearance of Fig. 10, where *i* is the cutting plane-iron proper; in front of which is screwed *b*, the break-iron (so called because it breaks the shavings and causes them to curl up). These two irons are connected by the screw *s*, which must be loosened by a screw-driver until it moves up and down easily in the slot, through which it is to be drawn until the screw-head comes opposite the big round hole at the top of the slot, through which it can be then drawn, and the plane-iron will be free.

Now it will be noticed at once that this iron is sharpened from the back only, its face being perfectly flat, and the angle at which it has been found in practice the best to sharpen it is one of 35° (there are, as everyone knows, 360° in a whole circle, and 90° between two lines that stand square to each other). Any one who knows the XXIXth proposition of the 1st Book of Euclid will see at once the explanation of the little "dodge" I am going to describe. By the aid of the "protractor," to be found in every case of mathematical instruments, we cut out a bit of card A B C with its angle at B=35° and that at A a right angle. If now we put our piece of card so that its side B C shall lie lengthways along the face of the plane iron P I, and placing the iron on our oilstone O S, Fig. 11, tilt up the plane-iron until the side of the triangle A B is parallel with T D, the top of the stone, we shall have B C D=A B C, or measuring 35°, so that we have only to keep our plane-iron steadily at this tilt to sharpen it accurately. After rubbing it sufficiently we must lay it perfectly flat on its face on the stone, and give it a rub or two to take off the rough or "wire" edge caused by sharpening it from behind. Then we replace our break-iron, and put the plane together again, being careful that the edge of the iron is *only* just visible when the bottom of the plane is looked at edgeways from the front. A firmer chisel (Fig. 6) may be sharpened in precisely the same way. It is almost needless to add that some clean olive oil must be dropped on the stone before we begin sharpening.

Very well. Suppose that we have got all our tools thoroughly sharp and in good order, we will begin by making the wooden frame-work for a three-leaved screen; to be afterwards covered with canvas and scrap engravings, or bronzed American cloth, and painted with flowers. The three frames, which must, of course, be identical in size and shape, I will suppose to be each 5 feet high by 2 feet wide, the framing being $1\frac{1}{4}$ inch wide and $\frac{7}{8}$ inch thick. In each frame we shall require two upright sides (technically called the "stiles"), each 5 feet long, and three transverse pieces (known as the "rails"), each 2 feet long. This will involve our buying 13 feet 3 inches (or thereabouts) of 1 inch deal planking, which will be 7 inches wide, and must be free from knots. It will, in one sense, cut to waste, *i.e.*, we shall not use it all, but a little reflection will show that we cannot get wood of the dimensions we want out of a smaller plank. It may, though, pretty evidently be in the form of two planks—one 5 feet 1 inch, and the other 8 feet 2 inches. The odd inches are to enable us to cut the ends of our styles and rails truly square, and yet leave them of the right length. Out of our 5 feet 1 inch piece of board we shall (allowing for planing-up) only get five stiles; so we begin by drawing four straight lines on it, equidistant from its edges, and parallel to them and to one another. This will divide the 7 inches of width into five equal strips each, $1\frac{4}{10}$ inch wide. The plane will reduce this width to our adopted one, when it comes to be used. But perhaps in a job like this, we had better plane up our board first; so, laying it on our bench, or a very flat table, with a stop of some sort in front of it (N.B. This stop must obviously project above the bench or table less than the thickness of

Fig. 13.

the board, or it will catch the plane every time), we begin with the jack-plane (Fig. 4), and go all over the board. Having taken off all the dark and rough outside, we finish up with our trying-plane. The amateur must try to plane *hollow*, or his plane will take off too much at each end of the board, and it will assume a more or less convex outline. From the very construction of the tool, he will fail in his attempt, but this must be the tendency of his planing. When, however, he can take off shavings of the whole—or nearly the whole—length of the board, he may rest satisfied. By looking at the board edgeways, he will see when it is perfectly flat on both sides, and then he must plane the edges too, taking care that they are square to the face of the board. He must try this all along with the square (Fig. 7). Now, then, he can mark his 5 feet 1 inch piece of board into the 5 equal strips, and laying it down on a very firm wooden chair or box, saw it into strips with the hand-saw (Fig. 1). He should pencil the lines along which he is to saw, clearly, and take particular care that the plane of the saw is square to the face of the board. It must be sloped, though, in the direction of its length. Little short cuts may be made at first, and then, when the saw is fairly in the pencil-line, longer ones; but the saw must be watched and brought into the line again, if it shows the slightest tendency to wander from it. In this way, then, must the beginner saw out the fifteen strips of wood he requires, the six "stiles" 5 ft. long, and the nine "rails" 2 ft. long. The edges of these must now all be planed up truly, and the strips cut to their exact lengths by the tenon-saw, the lines defining those lengths being marked by the aid of the square (Fig. 7) and pencil. As I began by saying, the planing should finally leave the strips $1\frac{1}{4}$ in. wide and $\frac{7}{8}$ in. thick. It now remains to fit our frames together. For simplicity's sake, we will make the corner joints like those of the frame of a school-slate. The middle rail, however, must be morticed in. I have said that the thickness of the wood is just $\frac{7}{8}$ths of an inch; so we begin by loosening the screw in front of the mortice-gauge (Fig. 9), separating the little points $\frac{3}{8}$ths of an inch, and then moving up the wooden fence or guide until it is $\frac{1}{4}$ inch from the lowest point, finally tightening all up by the screw again. It will be seen that if now the gauge be run along the edge of the wood, it will draw two parallel lines $\frac{3}{8}$ths of an inch apart in the middle of its thickness. Let us suppose that we have one of our 2 feet "rails" so marked, then at $1\frac{1}{4}$ inch from each end we draw a line truly square round it with the square and pencil, as before, and taking the tenon-saw (Fig. 2), cut along the line marked by the mortice-gauge down to our pencil-mark, and then saw from each face on our pencil-line down to this cut. This will obviously take off two thin slabs of wood, about $\frac{1}{4}$ in. thick, $1\frac{1}{2}$ in. wide, and $1\frac{1}{2}$in. long, and will leave the two smaller ends or "tenons," *t t*, standing as in Fig. 12, in which *f* represents the rail as seen from the front, and *e* as viewed edgeways. In sawing out these tenons the marks should all be *left visible*, and not obliterated by the saw-teeth passing actually through them. Leaving the mortice-gauge undisturbed, we now run it along the edge of our 5-ft. "styles" (Fig. 13), at each end of which we cut with the tenon-saw $1\frac{1}{4}$ inch down into the wood, leaving the gauge-lines visible on that, too, and by the aid of our quarter-inch firmer-chisel clear out the two apertures *s s*. As we went *inside* the marked lines in cutting these out, and *outside* the lines in cutting our tenons, the latter will fit very tightly into them; so tightly, perhaps, as to involve a little delicate shaving or scraping of the tenon before it will enter without splitting the end of the style. This joint may be seen at the corners of an ordinary school-slate. In the middle of the frame, though, at *m*, it is obviously inapplicable, so here we must make a regular "mortice." This is a rectangular opening through the whole width of the style, $1\frac{1}{4}$ in. long and $\frac{3}{8}$ in. wide (the width and thickness of the tenon respectively). Carefully outlining this on both edges of the wood, the amateur had better begin by boring a series of holes in this marked space with the biggest gimlet he has, and then carefully and truly clearing out the rectangular opening or mortice with sharp chisels. If the reader has followed me so far, he will see now that the tenons will drop, with a little pressure or knocking, into the mortice in each rail at *m*, and into the apertures *s s*, at the ends of them. When everything is neatly fitted together, the styles and rails laid in order must be once more separated, the tenons and the holes they are to enter rapidly brushed with fresh, thin, hot glue, and the whole frame put together again as rapidly as possible, tied or cramped tightly together, and set aside for the glue to cool. Finally, the reader may once more get his biggest gimlet, and bore holes through the styles and the tenons, and cutting some bits of deal *very* slightly conical with a penknife, dip them in hot glue, and drive them home as far as they will go. The tenon-saw will trim them off level, or practically so, with the face of the wood, and a finishing touch can be given with the smoothing-plane (Fig. 5). These wooden pins are technically called "dowels." The frame now completed is represented in Fig. 14. Three of these will, as we began by saying, have to be constructed, and they must be united by two pairs of brass hinges (called "butts"), which may be bought, with the necessary screws, at any ironmonger's. Note that they must be placed on—so to speak—*alternate* edges of the frame for the screen to fold properly. It only remains to cover the screen with canvas or American cloth, and this may be nailed on with the smallest tacks or with cabinet-maker's brads. The decoration of the screen with scrap engravings, pasted on to the strained canvas, or with flowers painted in oils on the American cloth, may safely be left to the taste of the reader.

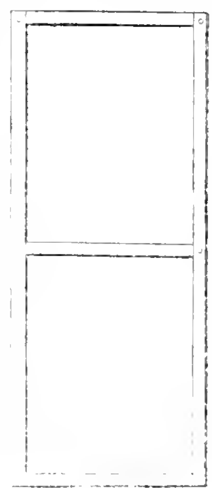


Fig. 14.

THE GREELY EXPEDITION.

By Andrew McPherson.

The account which was published in Knowledge last week of the doings and sufferings of the Greely band of explorers has been supplemented in an unlooked-for and unpleasant manner. A charge of cannibalism has been preferred against the surviving members of the crew, and, although the charge has not received official confirmation, it has not been met with that categorical refutation which one would wish for. But, after all is said, what does the charge amount to? That cannibalism is in itself abhorrent no civilised being would deny; but to go so far as some of our contemporaries seem disposed to do, is, so far as I can see, uncharitable in the highest degree. I think, rather, that to be so reduced by want of food as to render one capable of overcoming the feelings of revulsion which must present themselves, is indicative of agony of the acutest description, and demands our sincerest pity and commiseration rather than condemnation. As Dr. Rae, a well-known explorer, writing to a contemporary, says:—"It is all very well for those who, probably, have never been twenty-four hours continuously without food in their lives to enlarge most indignantly on the subject. Had they been for days, as I have, living, or, rather, existing on the smallest scraps of skin and bones, and enjoying the most disgusting-looking food as if it had been the greatest delicacy; had they but witnessed the sufferings and cravings of some of my fine fellows during these times of privation, they would have had some knowledge of what starvation meant."

Charges of bad discipline are also brought, as helping to account for the resort to cannibalism; but such charges require only a moment's consideration to be contemptuously hurled aside. Suffice it to say, that the members of the crew were picked from one of the best-disciplined bodies of men in the States.

We have occurring around us almost daily, suicides and perhaps murders, actuated only too frequently by want of food, and yet we do not give vent to the same feeling of horror that has found utterance against the supposed doings of the unfortunate travellers, icebound and starving.

It is possible, nay more, it is highly probable, that many a similar expedition has in bygone days resorted to similar means to sustain vitality, but surely no pleasure or satisfaction can accrue to a healthy-minded man in peering into and scanning with microscopic eyes all the doings of men when reduced to the greatest extremities to which humanity is susceptible. Let us then rather close our eyes to such pictures, regard the survivors with pity, and do what in us lies to prevent a recurrence of the dreadful episode. It is clear that nothing further can be gained by Arctic exploration—nothing that is which is likely to be of any use to mankind; and it behoves us therefore to discountenance any further expeditions. But, perhaps the most fitting conclusion to these few remarks is afforded by what Mr. Proctor said last week in the *Newcastle Chronicle*.

"The expedition has ended, as many feared that it must end, in the loss of nearly a score of lives, and the probable loss of health and strength on the part of the seven surviving members of the ill-fated party. *Per contra*, some little light has been thrown on the position of certain shores, mountains, and so forth, which will never be visited for any useful purpose by human beings, while the North Pole has been approached nearer by some eighty miles than at any previous Arctic expedition. In what respects such expeditions as these differ from Captain Webb's attempt to swim the Niagara rapids, except that many lives are risked instead of one, it would be difficult indeed to say. The members of the expedition were gallant and enduring men; but Webb was as brave and as resolute. They risked their lives; he risked his. It was certain beforehand that no good could come from Webb's attempt; it was no less certain that no considerable advantage to the human race could accrue from any new Arctic expeditions. A certain element of savagery in our most cultured races, by which importance comes to be attached (goodness knows how) to useless exploits, is exhibited in such attempts. That is all we can say for them."

A NEW VOLCANO.

THE Secretary of the Treasury has received from Captain M. A. Healy, of the United States revenue cutter, *Corwin*, under date of Ounalaska, May 28, two interesting reports by officers of the *Corwin* describing a visit to the recently upheaved volcano in Behring Sea at the northern end of Bogosloff Island, in latitude 53° 55′ 18″ N.; longitude 168° 00′ 21″ W.

This volcano, which is in a state of constant and intense activity, was upheaved from the sea in the summer of 1882, but was not seen by any civilised eye until Sept. 27, 1883, when it was discovered by Captain Anderson, of the schooner *Matthew Turner*. A few days later it was also seen by Captain Hague, of the steamer *Dora*, but no landing upon it was made previous to that by the officers of the *Corwin* last spring.

Dr. Yemans describes it as a dull gray, irregular, cone-shaped hill, about 500 ft. in height, from the sides and summit of which great volumes of vapour were arising. At a height of about two-thirds the distance from the base to the apex of the cone, there issued a very regular series of large steam-jets, which extended in a horizontal direction completely across the north-western face of the hill. Around these steam-jets were seen upon nearer approach deposits of sulphur of various hues, which at a distance had looked like patches of vegetation. A landing was effected without difficulty upon a narrow sand spit connecting the new volcano with the old island of Bogosloff, and Dr. Yemans and Lieut. Cantwell undertook the ascent of the smoking cone. It was covered by a layer of ashes formed into a crust by the action of rain, which was not strong enough to sustain a man's weight, and at every step the climbers' feet crushed through it, and they sank knee-deep into a soft, almost impalpable dust which arose in clouds and nearly suffocated them.

As the summit was neared, the heat of the ashes became almost unbearable. A thermometer buried in them half way up the ascent marked 196°, and in a crevice of the ramparts of the crater "the mercury rapidly expanded and filled the tube, when the bulb burst, and shortly afterwards the solder used in attaching the suspension ring to the instrument was fused." The temperature was estimated at 500° F. On all sides of the cone were perforations through which the steam escaped with more or less energy, and in some cases at regular intervals like the exhaust of a steam engine. The interior of the crater could not be seen on account of the clouds of smoke and vapour which filled it.

"A curious fact to be noted," Lieut. Cantwell says, "in regard to this volcano is the entire absence, apparently, of lava and cinder. Nowhere could I find the slightest evidence of either of these characteristics of other volcanoes hitherto examined in the Aleutian Islands." Volcanic dust or ash, however, is thrown out in considerable quantities, and carried by the wind to places as distant as Ounalaska. After carefully measuring the volcano, and photographing it from various points of view, the exploring party returned, without accident, to the ship. Captain Healy reports his intention to visit the new volcano again on his return from St. Michael's and the Arctic.—*Kansas City Review of Science and Industry*.

THE WESTINGHOUSE BRAKE.

By "Trevithick."

A FEW weeks since I commented upon one or two of the relative features pertaining to the various brakes used in railway working. It has, of course, been apparent from the time when the first train was started, that an efficient brake would, sooner or later, be an essential feature in railway working, and Stephenson, having this fact in view, patented fifty years ago a steam brake to be applied to the engine by the driver. The increased length of trains, their multiplicity and high speed, require something more than this. Several brakes have been introduced, which may be divided, as I have previously indicated, into two classes, viz., Local (that is, operative on the individual vehicle only) and Continuous. The local brakes are very rapidly dying out, and in all probability will soon become things of the past, so far at least as railway working is concerned. The continuous brakes may be subdivided into two sections, which may be denominated automatic and non-automatic, terms sufficiently clear to explain themselves. It is to the automatic that attention is now drawn, and the Westinghouse is taken as the specimen, although, as will be seen presently, it is nearly without a peer.

The Westinghouse Automatic Brake, named after the pateutee, is worked by air pressure. A small, but powerful, air-pump is placed on the engine, and with the aid of steam d rived from the locomotive boilers, air is forced either into a reservoir under the foot-plate of the engine, or through a one-inch pipe extending throughout the length of coupling with similar pipes on the adjoining vehicles. A branch-pipe connects E with an essential and eminently interesting piece of apparatus called the Triple Valve, F, which is in reality the controlling piece of mechanism, and of which Fig. 2 is an enlarged view. Enclosed in a case, 1, is a piston, 5, carrying with it a slide-valve, 6, which covers the port, *a*, to the brake cylinder, and in the position shown establishes a communication between *a* and the atmosphere by the exhaust-cavity *b* and passage c. Compressed air from the main pipe E enters the lower part of the case, and forcing up the piston, 5, feeds past it into an auxiliary reservoir (G, Fig. 1) through the groove *d* (Fig. 2) and the outlet C. This reservoir is thus filled with air under a high pressure (the same as that in the main pipe), and as things now are, this air cannot escape.

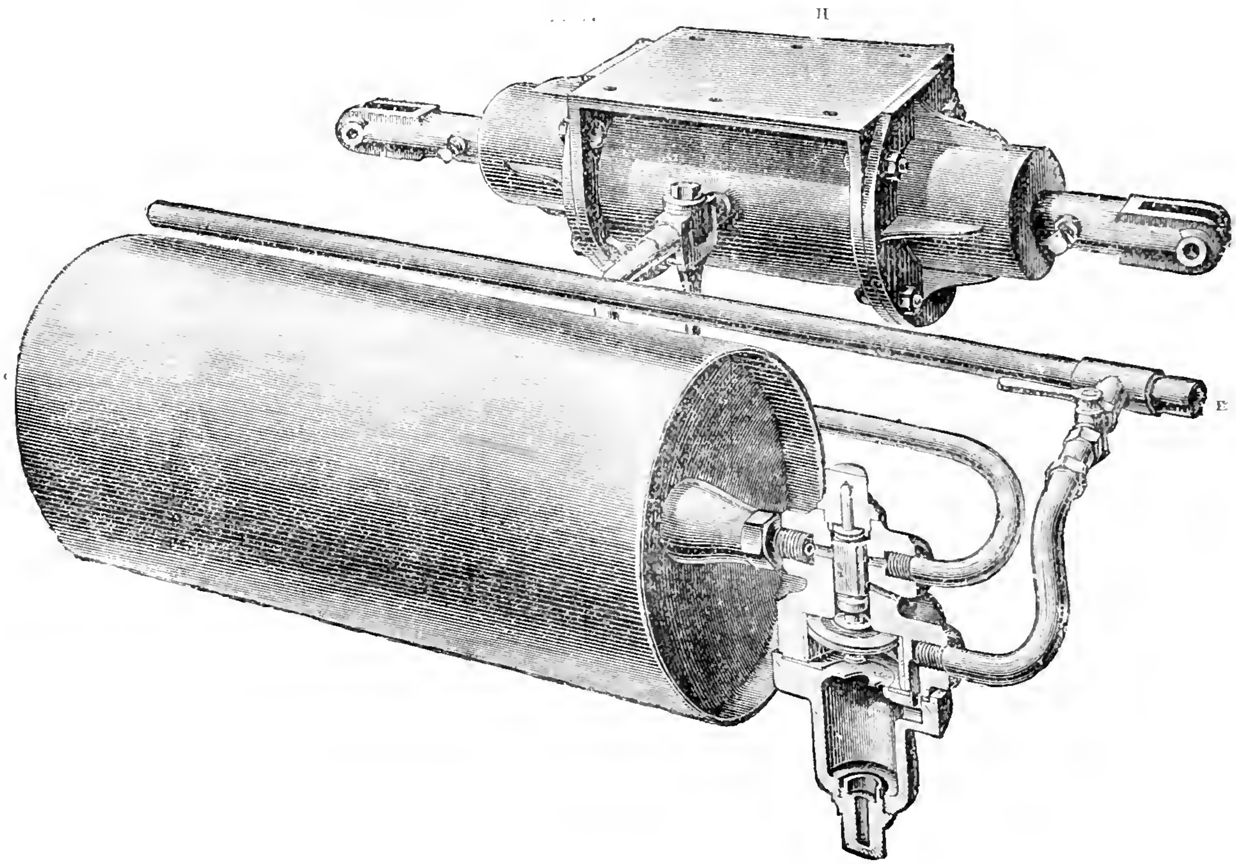


Fig. 1.

the train. The pump is entirely under the control of the engine-driver, and he is at liberty, by simply turning a handle, to connect it with his reservoir or with the pipe. He is also able to connect the pipe with the external atmosphere, so as to reduce more or less completely the air-pressure in the pipe, which nominally is about 70 lb. to the square inch. The pump and its appurtenances, however, need not further detain us, as nothing essential to the proper working of the system is involved; all that is required being a means of rapidly raising the pressure in the pipe, of easily exhausting it, and of speedily re-establishing it.

Let us turn our attention to the brake proper. The accompanying illustration will materially help us. Fig. 1 is a general representation of the apparatus as applied to every individual vehicle. A one-inch pipe, E, which runs the length of the carriage, is connected by an ingenious At the same time, the slide-valve (6) covers the port *a*, leading to the "brake" cylinder (H, Fig. 1), and is in such a position that air from the latter may exhaust through *b* and *c* into the atmosphere. In the brake cylinder are two pistons, which are pressed inwards and almost together by spiral springs; but when the air enters from *a* (Fig. 2), through the short connecting-pipe shown in Fig. 1, it passes into the small space separating the pistons, and drives them outwards. To each piston is attached a rod, which, acting on a lever, presses a friction block against each side of the wheel.

So long as an equal pressure is maintained in the reservoir, triple valve, and brake-pipe, the brakes are off, the brake cylinder being in direct communication with the air, and the springs, therefore, effectually keeping the pistons near each other, and consequently the friction-blocks clear of the wheels; but on the pressure in the main pipe and beneath the piston, 5, being suddenly reduced, the piston falls, and by so doing shuts off both the reservoir from the main pipe E and the cylinder from the exhaust port D; at the same time the passage from the reservoir to the cylinder is open, and air passing from the former to the latter, the brakes are applied.

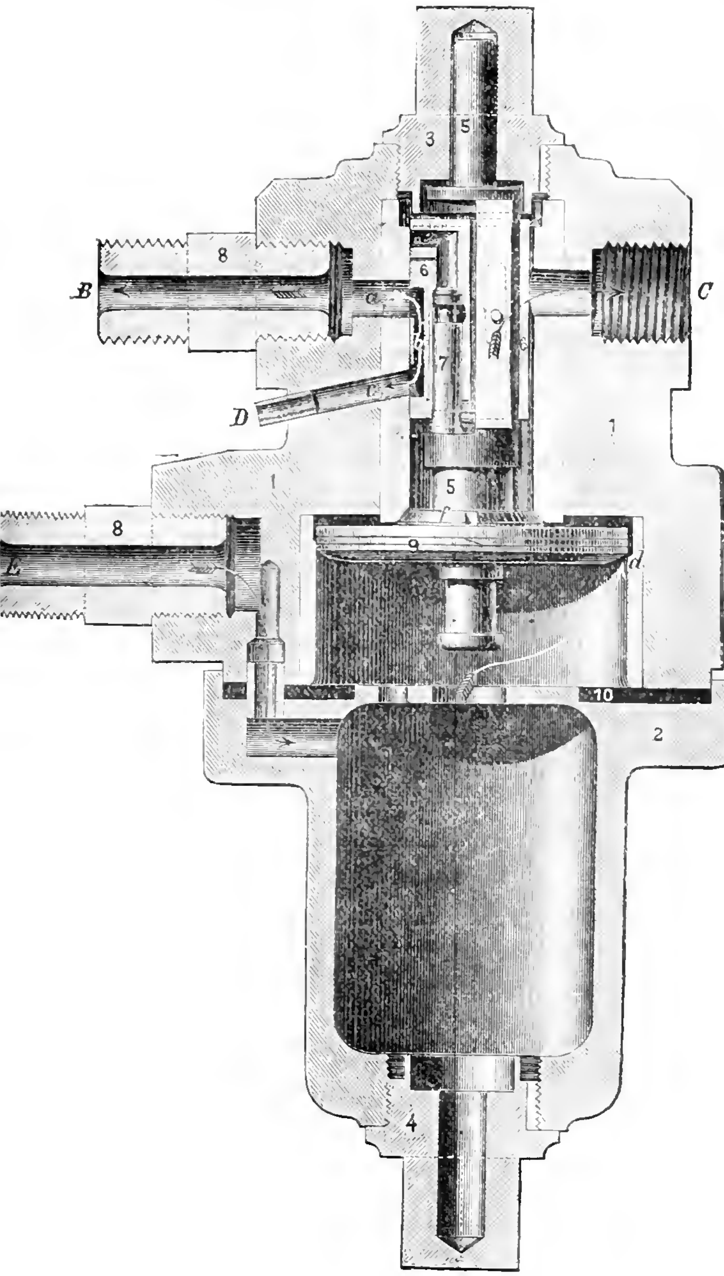


Fig. 2.

For the purpose of graduating the brake with the greatest nicety, that is to say, normally when approaching a station, a small valve, 7, is introduced into the slide-valve, 6. The action is as follows:—Upon a slight reduction of pressure in the brake-pipe being made, the piston, 5—having a limited movement, without affecting the slide-valve, 6—will descend, thereby closing the feed-groove *d*, at the same time unseating the valve, 7, which thus opens the passage *e*. The slide-valve, 6, then moves until the passage *e* opens into port *a*, leading to the brake-cylinder, the communication from which to the exhaust is at the same time cut off. The further downward movement of the slide-valve, 6, is arrested by the decrease of pressure above the piston, caused by the air flowing into the brake-cylinder. So soon as the pressure in the reservoir is thus reduced a little below that in the brake-pipe, the piston, 5, moves up of its own accord, and closes the valve, 7, while the slide-valve, 6, retains its position. By simply regulating the reduction of pressure in the brake-pipe, and causing the motion of the piston and graduating-valve, 7, to be repeated, the driver can gradually introduce any desired pressure into the brake-cylinder from zero up to full power. However, if a considerable reduction of pressure in the main pipe is suddenly made, the piston, 5, is seated on the leather gasket, 10, while the port *a* is entirely uncovered, and the brakes are thus applied with full force.

To release the brakes, air is again admitted from the main reservoir to the brake-pipe by means of the driver's valve. This store of power acting against the reduced pressure in the small reservoirs, forces the piston, 5, into the position shown, thus permitting the air in the brake-cylinders to exhaust, while at the same time the reservoirs are recharged.

To prevent such application of the brakes as might result from ordinary leakage in the brake-pipe, a small hole runs from the face of the slide-valve to the passage *e*. In such a case a piston and slide-valve descend very slowly, and as the port *a* is open both to the exhaust cavity, *b*, and the leakage hole during the first portion of the stroke, air from the reservoir is able to escape by this means into the atmosphere, instead of passing into the brake-cylinder. The reduction of pressure thus caused above the piston, as already explained, prevents the slide-valve from moving far enough to close the communication between the port *a* and the exhaust cavity *b*.

The only moving parts of the triple valve (*an ordinary piston and slide valve moving together as one piece*) do not make as many motions in fifteen years as are made by the piston and slide-valve of the locomotive in one day; hence their durability is beyond question, and this is confirmed by many years' experience.

A stop-cock is placed in the branch-pipe (between E and F, Fig. 1) for the purpose of closing the connection with the triple valve on any one vehicle without interfering with the operation of the brakes upon any other. A release valve (inserted in the tube connecting F with H, Fig. 1), operated by hand from either side of the train, may be opened to allow the air to escape direct from the brake-cylinder if necessary.

The reservoir space is about five times that of the brake-cylinder, consequently, a reduction of 20 per cent. in the brake-pipe pressure fully applies the brake, each pound reduction of pressure in the brake-pipe producing several pounds per square inch in the brake-cylinder. By the action of the triple valves, moreover, the brakes cannot be released without re-charging the small reservoirs, and owing to these features it has been found in working that the store of power is practically never-failing.

It is evident from what has been said that if by any means air is allowed to escape from the main-pipe, the brake must be brought into action, whether it is required or not. This fact constitutes the one great recommendation of the brake to the travelling public, which, I apprehend, embraces the vast majority of our countrymen. We are not so much interested in bone-shaking stoppages at stations, as we are in being arrested on what might otherwise be the high-road to destruction. The brake may be relied upon to operate within 200 yards when running at fifty miles an hour. It is not, however, in such cases only that the need for a brake exists. In the event of a train dividing, more especially when on either a rising or a falling gradient, it is important that the brake should be applied instantly to every section of the train. It may be taken as a certain eventuality that if a carriage gets off the rails, the couplings will be broken, together with the brake-pipe. The rupture of this pipe, however, causes an instantaneous reduction of pressure within it to 15 lb., that is to say, to the same as that of the atmosphere outside. The result is that the triple valve is brought into energetic action, is impressed downwards, and opens the small reservoir into the brake-cylinder. The brake is therefore immediately and most firmly applied, and the motion of the carriage arrested *automatically*. Had a device of this kind been fitted to the trains which met with such fatal accidents at Downton, Penistone, &c., there is every reason to believe that the lives of the victims would have been spared, because the carriages would have been so pulled up that they would not have rushed down the embankments as they did, but would in all probability have remained near the rails.

(*To be continued.*)

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p. 138.*)

THE SECOND EVENING.—THAT THE MOON IS A HABITABLE WORLD.

NEXT morning I sent to the Marchioness's apartments, to know how she had rested, and whether the motion of the earth had not disturbed her? She sent word back, she began to be accustomed to it, and that she had slept as well or better than Copernicus himself. Soon after, there came some neighbours to dinner, who, according to the tiresome rural custom, staid till evening, and were very obliging in going then; for the country also gives a privilege of extending their visit to the next morning, if they are so disposed: when they were gone, we walk'd again into the park, and immediately fell upon our systems. She so well conceiv'd what I told her the night before, that she desired I would proceed without any repetition.

"Well, madam," said I, "since the sun, which is now immoveable, has left off being a planet, and the earth which turns round him, is now become one, you will not be surprised when you hear that the moon is an earth too, and that she is inhabited as ours is."

"I confess," said she, "I have often heard talk of the world in the moon, but I always looked upon it as visionary, and mere fancy."

"And it may be so still," said I; "I am in this case as people in a Civil war, where the uncertainty of what may happen makes 'em hold intelligence with the opposite party, and correspond with their very enemies: for tho' I verily believe the moon is inhabited, I live civilly with those who do not believe it; and I am (like some honest gentlemen in point of religion) still ready to embrace the prevailing opinion: but 'till the unbelievers have a more considerable advantage, I am for the people in the moon."

"Suppose there had never been any communication between Paris and St. Dennis, and a cockney who was never beyond the walls of this city, saw St. Dennis from the towers of Notre-Dame, you ask him if he believes St. Dennis is inhabited as Paris is? He presently answers, 'No: for,' says he, 'I see people at Paris, but none at St. Dennis, nor did I ever hear of any there.' 'Tis true, you tell him, that from the towers of Notre-Dame he cannot perceive any inhabitants at St. Dennis, because of the distance; but all that he does discover of St. Dennis, very much resembles what he sees at Paris, the steeples, houses, walls, &c., so that it may very well be inhabited as Paris is: all this signifies nothing, my cockney still persists that St. Dennis is not inhabited, because he sees nobody there. The moon is our St. Dennis, and every one of us as mere cockneys as he that never was out of his own city."

"You are too severe," said she, "upon your fellow-citizens; we are not all sure so silly as your cockney; since St. Dennis is just as Paris is, he is a fool, if he does not think it inhabited: but the moon is not at all like the earth."

"Have a care what you say," replied I; "for if the moon resembles the earth, you are under a necessity to believe it inhabited."

"If it be so," said she, "I own I cannot be dispensed from believing it; and you seem so confident of it, that I fear I must, whether I will or no. It is true, the two motions of the earth (which I could never imagine till now) do a little stagger me as to all the rest. But, yet, how is it possible the earth should enlighten as the moon does, without which they cannot be alike?"

"If that be all," said I, "the difference is not great, for it is the sun which is the sole fountain of light: that quality proceeds only from him; and if the planets give light to us, it is because they first receive it from the sun. The sun sends light to the moon, and she reflects it back on the earth. The earth in the same manner receives light from the sun, and sends it to the moon; for the distance is the same between the earth and the moon, as between the moon and the earth."

"But is the earth," said the Marchioness, "as fit to send back the light of the sun as the moon is?"

"You are altogether for the moon," said I; "she is much obliged to you. But you must know that light is made up of certain little balls,* which rebound from what is solid, but pass through what admits of an entrance in a right line, as air or glass; so that what makes the moon enlighten us is that she is a firm and solid body, from which the little balls rebound; and we must deny our senses if we will not allow the earth the same solidity. In short, the difference is how we are seated; for the moon being at so vast a distance from us, we can only discover her to be a body of light, and do not perceive that she is a great mass, altogether like the earth; whereas, on the contrary, because we are so near the earth, we know her to be a great mass, proper to furnish provision for animals, but do not discover her to be a body of light, for want of the due distance."

"It is just so with us all," said the Lady; "we are dazzled with the quality and fortune of those who are above us; when, do but look to the groundwork, and we are all alike."

"Very true," said I, "we would judge of all things, but still stand in the wrong place; we are too near to judge of ourselves, and too far off to know others; so that the true way to see things as they are, is to be between the moon and the earth, to be purely a spectator of this world, and not an inhabitant."

"I shall never be satisfied," said she, "for the injustice we do the earth, and the too favourable opinion we have of

* We have here a popular account of the emission theory of light, which in Fontenelle's time (it is hardly necessary to say) was regarded as scarcely open to question.—R. P.

the moon, 'till you assure me that the people in the moon are as little acquainted with their advantages as we are with ours, and that they take our earth for a planet, without knowing theirs is one too."

"Do not doubt it," said I, "we appear to them to perform very regularly our function of a planet. 'Tis true, they do not see us make a circle round them, but that is no great matter. That half of the moon which was turn'd towards us at the beginning of the world, hath been turn'd towards us ever since; and those spots in her, which we have thought to look like a face, with eyes, nose, and mouth, are still the same; and if the other opposite half should appear to us, we should no doubt fancy another figure from the different spots that are in it: not but that the moon turns upon herself, and in the same time that she turns round the earth, that is, in a month; but while she is making that turn upon herself, and that she would hide a cheek, for example, and appear somewhat else to us, she makes a like part of her circle round the earth, and still presents to us the same cheek: so that the moon, who in respect of the sun and stars, turns round herself, in respect of us, does not turn at all: they seem to her to rise and set in space of [about] fifteen days; but for our earth, it appears to her to be held up in the same place of the heavens. 'Tis true, this apparent immobility is not very agreeable for a body which should pass for a planet, but it is not altogether perfect; the moon has a kind of trembling, which causes a little edge of her face to be sometimes hid from us, and a little edge of the opposite half appear; but then, upon my word, she attributes that trembling to us, and fancies that we have in the heavens the motion of a pendulum, which vibrates to and fro."*

(To be continued.)

THE INTERNATIONAL HEALTH EXHIBITION.

XIII.—WATER AND WATER-SUPPLIES—(*continued*).

THE excellent filter-case described in our last communication† not only provides for the outflow of every drop of filtered water, but can be taken to pieces and thoroughly rinsed when desired. A glance at the sectional figure (Fig. 22) will explain how this may be accomplished. To the apparatus thus constructed Messrs. Doulton & Co. have adapted the Patent Manganous Carbon Block, which is exempt from the disadvantages of the ordinary "block" principle. The latter are prone to harbour organic and other impurities to such an extent as to render them quite unwholesome. Thus, the Rivers Pollution Commissioners state that "the property which animal charcoal possesses in a high degree, of favouring the growth of the low forms of organic life, is a serious drawback to its use as a filtering medium for potable waters."‡ The Army Medical Report, again, states of charcoal in porous blocks, that, "after a time the purifying power becomes diminished in a marked degree, and water left in contact with the filtering medium is apt to take up impurity again.§

It is well known that carbon is adapted to filtering purposes, on account of its property for appropriating and condensing oxygen, which it parts with to organic substances brought to it, and oxidises or burns them up. Animal charcoal is peculiar in its decolourising or bleaching effects, and vegetable charcoal has the power to deodorise. A combination of the two deprived of all adventitious matters is, therefore, of the highest value to filter manufacturers who seek to purify water for drinking. To entirely discard such a valuable medium would indeed be to "fly in the face of Providence." The problem which here arises may be solved in either of two ways:—(*a*.) The purified mixture of carbon should be such as to provide for a constant reparation of its properties; or (β) It ought to be easily replaceable at a very trivial cost.

We have already stated that experiment has shown the "block" system to be faulty, because it soon becomes overtaxed, and no amount of boiling or scrubbing can restore it to its pristine active condition. The only remedy is to be sought for in a renewal of the block, but the frequent necessity for such an operation has the great disadvantage to be a very expensive process. Such was the state of affairs when the block system "ruled the roast," that the domestic filter came to be looked upon either as a troublesome luxury, or, when neglected, as a dangerous contrivance. Yet the necessity of an efficient household water purifier made itself sorely felt, and Messrs. Doulton & Co., as one of the oldest and most celebrated firms of filter manufacturers, felt themselves called upon to remedy matters. They consulted Dr. Albert J. Bernays, F.C.S., the Professor of Chemistry at St. Thomas's Hospital, and the result of his researches, which extended over a period of three years, is now embodied in their "Patent Manganous-Carbon Filter." Fig. 25 shows one of these filters

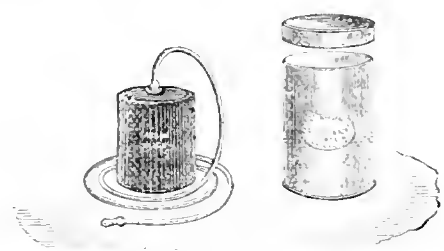


Fig. 25.—Doulton's Patent "Manganous-Carbon" Block Syphon Filter and Case. For the use of tourists and explorers.

as adapted to the use of tourists and explorers. The carbon block can be immersed in any pond or stream, and a draught of pure water sucked through the flexible tube. These filters may also be used upon the "Syphon" principle; the block may be placed in a pail of water, and the flexible tube permitted to hang over its side, below the level of the block; once set going by suction, their action thereafter becomes continuous.

The value of manganous-carbon as a filtering medium has been set forth by Messrs. Doulton in their prospectus, in the following outline of its reactions:—"With the object of rendering the charcoal pure in the manganous-carbon filter, each grain of the medium receives a coating of manganese dioxide, and is then reburnt at a high temperature in absence of air. By this means the hydrogen-bearing impurities are oxidised and removed. At the same time the manganese dioxide is reduced to a lower oxide. These lower oxides rapidly reabsorb oxygen from the air, becoming again converted into hydrated dioxide, which, in its turn, yields oxygen to the organic matters present in the water. Thus the manganese acts as a carrier of oxygen from the air to the impurities in the water, oxidising or burning up the latter, *and then again becoming revivified by the atmosphere.* Manganese also exerts a preventive influence on the growth of organisms, the

* Of course the lunar vibrations are not real tremblings, as here described. They arise, in fact, from the uniformity of her rotational motion, combined with her steady, though not absolutely uniform motion, on a path slightly inclined to the plane of her equator.—R. P.

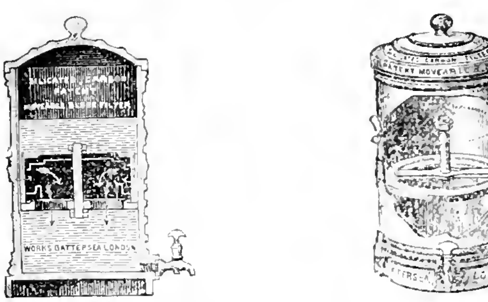
† *Ut supra*, p. 139. ‡ "Sixth Report," p. 220.

§ "Army Medical Report," XIX., p. 170.

result being that the charcoal, purified by the treatment, and increased immensely in oxidising power by the carrying action of the manganese, *acts better and lasts longer than any ordinary charcoal could.* This was proved by one of the early experimental filters of manganous-carbon, which ran for *two years* with ordinary water, and then, on taking to pieces, showed the charcoal perfectly sweet, and with no objectionable appearances under the microscope. The organic impurities had evidently been burnt up, not simply separated by straining: in the latter case, they would have remained in the charcoal." . . . "Manganous-carbon has a developing or increasing power of agency, and improves greatly after short use, as the lower manganous oxides gradually assume a flocculent and highly active peroxidised condition. The activity then remains for a long time unchanged, depending, of course, much upon the quality of the water."

It will be gathered from the above that the block is kept perpetually sweet and clean, by exposure to the influence of the atmosphere, and upon this depends the advantage to be gained by the use of manganous-carbon. Two blocks are supplied, if desired, with each filter, so as to allow of a weekly or fortnightly change for purposes of aeration.

Type III.—The "Silicated-Carbon Patent Movable Block Filter," as its name implies, is also constructed upon the "block" principle, and finds a place here, because it too has survived the severe ordeal to which filters are subjected now-a-days. All the working parts of the filter case are made of stoneware, and are hence incorrodible; the tap is placed on a level with the lowermost stratum of the reservoir, and the entire apparatus admits of being taken to pieces and easily cleansed. The mechanical details of these filters may be readily understood by a reference to Fig. 26. It may be observed that in Fig. 26, A, the direction of the passage of the water through the



A B

Fig. 26.—The Silicated-Carbon Movable Block Filter. A. Longitudinal Median Section. B. Interior view.

block is indicated by a series of arrows; this is caused by the novel construction of the block itself, the top and edges of which are made of non-porous material, so that the water is forced to pass through a maximum amount of the carbon. The block, moreover, is bolted down on to an asbestos seating, which is made to form a water-tight joint.

The company have informed us that—"*Silicated Carbon* is an admixture of carbon, iron, silica, and alumina in ascertained proportions; the carbon being Torbane Hill mineral, from which the oil has been abstracted." Professor Wanklyn states* that his confidence in the filter is such, that he has passed a solution of strychnine through it, and then drank the filtrate. His explanation of its action is as follows:—"It is an energetic oxidising process, very like the action of the strongly alkaline solution of permanganate with which we are in the habit of boiling the nitrogenous organic matters in drinking-waters. Just as by working the ammonia process we make the nitrogenous organic matter contained in water yield ammonia, so the Silicated Carbon Filter breaks up nitrogenous matters and makes them yield ammonia. In fact, it is possible to work the ammonia process of water analysis *by means of a Silicated Carbon Filter*, instead of the boiling alkaline solution of permanganate of potash.'* Its lead-removing property has been commented upon by Dr. Bartlett and others, and experiments have shown that it even softens water to an appreciable extent.

* The *Echo*, Aug. 9, 1884.

BRITISH SEASIDE RESORTS,

FROM AN UNCONVENTIONAL POINT OF VIEW.

By Percy Russell.

III.

PASSING from Bangor, famous for its slates and the tombs of veritable Princes of Wales, with its long crooked streets, in a fertile valley, guarded by steep heights, and proceeding eastwards, we reach Conway, the historic seaport of Carnarvonshire. Here can be studied some fine examples of ancient municipal fortifications, and the Castle is allowed to be the finest example of such structures in Great Britain. Some of the walls are nearly four yards thick. A "sight" of this place is the Plâs Mawr, *i.e.*, the Great Mansion—a stately pile dating from Elizabeth, and most curiously adorned without and within by heraldic devices. Conway contains the tomb of the Great Llywelyn, and to Welshmen is on that account a sacred city. The river is here, at spring-tide, full half a mile wide, and from the days of the Romans has had a reputation for pearls. The coast now takes a sharply northern direction. and brings us to one of the nineteen great headlands of England and Wales, Great Orme's Head. This striking natural feature lies about five miles only north east of Conway, and is an immense mass of limestone rock, rising to a height of nearly 700 feet, and surmounted by a lighthouse. East of this remarkable feature of the coast is Llandudno, with its soft airs and fine bathing, and passing Abergele and Rhyl, and still working eastward, we now reach the noble tidal estuary of the river Dee, which the ancient Britons, by the way, regarded as a sacred stream. The estuary of the Dee is nine miles long, and at seasons full six wide, and is hallowed to the students of Milton as the fatal shallow where "Lycidas," or, in plain English, Mr. King, the friend of the poet, suffered shipwreck and death.

Parkgate, little known to the ordinary tourist, is a small watering-place competing with the better-known Mersey resorts for visitors from Liverpool. No purer air can be found in England than that blown over the beautiful Dee and down from the Welsh hills, while the lovely scenery of North Flintshire and the splendid expanses of the estuary here give Parkgate a strange charm for all who love Nature in her picturesque phases. At times, indeed, and especially at low water, the estuary becomes in great part a vast waste of sand and ooze, and then aptly enough reminds one of the dirge-like song in Kingsley's famous Chartist novel or political pamphlet—

> Oh, Mary, go and call the cattle home,
> Across the sands of Dee.

Seen, however, with the tide in, the estuary is a grand

* In a paper read before the "British Medical Association," at Sheffield.

expanse, and fit for the haven of commercial fleets. This was, I believe, the Seteia Æstuarium of Ptolemy. About a century and a half since the Dee from Queenferry to Chester was embanked, and thereby the agricultural area of these islands gained about 50,000 acres. For persons of true pedestrian tastes, a ramble from Parkgate to Hoylake along the high ground parallel with the coast here has great charms, and in the vicinity may be seen the favourite resorts of many of the merchant princes of Liverpool.

Birkenhead—which originated in a Benedictine Priory of the twelfth century, possessing the important monopoly of the ferries over the Mersey—is a place of commerce, and in its present aspect in no way resembles the Berkin de Birchen of Edward III. Then one vast, beautiful forest extended in leafy luxuriance from the Dee to the Ribble, and thus amply justified an old local distich—

From Birchen haven to Hiltre
A squirrel might hop from tree to tree.

The shores of the Dee, by the way, are memorable as the place whence the English freelances and other worthies of the feudal time used regularly to set out for excursions to Ireland—excursions which, doubtless, sowed the fatal seeds of nineteenth-century Fenianism.

Traversing the coast at Bidston Hill is the historic Liverpool Observatory. I say historic, for here all the chronometers go to be regulated, and the equatorial of twelve feet focal length and eight and a half inch aperture, with other special scientific appliances, are worthy to be duly chronicled—more so than the doings of many of the iron-clothed gentlemen who found these remote shores a good place for rendezvous when on spoliation bent. From the lighthouse here a magnificent view can be had both of the estuaries of the Dee and of the Mersey, of Liverpool, that lordly seat of British commerce; of Birkenhead, Seacomb, Hoylake, Flint, a long and grand expanse of distant Welsh mountains, and, nearer to the gazer by far, New Brighton, which is just a pretty medley of seaside houses and hotels standing on a sandy promontory north of Birkenhead, and commanding extensive and lovely views of the Irish Sea. The lighthouse here is constructed of Anglesea granite, and cemented with a peculiar volcanic substance, brought, I am told, from Etna, and possessing the useful property of hardening more and more with the lapse of time.

One place on this coast must not be overlooked, that is Leasowl Castle, a singular quaint erection near a shoal known as Mockbeggar Wharf. This spot is associated with a racecourse, and as long ago as 1593 races were run here, and it was about then that Ferdinand, Earl of Derby, built Leasowl as a sportsman's lodge. It is said that the unfortunate Duke of Monmouth was prominent in one of these races in 1683, and once on a time Leasowl was quite a centre of Lancashire fashion. Although the magnificent forests which once clothed these shores in such sylvan beauty have long since perished, ample traditions thereof remain in the neighbourhood, and in the hall at Leasowl are preserved specimens of the *Cervus elephas*, not to speak of fibulæ and rings which silently remind us of the grandest civilisation of the Pagan world.

We now enter the region of the great Pennine range, that vast expanse of lofty moorlands and enormous masses of hill and mountain stretching south of the famous Cheviot hills. These ranges lie much nearer the Irish Sea than to the North Sea, and reach considerable altitudes—Cross Fell being 3,000 ft.; Mickle Fell, 2,591 ft.; Whernside, 2,414 ft.; and Ingleborough, 2,373 ft. above the sea level. The Cumbrian group of mountains lie in the west of the Pennine Chain, which is, in a manner, continued right down to the Cornish highlands, and is bound to the main range by lofty moorlands, beginning near Whernside. These moorlands dip and form the striking pass of Shapfell—the commercial road between all West England and Scotland—and north of Shapfell is the broad and beautiful valley of the Eden, ending in the famous estuary of the upper portion of the Solway Firth. Southward is the narrow estuary of the River Lune, on which stands Overton, whose inhabitants have become celebrated through their quaint petition, that, being surrounded by the sea twice every twenty-four hours, they might have a minister of their own instead of being obliged to go to Heysham. The Lune, which gave its name to Lancaster, doubtless, as antiquaries tell us, the Lengovicum of Roman days, flows into Morecambe Bay, one of the most beautiful indentations of the whole English north-west coast. Inland, within the wild and picturesque region bounded by the Lune on the one hand and the Solway Firth on the other, soars up in great grandeur a compact and somewhat circular mass of mountains, precipitous in general upon their northern and western faces, but subsiding gently to the wide sweep of Morecambe Bay in long and easy declivities. From the centre of this group, which imparts such a distinctive and romantic character to the north-west of England, there soars up the "mighty Llewellyn" (3,118 feet) as Scott calls it. Then there is the famous Skiddaw (3,054 feet), embalmed in the somewhat obsolete poetry of Southey, and Scafell, already mentioned, the loftiest peak in all England; and southward the hills slope away into the sea in the picturesque peninsula of Furness. Within, of course, is the great series of lakes, but with these I have here no concern.

Returning to the shore I note that on the pretty peninsula formed by the mouths of the Lune and the Cocker may be seen the ruins of Cockersand Abbey, once occupying the third place among the proud array of Lancashire monasteries, and, subsequently to the Reformation, falling into the possession of the Dalton family, who raised a whole regiment of cavalry for the service of Charles I. All along the coast, or but a little way inland, are to be found objects of great interest to archæologists.

Morecambe Bay receives the waters of the Lune, the Keer, the Winster, the Kent, and the Leven rivers, and is set in the midst of some of the very finest scenery in these islands. The coast is remarkable for its very picturesque sinuosities, and is characterised by its many lovely valleys, its noble parks, and in many cases rich woods, that come down to the very shores. The towns on or near the coast are mostly ancient, and all are rich in historic associations and generally abound in archaic remains of great and enduring interest; and in few, if any, regions of England are such truly picturesque villages to be found.

When the tide is out the enormous stretches of sand form an extensive plain which, in olden days, was traversed by the famous "Over sands" coach running from Lancaster to Ulverston. But the route was always perilous, consequent on the shifting nature of the sands and the action of the rivers flowing into the vast Bay. In one churchyard alone are the graves of over one hundred persons drowned while attempting, at dangerous seasons, the passage of the alluring but treacherous sands; and many are the legends current in the locality of hair-breadth escapes and romantic episodes connected with the far-stretching Bay. The railway constructed across the bend of Morecambe Bay ranks high as among the most remarkable achievements of modern engineering science, and was beset with extraordinary difficulties. The works are a monument of the genius of Mr. Brunlees, and have resulted *inter alia* in restoring land to agriculture where for generations fishermen cast their nets. The whole region abounds in places of interest, but for the greater part these are but little known, popularly speaking, in southern England.

The fishing-villages on some parts of the Lancashire coast are remarkable for the utterly primitive habits of the inhabitants, and for the large quantities of flounders and shellfish here taken. All along the wild shores of this beautiful region may be seen the picturesque limestone cliffs, mingled with hanging woods, peaceful-looking, fresh grassy mounds, and far away in the grey distance are the lofty mountains and elevated moors—virtually uninhabited stretches of country, swept by perfectly pure and fresh breezes, and equally refreshing to body and mind.

Barrow, the port whence the famous iron ore of the Furness district is shipped, lies on the coast of the peninsula, and is opposite a little island which tradition tells us was once a burial-place for the Norse Sea Kings. Until 1847 this place was only a small fishing-village, having barely 300 inhabitants, but in 1875 it had increased to 40,000, and now the docks and the various iron and steel works render this town one of the great sights on the Lancashire coast. Furness Abbey gives in its remains the finest examples extant of mediæval ecclesiastical architecture. It was formerly one of the most powerful of the great religious establishments of England, before, as Scott tells us, the ire of a despotic kind made altar shake and crozier bend. The landed property of the abbey once included the entire promontory on which it is situated, and extended to the river Duddon, whose beauties Wordsworth has crystallised for evermore in some of his exquisite sonnets. This domain was about equal to the area of the Isle of Man, and the Abbey could, and frequently did, send over a thousand regular troops into the field, sending, by-the-by, a large contingent to Flodden Field under Sir Edward Stanley. On the hill commanding the Abbey there was formerly a beacon, and thence alarm fires were flashed right across Morecambe Bay as far as the grim towers of Lancaster Castle. The Abbey has a very fine transept, and many very interesting monuments, and for full four centuries these proud and lordly representatives of what was emphatically a Church Militant held imperial sway far and wide. The last abbot was, if I mistake not, Roger Pyle, who surrendered his authority to Henry VIII., and thenceforth all the material pomp and circumstance of these lordly priests went to decay. For the last three centuries the rooks have occupied the ruins, which have been preserved from further decay by the Duke of Devonshire. These remains furnished subject-matter for one of Wordsworth's many fine examples of what may be called topographical poetry, and no one can stand amid these magnificent ruins without feeling some emotion, some touch of that fine sympathy with the past which imparts to every ruin its true pathos.

The Furness District, once the boundary between the Kingdoms of England and Scotland, and the scene of many a tough border scuffle which has found no historian, may be described as in some measure all mountain, and it was in these stern and natural fortresses that the ancient Britons lingered for two centuries and a quarter after the Saxons had obtained the mastery everywhere, except in Wales.

Straightaway due west of the mouth of the romantic River Duddon is the Isle of Man, its southern extremity being in a line with Walney Island, at the entrance to Morecambe Bay. Before, therefore, entering the Solway Firth, and proceeding, as I propose doing, up this wild coast and among the wilder islands of Scotland on the west, I shall rapidly sketch this remarkable island, which, as it richly deserves, is becoming more and more a place of resort for those who desire to be personally familiar with the less known seascape beauties of the British Isles.

Editorial Gossip.

The well-remembered words of Virgil, "Uno avulso non deficit alter," have had no more literal applicability in recent days than to the succession of shows at South Kensington. With the Health Exhibition in the very height of its popularity; with its innumerable forms of restaurant perennially mobbed by customers; with the instructive popular archæological lesson conveyed by the admirable model of Old London, daily and hourly being learned by the thousands who throng it; with the exhibition of historical costumes scanned by a perpetually densely packed crowd; with the third-rate Cremorne at night in the gardens, where 'Arry smokes his cheap tobacco and Jemimarann exhibits her fringe, her long gloves, and her box-pleated skirt; with the dairy cows in full milk; the sweet-stuff and candle-making machinery in full work; with the bands playing, the lamps twinkling, the steam-boilers hissing, and the dynamos whirling—already is the note of preparation in the air, and the prospectus of the International Inventions Exhibition in 1885 lies before me as I write. Reading through it, it seems as though the bazaar element, so obtrusive in the present show, will be—or rather may be—to a certain extent, modified; and that the Exhibition may possibly assume a more strictly scientific character than the present one. It cannot, however, be lost sight of that the Commissioners of the '51 Exhibition have now become as much showmen as Mr. P. T. Barnum, Mr. Hollingshead, or Madame Tussaud. If turning their buildings into a series of railway refreshment-rooms, or lighting their gardens with "10,000 additional lamps" *pays*, they will furnish the buffets, stick up the little marble tables, and light the lamps. They are merely trying to justify their *raison d'être*, and have hit upon periodical shows as a good device for giving employment to the officials on their estate and of making money. If money can be made by science, all well and good; if not, well, a slight soupçon of the Bartlemy-fair element obviously proves attractive.

The present "glorious weather" (to employ the phrase just now in every one's mouth) brings us once more face to face with the wholly inefficient means we possess in this country for meeting the somewhat violent extremes of temperature to which we are subject. Adapted, perhaps, best to the average warmth of an English spring or autumn, a very severe winter, and perhaps even more conspicuously an abnormally hot summer, shows the weakness at once of our domestic architecture and of our orthodox type of dress. That any human being should disport himself in a "pot" hat and black cloth coat with the thermometer registering 154 Fahrenheit in the sun, must seem almost incredible to any one who does not daily see the unnumbered thousands so attired who throng the streets of the metropolis. But the cult of Mrs. Grundy among Englishmen is so earnest and sincere that the average Londoner would about as soon think of carrying a Punch's show through St. James's-square, or of wheeling a barrow full of periwinkles down Bond-street, as of appearing in either of those localities in a "khaki" suit with a pith hat and "puggree." And what applies to our attire may be equally predicated of our contrivances—or, rather, utter want of contrivances—for keeping our houses cool. Why does not some enterprising tradesman devise something akin to the Indian "tattie," and furnish us with a sunblind constructed to be kept wet. The delicious coolness produced in the air by the rapid evaporation from such a device must be felt to be appreciated. Nay, even a moditification of the familiar punkah would not be without its pleasurable use on such a day as that on which these lines are penned. Will no one render us aid before we get into the condition so feelingly described by the negro, when he said that "it couldn't be no hotter in our house, for de termometer 'as got bang up to de top, dat's one comfut!"?

Miscellanea.

Some idea of the difficulties in the way of making large telescopes may be had from the fact that there have been nineteen failures to cast the thirty-six inch glass for the large telescope to be mounted in California.

The fire insurance companies of Sweden have offered a reward of 2,000 crowns for the most practical device to arrest sparks and cinders from locomotive and steamboat smoke-stacks. A trial of different devices that may be sent in will take place in Stockholm, Sweden, during the month of August, this year.—*Engineer.*

The effective armoured fleets of the leading naval Powers of Europe might be summarised as follows:—England, 329,520 tons; France, 201,789 tons; Germany, 74,007 tons; Austria, 63,110 tons; Russia, 83,621 tons; Italy, 59,905 tons. This is food for deep reflection. Had the energy expended in producing these munitions of war been devoted to labouring for the mutual welfare, instead of destruction of mankind, how much good might have been wrought?

As a passenger train on the Painseville and Youngstown Railroad was at Youngstown, Ohio, July 1st, and just as it was pulling away from a water tank, a valve in the latter broke, sending an 8-in. stream of water against the train, breaking all the windows and deluging the coaches. Many of the passengers, with their clothing thoroughly water-soaked, leaped from the train, rolling down an embankment, and some were bruised. Several ladies in the train had their dresses ruined.

On the Liverpool and Manchester section of the London and North-Western Railway, some of the trains are now lit by Swan 20-candle-power lamps. A Brotherhood engine on the tender drives the dynamo, and near the driver's hand is a regulator fitted with a lamp showing the candle-power of those in the carriages. Each compartment has duplicate lamps; in the event of accident to one, the other is instantly made incandescent.

The success of creosote as a preventive of the attacks of the toredo worm could not be better exemplified than by the tests made by the Louisville and Nashville Railroad. The company caused timber treated with the creosote process, and perfectly healthy cypress timber, sound in every respect, to be submerged at East Pascagoula. Both kinds of timber were recently raised, and that treated by creosote was found to be in a perfectly healthy state, while the other was found to be honeycombed by the worms. —*Picayune.*

Telephony.—Servia boasts one telephone line one kilomètre long, connecting the Ministry of the Interior and the Préfecture at Belgrade. Bulgaria and Luxembourg do not believe in the telephone; at all events, they have not a yard of line at work at present. Turkey has three lines, one used by the Administration of Telegraphs, the second used at a life-saving station on the Black Sea, and the third belonging to the Eastern Telegraph Company and the Ottoman Bank. The above lines represent a total length of wire of 41 kilomètres.—*Electrician.*

One of Barnum's secular elephants, "Allah," was attacked with enteritis while in Cincinnati. Dr. George W. Bowler, V.S., was called in, and relates his experience in *The Journal of Comparative Medicine.* The diagnosis being made, he prescribed and administered the following liberal dose: lard, eight pounds; linseed oil, one gallon; tincture of opium, one pint; spirits of nitrous ether, one pint; syrup, one quart. The lard and oil were first mixed, then the other ingredients added. The trunk was raised above the head and the mixture poured down the throat through a large metal tube. The animal recovered.—*American Druggist.*

Electric Lighting in Lausanne.—The Swiss Electrical Company have, says the *Electrician,* lighted the Cantonal Hospital at Lausanne on the Edison system. The installation comprises 236 lamps and three dynamos, the latter being driven by three turbines. The company also have a central station in the same town, where there are two dynamos driven by two turbines of 35 horse-power each. These supply current to 280 lamps. There are 72 subscribers to the company's system.

A Red Lunar Halo.—A magnificent lunar halo of a red hue was, says *Engineering,* observed at Rome by M. Tacchini, on July 4, at 9.30 p.m. The moon itself showed of a reddish hue, and was surrounded by a reddish aureole, of a width rather more than the diameter of the moon. The tint was nearly that of bright, pure copper. The moon at the time was nearly 30 degs. high; and the phenomenon was seen till 10 o'clock. On July 5, the same phenomenon was visible, but more feeble; on the 6th, the sky was clouded. Afterwards the phenomenon was no longer seen. During the nights of the 4th, 5th, and 6th the atmosphere was excessively humid, from 9 p.m. to 6 a.m. of the following mornings. The saturation during these intervals was almost complete; whereas, during the day, the humidity fell to 0·40.

As a commercial port, the trade of Antwerp has increased to an astonishing extent within the last few years, as shown by the following figures:—In 1869 the tonnage of the port of Havre was 1,042,236; of Hamburg, 946,154; of Rotterdam, 673,830; of Antwerp, 546,554; of Bremen, 426,237; of Amsterdam, 413,780; of Dunkirk, 279,144. Of all the northern ports, therefore, Antwerp ranked fourth. But in 1882 it had so rapidly increased, owing to the improved harbour works and navigation of the Scheldt, as also to the greatly extended railway communication, that Antwerp has mounted to the top of the tree, and now stands first. The figures of 1882 show that the tonnage of the port was 3,401,534; while that of Hamburg was 3,030,909; of Havre, 2,266,927; of Rotterdam, 2,085,338; of Bremen, 1,129,217; of Dunkirk, 939,343; of Amsterdam, 784,379.

M. Lazare Weller has conducted a series of valuable experiments with the object of ascertaining the relative electric conductivity of metals, submitting the results to the Société Internationale des Electriciens. They are referred to a pure silver wire, 1 millimètre in diameter, and having a resistance of 19·37 ohms per kilomètre at 0 deg. C., as a standard. The following are his figures:—Pure silver, standard 100·00; pure copper, 100·00; silicon bronze (telegraph), 98·00; alloy of equal parts silver and copper, 86·65; pure gold, 78·00; pure aluminium, 54·20; silicon bronze (telephone), 35·00; pure zinc, 29·90; phosphor bronze (telephone), 29·00; alloy of equal parts silver and gold, 16·10; Swedish iron, 16·00; pure Banca tin, 15·45; 10 per cent. aluminium bronze, 12·60; Siemens steel, 12·00; pure platinum, 10·60; pure lead, 8·88; pure nickel, 7·89; antimony, 3·88.

The report of the directors of the Panama Canal Company on the present condition of the works states that the number of men employed in May, 1884, was over 19,000. It is calculated that the excavations amount to 110,000,000 cubic mètres, in addition to 10,000,000 cubic mètres of earthworks in altering the course of the Chagres. Up to the end of April, 1884, the total amount of work done is represented by 5,243,302 cubic mètres of earth removed. Until January 1, 1884, however, the real work of cutting the Canal had scarcely fairly begun, and of the total of 5,243,302 cubic mètres of earth removed, nearly half, that is to say, 2,482,768 cubic mètres, have been removed in the first four months of the present year. In the total of 120,000,000 cubic mètres of ground to be excavated, 40,000,000 will be taken away by means of dredgers. The projector says there can be no doubt of the Canal being open for navigation before the close of 1888.

Tramways at Rio de Janeiro.—The Brazilian capital is particularly rich in tramways, there being no less than 133¾ miles within the city and suburbs. The four largest of these tramways are the Botanic Gardens, 22½ miles; the St. Christo, 27½ miles; the Villa Isabel, 17 miles; and the Urbain, 28½ miles. Altogether the 133¾ miles of tramway existing in Rio de Janeiro and the neighbourhood are owned by nine companies. The rolling stock placed by these companies upon the lines comprises 554 carriages, of which 363 are used for the conveyance of passengers, and 191 for the carriage of goods. The traction service is carried on by mules and horses, and there are no less than 4,921 of these animals at work upon the lines. The working staff comprises 1,482 persons. The number of passengers conveyed over the lines has averaged 35,532,926 per annum. The net profits realised upon the four principal lines last year were as follows: Botanic Gardens, £63,024; St. Christo, £62,165; Villa Isabel, £17,516; and Urbain, £43,666. Two of the smaller tramways were worked at a slight loss last year.—*Engineering.*

Pasteur's Experiments on Rabies.—The commission deputed by the French Government to verify the discoveries reported by M. Pasteur in relation to canine madness have so far completed their investigations as to send in an official report. The report, which appears in the *Journal Officiel*, certifies that M. Pasteur has advanced nothing that has not been found strictly correct. Science, it adds, has solved the problem of rendering the dog proof against the disease, by means of a preventive inoculation of attenuated virus. All the dogs declared by M. Pasteur to be protected by the immunity he had conferred upon them resisted the inoculation with the strongest virus, while the majority of dogs who had not been so protected became rabid when inoculated with the strong virus, and died. The committee propose hereafter to make further experiments as to the duration of immunity after preventive inoculation, and also as to whether protection is afforded if the preventive inoculation does not take place until after a bite has been inflicted by a rabid dog. The committee said that they have prepared this preliminary report in order that M. Pasteur may use it for his communications to the scientific congress at Copenhagen "on results which honour in so high a degree French science, and give it a new title to the gratitude of humanity." The committee consists of MM. Beclard, Paul Bert, Bouley, Tisseraud, Villemin, and Vulpian.

A Marsh under the Ocean.—Every south-east and southerly storm throws upon the south side beach of Long Island large masses of peat, lignitic branches, trunks of trees, fossilised leaves, and animal remains. The coast, it is said, after a heavy wind and surf, is strewn with these apparently unaccountable objects from Atlanticville to Water Island. The geologists state that the appearance of débris seems to be the result of the wave action of the surf upon the remains of a vast swamp, at present submerged beneath the Atlantic. After due calculations they have decided that this submarine swamp extends fifty miles longitudinally and half a mile latitudinally. Professor Newberry, of Columbia College, gives the following explanation of the existence of this marsh:—"The coast is settling, and what had been swamped places on the land have been submerged by the waves. We find along the coast of New Jersey, Staten Island, and Long Island, evidences of subsidence going on at the present time, and that which was forest land and marsh land is now out at sea. In some places the peat beds which were marshes on the land have been submerged, and we find shell-fish bored into the peat. I have plenty specimens to show that the level of the land has changed, and we have also fresh evidence of that circumstance in the fact that stumps of trees of a large size are found along the coast at some distance in the water, where they are only, perhaps, visible at low tide. They must have grown on comparatively dry ground."—*Engineering.*

Small-pox, Chicken-pox, Cow-pox, and Vaccination.—By far the most important medical work for the past quarter is the report on the above-named subjects, by Joseph Jones, M.D., President of the Board of Health of the State of Louisiana. The report consists of 410 closely-printed pages, and, like everything that comes from the pen of this most original, industrious, and truly gifted author, is a model from which every one who reads it may take something for copy and instruction. Reading the essay carefully through, I am brought to the conclusion that no approach to it as a history of vaccination can be found elsewhere, and that we, in England, have nowhere collected in any volume anything like the amount of information that has been here produced by our learned American *confrère*. Every point connected with small-pox, vaccination, and spurious vaccination has been sought out, condensed, analysed: while drawings, very natural in character, are freely interspersed to illustrate, from point to point, the author's histories, views, or conclusions. Amongst the general conclusions which the author draws at the close of his treatise the following are some of the most important:—(*a*) Vaccination, when carefully performed on Jenner's method, is as complete a protection from small-pox now as it was in the early part of the century; (*b*) Without vaccination, the application of steam and navigation and land travel would have, during the past fifty years, scattered small-pox in every part of the habitable globe; (*c*) Vaccination has not impaired the strength and vigour of the human race, but has added vastly to the sum of human life, happiness, and health; (*d*) Inoculation for small pox, which preceded vaccination, induced a comparatively mild and protective disease, but multiplied the foci of contagion, kept small-pox perpetually alive, and increased its fatal ravages among mankind. On one subject only could it be wished that this excellent authority had bestowed more labour—namely, whether the diffusion of small-pox in last century by the process of inoculation did not form the background on which vaccination stands so prominently as a blessing, not altogether unalloyed, to our race. In other words, if there had been no universal distribution of small-pox by inoculation, would the disease under an improved hygiene have died out altogether without vaccination? There is, perhaps, no one living who could answer this one all-important question more completely than our author. Will he undertake the task?—*The Asclepiad.*

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

THE SENSE OF TASTE.

[1364]—In the interesting article on "The Sense of Taste," Knowledge, 8th inst., its author makes no reference to instinctive desires or longings, and how these may influence taste. An acid drink or unripe orange may be enjoyed at one time, but much disliked at another: or, again, pickles, uncooked lettuce, raw onions, &c., are sometimes eagerly accepted and enjoyed, while at other times they are rejected as most uninviting. These instinctive cravings are most interesting to watch, as in my experience they often indicate certain wants of the body. Several times I have seen a very young infant object to suck its mother, apparently because the milk was poor and unsatisfying: while it readily took the nursing-bottle, which, moreover, did not always agree with it.

If Mr. Grant Allen could give us an article embracing and explaining these and such like points, it would be most interesting and instructive.

Wm. Main.

PERSPECTIVE.

[1365]—I must still maintain that R. Jones is wrong "in his criticism" on perspective.

If, instead of one cube, he had a row of them extending right and left of his point of sight, it would be curious to know whereabouts he would begin his two slopes; for, according to him, only the middle cube is parallel to the spectator.

Now, instead of cubes, let him stand in the middle of his shelf and draw that. The longer the shelf the better, if he only remembers another rule in perspective, viz., not to attempt to "take in" more than you can see without turning the head (or about one-third of your hemisphere).

Lest his preconceived notion should interfere with his drawing the line correctly, let him test its position by holding up a ruler, so as to tally with the edge of the shelf.

Or, instead of "an imaginary plate of glass," let him spread a thin layer of gum on one of his window-panes, and, standing directly in front of it, let him (when the gum has dried) trace on it with pen and ink (shutting one eye), both to right and left, say, the area-rail of the opposite houses, if in a street. He will, doubtless, thus become a convert to the received system, as he cannot deny that the result is "as it appears to his eye."

Rosalie Vansittart.

[1366]—The horizon line of the sea, as viewed from an elevated point, is evidently a hyperbola. At St. Helena, at the back of the Artillery Barracks (which are on the top of a cliff 600 ft. high), is a long wall with a level top. Standing on the hillside behind it, at such a height that the wall-top and horizon about coincide, the latter may be seen to rise in a distinct arch above the former, the ends of the arch cutting the wall at a very acute angle.

Aug. 4, 1884. Musafir.

WEARING THE DEAD.

[1367]—In your article on "Embalmers," mention is made of a Guinea tribe who "reduce their relatives to a liquid state and drink them down." It may interest your readers to hear of a tribe who *wear* the remains of their dead.

When in the Yosemite Valley, N. California, in October, 1870, I met a small band of that very low type of the human race, the Digger Indians. They had come down into the valley from Mono

Lake to collect acorns for their winter supply of food. In stature they are short, and almost ape-like in expression. Like all Indian tribes, the hair is worn long, but in this case growing low on the forehead, nearly to the eyebrows.

I noticed, however, that one of the band had his locks cut short, and the head smeared all over with a tarry mess. On naming this to the Indian agent whom I afterwards met, he informed me that what I had seen was the "Digger's" sign of mourning. When one of the tribe dies, the body is burnt, the ashes are collected by his nearest relative, who cuts his hair short, mixes the ashes with a resinous gum from a pine-tree, and smears his head with the mixture, which is allowed to remain on till spontaneously removed. This statement was afterwards confirmed by Mr. Hutchins, the first resident in the valley. T. R. Clapham.

Austwick Hall, Aug. 9.

A WORM I' THE BUD—WHAT'S IN A NAME?

[1368]—With reference to Mr. Clodd's paper on tooth-ache depending on the presence of a worm, I may say it is a popular belief in this and neighbouring counties.

Tooth-ache is cured by pouring hot-water on henbane seeds contained in a jug. The seeds germinate at once in the boiling water; the plumule looking, to a casual observer, just like a worm. It seems strange to me boiling water should have this effect on seeds, especially the bought henbane seeds of a druggist's shop, which I have sown many times, but could never get to come up; I presume on account of their having been dried with the aid of heat.

Is the following a coincidence? Fourteen years since the minister of George-street Congregational Chapel was a Mr. Parkinson; on his leaving a Mr. Parkyn succeeded him; Mr. Parkyn then left and was succeeded by a Mr. Park. Since then I believe they have been without a regular minister. Eligible candidates having appropriate names might apply. Thomas Ladwick.

Red Hill, Surrey, Aug. 14th, 1884.

A COINCIDENCE.

[1369]—The following curious coincidence may, perhaps, just escape the editorial waste-basket so well-known to readers of Knowledge. The death of the late Duke of Wellington was announced in the evening papers on August 13. Our family had been engaged in preparations for removal to a new residence for two or three days previously, and some packing-cases sent from the contractor had been lying awaiting use during that time. On the evening above-mentioned these were opened, and there was found, amongst some straw, an old newspaper of the year 1852, in which, singular to say, we came upon a report of the funeral ceremony of the former Duke,—the illustrious hero of Waterloo. G. H. H.

PROPOSED MEMORIAL TO SIR WILLIAM HERSCHEL IN THE OCTAGON CHAPEL, BATH.

[1370]—[We willingly reproduce the subjoined letter, which appeared in the *Bath Chronicle* of August 7. Communications may be addressed to Rev. Wm. Anderson, 18, Pulteney-street, Bath.]

Sir,—Among the persons whose lives and labours have ennobled the city of Bath, none stand so high in force of character, in difficulties overcome, and in magnificent services rendered to science as William Herschel and his scarcely less distinguished sister and fellow labourer Caroline. Herschel was great as a thinker, a worker, a philosopher, and, above all, a discoverer. Inferior to Newton as a philosopher, he was greater as an astronomer. Arago was astonished by "his extraordinary success as a discoverer." Judged by the difficulties which he overcame, as well as by the actual additions which he made to human knowledge, by the instruments which he invented and bequeathed to future discoverers, and by his prescient anticipations of the future triumphs of science, he was by far the most distinguished citizen who ever lived in Bath. During the sixteen most fruitful years of his life—from 1766 to 1782, *i.e.*, from his 28th to his 42nd year—he resided in Bath, as organist of the Octagon Chapel and director of the public concerts. He frequently composed anthems, chants, and whole services for the choir under his management. Music was the business, astronomy was the amusement of his life. Before he made the discoveries which have given him an immortal name, he had to bring to completion, by a series of labours of almost incredible industry and perseverance, sometimes extending to sixteen hours of continuous work, the instruments of discovery. He erected a furnace in his garden, where he and his brother worked for months of almost incessant toil, and made hundreds of specula before he completed the great reflector through which he discovered the planet Uranus, on the 13th of March, 1781. His illustrious sister read to him while turning the lathe or polishing the mirrors. Subsequently, after he had been invited to Windsor, he said, "I would rather be polishing a speculum than at Court." Then he found that the telescope which he and his sister had constructed was superior to anything in the Royal Observatory. He discovered the motion of the solar system in space. He mapped out all the double stars he met with. He first discovered the lunar volcanoes.* He constructed a telescope of 40 ft. focal length and 8 ft. aperture. In the words of his biographer, in the last number of the *Encyclopædia Britannica*, "He demonstrated the action of the same mechanical laws among the distant members of the starry firmament which bind together the harmonious motions of our solar system. This sublime discovery would of itself suffice to immortalize his memory in the respectful homage of all future races of intelligent men." In him there were combined—each in its highest form—the attributes of the artisan, the artist, and the astronomer in a degree so high and employed for purposes so noble, that few cities can point to a citizen so noble and so worthy of lasting remembrance. I have been requested by the committee of the Octagon Chapel, in which the organ associated with the name of Herschel still remains, to write this letter, in the hope that their efforts to put up in the chapel a memorial window not unworthy of its distinguished organist may be aided by those of our fellow-citizens who desire to honour an illustrious name and transmit a memorable example. William Anderson.

LETTERS RECEIVED AND SHORT ANSWERS.

T. R. Clapham. Does your sketch of a flash of lightning represent the appearance it represented to the naked eye, its track through the ground, or what?—Galvaniser. No.—T. McIlvenie. Probably the situation of assistant in the Science and Art Department, or in the British Museum, would be one as congenial to your tastes as any; but either would involve a pretty severe competitive examination. There is no profession or occupation outside of such subordinate Government appointments as these, in which you can begin to earn anything for many a long day.—Quidam. Your mistake lay in writing a second time for an explanation. Such articles are merely used as "padding" in a daily newspaper, and may lie unused for an indefinite time. I have seen one of my own appear after a lapse of twelve months! An editor (like the Captain of one of her Majesty's ships) must, *e necessitate*, be an autocrat; and, according to the usages of journalism, you have nothing whatever legitimately to complain of.—James Gillespie. Will you be good enough to read my replies to you on pp. 40 and 79. I neither will nor can answer correspondents privately through the post.—M. asks how distemper painting is practised, the colours required, where they are to be obtained, and the ground used for painting on. He further wishes to know whether the process might not be employed in painting landscapes from nature, it being alleged that J. M. W. Turner so used it. Pending any detailed reply with which he may be favoured by some brother reader, he may get some hints from Godwin's "Art of Mural Decoration," published for a shilling by Winsor & Newton.—Con Spirito. There cannot be the slightest doubt that when a table moves in a *boná-fide* experiment such as you refer to, it does so through the unconscious muscular action of the operators. At the time when table-turning became a fashionable craze, our great departed Physicist Faraday devised a simple piece of apparatus, by the aid of which any pushing action on the part of the experimenters was at once rendered visible by the motion of the long arm of a lever. When the top and bottom parts of this simple contrivance were rigidly connected (so that the arm was a fixture) and the hands of the persons sitting about the table were placed upon it, the table went round merrily. The moment, though, that such connection was broken, so that a push on the top plate of the apparatus caused the arm to move, the performers had ocular demonstration, by its swinging round, that they were (wholly unconsciously) themselves pushing; and, their attention being thus directed to it, ceased to do so; the inevitable result being that the table stood stock-still. Thanks for your friendly expressions.—C. J. Pettit. I can find nothing about a tricycle (American or otherwise) in Knowledge for August 8. See concluding paragraph, in capital letters, at the head of Correspondence Column.—C. E. Parker-Rhodes. Received too late. Thanks.—H. Romeike. I am much obliged; but the needs of a scientific journal scarcely include such paragraphs.

Errata.—In column one, p. 130, line 14 from the bottom, the words "at S', 4 feet from it," should immediately precede "and so on."—In line 17, col. one, p. 145, "for what" should be "for which;" and in line 40 of the same column the word "where" should follow "Cassiopeia."

[* This is erroneous; but in no sense affects the appeal.—Ed.]

Our Chess Column.

BY MEPHISTO.

PROBLEMS BY I. G.

No. 121.

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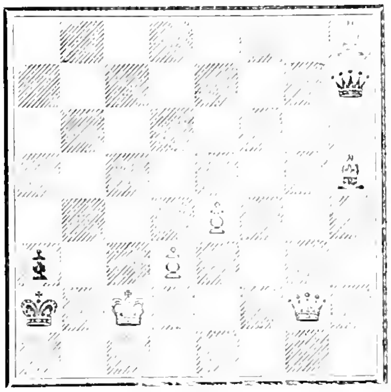

WHITE.

White to play and mate in three moves.

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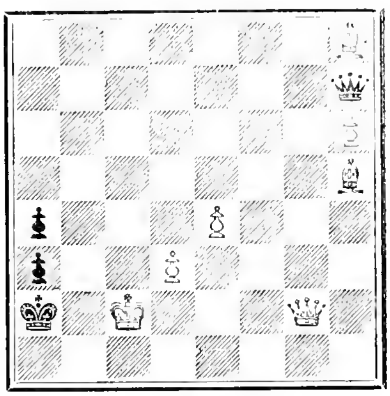

WHITE.

White to play and mate in three moves.

1. Kt to KB3. This first move leads to a close opening, producing a very safe game for White. The opening is remarkable for an entire absence of combination leading to any direct line of play. The player is soon thrown upon his own resources, and he has to struggle for position. This kind of game is specially adapted for match play between strong players, as it requires first class judgment and experience to conduct these subtle wrangles for position in which minute advantages are gained, which, if properly followed up, lead to a winning advantage for the End game. Weaker players not having sufficient judgment, miss the subtle points in this opening, which then becomes dull and featureless, but always affording a comparatively safe gamo to the first player.

The opening affords but very poor practice for young players, who ought to adopt lively and attacking debuts, as by undertaking such attacks and defences they will gradually gain experience and a deeper insight into the game, they will also derive much pleasure from such practice, which after all is the main object of Chess play.

The effect of 1. Kt to KB3 is twofold—to prevent P to K4, also to enable the first player to avoid the French defence. If Black plays 1. P to Q3 with the object of playing 2. P to K4, White will gain an advantage by playing 2. P to Q4, or he may play 2. P to K4; and if 2. P to K4, White may reply as in the Philidor defence by 3. P to Q4 with advantage.

If in reply to 1. Kt to KB3, P to QB4, the same as in the Sicilian defence, White can at once play 2. P to Q4, and the QP will be weak, 2. P × P. 3. Kt × P, P to K4. 4. Kt to Kt5, &c. 1. P to QB3 may be played, but the best replies are 1. P to K3 and 1. P to Q4. It is not desirable to play 1. Kt to QB3 as it is requisite to play P to QB4 later on, to counteract the advance of White's centre Pawns. Having stated sufficiently to indicate the import of 1. Kt to KB3, we will proceed to the normal variation arising out of that move:—1. Kt to KB3. P to K3. 2. P to Q4. P to Q4. 3. P to K3, Kt to KB3. 4. P to QKt3. B to K2. 5. B to Kt2, Castles. 6. B to K2. P to QKt3. 7. P to QB4, B to Kt2. 8. Castles, P to QB4. 9. Kt to B3, Kt to B3. 10. R to B sq., R to B sq. 11. Kt to R4, Kt to R4.

In this opening, the player who is too soon compelled to change Pawns, is at a disadvantage, as the opponent, by retaking with Pawn, obtains a commanding position. If 12. P × BP, P × QP. 13. B × Kt, P × B. 14. P × P, P × P. 15. Kt to R4, threatening B to Kt4, B to B5, and Q to R5, &c. If in reply to 12. P × BP, B × P. 13. P × P, B × P. 14. Kt × B, isolating and weakening the BP. If Black, on his 11th move, instead of Kt to R4 plays Kt to K5, then 12. Kt to Q2 still threatening to win the BP by P × KP. We must now come to consider the various deviations from this line of play by which Black seeks to avoid this knotty position.

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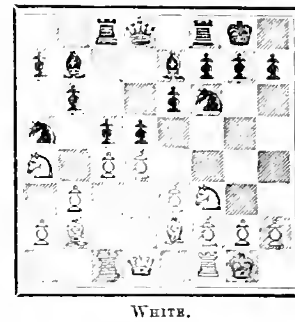

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For that purpose we quote Blackburne's method of posting the P on QB3, playing the Kt to Q2 and B to Q3. viz., 1. Kt to KB3, P to Q4. 2. P to Q4, P to K3. 3. P to K3, Kt to KB3. 4. B to Q2, Kt to Q2. 5. P to QKt3. B to Q3. 6. P to B4, P to B3. 7. Castles, Castles.

In this position, which of course may be arrived at by various transposition of moves. Black is somewhat confined. His intention is to play R to Kt sq., but we doubt whether any attack need be feared on the K's side, as P to KKt3 is always available. White, when opposed to strong play, not wishing to incur any risk, may play B to R3, compelling the exchange of Bishops. White may also play B to Kt2 or Kt to QB3. The latter move may lead to complications unfavourable for White, for if Kt to K5. Kt × Kt, P × Kt, Kt to Q2. P to B4, White cannot play P to B3 now, on account of Q to R5. It seems that when Black does not play P to QB4 but P to B3, then the White B is better placed on Q3.

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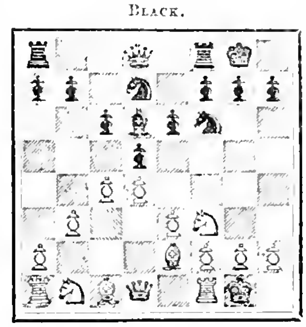


WHITE.

White may arrive at the same position by playing as his first move either 1. Kt to KB3, P to Q4. P to QB4, P to K3, &c.; while he may vary his moves considerably. Black has to be careful to answer correctly.

We think we have given the leading principle of this opening. Endeavour to develop all the pieces and to support the QP and QBP until the position is ripe for an advance on the Q's side. White must meet deviations in a careful manner, guarding against exposing his game or attacking prematurely, and he will always obtain a fairly developed and safe game.

SOLUTION.

PROBLEM No. 122, p. 124.

1. R to B4	B × R, or		B × B
2. K to Kt5	Any	2. Q to Kt4	K to K4
3. Q to KR sq.	Mate	3. Q × P	Mate

If B to B3. 2. B × B and mate next move.
If K to B5. 2. Q × P and mate next move.
"Well constructed and somewhat difficult."

ANSWERS TO CORRESPONDENTS.

*** Please address Chess Editor.*

Correct solutions received.—Problem No. 122, Geo. Thompson, W., A. W. Overton, J. K. Milne. No. 123. John Watson, Geo. Thompson, C. T. G.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, AUG. 29, 1884.

Contents of No. 148.

NEXT YEAR'S EXHIBITION.

By Inventor.

THE operations of exhibitions are very manifold. Primarily, I suppose, they are intended for educational purposes, to show people what advances have been made in the development and product of the human intellect. Were this, however, the only purpose they are capable of serving, we should find these now oft-recurring shows attain but very shadowy dimensions compared with what is actually seen. In reality, an exhibition has a more or less distinct business ring about it, and if this element is once lost sight of, the fate of the show is almost infallibly sealed. Much was said and done to give backbone to the greatest educational effort ever put forth in this direction, viz., the Loan Exhibition of 1876. It was a grand display—such a one, perhaps, as will never again be seen; it was purely educational: the business element was conspicuously absent, and consequently, although not so decided a failure as some, it cannot be said that the exhibition was a success, particularly when compared with that which has been achieved by more recent shows.

A similar fate attended the Exhibition of Electrical Apparatus at the Albert Hall. The Paris Exhibition of 1880-1, and the Crystal Palace Exhibition of 1881-2, regarded electricity as a marketable something, and succeeded—that is to say, they paid their expenses and left a balance, stimulated trade and spurred on scientists as well as unscientific inventors to produce something even better than the best then producible. And these I take to be some of the main points to be regarded in estimating the measure of success accomplished.

It follows by implication that for an exhibition to succeed, not only must the guarantors be relieved of all anxiety so far as the claims upon their pockets are concerned, but the exhibitors must see a prospect of recouping themselves. To collect and adorn a case or stand of commodities more or less novel, to print circulars, to pay the cost of packing, of carriage and fixing, &c., involves no small expense, which, if there is little or no prospect of business, the would-be exhibitor is not likely to incur. And why should he? Are we to suppose him to be endowed with a greater share of self-abnegating philanthropy than the rest of mankind? It is all very well for a wealthy or independent man to exhibit his hobby, or for a traveller to display his collection of curiosities; but, if we waited for a sufficient number of such enthusiasts, we should be compelled to wait for many a year, and then, doubtless, we should only succeed in getting together such a motley collection as would please nobody, not excepting even the exhibitors themselves. The man of the world, the man of business, knows full well that a show which is purely educational will have little attraction for the great majority of people, and it is only by the drawing together of great crowds, and entertaining and interesting as well as instructing them, that he can hope to defray his expenses and pay himself for his trouble. Would it were otherwise; but we must take people as we find them, and this I take to be the main feature which, though perhaps never formulated, affords excuse for the general plan adopted by the executive councils of the present Kensington exhibitions.

There are, of course, some points we might feel disposed to find fault with; they are so far too superficial, and possibly offer too many facilities for airing the obtrusive peculiarities of certain people; but we should be unjust were we to blame the working class for not being wiser or more cultured than they are. Maybe the fault rests more with the teachers. Indeed, it is to remove as much of the existing ignorance as possible that Knowledge is issued week by week, and we are fond of regarding the pages of this journal as among the educational influences of the day

The mere show of articles of every-day consumption is, however, little calculated to educate, or even to interest, the beholders, and can only find excuse from an advertising standpoint. Such displays are, in fact, outside the business region of my purview.

The coming Exhibition of Inventions and Musical Instruments promises to be of such a nature as to satisfy the hungriest searcher after knowledge, while, at the same time, business people will see in it an opportunity for entering into competition with the keenest energy. Those also who will visit it for fashion's sake stand a chance of reaping some benefit from it. The field embraced by "inventions" is so extensive that we may fairly and confidently look for an excellent display, in which jam-pots and such like impedimenta will scarcely find a place. The scientific element will be more predominant, and there is, in fact, a prospect of its satisfying all sections of the community. Music is doubtless introduced as a kind of leaven. The idea upon which the exhibition is planned is not to bring together a mere collection of models of inventions, but rather to illustrate the progress which has been made in the practical application of science during the past twenty years. In order to carry out this intention, the council will, as far as possible, confine the exhibits to processes and appliances, products being admitted only where they are themselves novel, or where their introduction is required to make the purpose or advantages of that which is new in any process more interesting and intelligible. It is not proposed to allot space for manufactured goods unaccompanied by any illustrations of the process of manufacture. Generally, it may be said that, as far as is practicable, inventions will be shown by models, with, in the case of models of entire machines, actual specimens of the portions improved under the exhibitor's patent, and when the invention relates to parts only, the whole machine will not be admitted, unless, indeed, the improvement effected cannot be sufficiently shown without the exhibition of the entire apparatus. The limitations of space which make these restrictions necessary, also compel the Council to decline, unless in exceptional circumstances, to receive objects which have already been shown in either of the recent exhibitions.

The second division—music—will, of course, be arranged on somewhat different principles. Here the object will be to illustrate as completely and in as interesting a manner as may be all that relates to the development of the science and of the art of music. Examples of musical instruments of a date not earlier than the commencement of the present century, and any machinery, apparatus, or appliances connected with their manufacture or their use, will be admissible. And, further, without restriction of date, contributions to an historic collection of musical instruments, and paintings and engravings representing musical subjects, are invited, and many, it is known, will be forthcoming.

Criticism at this early stage is practically out of the question, but the Council includes such a phalanx of good men (Sir Frederick Bramwell, F.R.S., vice-president of the Institute of Civil Engineers, Sir Frederick Abel, C.B., Mr. I. Lowthian Bell, F.R.S., president of the Institute of Mechanical Engineers, Colonel Sir Francis Bolton, Professor Dewar, F.R.S., Sir George Grove, D.C.L., Mr. W. H. Preece, F.R.S., Sir E. J. Reed, M.P., F.R.S., Professor Chandler Roberts, F.R.S., Dr. Stainer, Mr. R. E. Webster, Q.C., &c.), that there will, I fancy, be little to find fault with.

One thing is very certain, and that is, that the Exhibition will be one from which excellent results may, and most assuredly will, be looked for. The first division will be divided into some thirty or thirty-one groups, and single specimens of the objects mentioned in the prospectus would in themselves constitute a show of no mean proportions. We hope, naturally, for something more than this. Practically, every branch of human industry is taken up—and, indeed, it is almost a matter of impossibility to conceive how any one thing could be regarded as outside the scope embraced by the title. It follows that there will be whole multitudes who will visit the Exhibition, and who will leave it minus that benefit which they ought to derive. It will be the duty of Knowledge to help its readers to grasp more truly the lessons to be learned from what we have no doubt will be a great and a highly interesting exhibition. Such exhibits as may be likely to prove beneficial to the community will be referred to, and described more or less fully, sight not being lost of the fact that while many of our readers may be able to view the objects themselves, many others, possibly the majority, will be debarred for various reasons from ever visiting the Exhibition.

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE BOTTOM (*continued*).

The *Ranatra linearis* is a creature of three elements, though, of course, its proper sphere is the water. It can manage to progress on land better than most aquatic insects, carrying its body high up on its stilt-like second and third pairs of legs; still, its movements are, at best, but slow and awkward. It will also, sometimes, take to the air, and on returning to its pond, finds occasionally a little difficulty in re-entering the water, on account of its own slight specific gravity and the dryness of its tail filaments, so that quite a struggle is necessary before it is completely immersed. It is a sluggish insect, and will often remain motionless amongst the pond weeds for a long time together, only rising to the surface to breathe, and this, as one might expect in so inactive an insect, it needs to do very infrequently. It makes its way through the water, either by the help of aquatic plants, or by the movements of its two hind pairs of legs; but these are worked somewhat peculiarly, the third pair being driven backwards at the same time that the second are moved forwards, and *vice versâ*, all the movements being performed in a leisurely manner. But when we come to the front legs, the case is altogether different; all the celerity of which the insect is capable seems to be concentrated here. Ranatra, indeed, is more of a living trap than a hunter, lying in wait for, more frequently than pursuing, its prey, which consists of other aquatic insects, especially the larvæ of Mayflies, and even small fishes. With fore-legs extended, it patiently waits till some unwary and unsuspicious being, on pleasure only bent, approaches within the charmed circle guarded by those long-handled sickles, and then, with a rapid and forcible stroke and with unerring aim, down come the powerful limbs and seize the hapless pleasure-seeker as between a pair of pincers. Dragged to the cruel beak of its thirsty foe, its juices are gradually extracted, and the grasp is not relaxed till the dregs have been drained and nothing but the skin is left; the useless pellicle is then rejected and the lanky tyrant brings itself into position for another attack. It is said sometimes to regale itself on fish spawn, a proceeding which naturally excites the ire of pisciculturists. It holds its prey with astonishing tenacity, of which the following instance, recorded in the "Entomologist," by Mr. A. G. Laker, may serve as an example. He says:—"I placed some sticklebacks in the glass with a Ranatra, when one of them, about an inch long, was seized (the total length of the Ranatra, exclusive of its anal filaments, being only eighteen lines), and, notwithstanding the fish's repeated and vigorous struggles, it was held fast. I then took hold of the stickleback and raised it out of the water; the Ranatra, however, would not let go, and was drawn out of the water with the fish. I forcibly separated the two, replaced the insect, and immediately afterwards the fish; but the latter was again seized in a very short time, and the insect continued its meal." Ranatra is an exceedingly bold and fearless insect, manifesting surprising readiness to attack any foe, let its size be what it may. In fact, under ordinary circumstances, there are probably but few enemies that it has any need to fear. It is the giant of the insect population of the pond, and can hold its own against almost all comers. The great Dytisci are probably the only insects of which it has any need to stand in awe; and these, if hard pressed by hunger, would probably have no hesitation in attacking it, and, protected by the invulnerable nature of their chitinous armature, would soon make mincemeat of the slim and long-legged bug. The hard integument of beetles, however, does not always baffle Ranatra, not even when it seems to offer an insurmountable obstacle. There is a little oval, reddish-brown beetle, *Hyphydrus ovatus* by name, about the size of a small pea, and not unlike a somewhat flattened one in shape, which is about as unmanageable a morsel as could well fall to the lot of any insect; but even this Ranatra will not refuse, turning and twisting it about with its pincers in vain efforts to find a soft spot in which to plunge its beak, till at last it lights upon the extremity of the abdomen, as being a little less hard than the rest, and manages to extract even thence at least enough nutriment to whet its appetite and make it long for more.

Our other British water-scorpion, *Nepa cinerea* (Fig. 1), occurs commonly in ponds. It is a smaller and much broader insect, extremely flattened (like many other bugs, notably our disgusting household pest), with shorter and stouter legs, but still similar in plan to Ranatra, which it resembles also in its brilliant scarlet body. It is a most sluggish insect, and can easily be secured by the hand when seen near the edge of the pond; but the difficulty is to catch sight of it, for so exactly similar is its colour to that of the mud amongst which it lies, that unless the observer can bring to bear upon it a pair of keen and well-trained eyes, it will in nine cases out of ten remain undetected, if only it have the sense not to betray its presence by moving. In consequence of its sluggish habits and mud-loving propensities, it sometimes becomes covered with an incrustation which does not render its detection any the easier. Its protective coloration, no doubt, gives it chances of many more meals than it would otherwise get, for unwary insects will often approach near enough to come within range of the hooked fore-feet without being conscious of the risk they run, and are only aroused from their fancied security by finding themselves suddenly clutched and pressed in a deadly embrace against the sharp beak which is ever in waiting to tap any juicy body that may be presented to it.

Fig. 1.

The breathing apparatus is a marvel of complexity; there are both spiracles and tail filaments, the latter leading into the two longitudinal tracheæ, which run parallel to the sides. From these, innumerable minute tubes ramify all over the body, and if only it were possible to dissect out the whole tracheal system, and separate it from the rest of the body, it would form a most elegant object, and appear like an exquisite network of silver filagree, built up, as it were, upon a gridiron-like framework consisting of two long curved side-pieces connected by arched cross-pieces. In the thorax there are a few dilatations of the tracheal system, in the form of air-bags, such as in many other insects, especially those that are vigorous in flight, may be found in other parts of the body as well.

The eggs of Nepa are very peculiar. They are oval, with seven long filaments at one end; while they are being laid, the filaments of each serve as a sort of cup to keep its successor in position, but when the egg is once deposited, the filaments bend backwards and form a circlet of recurved hooks. The eggs of Ranatra are more elongate, and furnished with only two bristles.

As these water-scorpions are bugs, they do not undergo much change of form in the course of their life; the larvæ are very similar to the adult, the chief differences being the smaller size and the absence of wings and tail-filaments, the place of the latter being taken by a small pointed projection.

(*To be continued.*)

THE PHYSICS OF THE EARTH'S CRUST.

By Richard A. Proctor.

PROFESSOR DAVIDSON, of the United States Geodetical Survey in California, has noticed most remarkable deviations in the direction of the action of gravity in the region which he has surveyed. Deflections of ten or eleven seconds of arc—which would correspond, in the determination of the position of a place by astronomical methods, to errors of 1,000 or 1,100 feet—are common. This shows that the density of the materials beneath the visible surface of the earth is very irregular. But what is remarkable is that the deviations of the plumb-line (so, for convenience, to describe a peculiarity which in reality is far too delicate to be dealt with by a plumb-line observation) are not, as might be expected, towards the great mountain ranges, but towards the regions of depression. It would seem that the depressions indicate the downward tendency of very dense matter, and a resulting closeness of packing, so to speak, which makes those depressed regions exert a very powerful local attraction, causing the plumb-line in their neighbourhood to deviate towards them. On the contrary, in the neighbourhood of the mountain ranges, and even on their flanks, the deflection of the plumb-line is *from* the regions of elevation, as though vacant spaces or matter of relatively small density existed beneath the upheaved portions of the crust.

Another point, still more remarkable, and apparently established on sufficient evidence, is that in certain regions the direction of gravity seems to have changed largely during a period of less than thirty years. Professor Davidson mentions one place where the position, as determined by astronomical methods depending on the direction of gravity, has varied no less than 16 seconds of arc since 1854. The arrangement of the masses beneath the surface in the neighbourhood must have greatly changed—marvellously, in fact, when the shortness of the time is considered. One cannot wonder that California should be a region of great earthquakes, insomuch that no large building can safely be made of stone in that part of the earth.

Prof. Davidson's observations tend to throw some doubt on all such methods of determining the earth's density as depend on variations in the force and direction of gravity in the neighbourhood of mountain masses, at the bottom of deep mines, and so forth. It is certain that had such observations been first made in such a region as California, they would have led to entirely erroneous results, or, rather, they would have failed utterly; for it appears that instead of the plumb-line being deflected towards the upraised masses (supposed to be of known density), as in the case of the Schehallion experiment, it would have been drawn from them towards masses of compressed matter beneath the lower levels, and before unsuspected. As for pendulum experiments in mines, such as the celebrated Harton Colliery observations, they seem utterly discredited by such observations as Professor Davidson's. But, to say the truth, they have long been regarded as worthy of little trust. In dealing with Airy's observations (really conducted by his assistant, Mr. Dunkin), in Rodwell's "Physical Cyclopædia," I pointed out fifteen years ago that the result obtained was altogether unreliable, chiefly because of the uncertainty necessarily existing in regard to the density of the regions surrounding the scene of operations. The result obtained at Schehallion by Maskelyne was more nearly correct, judged by the indications of the Cavendish experiment, the only method which seems really trustworthy. But what was learnt from the Schehallion experiments was simply that the rock masses in that region are tolerably uniform in structure, and of about the mean density assigned by Maskelyne, *not* that the earth has the mean density deduced by that observer from his observations there. This last we learn from Baily's experiments by the Cavendish method, in which the earth is weighed against metallic masses of known density.

Other observations in California show how little reliance can be placed on certain results which have been accepted with considerable confidence. Not only does the rate of increase of temperature with descent vary greatly in different regions, but in some places the law is reversed. Thus, in the new Almaden Quicksilver Mine in California, the temperature is about 115° at a depth of 600 ft., while in the deepest part of the mine, 1,800 ft. below the surface, and 500 ft. below the sea level, the temperature is not higher than 80°. At the Eureka mines, California, the temperature, 1,200 ft. below the sea level, is not higher than it is 100 ft. below that level.—*The Newcastle Weekly Chronicle.*

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XLI.—AUTHORITIES ON TEA AND COFFEE.

SINCE the publication of my last I have been reminded of the high authorities who have defended the use of the alkaloids, and more particularly of Liebig's theory, or the theory commonly attributed to Liebig, but which is Lehmann's, published in Liebig's "Annalen," Vol. 87, and adopted and advocated by Liebig with his usual ability.

Lehmann watched *for some weeks* the effects of coffee upon two persons in good health. He found that it retarded the waste of the tissues of the body, that the proportion of phosphoric acid and of urea excreted by the kidneys was diminished by the action of the coffee, the diet being in all other respects the same. Pure caffeine (which is the same as theine) produced a similar effect, the aromatic oil of the coffee, given separately, was found to exert a stimulating effect on the nervous system.

Johnstone ("Chemistry of Common Life") closely following Liebig, and referring to the researches of Lehmann, says:—"The waste of the body is lessened by the introduction of theine into the stomach—that is, by the use of tea. And if the waste be lessened, the necessity for food to repair it will be lessened in an equal proportion. In other words, by the consumption of a certain quantity of tea, the health and strength of the body will be maintained in an equal degree upon a smaller quantity of ordinary food. Tea, therefore, saves food—stands to a certain extent in the place of food—while, at the same time, it soothes the body and enlivens the mind."

He proceeds to say that "In the old and infirm it serves also another purpose. In the life of most persons a period arrives when the stomach no longer digests enough of the ordinary elements of food to make up for the natural daily waste of the bodily substance. The size and weight of the body, therefore, begin to diminish more or less perceptibly. At this period tea comes in as a medicine to arrest the waste, to keep the body from falling away so fast, and thus to enable the less energetic powers of digestion still to supply as much as is needed to repair the wear and tear of the solid tissues." No wonder, therefore, says he, "that the aged female, who has barely enough income to buy what are called the common necessaries of life, should yet spend a portion of her small gains in purchasing her ounce of tea. She can live quite as well on less common food when she takes her tea along with it; while she feels lighter at the same time, more cheerful, and fitter for her work, because of the indulgence."

All this is based upon the researches of Lehmann and others, who measured the work of the vital furnace by the quantity of ashes produced—the urea and phosphoric acid excreted. But there is also another method of measuring the same, that of collecting the expired breath and determining the quantity of carbonic acid given off by combustion. This method is imperfect, inasmuch as it only measures a portion of the carbonic acid which is given off. The skin is also a respiratory organ, co-operating with the lungs in evolving carbonic acid.

Dr. Edward Smith adopted this method of measuring the respired carbonic acid. His results were first published in "The Philosophical Transactions" of 1859, and again in Chapter XXXV. of his volume on "Food," International Scientific Series.

After stating, in the latter, the details of the experiments, which include depth of respiration as well as amount of carbonic acid respired, he says:—"Hence it was proved beyond all doubt that tea is a most powerful respiratory excitant. As it causes an evolution of carbon greatly beyond that which it supplies, it follows that it must powerfully promote those vital changes in food which ultimately produce the carbonic acid to be evolved. Instead, therefore, of supplying nutritive matter, it causes the assimilation and transformation of other foods."

Now, note the following practical conclusions, which I quote in Dr. Smith's own words, but take the liberty of rendering in italics those passages that I wish the reader to specially compare with the preceding quotations from Johnstone:—"In reference to nutrition, we may say that *tea increases waste*, since it promotes the transformation of food without supplying nutriment, and increases the loss of heat without supplying fuel, and *it is therefore especially adapted to the wants of those who usually eat too much*, and after a full meal, when the process of assimilation should be quickened, but *is less adapted to the poor and ill-fed*, and during fasting." He tells us very positively that "to take tea before a meal is as absurd as not to take it after a meal, unless the system be at all times replete with nutritive material." And, again, "Our experiments have sufficed to show how tea may be *injurious if taken with deficient food, and thereby exaggerate the evils of the poor;*" and, again, "The conclusions at which we arrived after our researches in 1858 were that tea should not be taken without food, unless after a full meal; or with insufficient food; or by the young or very feeble; and that *its essential action is to waste the system or consume food*, by promoting vital action which it does not support, and they have not been disproved by any subsequent scientific researches."

This final assertion may be true, and to those who "go in for the last thing out," the latest novelty or fashion in science, literature, and millinery, the absence of any refutation of later date is quite enough.

But how about the previous scientific researches of Lehmann, who, on all such subjects, is about the highest authority that can be quoted. His three volumes on "Physiological Chemistry," translated and republished by The Cavendish Society, stand pre-eminent as the best-written, most condensed, and complete work on the subject, and his original researches constitute a lifetime's work, not of mere random change-ringing among the elements of obscure and insignificant organic compounds, but of judiciously selected chemical work, having definite philosophical aims and objects.

It is evident from the passages I have emphatically quoted that Dr. Smith flatly contradicts Lehmann, and arrives at directly contradictory physiological results and practical inferences.

Are we, therefore, to conclude that he has blundered in his analysis, or that Lehmann has done so?

On carefully comparing the two sets of investigations, I conclude that there is no necessary contradiction *in the facts:* that both may be, and in all probability are, quite correct as regards their chemical results; but that Dr.

Smith has only attacked half the problem, while Lehmann has grasped the whole.

All the popular stimulants, refreshing drugs, and "pick-me-ups" have two distinct and opposite actions—an immediate exaltation which lasts for a certain period, varying with the drug and the constitution of its victim, and a subsequent depression proportionate to the primary exaltation, but, as I believe, always exceeding it either in duration or intensity, or both, thus giving as a nett or mean result a loss of vitality.

Dr. Smith's experiments only measured a partial result (the carbonic acid exhaled from the lungs without that from the skin) *of the first stage*, the period of exaltation. His experiments were extended to 50 minutes, 71 minutes, 65 minutes, and in one case to 1 hour and 50 minutes. It is worthy of note that in Experiment 1 were 100 grains of black tea, which were given to two persons, and the time of the experiment was 50 and 71 minutes; the average increase was 71 and 68 cubic inches per minute, while in No. 6, with the same dose and the carbonic acid collected during 1 hour and 50 minutes, the average increase per minute was only 47·5 cubic inches. These indicate the decline of the exaltation, and the curves on his diagrams show the same. His coffee results were similar.

We all know that the "refreshing" action often extends over a considerable period. My own experiments on myself show that this is three or four hours, while that of beer or wine is less than one hour (moderate doses in each case).

I have tested this by walking measured distances after taking the stimulant and comparing with my walking powers when taking no other beverage than cold water. The duration of the tea stimulation has been also measured (painfully so) by the duration of sleeplessness when female seduction has led me to drink tea late in the evening. The duration of coffee about one-third less than tea.

Lehmann's experiments extending over weeks (days instead of minutes), measured the whole effect of the alkaloid and oil of the coffee during both the periods of exaltation and depression, and, therefore, supplied a mean or total result which accords with ordinary everyday experience. It is well known that the pot of tea of the poor needlewoman subdues the natural craving for food; the habitual smoker claims the same merit for his pipe, and the chewer for his quid. Wonderful stories are told of the long abstinence of the drinkers of maté, chewers of betel-nut, Siberian fungus, coca-leaf, and pepper-wort, and the smokers and eaters of haschish, &c. Not only is the sense of hunger allayed, but less food is demanded for sustaining life.

It is a curious fact that similar effects should be produced, and similar advantages claimed for the use of a drug which is totally different in its other chemical properties and relations. "White arsenic," or arsenious acid, is the oxide of a metal, and far as the poles asunder from the alkaloids, alcohols, and aromatic resins, in chemical classification. But it does check the waste of the tissues, and is eaten by the Styrians and others with physiological effects curiously resembling those of its chemical antipodeans above named. Foremost among these physiological effects is that of "making the food appear to go farther."

It is strange that any physiologist should claim this diminution of the normal waste and renewal of tissue as a merit, seeing that life itself is the product of such change, and death the result of its cessation. But in the eagerness that has been displayed to justify existing indulgences, this claim has been extensively made by men who ought to know better than admit such a plea.

I speak, of course, of the *habitual* use of such drugs, not of their occasional medicinal use. The waste of the body may be going on with killing rapidity, as in fever, and then such medicines may save life, provided always that the body has not become "tolerant," or partially insensible, to them by daily usage. I once watched a dangerous case of typhoid fever. Acting under the instructions of skilful medical attendants, and aided by a clinical thermometer and a seconds watch, I so applied small doses of brandy at short intervals as to keep down both pulse and temperature within the limits of fatal combustion. The patient had scarcely tasted alcohol before this, and therefore it exerted its maximum efficacy. I was surprised at the certain response of both pulse and temperature to this most valuable medicine and most pernicious beverage.

The argument that has been the most industriously urged in favour of all the vice-drugs, and each in its turn, is that miserable apology that has been made for every folly, every vice, every political abuse, every social crime (such as slavery, polygamy, &c.), when the time has arrived for reformation. I cannot condescend to seriously argue against it, but merely state the fact that the widely-diffused practice of using some kind of stimulating drug has been claimed as a sufficient proof of the necessity or advantage of such practice. I leave my readers to bestow on such a plea the treatment they may think it deserves. Those who believe that a rational being should have rational grounds for his conduct will treat this customary refuge of blind conservatism as I do.

THE ELECTRO-MAGNET.

By W. Slingo.

THE experiments referred to at the close of the previous article as having been made by Professors Ayrton and Perry* present many features full of interest and worthy of study. They are all such as may be easily repeated by the student. The object was to determine which mode of winding a given length of wire on an iron bar gave the strongest electro-magnet for the same current. Four bars of iron, each 12 inches long, were cut from the same rod $\frac{3}{8}$ in. thick; and an exactly equal length of wire was wound on the four bars respectively, in the following way:—

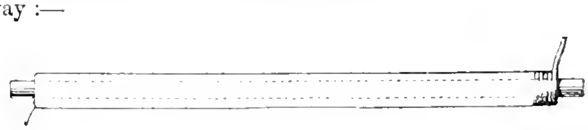


Fig. 1

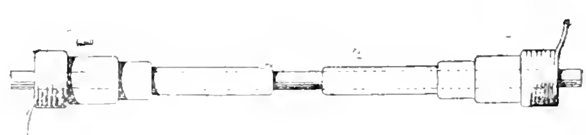


Fig. 2.

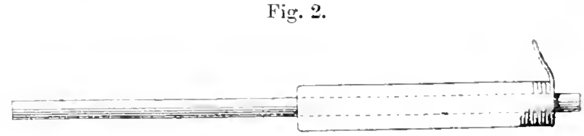


Fig. 3.

1. Wire wound equally over the whole length, Fig. 1.
2. Wire coned towards each end, Fig. 2.
3. Wire wound equally over half the iron bar, leaving the other end bare (Fig. 3).

* "Phil. Mag.," Vol. XV., p. 397.

4. Wire wound on one half, but coned towards the end (Fig. 4).

Fig. 4.

To ascertain their relative strengths, electro-magnet No. 1 was put so that its axis was at right angles to the axis of a small magnetic needle and passed through the point of suspension of the needle, which was suspended so as to move freely in a horizontal plane, and far enough away that the magnetic field due to the electro-magnet, when magnetised by passing a current through it, was nearly constant over that portion of the field in which the little suspended needle moved when deflected. A constant current was now passed through the coil, and the deflection of the little needle observed when the electro-magnet was placed at different distances from the centre of the test-needle, the axis, however, always remaining in the same line. Under these circumstances, the strength of the field produced by No. 1 at the centre of the test-needle is approximately proportional to the tangent of the angle through which the needle is deflected. Experiments were made in a similar way with electro-magnet No. 2, and with each end of No. 3 and of No. 4, the same current being used in all cases.

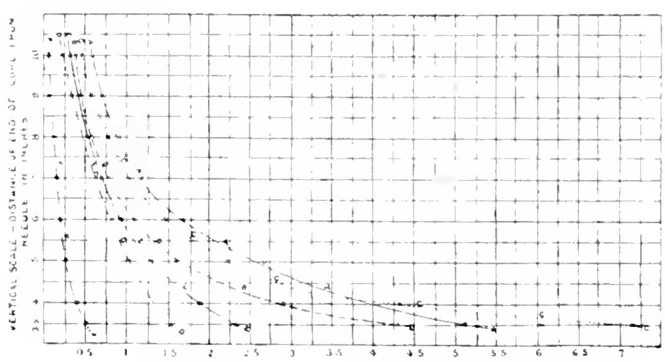


Fig. 5

The results obtained are shown plotted in the accompanying curves (Fig. 5), vertical distances representing the distance between the near end of the electro-magnet and the centre of the test-needle, and horizontal distances indicating the tangents of the deflections of the test-needle: A A A A is that for No. 1; B B B B for No. 2; C C C C for the covered end of No. 3; D D D D for the uncovered end of No. 3; E E E E for the covered end of No. 4; and F F F F for the uncovered end of No. 4.

These curves show that at considerable distances from the end of the electro-magnet the uniformly coiled magnet No. 1 produces the most powerful field, while for points nearer the magnet, but still at a distance of about 3 inches from it, the covered end of No. 3 magnet, corresponding with the curve C C C, produces the strongest field, the next in strength being produced by the magnet No. 2, with the wire coned towards each end, since obviously the curve B B B cuts the curve A A A at a point corresponding with a distance of about 3 inches from the end of the magnet. The strength of the field at shorter distances than those indicated cannot be measured by the means above adopted. There is, however, another, although perhaps a rougher, means of observing the strength of the various parts of the field produced by the electro-magnet. It is well known that a magnet is capable of attracting iron filings, and that they take up definite positions when attracted. It is also an every-day experiment to lay a magnet under a sheet of paper, thin glass, or other non-magnetic material, upon which iron filings are then sprinkled, when they form certain definite figures. If the magnet is a straight bar of steel, the filings take up their position in a manner analogous to that depicted in Fig. 6. Professors Ayrton and Perry pursued a similar course in investigating the magnetic properties of their coils, and obtained some interesting and instructive results.

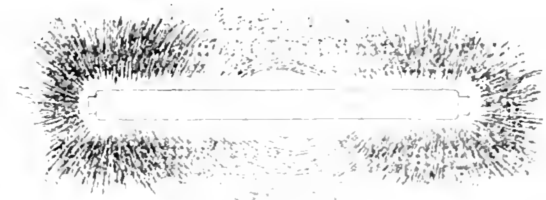


Fig. 6.

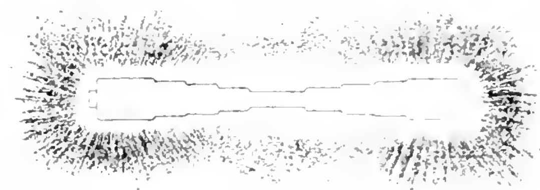


Fig. 7.

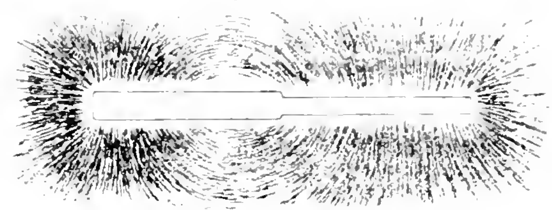


Fig. 8.

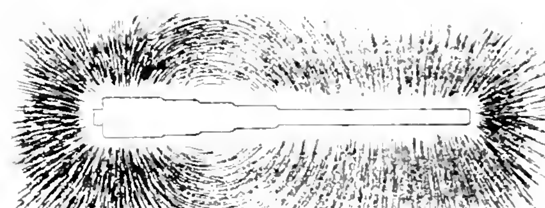


Fig. 9.

Figs. 6, 7, 8, 9 afford remarkable illustrations of the effects produced. The iron filings are seen to take up definite positions, and supposing Fig. 6 to represent an ordinary bar magnet, there is observable a concentration of filings around the extremities indicating the positions of maximum magnetic strength. It will also be noticed that all the filings set themselves in curves, and that these curves exhibit a strong tendency to connect the one pole with the other, much in the same way that they do when the poles of an ordinary horse-shoe magnet are dipped into a quantity of filings. Even the apparently straight lines taken by the filings at the extremities (Fig. 6) are in reality only parts of large curves, easily discernible in the actual experiment.

The effect, then, of winding an electro-magnet evenly is to produce an ordinary magnetic field as shown in Fig. 6. With the second mode of winding, *i.e.*, coning the wire towards the two ends of the iron, we obtain a field (Fig. 7) similar to the one produced by the usual winding, with the exception that the field between the poles is very weak. With the two other modes of winding (Nos. 3 and 4) there is a considerable concentration of force in the vicinity of the covered end, while the uncovered end "seems to form a long, weak pole," the difference between the two being that with No. 4 as contrasted with No. 3 there is a greater concentration at the wound end, and that the opposite pole is longer. The movement made by the "neutral zone" towards the left hand is clearly indicated.

The professors completed their experiments by ascertaining the weight necessary to detach the armature from the covered end of each magnet, a constant or equal current flowing through each coil. The result was that with :—

1	45	ounces were required to detach the armature.
2	57	" " "
3	57	" " "
4	77	" " "

These results show, then, that the effect of coning the wire is to produce a strong field near the pole, which, however (as may be gathered from Fig. 5), falls off rapidly as the distance from the pole increases. It is also seen that in contact or close proximity with the magnet numbers, 2 and 3 are equal, and are stronger than No. 1, while the effect produced by No. 4 is much greater than that produced by either of the others. The deductions to be drawn are that with a given piece of iron, a given length of wire, and a given current, at distances from the end of the magnet very small compared with the length of the core, the wire should be coiled up at the near end. At points a little removed, equal, say, to one third the length of the core, winding evenly over one half is advantageous, while, for greater distance, uniform winding is the best.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

(*Continued from page* 152.)

CHAPTER III.—THE ANNUAL MOTION OF THE SUN AND STARS.

ALTHOUGH during a single day the sun's motion is such as I have described it, yet it is impossible to watch the sun many days without noticing that the place of his rising and setting is continually changing, and also the elevation which he attains when in the south. Supposing our observations to commence in spring, we should notice that the sun began to rise further and further to the north of east, setting, of course, further and further to the north of west. We should further see his mid-day elevation gradually increasing. In about three months these changes would attain their greatest effect, and at this time we should find that the sun rose almost as far north as north-east, and set almost as far north as north-west, while at mid-day he attained an elevation of no less than 62°, instead of 38½°, as at first. Then in the next three months we should find these changes taking place in reverse order, so that at the end of the three months the sun would be rising nearly in the east and setting nearly in the west, as at the beginning of the observations. After this the sun would be found to rise towards the south of east, setting towards the south of west, while his mid-day elevation would continue to diminish. At the end of three more months these changes would produce their greatest effect, when the sun would be rising nearly as far south as south-east, and setting nearly as far south as south-west, attaining a mid-day elevation of only 15°. Lastly, during the next three months the sun would gradually return to the path he had at the beginning of the observations.

Year after year these circumstances are repeated with the utmost regularity, so that the observer would find no difficulty in forming a table recording the height which the sun would attain when due south on any day of the year. This, at present, is all that we shall note on this point. We shall shortly have to return to this part of our subject, and by considering the annual changes of the sun's apparent path more exactly—that is, in quantity and measure, instead of in a general manner, we shall be enabled to form an estimate of the real character of the sun's annual motion relatively to our earth. At present, however, our observer is supposed to be limiting his attention to those observations which may enable him to determine the earth's figure by travelling from the scene of his first researches. He is, in fact, endeavouring to learn how the sun or the stars would seem to move on any day of the year, as seen from his first station, in order than when he goes to others he may estimate the effect of change of place on these motions, and so learn what is the shape of that surface over which he is travelling.

Our observer might notice also with special care where the sun rises and sets on different days, were it not that after some attention to this point, he would find that in the immediate neighbourhood of the horizon, celestial objects are not seen in their true places. He would quickly see that this was an atmospheric effect, because he would notice that even terrestrial objects, at a considerable distance, appear often to be disturbed or distorted. Presently this peculiarity will need to be carefully considered. At present, all that is necessary is that the observer should avoid laying any stress on the observations of celestial objects when very close to the horizon.*

The result, then, to which our observer pays special attention is the circumstance that on any given day in the year the sun always attains a certain elevation when in the south. If he should find that when he travels to some other place, the sun, on any particular day, *does not* attain the elevation it would have had as seen from his first station, he will have to explain that circumstance—he will, in fact, have something to guide him to a true estimate of the earth's figure, of which, at present, he is supposed to know nothing, except that it has limits.

In the meantime, and with a similar end in view, he notices the annual changes in the apparent position of the stars. This part of his work also leads to certain definite and very interesting results.

Night after night he sees the stars following the same orderly movements which he had before detected. But gradually he begins to notice, that, at any given hour of the night, the aspect of the heavens is not the same as at the same hour on the first night of observation. The stars seem to have got further forward in their apparent rotation-movement.

Carefully noticing this change, he is led to the conclusion that it is taking place in a regular manner. He can very effectually test its rate and character by means of the instrument figured in Chapter I. (Fig. 5), modified (as described in Chapter II.) for sidereal observation. He

* It may be necessary to remind the reader that the refractive effects of the atmosphere slightly affect the apparent position of every celestial object, but in this part of my subject I avoid all reference to corrections so minute that the simple process of observation I am describing would not suffice to detect them.

directs the tube L M at a given hour on any night to a certain star, and notices what division of the card circle, H K, falls opposite the mark on the upright. At the same hour on the next night, he will scarcely notice any appreciable change; but if he repeat the observation a fortnight later, he will find that he has to turn the card circle round about as much as for an hour's diurnal motion—that is, through about 7½°—before L M points to the star. He will notice, however, that L M has not to be turned on its own pivot; in other words, he will see that the star's distance from the pole of the heavens (the point to which F G is directed) remains unchanged.

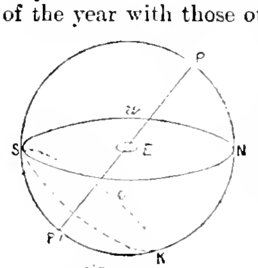
He may confirm this result by a second observation. Let him direct L M towards a star, and in any convenient manner clamp the axis F G, so that L M will remain fixed in position. Then at the end of fourteen or fifteen days let him come to the instrument an hour earlier in the evening than it was set. He will find L M pointing directly towards the star.

He finds this to be true of every visible star in the heavens, except five. Consequently, all the stars retain the same relative positions among themselves, except those five, which he will therefore look upon as wanderers, a word synonymous with the term *planet* given to these five stars by the Greek astronomers. Our observer will, for the present, however, confine his attention to the other stars, which he will call for distinction's sake the fixed stars.

He now knows that these stars have a somewhat swifter daily motion than the sun, insomuch that in half a month the stars have gained an hour's motion on the sun. It follows that in a year they have gained twenty-four hours' motion, or one complete rotation.

Now here we shall avoid any reference to the difficult processes by which the exact length of a year is determined. We will suppose that our observer is satisfied by noticing the perfect regularity of the stellar rotation, not only from hour to hour, but from day to day; and that by some means or other he enables himself to measure time with such exactness that he could detect any apparent departure from the observed regularity of motion, should any such result seem to follow from his excursions over the earth's surface. We shall see that this knowledge, combined with his knowledge of the sun's altitude at noon of every day, or even only with his knowledge of the position of the pole of the heavens, round which the rotation seems to take place, will enable him to form the most certain and conclusive opinions as to the figure of the earth on which he lives.

On one point he has already gained new information. He has noticed that the star-groups retain their configuration altogether unchanged in whatever part of the sky they may be seen. And comparing the observations of one part of the year with those of another, he is enabled to see that the stars are strewn over the surface of all that portion of a sphere having E P as axis which can rise above the horizon circle S *e* N *w*—in fact, over every part of a complete sphere S *w* P K, except the small segments S P′ K. Now, at any moment the observer can only see half of the sphere S *w* P K. He knows that unless the stars, when below the horizon, take up relative positions very different from those they have when visible, they must at every instant cover the portion S *w* N K of space beneath the horizon, and as he sees no sign of any such change when the stars are visible, while at every season of the year he sees the known star-groups unchanged in aspect, he is clearly justified



in feeling very certain that no such change takes place after the stars have gone below the horizon. Hence he is certain that the earth is not only limited in the direction of the horizon, but in every direction below the horizon (except possibly towards the segment S P′ K, about which he has as yet no certain information). He will naturally infer that a complete sphere around him is bedecked with stars, and not a sphere wanting such a segment as S P′ K; but whether this be so or not, he is quite certain about the earth being limited towards all points below S *w* N K, except points in S P′ K, *for he knows that stars are strewn towards all such points.* Knowing that the earth has limits, and perhaps even suspecting already that the earth, which lies within the celestial sphere, is more likely to be in rotation than the sphere itself, he sets out to explore his abode. He will direct his explorations first towards the north, to see what changes, if any, may be perceived in the position of the apparent pole of the heavens. Then he will return and travel southwards; and, lastly, he will make a series of explorations towards the east and towards the west; until, finally, the secrets of the earth's figure shall have been completely mastered.

OUR SUPPLY OF COAL.

At a time when approximate calculations have been made of the date at which our British coal supply will be exhausted, the discovery of a reserve of some 8,000,000 tons must possess great popular, as well as more purely scientific, importance. Hence a *précis* of a lecture delivered before the members of the Cotteswold Field Club on the 12th instant, by Mr. Handel Cossham (for which we are indebted to the *Bristol Mercury and Daily Post*), can scarcely fail to be of considerable interest at once to the geologist and to the coal consumer:—

After remarking on the complicated geology of the Bristol coal-field, and particularly of the northern part of it, he mentioned that twenty years ago he was able to correct the geological maps of the district by showing that the supposed Millstone Grit, or Farewell Rock, between Bristol and Wick, was one of the Siliceous Sandstones of the coal-measures. It had consequently been discovered that the coal-bearing strata extend south of Kingswood and St. George under the river Avon, and, as far as he knew, to the Mendip Hills. That discovery had had an important bearing on the mining industry of the district, and would help in the future to unlock the mineral resources of the neighbouring county of Somerset. He had, however, now to describe a discovery he had recently made, which, he believed, would prove of much greater importance. He reminded them that the Kingswood section of the Bristol coal-field contains probably the most ancient coal workings, not only of this country, but probably older than those of South Wales, Somerset, or Dean Forest. In 1371 Edward III. issued a mandate to the keeper of the chase of Kingswood to allow Edward, the son of Hugh Blunt, lord of the manor of Bitton, to take, sell, and carry away wood, gorse, and sea-coal found within the demesne; and by the second half of the seventeenth century he saw by a map which passed to him as lord of the manor, that in the year 1672 there were no less than seventy small coal-pits at work in the Chase of Kingswood. The workings, down to the early part of this century, were of course confined to shallow depths, chiefly drained by levels into the Avon and Froom rivers, and were mainly confined to the upper section of the seams now worked in the district. About fifty years ago the Great Vein series were discovered, and have been largely worked ever since on the

South dip, and over a considerable area. Some time ago he resolved to explore the whole of the area, about 2,500 acres, the mineral freehold of which he purchased some years ago. To do this he commened an exploring drift to the south, at a depth of sixty-eight fathoms from his Belgium pit, to cut the upper section of seams that lie over the ordinary Kingswood series and between those and the Pennant rock; and at the same time he started a drift to the north, at a depth of 500 yards from the bottom of Speedwell pit, and it was the discoveries made by the latter, or north drift, from Speedwell, that he wished to describe. For some 200 yards this drift was driven in strata nearly upright, and exhibited traces of great disturbance and enormous lateral pressure; and, in fact, the whole of the Kingswood district has in past workings exhibited proofs of enormous disturbance and displacements, chiefly, as he some time ago explained in a published paper, having been produced by lateral pressure and not by vertical movements. Some 250 yards north of Speedwell pit they cut a seam of coal about 2 ft. 4 in. thick, lying in an upright position, and for a long time he supposed this to be the first of the lower or Ashton series of veins, which was what he expected to find when he drove the underground tunnel. But, extending the drift some 50 to 100 yards farther to the north, they found the strata became horizontal, and they struck a second seam of coal in several separate beds, the thickest of which was about 20 in. After following the vein for some 50 to 100 yards, he found that it was one of the old Great Vein group that had been worked 300 to 350 yards overhead up to the outcrop of the vein near the surface. This fact was so difficult to explain that he resolved, before coming to any decided conclusion, to drive cross-measure drifts to the veins above and below, so as to prove the fact beyond doubt before accepting it himself or announcing it to others. At the proper distance below this second vein, known as the Giller's End Vein, he found a particular and remarkable bed of strata, known in the district as the "Worm Bed," in its proper position in connection with this vein. He also knew that if he were correct in his opinion he should find at a distance of some 30 yards vertical above this vein the splendid seam or bed of coal known as the Kingswood Great Vein, which he had no doubt was the equivalent of the celebrated 4 feet Aberdare Steam Coal Vein. Driving a drift across measures he discovered, on the 21st of last February, the vein known as the Kingswood Great Vein, lying in splendid position, and an average of about 5 feet thick, or from that to 5 feet 6 inches, Since that time he had been driving on these veins north, east, south, and west, and found that he was on the floor of the original coalfield, with a gentle dip to the west and rise to the east of about 3 in. to the yard, and apparently extending to the north and east far beyond the bounds of his mineral estate. He did not want to trouble his hearers with anything that was merely personal and commercial, but he was sure they would pardon him for saying that not the least interesting feature of this discovery to him was that it had revealed the existence of from six to eight million tons of magnificent steam coal in his mineral estate that he had no expectation of having, and he could see clearly that for the next 50 to 100 years, at least, the collieries he worked could go on landing a large quantity of splendid coal, at a cost that would enable those who worked them to hold their ground against all competition, come from where it may, and thus continue to develop one of the important industries of the district. . . . . . . Proceeding to the source of the dislocating force, he said the Mendip Hills formed the southern boundary of the Bristol coal-field, though their distinguished president (Sir William Guise), Mr. Etheredge, and himself were able some two or three years ago to gather proofs from the rocks at Cannington Park, near Bridgwater, that those rocks, which had previously been regarded as Devonian Limestone, were after all the Carboniferous Limestone, though in a highly crystalline condition, and very sparse of fossil remains. Being, however, genuine mountain limestone they showed almost certainly the existence of a coal-field south of the Mendips. His object in referring to this was to recall their attention to a fact that was proved by their friend Mr. Etheredge, and the late Mr. Charles Moore, of Bath, beyond all question, namely, that the Mendips were lifted after the deposition of the coal measures—but prior to the deposition of the secondary rocks—and that when those hills were thrust up by the volcanic force that in some portions had pushed the lava right through the limestone and Old Red Sandstone, the whole country to the north, and possibly to the south as well, was thrust forward. At Radstock, five miles north of the Mendips, this thrust had given Lady Waldegrave a double quantity of the Radstock or upper series in veins. They must, however, look for the force that has thrust the Kingswood coal-field over itself at a nearer point than the Mendip Hills, and he thought if they would look at the enormous development of carboniferous limestone at Blackdown, Bourton, and in that district, they would see the seat of the force that has caused this displacement. It was singular and exceedingly interesting to note the effect of this thrust. If they looked at the map they would see that south of where they stood the river Avon has been pushed a mile to the north out of its natural course by the same force that had thrust the coal-field over itself, and he happened to know that two or three miles below the level course of the seam of coal in the coal-field had been turned almost at right angles to its regular course by the same upheaval of Carboniferous Limestone, and the displacement caused thereby and the level course of the workings on the south dip of the coal-field at Kingswood at a great depth, followed the remarkable course in the river to which he had called attention—thus showing pretty conclusively that the course which had caused the one had produced the other. The level course of the workings at the South Liberty of the Ashton Colliery had been turned round by the same course. In conclusion, Mr. Cossham remarked that the problem he had endeavoured to explain would have a very important influence on the future of the district, and was associated with an industry upon which the future of the country largely depended. Whenever England's mineral resources failed, her commercial supremacy must end, and therefore every discovery that widened the area and increased the extent of their mineral resources should be regarded with interest.

A PRACTICAL METHOD OF ESTIMATING DISTANCES.

DRAW one or more silhouettes of standing or kneeling men upon a card—the standing ones 25 mm. in height and the kneeling ones 16 mm. If you are an artist and have the means at disposal, instead of simply blackening the figures, you may paint both surfaces with the colours that are peculiar to the different uniforms of the enemy, but care must be taken not to lay the colours on too thin. Now cut the figures out with care, leaving sufficient paper attached to their bases to allow the instrument to be held between the thumb and first finger.

The apparatus being constructed, it only remains to use it. At 200 mètres distance station one or more men, and, where you are standing, allow an assistant to hold the instrument at the height you direct him to. Now proceed to a distance of exactly four paces, of 0·75 m. each, from your figures, and ascertain whether their general aspect, as regards height and width, corresponds to that of the men stationed 200 mètres off. If the resemblance is perfect, you are in possession of one of the simplest and most portable of telemeters; if it is not, you will have to begin all over again. You may renew the operation by placing your men at 300 mètres, and taking six paces instead of four (Fig. 1).

The arrangement adopted permits, on holding the instrument away from the eye, of diminishing the difficulty that the latter has of seeing the objective and image simultaneously. Besides, it lessens the trembling of the hand that holds the apparatus, and which would render observation impossible in an ordinary stadium placed at 0·6 m. from the eye.

What is the value of $\frac{H}{h}$? In the majority of proportional base telemeters the distance sought is 50 times greater than the base. Such a ratio is very convenient, since it necessitates a base of only 20 mètres for a distance of 1 kilomètre.

Fig. 1—Method of Estimating Distances.

Supposing that the apparatus has been constructed satisfactorily, the manner of using it for estimating distances will be readily understood. Let an assistant hold the instrument in the direction of the troop that serves as an objective, while you move backward in keeping your eye upon the silhouettes and the objective, and stopping when the figures and men exhibit the same aspect and seem to form part of one and the same group. Then returning to your assistant, you count the number of paces that separated your eye from his hand. Upon multiplying this number by 50, you will obtain a product that will give you in mètres the distance sought.

Notwithstanding the wonderful simplicity of the instrument, it is easy to control the accuracy of the principle upon which it is based, first, by reasoning, and then by experiment.

In the similar triangles, A B C and D E C (Fig. 3), we have the ratio:

$$(a) \qquad x = l\frac{H}{h}$$

H and h being constants, l will have to vary with x, that is to say, with the distance.

However, as the observer can scarcely measure the base otherwise than by pacing it off, it has seemed preferable, in order to expedite the operation and avoid a conversion of pace measurements into mètre ones, to take a mean pace of 0·75 m. as unity, and to modify the formula so as to at once obtain the distance in mètres.

In formula a, on substituting $n \times 0{\cdot}75$ for l, and making $\frac{H}{h} \times 0{\cdot}75 = 50$ (H being equal to 1,665) we shall have 0·249 m. as the value of h.

If, however, greater precision were required in the results, the mètre might be preserved as the unity of measurement of the base, the silhouettes be given a height of 33 millimètres, and a cord about 30 mètres, with knots 1 mètre apart, be employed. But it will be readily understood that this process, although more accurate, is much less practical.

Let us now examine the causes of error, as well as their limits.

The height of a soldier, taken as a base, varies between 1·45 m. and 1·8 m. As the mean height generally admitted is 1·665 m., we should, upon taking this as a basis and operating upon extreme heights, commit an error of about one-thirteenth, more or less, of the distance sought. But if, besides the height, we consider (and it is the case here) the breadth of several men, we see that this dimension has less variation, and that we could not assign to the error a value of more than one-fourteenth. This might, moreover, be sensibly reduced by means of operations repeated upon different subjects.

Another cause of error is due to the manner of doing the pacing, which may vary from 0·7 m. to 0·8 m. at the most when some little attention is paid to it, or 0·05 m., more or less, than the normal pace. But the error committed in this case will represent only one thirty-fifth, more or less, of the distance sought, and this may be thrown entirely out of consideration when regulating firing is concerned. The two errors, upon being added, will, at the worst, never give a deviation of more than one tenth in the real distance, and we shall admit that such an approximation is sufficiently exact if we reflect upon the gross errors that we should commit in estimating by eye, and upon the great variations in range that occur in the best-regulated firing.

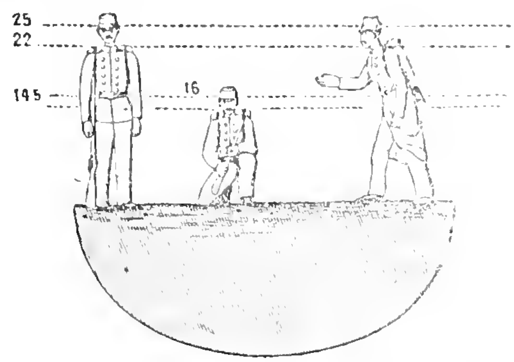


Fig. 2.—Apparatus for Estimating Distances (actual size).

Let us add, that with this instrument it is not necessary to see the entire object; if the upper part of a man's body can be seen, it will be sufficient.

In clear weather this process can be applied to distances of 1,000 mètres and beyond; but if there is a field-glass at one's disposal, it will be preferable to use it for very long distances. In all cases it is well to light the image as much as possible in the same manner as the men observed. If, for example, these latter were in shadow and the instrument were too brightly lighted, it would be necessary to

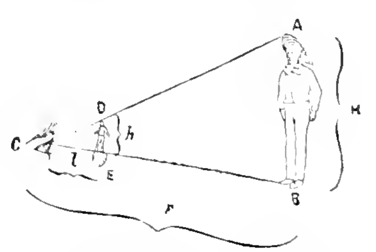


Fig. 3.—Apparatus for Estimating Distances.

cut off with the hand or cap the solar rays that were falling thereupon.

It resulted from experiments made at Fort Cagnelot, on the Langre plateau, that, out of thirty measurements, one only could be considered as insufficient, this having given an error of at least one-eighth of the distance. All the rest showed a deviation much less than that which had been fixed on as a limit; and, if a mean of such deviations be sought, it will be found that it was only one twenty-second. The little instrument that we have just described has in nowise the pretension to replace those excellent telemeters that all infantry corps are provided with; but it offers a sure and convenient means of estimating distances, and we believe that a frequent use of it will quickly familiarize the observer with making such estimates by the unaided eye, and this, it should not be forgotten, will always be the most really practical method on the field of battle.—*La Nature*.

PLEASANT HOURS WITH THE MICROSCOPE.

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

The dry season has not been favourable to the growth of fungi, but in cool houses, stoves, and out of doors, some of the gardener's plagues are sure to be found. Here, for example, is a plum-tree against a wall, with leaves looking as if all manner of minute rubbish, plentifully mixed with soot, had been stuck upon them. An inspection with a hand-glass shows amongst the smut-patches numerous cast skins of aphides; here and there a small, live object—the so-called red spider, which is a mite—and some scale-bugs. So little of the leaf is left in its natural state that all its functions must be suspended. If an orange-tree is examined, some of its leaves will most likely exhibit similar dark spots. Geraniums in a cool house may here and there have on their leaves the same sort of sooty stuff, and ferns are not infrequently attacked. The only thing to be done for the health of the plants is to wash all the objectionable stuff off with soap-and-water, or the Gishurst compound—a sulphur soap. If the leaves of any plant exudes honey-dew, or that substance deposited by aphides, black fungi are pretty sure to grow; but leaves are often covered with them when no particular reason can be detected why they should be assailed.

If a bit of infected leaf is viewed under the microscope, as an opaque object, small tufts may be discovered, looking less black than they appear to the naked eye. They are composed of thread-like tubes and spores of various shapes, which are translucent enough to transmit some rays of brownish or sometimes olivaceous light. A little of the black stuff may be removed with a pen-knife placed in a drop of water on a glass slide, and spread out by moving a covered glass over it. The annexed figures represent the miscellaneous objects likely to meet the view. It is hopeless for any one not well practised in fungology to name these things with proper discrimination, and great authorities like Berkeley or Cooke would not pronounce upon some except after carefully cultivating them, and seeing what they should do. The old authors called the black stuff *Cladosporium fumago*, but Dr. Cooke tells us it is now usually named *Fumago varians*, and that it is considered a conidial stage of Caprodium. If the inquirer examines these things under a microscope, and compares what he sees with the drawings and descriptions of the fungologists, he will think they might be taken for *Helminthosporium*, *Cladosporium*, *Macrosporium*, and *Sporidisinium*.

What is remarkable, and of great though puzzling interest, is the variety of forms under which fungi of the same species can carry on their life processes. In the aggregate, a prodigious amount of work is done by fungi of the minuter kinds. They and their relations—bacteria, &c.—

preside over the disintegrating processes of decay and putrefaction. Their spores abound in the air of towns, and in rural places that are not very high above the sea level and remote from sources of contamination. Their adaptation to various conditions of heat, cold, moisture, dryness, rich or poor supply of appropriate food, &c., is obtained by their power of modifying their growth according to circumstances to an extent quite unknown amongst the higher plants. In

the group of objects in the sketch some are spores of different shapes, some naked, some in little bags (*asci*). The tubular threads are the mycelium which produces them. There are also numbers of extremely minute round objects, which are no doubt capable of starting fresh growths. A fungus spore may be a single cell growing out of a spicular or a thread-like support; or it may be produced in an *ascus*, or sporange (spore vessel), or be in a dust-like condition, *conidia* (secondary spores).

What is a spore? This question requires a rather elaborate answer, and, in reply, it is perhaps best to explain what seed is in the higher plants. In the phanerogams, or plants which show distinct sexual organs, pollen-bearing anthers, pistils, and ovaries, the seed is the result of pollen action upon a plant egg, or ovule. This seed produces a plant like the parent by apparently direct growth. If we look to the spore of one of the higher vascular cryptogams —say a fern—its first visible process of development is a little expansion called a *prothallium*, and then comes the growth of sexual organs, and their concurrence to give rise to a new plant. Vegetable physiologists trace resemblance between pollen grains and spores, and Sachs tells us that "the fertilised embryonic vesicle of phanerogams is not directly developed into the embryo; it first of all produces a pro-embryo, the *suspensor* growing towards the base of the embryosac, and dividing, and on the apex of which arises a mass of tissues from which the embryo is developed." To a beginner this will seem rather obscure, but what it means is this: that the plan of nature is similar and continuous from lower to higher forms, and there is no impassable gap between the growth of a spot of mould upon stale paste and the reproduction of an oak from an acorn its parents made. Besides spores which are adapted to immediate development, fungi produces resting spores, which can wait uninjured for another season, and the dust-like conidia are, in many cases at least, able to withstand prolonged drought. "The same species," observes Berkeley, "may at different times have simple, uniseptate, or multiseptate fruit, and its form will vary in different *asci* of the same individual, though some general characters may be exhibited by all."

To determine the species of a fungus accurately, it is necessary to know it in all its forms, which, in a great many cases, no one has succeeded in doing, and the number of real species is probably only a fraction of those mentioned in the books. The modes of reproduction of fungi are very various, but Sachs informs us that in those species whose cycle of development is fully known, either sexual reproduction, or conjugation—a form of it—always occurs, and in those cases where neither of these processes has been observed, it may be assumed that their life history is incomplete.

The black fungi which more immediately concern us, are often terribly destructive when they attack orange and coffee plantations, and have caused most serious losses in Ceylon and the Azores. In Europe, they often ruin the olive crop. With a few plants to care for, the plan of washing each leaf can be adopted, but the owner of an estate on which thousands are grown is in a helpless condition. These black plagues are not strictly parasites, as many of their relatives are. If a slightly or newly-affected orange-leaf, for example, is carefully washed, and then examined under the microscope, its surface will be found uninjured, and if the cleaning is done in time, the plant is not damaged, and the leaf fulfils its functions as before. If, however, the black mildew is allowed to flourish and cover the whole leaf surface, as with a black felt, the leaf is killed, and if a large proportion of the leaves suffer, the plant may not recover. In one instance in the writer's grounds, a small bush of the bay (*Laurus nobilis*) was attacked and a great many of its leaves partially covered by the fungus. Most of it was gently scraped off, and the shrub seemed none the worse, but most of the branches died in the ensuing cold winter, while others of the same species, which were not invaded by the black enemy, did not mind the frost.

PHOTOGRAPHY FOR AMATEURS.

THE question of popularising photography being now prominently before the public, we propose to offer a few remarks bearing thereon, premising that the subject is one in which many of our readers may be interested.

Less than half a century ago the art of photography was regarded, by all but the very few initiated into the secret of its working, as being little short of magic; and although, by the improvements it has undergone from time to time it has to a certain extent become familiarised with many, it nevertheless continued to be regarded as an "art and mystery" by a great majority of the public until within the last decade. During this period, however, a change has been experienced which may be pronounced as little less than a revolution,—a change which has placed photography in the first rank as a study and an amusement. Its value as an aid to scientific research has long since been conceded; but owing to the technical difficulties in working the old "wet" process. it has, till within comparatively recent times, been little used for this purpose except through the professional artist.

The change referred to consists in the substitution of "dry" for wet plates in producing the negatives; and in order that those of our readers who are unacquainted with the methods may understand the full significance of this improvement, we will endeavour to give a rapid contrast of the two processes, though considerations of space prevent us from entering on a detailed description.

By the wet process the amateur desirous of practising, say, landscape photography, would have to carry about with him quite a laboratory of chemicals, requiring very delicate handling; and if the size of the intended picture were to exceed the meanest proportions, the carriage of the necessary materials, by reason of their weight and bulk, would constitute a potent antidote to the pleasure that might be otherwise obtainable. And even were the amateur artist to overcome the difficulties of transport, his troubles would be still considerable, for his wet plate requires the most exact and careful manipulation, or, notwithstanding all the pains taken in its preparation, it would be absolutely useless for the purpose intended. Another objection to wet-plate photography consisted in the destructive nature of the chemicals used in preparing the "bath." The would-be artist of fifteen years ago was far more likely to be successful in staining his hands and his clothes—the latter beyond recovery—than in producing a picture worthy of the name.

All this has been changed since the introduction of the dry-plate process. The plates can now be purchased ready prepared; all "bath" troubles are dispensed with; cleanliness in working is secured; and the amateur can start on his photographing expedition carrying his whole apparatus in one hand (unless he be unusually ambitious as to the size of his picture), with the certainty of producing far better results than by the discarded process.

This simplification of the method has, of course, done much towards rendering photography popular, not only as a study for amateurs, but also as a cultivated amusement. With the pleasure-tourist the art is already in great favour; it is self-evident that the pleasures of travel may be greatly enhanced when one is in possession of the means of easily photographing the various places of interest visited. We say easily, for by the new dry process the plate does not require immediate "development;" after the negative has been taken it may be put aside, and the picture can be developed with perfect success months after the plate has been "exposed." We number amongst our acquaintances an amateur who, though he spends much of his time in travelling both by land and sea, invariably takes his apparatus with him. The result is that he possesses an interesting collection of pictures taken by himself in different parts of the world; and many a pleasant evening has been passed in contemplating them and chatting over the reminiscences they recall.

We believe that ere long photography will be generally regarded as a ready and pleasant dissipator of the *ennui* sometimes attending a prolonged residence in the country. Indeed, we will go so far as to say that a set of photographic apparatus should be considered to be an almost necessary adjunct to every country house; to lady visitors especially would such afford the means of amusement, now that the process has been divested of its objectionable features—an hour or so with the camera could hardly fail to prove a welcome relief to the sport of "killing time" so often perforce resorted to by the fair sex when away from the "busy haunts of men." Could aught be more enjoyable, for instance, than to be able to reproduce the glories of favourite scenery, and not only to reproduce them, but to easily multiply such reproductions for distribution, maybe, amongst an unlimited circle of friends? Again, in a lesser degree, perhaps, personal pleasure may be found in photographing one's house, gardens, servants, or domestic pets. All objects, animate or inanimate, are easy subjects for treatment by the new process, and in a thousand ways—trivial as these may appear at first sight—would a knowledge of the art be a source of pleasure and profit, not only to country residents, but also to dwellers in cities. So apparent is this to any one who take will the trouble to consider the matter, that we need not further enlarge on this portion of our subject.

Granting, then, that photography *is* an art to be cultivated for amusement, or as an aid to the student, the next question to consider is the best means of becoming conversant with the process. And, in the first place, we would advise the intending student not to rely only upon the perusal of text-books, for although many of these undoubtedly contain much information on the subject, the untutored beginner will rarely succeed in eliciting from them the real *practical* instruction which is necessary. Personal instruction is, in our opinion, essential to the complete understanding of the process; although the *technique* of the art is now so simple that but little time need be expended in acquiring a fair knowledge of it by a person of average intelligence. The London Stereoscopic Company, by the way, seeing the force of this argument, are now giving gratuitous instruction to purchasers of their apparatus, at their studios, 110, Regent-street, W. We are ourselves able to testify to the thoroughness of their system of teaching, and the world-wide renown the Company enjoys is quite sufficient guarantee of the quality of their instruments, which are, it is only fair to mention, marvels of compactness, and, furthermore, may be purchased at but little cost. The lessons are conducted privately and individually, palpably a great advantage to the learner; while the studios are comfortably appointed, and, what is of far more importance, excellently provided as to light. Intending students resident in the country may, if they prefer it, receive instruction at their own homes, thereby avoiding the inconvenience sometimes attending a journey to town, for the Company are prepared to send, by arrangement, a competent instructor to any given address; this plan would also afford to those desiring it the opportunity of acquiring, at the same time, skilled professional assistance in photographing such objects in their own neighbourhood as might possess for them special interest.

In conclusion, we may say that, considering the many advantages to be derived from the study of photography for pleasure, the comparatively insignificant outlay of time and money involved in its acquirement, the cleanliness and simplicity now secured in working, and the facilities offered—as above mentioned—to the public as regards tuition, it would be surprising if what has been called "the black art" (presumably in reference to the suggested mystery attaching to it, but with more reason in sarcastic allusion to the dirty nature of its manipulation when the wet process was in vogue) does not become, at an early date, a first favourite amongst the amusements of the time.

Cork Bricks.—A composition of cork, sand, and lime moulded into bricks is now being tried in Germany for building light partition walls. It is said to have the advantage of excluding sounds better than ordinary brickwork, while being light and a good non-conductor.—*Engineering.*

The Commercial Aspect of Cholera.—The diversion of tourists from the Continent to English holiday resorts this year must be bringing an immense harvest to the inhabitants of the latter. One leading bank estimates the falling-off in the number of its circular notes issued this year, so far, at 3,000. At an average of £66 each note this would be £200,000, and if multiplied by fifty, to get at the approximate similar decline among other English banks issuing such notes, we get already a total of ten millions less to be expended this year by tourists on the Continent, without taking into account the numbers who never make use of circular notes, but usually take Bank of England notes and British coin for exchange into foreign money as soon as they cross the Channel. It must not be supposed that all the money restrained from flowing to the Continent is spent here instead, a great many families being probably glad of the excuse presented by the cholera to stay quietly at home and economise; but, anyhow considered, the saving to the country this year by reduced tourist expenditure abroad is probably thirty millions sterling or so, which ought to materially assist the good harvest in adding to the national accumulations of capital.—*Daily News.*

Editorial Gossip.

Another illustration of gross superstition reaches me: this time from across the Channel. In *La Petite République Française* for August 10, I read an announcement, that some pious pupils at a school having forwarded five francs to an establishment of the Sacred Heart, had been prayed for and passed their examination with flying colours. Appended to this are testimonials conceived in the true "Pills and Ointment" style. One from a young lady (seemingly well on her way to a lunatic asylum) would be ridiculous were it not positively pitiable and humiliating. After saying that she knew nothing and dreaded everything ("Je ne savais plus rien et je redoutais tout"), she goes on to attribute her success to having a statuette of Our Lady of the Sacred Heart in her hand or by her side during the whole of the oral and written examinations. Rude people may, perchance, attribute the success of these pupils to something approaching collusion between the examiners and the knaves who defraud these poor girls of their 5 f. pieces. If, however, this explanation be not accepted, and a candidate for examination has nothing to do but to hold a statuette in his (or her) hand to pass it, the plaster image trade about Hatton-garden ought speedily to revive and flourish hugely, while Professor Loisette will have to look to his laurels.

Every true student of astronomy must learn with sincere gratification of the continued success of that most practical working association, the Liverpool Astronomical Society. From its third annual report I learn that during the year ending August 16, 114 fresh members and associates were elected; and that the Society has during the same period issued 114 pages of printed matter, illustrated by 16 plates. The list of officers for the ensuing year could hardly be improved upon; while it is instructive to note that, out of a total expenditure of £72, 32 *shillings* (!) has gone for purely local expenses. It is hard to avoid a comparison between such trading on science as this on the part of the local authorities proper of the Liverpool society, and the beautiful disinterestedness and self-abnegation of certain gentry at Brompton!

If we may believe all we read in the French newspapers, the problem of aërial navigation has been solved by Captains Renards and Krebs in the very way in which we have been assured by experts that it was hopeless to attempt it; that is, by directing a balloon, with all its enormous resisting surface. I seem to remember reading an essay by the late Dr. Lardner, published in the days of our fathers, in which he demonstrated the physical impossibility of a steamer crossing the Atlantic.

The prediction of M. Ch. Montigny, of Brussels, that the present summer would be a very dry one—a prediction founded on his observations of the change in the character of stellar scintillation—has been fulfilled *au pied de la lettre*. Apparently, the scintillometer affords a rather more trustworthy method of meteorological vaticination than the quack method of sun-spot watching.

I have just got a new adjective out of the *Mirror of American Sports*, which will last me for some time to come. A performer on roller-skates is called "a Zampilirationistic artist"! How's that, Umpire?

Sir W. Parker Snow sends me a stirring Appeal to the English Nation to equip yet one more Arctic Expedition, and to place him in command of it; pledging himself to conduct it safely to the actual North Pole of the earth. In the face of the ghastly series of records of failure, culminating in that of the appalling sufferings of Greely and his band of fellow-explorers, I can conceive of no possible advantage, religious, social, commercial, or scientific, to be gained by the exposure of yet another company of brave and devoted men to imminent death and destruction, in order that they may (in the incredible event of their reaching their destination) be able to *say* that they have stood over the extremity of the earth's axis of rotation. For surely no other result than this could accrue; and, knowing from bitter experience at what an awful risk it must be achieved, I cannot consent to aid any attempt to effect it. Le jeu ne vaut pas la chandelle.

THE FACE OF THE SKY.

From August 29th to September 12th.

By F.R.A.S.

The student will keep, as far as may be, his daily watch on the Sun for spots and faculæ. He will find the night sky portrayed on Map IX. of "The Stars in their Seasons." There will be minima of Algol ("The Stars in their Seasons," Map I.) at 1h. 3m. a.m. on Sept. 5, and at 9h. 51m. p.m. on the 7th. Two other minima occur at such inconvenient hours during the next fortnight as to need no mention here. Mercury is an evening star during the whole of the succeeding fortnight, but can scarcely be picked up by the observer unprovided with an equatorially-mounted telescope. Venus is a morning star, and is a most brilliant and conspicuous object before sunrise, presenting the appearance, under proper optical aid, of the Moon when she is between twenty-two and twenty-three days old. Mars is invisible for the purpose of the observer, a remark which applies to Jupiter too; but Saturn rises soon after half-past ten o'clock at night at the beginning of September, and before ten p.m. when these notes terminate. He will be found a little to the north of ζ Tauri ("The Stars in their Seasons," Map I.), and, with his rings nearly as wide open as they can be, forms a glorious object in the telescope. Neither Uranus nor Neptune is fairly visible just now. The Moon will be full rather more than an hour before noon on Sept. 5, so that she will be visible during the first half of the fortnight which our notes cover. She has, though, too great south declination during the major part of this week to be scrutinised in the telescope to any great advantage. Two occultations only will occur at convenient hours during our specified period. The first is of the 6½th mag. star 11 Piscium, which on the night of Sept. 5 will disappear at the Moon's bright limb 4 min. after midnight, at an angle from her vertex of 117°. It will reappear at her opposite limb at 19 min. after 1 a.m. on the 6th, at a vertical angle of 301°. The next occultation will happen on the 12th, when the Moon will already have occulted BAC 1930, another star of the 6½th magnitude, before she rises. Later, however, at 11h. 14m. p.m., the star may be seen to reappear at her dark limb at an angle from her vertex of 220°. The Moon is in Ophiuchus to-day and to-night, leaving that constellation for Sagittarius to-morrow at 1 p.m. It takes her until 2 o'clock in the morning of Sept. 2 to cross Sagittarius and enter Capricornus, across the northern part of which she has travelled by 7 o'clock the same evening, at which hour she crosses into Aquarius. She quits Aquarius for Pisces at 6 p.m. on the 5th, and occupies until 4 p.m. on the 8th in traversing this great constellation. At that hour she enters Aries, which she leaves at 7h. 30m. on the morning of the 10th for Taurus. She is travelling through Taurus until 7 p.m. on Sept. 12, and she then crosses into the extreme northern part of Orion. As it is 6 o'clock in the morning of Sept. 13 before she emerges from the narrow strip of Orion into Gemini. We there leave her.

To Cleanse Laboratory Vessels.—*Dinglers' Journal* says that flasks which have contained oil or fatty matter may be easily cleansed by a solution of permanganate of potash. Hydrated peroxide of manganese is formed, which, on addition of strong hydrochloric acid, liberates chlorine. This decomposes the organic matter, and allows of washing with water. When the flasks have held resinous solutions it is necessary to wash with a caustic alkaline lye, and afterwards to rinse with alcohol. To remove turpentine, petroleum, photogene, &c., wash with thirty or forty grammes of sulphuric acid and rinse thoroughly in a stream of water.

Reviews.

Introduction to Science Note Book. By C. H. HINTON, B.A. (London: John Haddon & Co. 1884.)—The Science Note Book is a kind of copybook ruled in squares of various sizes. In his "Introduction" Mr. Hinton shows how the rudiments of Co-ordinate Geometry, Mensuration, and various facts of size, shape, and number may be taught in the most simple way. The idea is a good one, and the system well adapted for teaching the Elements of Mathematics.

The Elements of Euclid. Books I. to VI. By J. STURGEON MACKAY, M.A., F.R.S.E. (London: W. & R. Chambers. 1884.)—Following, to a great extent, Simson's editions of Euclid, Mr. Mackay has not done so slavishly; and in certain respects has improved upon that time-honoured editor of the immortal "Elements." His alterations are certainly, so far as we have tested them, all in the direction of perspicuity; and are calculated to remove those little difficulties which beset the incipient efforts of the student of geometry. The figures are capital.

Picturesque Wales. By GODFREY TURNER. (London: W. J. Adams & Co.)—This very cheap, readable, and prettily-illustrated description of the various points of beauty and interest accessible by the Cambrian railways may be advantageously studied by those who, declining to subject themselves to the untold miseries of Continental quarantine, are ignorant of the wealth of glorious scenery to be enjoyed in their own country. The tourist, undecided where to spend his holiday, may invest sixpence in Mr. Turner's little book very profitably indeed.

The Moselle, from the Battlefields to the Rhine: Tourists' Travel Talk. Holiday Handbooks. (London: 125, Fleet-street.)—If, however, undismayed by foreign sanitary regulations, the traveller should determine to quit his own country in search of health and change, he will find all needful information as to the best means and cost of visiting the theatre of the Franco-German War and the glorious scenery of the Moselle generally in the first *brochure* whose title heads this notice. The second should enable him to make himself sufficiently intelligible to get about.

Expository Thoughts on the Creation. By JAMES ROBERT SMITH. (London: Printed for the Author by Elliot Stock.)—In the preface to the mass of hopeless nonsense whose title heads this notice, its author deprecates adverse criticism, on the somewhat incoherent grounds that it was written "when the writer was but temporarily engaged in his calling;" that "neither *leisure* nor *learning* (properly so-called) has been brought to bear upon it," that the "life-experience" of its writer "has been mainly gained in another and far different sphere—viz., in a department of the *legal* world," and "to a consequent lack of sufficient knowledge of natural history and other branches of learning and research." It is really difficult or impossible to conceive the mental condition of a writer who can put forward his ignorance of a subject on which he presumes to attempt to instruct others as a reason why such an attempt should be tenderly dealt with! For ourselves, we refuse to accept such an utterly irrelevant excuse. The inexorable rule which excludes the discussion of all purely theological subjects from these columns, prevents us from referring to Mr. Smith's polytheistic exordium: let us then see what his Science (Heaven save the mark!) is like: In limine he adopts the fifty times exploded idea that the "day" of Genesis "is age or era"; ignoring wholly that "the evening and the morning were the first (and each succeeding) day," and calmly putting Exodus xx. 8, 9, 10, and 11, out of sight altogether. However, having got his "ages or eras," let us see what our author does with them. Prior to the commencement of the first, the female Deity, by a "corporeal act," originated the compound elements of nature, "which were . . . . five in number—viz., aëriform vesicular matter, wind, watery vesicular matter, oleaginous vesicular matter, and salt." Then the wind, salt, &c., "began moving and rotating." Globules were poised in space, the air, at first thin, became thick, "the sea began to be developed," and "by virtue of the generating elements composing it, and those of air, being in constant and two-fold motion, there gradually started into being multitudes of animalculæ and microscopic life." With this "start" the transition to shell-fish and "many marine creatures . . . . who attained unto immense size," presents no difficulty at all—or, at all events, as little as the method in which their deposits formed "at last by far the greater portion of the *earliest* earth-crust—namely *that* composed of chalk and lime." Geologists and Palæontologists will be as interested to hear that Icthyosauri, Plesiosauri, and Megatheria (!) existed during the "third age" (or day) as physicists will that "the air was formed by the aggregation of innumerable globules or vesicles . . . . consisting principally of aëriform unctuous matter and watery unctuous matter"; or zoologists, that the same third day witnessed the creation of the penguin, petrel, dinornis, kestrel-hawk, sparrow, and red-pole. It will also, in all probability, be new to mineralogists to learn that during the fourth day (or age) there was a "*lead* formation in the northern hemisphere," and the "formation of *tin* in the southern; but that subsequently, on the fifth day (or age), there was "a *copper* formation in the northern hemisphere," and a *brass!!!* one in the south. "Pig-iron and dense iron," by the bye, came into existence on the sixth day. The generation of Adam "*solely* by a female gorilla," after all this, will scarcely cause any surprise. We would rather not trust ourselves to describe the genesis of Eve, as set forth by our author. At first sight it may appear that an apology is really due to the reader for occupying his time with such trash as that from which we have culled a very few specimens; but we have done so in order to show where the latest attempt at reconciliation between the irrefragable facts of natural and physical science and the legend in Genesis lands us. The harm to religion done by those who have, so far, essayed to effect this "reconciliation" can hardly be over-estimated. To address advice to the author of a book such as that on which we are commenting, can scarcely be anything but a waste of time. Inasmuch, however, as he seems to pay great deference to texts (with which his earlier pages bristle), we would urge that he should read, mark, learn, and inwardly digest Matthew xv., 14 v. as soon as may be.

Messrs. Hodder & Stoughton send us, under the title of *Health Studies*, a reprint, in three separate shilling volumes, of Dr. Paterson's work, of which we were able to speak so favourably in p. 461 of our last volume.

We have received from Messrs. Cassell & Co. the current parts of *European Butterflies and Moths*, *Cassell's Household Guide*, *Cassell's Popular Gardening*, *The Book of Health*, the *Library of English Literature*, and the *Countries of the World*, each and all of which are as pleasant to the eye as they are profitable to the various classes of readers whom they severally especially address.

We have also on our table *Le Franklin*, *Bradstreets*, *The Tricyclist*, *Naturen*, *The Australian*, *Society*, *The Medical Press and Circular*, *The Medico-Legal Journal*, *Ciel et Terre*, *The American Druggist*, *The Dyer*, *The Factory News*, *The American Naturalist*, *Sunday Talk*, *Our Monthly* (published in Rangoon), and *The Hindu Excelsior Magazine*.

Miscellanea.

The *Lawrence American* of July 9 says:—For more than ten days past the entire power for running not only the large Hoe press upon which this paper is printed, but for the cylinder and job presses of the entire printing establishment, has been from electricity coming over a single wire from the dynamos, four blocks away.

The National Health Society have issued another of their admirable, timely little pamphlets, entitled "How to Prevent and Oppose the Cholera." Charitable people might make infinitely worse use of their money than by circulating this tract widely in poor and crowded neighbourhoods, which could be done at a very small cost.

Professor Hall, of the United States Naval Observatory at Washington, calls attention (in No. 2,602 of the *Astronomische Nachrichten*) to the necessity for a uniform catalogue of clock stars for general use. He suggests that it should be sufficiently elaborate to enable the apparent position of a star to be interpolated with ease and certainty for any given time. Its cost ought not to be great.

The following telegram from St. Petersburg appeared in Tuesday's *Standard*:—"The list of modern books which, according to the Decree of the 5th of January, are not to be allowed in the reading-rooms and public libraries of Russia, includes translations of works by Agassiz, Bagehot, Huxley, Zola, Lassalle, Lubbock, Lecky, Louis Blanc, Lewes, Lyall, Marx, Mill, Reclus, Adam Smith's 'Wealth of Nations,' and 'Theory of Moral Sentiments,' and Herbert Spencer's works."

The Smoke Nuisance in Glasgow.—At a meeting of the Town Council of Glasgow, held recently, the chief constable stated that the number of observations of chimney-stacks made by the police in Glasgow during the year 1883 was 1,312; that in 132 cases reports were made to the Procurator-Fiscal; that in 70 of those cases no proceedings were taken; and that in 25 cases the parties were tried and acquitted, while in 37 cases the parties were convicted.

The total cost of the Greely relief expedition is estimated by the officials of the Navy Department at about £140,000. The original estimate was £100,000. Of the amount expended, £50,000 was for supplies and £62,000 was for the purchase and repair of the steamships *Bear* and *Thetis*. The repairs made to the *Alert*, lent by the British Government, involved a cost of £3,033. Instruments for making observations cost £5,000, and the coaling charges came to £3,000.

The Panama Canal.—Considerable deliveries of plant have still to be made in connection with the Panama Canal works. Among this plant may be mentioned 1,500 trucks, 28 locomotives, 23 dredgers, 3 hopper barges, 25 portable steam-engines, 20 steam navvies, &c. Altogether plant has been ordered to the aggregate value of £1,400,000. The aggregate quantity of earth which has to be removed to render the canal available for navigation is 120,000,000 cubic mètres. Two-thirds of the earth thus to be excavated will be removed in a dry state, and the balance of one-third will be dredged.

We regret to announce that Mr. Henry George Bohn, the publisher, died at his residence, North-end House, Twickenham, on Friday, at the advanced age of eighty-eight. The son of a London bookseller, he was born in January, 1796, and, after completing his education, entered his father's business, where he soon acquired a knowledge of books which made him one of the best bibliographers of the age. In 1831 he commenced business on his own account, and it is impossible to estimate too highly the services he rendered to the more intelligent portion of the community by republishing, at a cheap rate, a vast number of the most valuable works in literature, science, philosophy, history, biography, topography, archæology, theology, natural history, poetry, art, and fiction. He retired from business some years since, when the whole of his stock passed into the hands of Messrs. George Bell & Sons.

A great stir is being made about the recent application at Berlin of a dynamo machine to operate about forty telegraph circuits. It appears to be regarded as a new and important departure. Presumably, sight is lost of the fact that thirteen years ago a gramme dynamo was in use in Telegraph-street supplying the current necessary for forty, and sometimes upwards of sixty, circuits, and was only allowed to pass out of use because a workman ran his file over the insulation, and so spoiled the machine. But what purpose can be served by such an experiment? It seems something like using a steam-hammer to crack a filbert. Thirty to forty London wires have been worked for months together from fifteen quart bichromate cells. The objection to working a great number of circuits from one source is that should that source fail, if only for two minutes, the whole of these circuits are stopped for a similar time, and the stoppage of a circuit for even two minutes is often a serious matter.

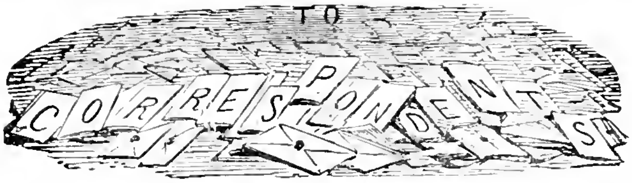
At this season alarm is expressed at the diminution of the water-supply of Paris, and the municipal bodies are in a hurry to deal with the question forthwith every year. But it is forgotten as soon as the drought is at an end. The volume of water in the reservoirs is again reported very low, and the waterworks are unable to yield at the present moment more than 378,000 cubic mètres per day, which is scarcely half the quantity considered necessary for the supply of Paris. In many quarters of Paris there is not a dwelling supplied with water. Water-closets, properly so called, are only to be found in the newest houses; and, as everybody knows, the system of sewage is behind the age, every Paris house being still supplied with a cesspool, which is emptied about once a year, and from which, from year's end to year's end, noxious gases ascend into the apartments, rendering, a *Times* correspondent says, the French metropolis a hotbed of typhoid fever.

Subsidence in Cheshire.—The demand for salt is now so great that the subsidences usually to be observed in the great Cheshire salt-fields are more apparent than ever, particularly at Northwich. These culminated recently in the settling down of a vast body of earth, upon which a boy in charge of a horse was standing. Both boy and horse were engulfed, and would have been killed but for the assistance speedily rendered by onlookers. In order to form some sort of an estimate of the quantity of brine extracted at Northwich and Winsford, it may be stated that the returns made up for last month show that the exports of salt were 127,998 tons, against 103,878 tons for July last year. Of this large quantity the East Indies took no less than 46,431 tons, and the United States 17,552 tons. The exports for July were, with one exception, the heaviest for any corresponding month for the past seven years.

Church-bells and Thunderstorms.—On July 5 last a violent thunderstorm, lasting three hours, occurred near Saintes, in the south-west of France. A poplar about sixty feet high and twenty inches in diameter at the foot was cut off quite clean and level, six feet above the ground. The rest of the tree was splintered into thousands of fragments, which resembled a wood-cutter's "waste," the largest weighing about thirty pounds, and the smallest mere chips. These lay evenly all round in a circle to a distance of 100 yards from the trunk. In that district the funny old superstition of ringing the church-bells during a thunderstorm as a lightning protector survives, and the dutiful old sacristan was ringing away as hard as he could at three o'clock in the morning, when, the steeple being about 300 yards from the poplar-tree, he was knocked down by the shock. Hearing the bells stop, the village population thought he was killed, and turned out in a body to find him more frightened than hurt.—*La Constitution* (of Cognac), July 11, 1884.

The Patent Office Report.—The first report of the Comptroller General of Patents, &c., under the new law has been issued. The most striking fact of the report is the record of the sudden pressure thrown upon the Patent Office during the first month of the year, when cheap patents became available. The applications during January numbered 2,499; whereas the previous average for the month was about 500. Not only was the number of applications increased fivefold, but the work on them was much heavier; for the provisional specifications were not merely pigeon-holed, as formerly, but were all examined, and in many instances amendments were introduced at the suggestion or by the requirement of the examiners. During the four months covered by the report the total number of applications made was 7,060. The expectations of those who imagined that the new law would dispense with agents are not justified by the facts; for 72 per cent. of the applications still pass through the hands of patent agents.

Solar Heat and Weather Change.—Mr. Slack writes on Saturday, Aug. 23:—"A black bulb vacuum thermometer, placed on the ground in a shallow box filled with cotton-wool, and black cotton-velvet under the bulb, registered 125° F. at 10h. 27m. a.m. A sensitive spiral thermometer, hung against a post of dark purple colour, rose a few minutes earlier to 104°. At 11h. 9m., B.B. 140°; 11h. 42m., S.T. 112°, and at 11h. 45m., 114°; 12h. 28m., B.B. 149°; 12h. 31m., S.T. 117°; 1h. 2m., B.B. 150½°. During this time a cool easterly wind was blowing. B.B. was in a sheltered place; S.T. more exposed. The two thermometers were then placed together on the cotton-wool and velvet, and at 1h. 40m. B.B. was at 152¾°, and S.T. 126°. On Sunday, the 24th, at 12h. 35m., B.B. 143°, S.T. 116°. At 1 o'clock, B.B. 145°, S.T. 118°; 1h. 40m., B.B. 152°, S.T. 123°; a cool wind was blowing. On the 23rd, at 1h. 54m., the temperature in shade was 75° with dry bulb of hygrometer, and 60° wet one. At 1h. 40m., on 24th, the two bulbs stood at 75° and 65°. On the 25th the weather changed, and at 1h. 15m. the two bulbs showed 62° and 60°. Ashdown Cottage, where the observations were made, is on the north slope of the Ashdown Forest range, and 406 feet above sea-level."



"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

SUNFLOWERS.

[1371]—Mr. Grant Allen, in his article on "Sunflowers," mentions the sealy bracts which, he says, serve as a protection to the unopened flower-buds, but makes no reference to the secretion which appears at the apex of each of these bodies. Having had several sunflowers under my observation during the present season, I should like further information on the subject. What is the nature and purpose of the substance secreted? Is it gum?

Will the author of the article also answer the following questions for the benefit of the readers of Knowledge?—

What causes the contraction of the filaments which draw the united anthers within the tube of the corolla after the pollen has been shed?

What is the action of the style after fertilisation?

Robert Paulson.

VISIBILITY OF THE DIRECTION OF A FLASH OF LIGHTNING.

[1372]—Having just now read "The History of a Lightning Flash," which appeared in your issue of the 15th, I am induced to ask space in your columns for a narrative of facts which may possibly interest some of your readers. One day, about midsummer (in the year 1842), I was standing—along with four others who have since passed over to the majority—on the deck of a yacht, at no great distance from St. Anne's Head, Isle of Man, watching the progress of a thunderstorm, which had just before passed over our heads from the S.S.E., and from which our escape had been a narrow one. For some time nothing remarkable occurred; but ere long I suddenly called out, "Did you see that?" to which, with one voice, the answer was "Yes." And if it had not been "Yes," I should most certainly have disbelieved my own eyes, knowing well, as I did even then, that the eye is "a deceitful member—very." What then, think you, did we see? Simply the establishment of an electrical equilibrium between two clouds; but that was effected by a flash of lightning striking the top of South Barrule Hill (towards which the storm had passed from where we were), and rising out of that of Snaefell, which lay several miles towards the N.E., and so was not in the track of the storm. It is almost needless to add that from that moment to the present I have never doubted that the direction taken by a flash of lightning is perceptible to the sight; though, of course, others are at perfect liberty to think otherwise if they please.—W. A.

IS TEA INJURIOUS?

[1373]—Will Mr. Williams say whether he thinks tea may not be drunk in moderation (say two cups in the evening) with immunity, unless, indeed, the contrary only is to be inferred from his article ("Chemistry of Cookery," page 128). What are the effects produced by the use of the noxious herb and the symptoms of the mischief wrought? I enjoy my cup immensely, and experience all that Mr. Williams describes, especially the "fit for anything" condition, without, however, being aware of any ill effects (and is this without its value?), but would relinquish the habit (not without a pang) on the advice of so eminent an authority. With thanks in advance,

A. Gaubert.

THE PREVENTION OF SMALL-POX BY VACCINATION.

[1374]—The cases of salvation through vaccination in the extract from the *Medical Press and Circular* cited in Knowledge, give neither names, dates, nor any means of authentication, and, if correctly reported, may, I venture to say, prove nothing to the point. No opponent of State-enforced medical prescriptions believes that the omission of vaccination affords immunity against small-pox. What they maintain, however, is that there is no scientific evidence that vaccination affords such immunity. The recent devastating small-pox epidemics amongst the well-vaccinated populations in Sunderland, Liverpool, Birmingham, and London ought to settle the question to every unprejudiced mind; but the bulk of the population are not unprejudiced, and fail, therefore, to recognise the force of facts that run counter to popular theories. It may, however, interest some of your readers to learn that this important question has, during the past few years, been carefully investigated by a distinguished scientific observer, Dr. Alfred Russel Wallace, whose memoir on the subject is now in the press, and who summarises his conclusions as follows:—

1. That vaccination has not saved a single life; this not being an opinion, but a fact proclaimed by the Registrar-General's own facts and figures.

2. That vaccination does not diminish small-pox mortality—demonstrated by the same official facts, and by the record of small-pox deaths of our re-vaccinated and "thoroughly protected" soldiers and sailors.

3. That, while utterly powerless for good, vaccination is a certain cause of disease, and death in many cases, and is the probable and almost certain cause of about 10,000 deaths annually by five painful and disgusting diseases, which have increased to this extent since vaccination has been officially practised and enforced.

In the presence of such weighty testimony, it is surely not too much to ask the medical profession at whose instigation these compulsory laws have been enacted, to do what in them lies to retrace their steps, and to petition Parliament for their immediate abrogation. The Imperial Parliament of Germany, unable to resist the accumulation of testimony showing the futility of vaccination as a prophylactic, and its pernicious effects on the public health, has recently appointed an Imperial Medical Commission to investigate the question *de novo*. It may not be generally known that nine of the Swiss cantons have already abolished compulsory vaccination, with the result of an important diminution in infantile mortality.

William Tebb.

[I insert Mr. Tebb's letter in what he himself calls "the interests of public health and fair play"; albeit, his idea of "fair play" would seem to be the attribution of disingenuousness and moral perversity to all who differ from him. That the *Medical Press and Circular* may have suppressed names for fear of giving pain to the survivors of the unfortunate creatures whose lives were sacrificed to the Anti-vaccination craze, appears never to have occurred to him. No one who is not monomaniacal on the subject can shut his eyes to the patent fact of the immunity of the well-vaccinated officials of the small-pox hospitals from the fell disease with which they are surrounded. As for Dr. Alfred Russel Wallace's opinion on the subject, it must be taken *quantum valeat*. As a natural historian and as the independent co-discoverer with Darwin of evolution his name must command universal respect. As the author of "Miracles and Modern Spiritualism" he . . . but I do not wish to say anything hurtful or offensive of a man for whom I entertain both admiration and esteem. I have no more doubt that vaccination has saved hundreds of thousands of lives than I have that I am writing these lines.—Ed.]

SHIPS' LIGHTS.

[1375]—As a constant reader of Knowledge, your articles "Sent to the Bottom" have been to me, as all others always are, interesting as well as instructive. With regard to the lights you propose ships should carry, the opinion and ideas of one actually concerned in their importance may not be without value and significance to your readers.

In the first place, your plan appears to be open to one very serious objection—the lights would be too numerous about a ship's deck. I think all who follow the sea will agree with me that the fewer lights carried, and the more simple their disposition is made, the better. No method of placing lights on board ship is absolutely safe, except in the iron lighthouses now in great use in steamers. The exposure in other cases often causes their total extinction by a heavy sea at a critical moment; and your plan would require six lights, three on each side, the lighthouses for which would be too much in the way of working ship. Again, in narrow channels crowded with shipping, the multiplicity of lights would be simply bewildering. Your remarks about fixing the fine, parallel threads equidistantly in a small diaphragm at the focus of a telescope's eye-piece might answer very well in fine weather; but, recollect, sir, that such weather does not always prevail; nor is the ship at all times steady enough to use a telescope thus fitted. In fact, there are really such bad nights, when it is blowing and raining hard, and sprays are drenching the ship fore and aft, when glasses cannot be used at all, and we must trust to our own unaided powers of sight.

Experience has taught me that the plan suggested by "J. H. G." of carrying a white light under a coloured one has this objection, that the white light outshines the coloured one. I have often observed, when meeting steamers at sea by night, a white light placed in a position where I expected to see the coloured one, and which ought not to have been there at all, shining so brightly that I could not detect the presence of the coloured one above it till nearly abreast of the steamer, and at no great distance from her.

With your correspondent "Chas. Rice's" plan, we could not tell which side of the ship was presented to us, as the lights on each side, when seen from before the beam, would be all of the same colour.

I think the lights as at present carried by ships, with the addition I will presently name, would answer the purpose, and all others should be effectually screened or put out, so that they might not be misleading, perhaps fatally so.

Many of your readers know that the lights carried by sailing vessels are a red light on the port or left side, and a green one on the starboard or right side, each visible over an arc of ten points, or 112° 30′, from right ahead. Steam vessels carry a white light on the foremast head as well, visible over double this arc—that is, from right ahead to 112° 30′ on each side. The addition I would make is to have two red lights placed vertically about six feet apart, and about ten feet lower than the white light of steamers, and on the after part of the after-mast, or in some such prominent position, visible through an arc of fourteen points, or 159° 30′—that is from right astern to seven points on each side, thus overlapping the other lights, and all being visible together through one point, or 11° 15′. The two vertical red lights to be carried in both steam and sailing vessels, and by means of which we could always see when we were overtaking another vessel.'

I may inform your readers that as soon as a ship's light is seen at sea, its direction and colour will always show whether it is on the danger side of the observer, and the plan always adopted when first seen of taking its bearing, and a few minutes afterwards taking another, and noting the difference (if any) will show which ship is crossing the other; if there is no difference, it shows the ships are meeting, and there are proper rules by which one gives way while the other holds her course, and we never aim at passing as close as two hansom cabs in a street.

It is always the practice, as well as the constantly-repeated order, to give all vessels seen, especially at night, a wide berth. A vigilant look-out carefully kept by the officer of the watch, as well as those two most excellent qualities, a clear comprehension and a ready resource, will, in all cases where appliances are not faulty and the atmosphere fairly clear, keep any ship from collision with another. It is further greatly to be desired that under equal conditions all ships' lights should be visible the same distance.

There is also great need of distinction between the lights carried by disabled ships and telegraph ships laying or repairing telegraph cables. There being none at present, other ships are often taken miles out of their course to find, instead of a ship in distress, a telegraph ship at work.

The three red vertical lights visible all round the horizon, and which are carried in the place of the white masthead light, in telegraph ships at work might be changed to white.

The light carried by a sailing pilot vessel is the same as that of a ship at anchor, so that it is difficult at times to tell in what direction the pilot-vessel is going; it should be made obligatory to carry the red and green lights on each side, the two red vertical lights astern, and in addition, a red, white, and green light at the masthead, separated about six feet from each other, and visible all round the horizon, as well as to use the flare-up light as at present, which latter would show when they were on station with pilots aboard. A British Shipmaster.

THE SPECTROSCOPE AND WEATHER FORECASTING.

[1376]—Not long ago I invested in a Grace's Spectroscope, being fond of the study of meteorology, and anxious to prove for myself the accuracy of the accounts given in Knowledge relative to the interesting instrument, and its power of predicting rain. My object in writing this note to you is to state my gratitude to Knowledge for introducing the Spectroscope to me as an aid in the prediction of the weather. I have effectually proved the importance and reliability of the instrument by this time. The following instance of its validity is so conclusive that I venture to inform you of it.

A few days ago the weather was very unsettled here (as it still is), and there had been much rain in the early part of a certain day; towards evening, however, it cleared up a little, but on asking the keepers, gillies, and sailors about what they thought the morrow would be like, they all agreed in saying there would be "a lump o' rain." The glass was falling, wind was N.W. I then referred to my Spectroscope, and was much surprised by its appearance, which only showed an extremely faint rain-band. So confident was I of my instrument, that in spite of disagreeing with all the weather-wise people of the neighbourhood, I predicted there would be *no* rain for forty-eight hours, and I proved, or rather the Spectroscope was, quite correct; not a drop of rain did we have, though the weather continued to be most unsettled, and the aspect of the sky very threatening. I may venture to say that the people (natives) about here (contrary to custom) are very weather-wise, and are seldom out to any extent in their judgments.

County Antrim, Ireland. H. M. McI.

AUGUST METEORS.

[1377]—Several meteors were observed here on the 11th, between 10h. 15m., and 12h. p.m. Attention was directed almost exclusively to the constellations Cassiopeia and Perseus, no attempt being made, except in two instances, at estimating the duration of visibility. The first, seen at 10h. 23m., surpassed all subsequent ones in brilliancy. It emanated from right ascension 2h. 57m., declination 51°, moved slowly towards β Camelus, exhibiting along the whole track a phosphorescent haze, and after attaining its maximum brilliancy, disappeared from view in right ascension, 4h. 40m., declination, 60°; after having been visible for fully six seconds. It was immediately followed by one whose path, when prolonged backwards, came close to ν Perseus. At 10h. 48m., one appeared from between ν and η Perseus, described a path 6° long, and faded near θ. At 11h., a bright one, equal to a star of 1st magnitude, came from right ascension, 1h. 40m., declination 61°, and disappeared close to 32 Cassiopeia; the path appeared to be foreshortened. 11h. 31m., one emerged from ϵ Cassiopeia, and was lost to view near η Perseus; it was followed at 11h. 51m., by one that appeared in right ascension 9h., declination 75°, and disappeared close to κ Draco. Between 11h. 51m., and 12h. none were detected.

Clouds prevented observations on the 12th. On the 13th, at 10h. 10m., one came from λ Perseus, and disappeared close to δ; it was followed by one at 10h. 21m., that came from Mirfak, and disappeared in right ascension 2h. 52m., declination 47°. At 10h. 46m. one came from Algol, and travelled 9° in direction of ϵ Perseus; this was followed at 10h. 48m. by one from a point 1° north of Algol, that disappeared near κ Perseus; 11h. 40m. appeared from direction of 50 Cassiopeia, disappeared near θ. At 11h. 50m. a very bright one traversed a path that can be represented by a line drawn from μ Andromeda, midway between η and δ, to right ascension 0h. 25m., declination 30°. The luminous train continued visible for three seconds. 12h. 8m., the last observed, appeared near ψ Cassiopeia, and was lost to sight near ν Camelus.

The above-mentioned are only a few whose paths were determined accurately. A great many more were seen, but, owing to the rapidity of flight, combined with the diminution of luminosity by moonlight, their respective courses could not be traced with a sufficient degree of certainty necessary for projection. On the 12th the radiant for the Perseids lay near 45° + 53°, and on the 14th 50° + 49°. Theoretically, its position is 51° + 55°.

Liverpool, Aug. 16, 1884. W. K. Bradgate.

THE SATELLITES OF MARS: A COINCIDENCE.

[1378]—Is it not truly noteworthy that Swift, in his "Voyage to Laputa," should have written: "They have likewise discovered two lesser stars, or satellites, which revolve about Mars, whereof the innermost is distant from the centre of the primary planet exactly three of his diameters, and the outermost five; the former revolves in the space of ten hours, and the latter in twenty-one and a half"?

I do not recollect whether the Laputan observers were right, or nearly so, as to distances; but if not, the discovery of these moons' existence in the middle of the eighteenth century is sufficiently striking. Simplex.

[It must not be assumed that the Dean of St. Patrick's was speaking of an actual discovery in the words which "Simplex" quotes. In reality, Phobos, the satellite nearest Mars, is only about a diameter and a half of the planet from his centre, and goes round him in 7h. 39m. Deimos, the outer satellite, is rather more than three and a half diameters of Mars from his centre, and has a period of revolution of 30h. 18m. Even with these discrepancies, though, the coincidence is sufficiently remarkable.—Ed.]

A GHOST—A FACT.

[1379]—As General Sherbrooke was sitting after dinner with General Winyard, in America, a figure appeared between them and the fire, dressed in uniform and a *strange-looking new hat*. After a pause, it retired through a door into an adjoining room; the Generals followed, and were somewhat alarmed on finding no one there, there being no egress but by the door they had entered. General Winyard remarked that the figure bore the strongest resemblance to his brother, then in England. The time of its appearance was therefore noted down, and it was afterwards ascertained that that very brother died at that very hour. Upon General Sherbrooke's return to England he one day met in London General Winyard's father, who introduced the subject and asked for a description of the *appearance;* General Sherbrooke, having never seen General Winyard's brother, observed that it was very like that gentleman, pointing to a person passing at that moment near them. Now it is very singular that that gentleman was known to Mr. Winyard, the father, and had always been reckoned a striking likeness of his late son. It is further remarkable that the regiment to which the young Winyard belonged was ordered about the time of his death to wear a new kind of hat, of rather an extraordinary make, as the army then thought, and this new military hat the ghost appeared in.

Arthur S. Lodge.

[The very familiar story related by Mr. Lodge is told with decided variations in the details. See for one version Howitt's translation of "Ennemoser's History of Magic," Vol. II. pp. 380, *et seq.* in Bohn's "Scientific Library."—Ed.]

DAISIES.

[1380]—Many months since Mr. Grant Allen, in Knowledge, said some very elegant and pretty things in favour of daisies; but it didn't make me love his pets then, and I don't like 'em now.

An amateur daisy-killer has, with sulphuric acid, turned half my lawn into brown spots, and it has the queerest look of hybrid efflorescence in a state of great discomfort.

Will Mr. Grant Allen kindly take compassion on a distracted lady, and say how she can get rid of his pets, being her pests, and so relieve the heart of a Disconsolate Female?

LETTERS RECEIVED AND SHORT ANSWERS.

F. Overton.—To give the prices of books noticed in these columns would be to convert our reviews into advertisements.—J. G. Fisher. Thanks for your very courteous communication. Pray do not imagine that I consider our existing mode of spelling as absolutely perfect or inexpugnable. My replies were rather intended to indicate the impossibility of adopting Mr. Pitman's or any other novel form of orthography in a paper like this.—A.M.I.C.E. I shall be pleased to accord you permission to make whatever quotations you may require from the articles to which you refer; the sole condition being the acknowledgment that they are derived from this journal.—Julia Usher. Mädler's idea that Alcyone is the centre round which the orbit of our solar system through space is performed, is now absolutely exploded. He went so far as to predicate that that star was actually the centre of gravity of the entire visible stellar universe, an assumption now definitely disproved by the proper motions of a considerable number of stars. In reply to your second question, the instruments in use at the Royal Observatory at Greenwich are by various makers. To begin with, the oldest (I mean the oldest now ever employed), the Shuckburgh Equatoreal: this is the work of that famous optician Ramsden, who flourished during the latter half of the last century. The Sheepshanks Equatoreal has a Cauchoix object-glass, but the mounting is by Mr. Grubb, of Dublin. The capital instrument of the Observatory, the Great Transit Circle, has an objective made by Troughton & Simms, who are largely responsible for the rest of this superb instrument. Messrs. Ransomes & May, Ipswich, however, cast and turned the massive metallic parts of it. The Altazimuth is by the same makers. The object-glass of the Great Equatoreal was made by Merz & Son, of Munich; the engineer's work by Ransome & Sims (successors to Ransomes & May); the graduation and mounting generally by Mr. Simms. There is a reflecting telescope of 24 in. in aperture in the grounds, constructed by that eminent amateur, the late Mr. W. Lassell; a 6-in. equatoreal, by Cooke & Sons, of York; another of the same dimensions by Simms, and so on.—C. E. Johnson. Speaking off-hand, I should say that the Castle in the Arms of Northumberland had *not* any connection with that in the Arms of Spain; but that its origin was rather to be sought in something akin to what gave the name of Newcastle to its chief town, *i.e.*, the building of a fortress, or new castle, by Robert, William the Conqueror's son, on his return from Scotland, probably on the site of an ancient Roman fortification. Perhaps some heraldic reader will notice this question. In reply to your second question, the late Mr. John Payne Collier, the eminent Shakespearean scholar, wrote a work entitled "Punch and Judy;" I forget the publisher's name. There are, too, references to that subject scattered up and down *Notes and Queries*. Or, again, you will find an excellent *précis* of what is known—or conjectured—on the origin of our popular street drama, in an article entitled "Punch and the Puppets," on p. 517 of Vol. VII. of the New Series of *All the Year Round*. This is, I imagine, exactly what you require.—Paul Schutz. Received.—S. G. Your bees have no doubt been both decapitated and eviscerated by Tits, those destructive little birds being among the worst enemies they have. Cockchafers, too, will sometimes destroy them in somewhat similar fashion.—H. G. F. Taylor. I am unable to add to the four names you mention, save with those of men who have merely temporarily influenced large masses, such as Peter the Hermit, Savonarola, &c.—Exhibitioner. Mr. Twiss must have an intellectual twist of a remarkable description. He might approximately measure the diameter of a garden-roller by his method; but to acertain that of a cylinder ¼ inch in diameter—for any accurate purpose—in the same way, would be utterly impossible. Plenty of people can "square the circle" with a two-foot rule and a piece of string; albeit, the actual operation is demonstrably impracticable.—Reader. The mammæ is the male sex, like the os coccyx (or rudimentary tail at the end of the spinal column), the incisor teeth of ruminants which never penetrate the gums, &c., are one and all organs which have become rudimentary from disuse. They were doubtless originally parts acquired by one sex and partially transmitted by inheritance to the other, and afford yet another proof of the evolution—as contradistinguished from the special creation—of species. At a very early embryonic period both sexes possess true male and female glands. Hence in the dimmest ages of the past it would seem that the progenitor of the mammaliæ—nay, of the whole vertebrate kingdom—must have been hermaphrodite—G. Lacy Hillier. Received.—X. B. T. There is no such (recognised) society as that which you name. It is absent from the exhaustive list on pp. 221 to 224 of "Whitaker's Almanack." Its title suggests some sort of quackery or paradox.—Alex. Smith. The idea of Olbers, that the planetoids are fragments of a larger body which has exploded, has long since suffered that fate itself. Dismissing this, though, how about the dynamics of your "wobbling" ring—and whence its "wobble"? See, moreover, pp. 173 to 192 of "The Expanse of Heaven." Some of the most remarkable of the variable stars (judged by the colour-test) are among the very oldest—*e.g.*, T. Cassiopeiæ, R. Sculptoris, R. Doradûs, R. Leporis, S. Urigæ, S. Orionis, and so on. Are you familiar with Pickering's admirable researches on variable stars?—J. Greevz Fisher. Received.—W. G. Reeve. It is impossible for me to make a personal appointment to view your orrery.—Mrs. Robert Langton. I regret my inability to help you. Type-writing is a thing rarely if ever performed, if I may so speak, vicariously. I question if the possession of that accomplishment would be of the smallest use to the young lady, who, by the by, already writes a hand scarcely surpassed in beauty and legibility by any merely mechanical work.—A. B. As the most absolutely contradictory opinions have been expressed on the question of the influence of sun-spots on terrestrial temperature, it is safest to say that no evidence exists that they affect it at all.—M. M. Heron. The lady to whom your letter is addressed is at present not in England.—T. R. Clapham. Thanks. Perhaps "Our Place among Infinities."—H. Romeike. We number every scientific journal of repute or standing among our list of weekly receipts, and so obtain, at first hand, what you obligingly proffer.—J. T. Routledge. You have hit the blot in Professor Stewart's reasoning (?). Those who argue after this fashion postulate such a perfect knowledge of the entire physical universe as the majority of those whom they address will scarcely credit them with possessing. There would be no insuperable difficulty in showing that $2+2=5$ if such arguments as you quote were valid.—W. H. Harrison. To print your letter would be simply to give to the paper to which it refers a gratuitous advertisement in Knowledge, for which it has been long striving. Its efforts to provoke me into a discussion to this end have been so transparent as to be amusing; but I have treated it with a contempt which I am a little surprised to find that you do not seem to share. Why in the world need you or I take the very slightest notice of abuse in a publication of such an order as that?

Our Chess Column.

By Mephisto.

SOLUTION.

Problem No. 123, p. 156.

1. Kt to Kt7	K × B, or		K × P
2. Q to K8	Mate	2. Kt to Q8	Mate
If	K to Q2	If	B × R
2. Kt to B5	Mate	2. Q × R	Mate
If	R moves	If	K to K4
2. Kt to Q8	Mate.	2. Q × R	Mate.

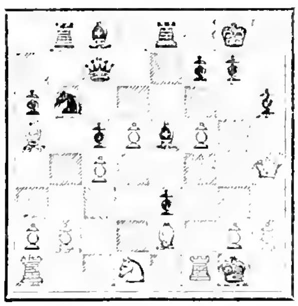
A well-fought Consultation Game, played at the Chess Club, at Amsterdam:—

Two Knight's Defence.

White. R. J. Loman and B. J. Meyer.	Black. Herr von Forrest and H. J. Sohlberg.
1. P to K4	P to K4
2. Kt to KB3	Kt to QB3
3. B to B4	Kt to B3
4. Kt to Kt5	P to Q4
5. P × P	Kt to QR4
6. B to Kt5 (ch)	P to B3
7. P × P	P × P
8. B to K2	P to KR3
9. Kt to KB3	P to K5
10. Kt to K5	B to Q3 (a)
11. P to KB4 (b)	Q to B2
12. P to Q4	Castles
13. Kt to QB3	P to QR3 (c)
14. Castles	R to Q sq.
15. B to K3	P to B4
16. Q to K sq.	R to Kt sq. (d)
17. Kt to Q sq.	Kt to Q4
18. B to Q2	Kt to QB3
19. Kt × Kt (e)	Q × Kt
20. P to B4	P to K6 (f)
21. B to QR5	Kt to Kt3
22. P to Q5	Q to B2
23. Q to R4	R to K sq.
24. P to B5	B to K4 (g)

Position after Black's 24th move.

Black.



White.

White.	Black.
25. P to B6 (h)	B × P
26. R × B	P × B (i)
27. Q × RP	Q to K4
28. P to KR4 (j)	Kt to R5 (k)
29. Kt to B3	R × P
30. B to Q3	B to B4 (l)
31. B to B7 (m)	Q × B
32. B × B	Resigns (n).

NOTES.

(a) This move seems to afford the best chance for Black in this defence.

(b) It is requsite to advance this Pawn before the QP.

(c) To prepare for P to B4.

(d) Here the following line of play seems advantageous for Black:—

16.	P × P
17. B × P	B to R6
18. P × B	R × B

and White's position is somewhat disarranged.

(e) A judicious exchange, by which the subsequent advance of the Pawns becomes more effective.

(f) A prematnre advance, which weakens Black's game; they ought to have returned Kt to K2, for the better protection of his K's side.

(g) P to B3 would have stopped the advance of the bold BP

(h) White is assuming the offensive in a very vigorous manner; they are prepared to give up the exchange.

(i) It certainly seems to us that Black ought to be able to defend the position.

(j) To prevent Q to Kt4.

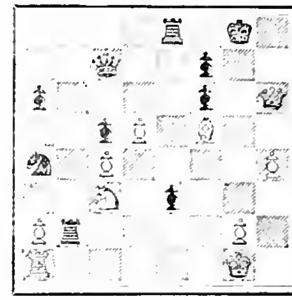
(k) To stop B to QB3. But we should have ventured upon Q to B4, to be followed by Q to Kt3.

(l) Of course Black did not see White's reply; the only other move, P to B4, would result in the loss of the Black Kt, after Q to Kt5 (ch).

(m) Very fino play. Black has no satisfactory reply.

(n) The position is both interesting and instructive, and will well repay a little study. To many players it will by no means be clear why Black resigned at this point, although he may have the worst of it, yet with *precise* and *correct* play White can force a win very soon. Apparently B to R7 (ch), K to R sq., B checks, K to Kt sq. or Q to R7 does not directly threaten mate. If, therefore, as it is Black's move, he should play 32. Kt × Kt, White would reply with the preparatory move of 33. P to Q6, to which there is no answer, for if Q × P 34. B to R7 (ch), K to R sq. 35. B to Kt6 (ch), K to Kt sq. 36. Q to B7 (ch), K to B sq. 37. Q × P mate. It is equally bad if the Q does not take the P, for then Q to R7 (ch), followed by Q to R8 mate. It is, therefore, evident that Black cannot withdraw the Q from guarding the BP, and also that he must prevent P to Q6, which blocks K2, but how? If Black plays 32. R to Q sq. 33. Kt to K4 wins. Or if 32. R to Q7, White has several ways of winning, the simplest probably being 33. P to Q6, R × P. 34. Kt to Q5, R × Kt. 35. P × R (again threatening P to Q6), R to Q sq. 36. R × P and mate in two. Again, if Black plays 32. R to Kt3, White can play as before, P to Q6 and win.

Black.



White.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

S. B. C.—We have not seen Horwitz's book. The Problem 120 cannot be solved by Q to B2, as B to Kt2 defends.

H. A. Du Croz.—Problem 121. If 1. Q to Q3, K × B. 2. Q to B3 mate.

J. M. Melville.—Problem 120. If 1. Q to Kt5, K to Kt7, then 2. Q to B sq. mate.

Correct solutions received.—Problem 122, M. T. Hooton. No. 123, A. W. Overton, W., H. A. N., C. T. G., Donna. No. 124. S. B. C. (both), John Watson, W.

Contents of No. 147.

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Contents of No. 149.

OUR TWO BRAINS.

By Richard A. Proctor.

THAT we have two brains may be said to be as certain as that we have two eyes, two ears, and two nostrils. Whether the two brains— I use the expression purposely, instead of the usual expression, the two hemispheres of the brain—act as independently of each other as the two eyes or the two ears may be disputed. It may be maintained by some that though they *can* thus act independently, should occasion arise, the two halves of the brain, as a rule, work not only as one but as parts of a single organ. Others may hold (though the evidence is strong against this extreme view) that one brain alone of the two can never suffice for the process of reasoning. Others again may believe that the two brains are absolutely independent organs, a view as extreme on the other side. But whatever opinion may be held as to the action of the two brains, there can be no question as to their existence in all normal cases. That the two brains are connected or associated together, is no doubt true. So are the two eyes connected by the optic commissure. But we do not speak of the two eyes as one organ, though they serve a single sense. Even less can we speak of the two brains as a single organ, when we find no clear evidence even that they do the same work. If each does or can do the same work, independently of the other, they must be held to be distinct organs even as the right eye is distinct from the left, when both work together in ordinary vision. If the two brains do different work, they are still more obviously distinct organs,—even as I, for instance, more definitely recognise the duality of my eyes than most persons, because, unlike most, I use one eye for distant vision and the other for fine work at short focal ranges.

Of course a case might be made out for the oneness of the brain as an organ, despite its duality of form, if it could be shown that the individuality of the owner of the brain depended wholly and solely on the co-existence, in a complete state, of both hemispheres of the cerebrum (or of both *cerebra*, as one should more correctly say). Even if the two eyes, distinct though they are in appearance, were found to be severally essential to vision, we should be obliged to regard them as a single organ, much as we regard the upper arm and the lower arm as forming a single limb. Nothing short of this, however,—and we have no evidence even approaching this,—could compel us to reject the doctrine of the duality of the brain.

I propose to consider some of the evidence which led Dr. A. L. Wigan to definitely enunciate this doctrine, suspected apparently by Dr. Holland and others before Wigan's time, but not clearly perceived or stated till he wrote his work, now I believe out of print, "The Duality of Mind." I would, however, at the outset, point out how interesting, nay important, the inquiry is. How many moral problems of difficulty find their solution if we recognise in each one of us two minds, and in effect two wills, working it may be in harmony together at all times, or only in harmony when the body is in sound health, or one usually holding sway over the other, or alternating in their influence on conduct, or one it may be diseased and only held in restraint by the other from guiding the man astray! Again, how many interesting mental problems appear in a new light when thus viewed! We have to consider two memories, usually no doubt synchronising in their action, but not necessarily working thus simultaneously; two attentions; two reasoning processes; and so forth. Again, the two brains may differ in their physical powers, even as one arm may be stronger than the other, one eye more sensitive than the other to light, more easily wearied, and so on. Such considerations are full of interest, and may throw important light on mental phenomena: but they are most important in their bearing on character and conduct.

I might here occupy much space with a description (in outline) of the human brain as analysed and interpreted in our time. But for my present purpose this is unnecessary. The following points, only, need here be specially noted :—

If a vertical section be supposed to be taken through the middle of the head from front to back, that is so as to divide it (through the middle of the chin, nose, forehead, crown, and nape of the neck) into right and left portions, this section will divide the whole nervous mass within the skull into two symmetrical halves. Each part on one side of the plane of division has its counterpart on the other side, in the same way that each bone, muscle, tendon, fibre, and nerve in the right arm has its counterpart in the left arm. There is not *perfect* symmetry, nor *exact* correspondence, any more than in the case of the two arms. In some cases there is a marked want of symmetry, just as in some men we see one arm much better developed than the other: but such abnormal cases do not affect the general truth that the right and left sides of the outer head are symmetrical, and that the right and left arms correspond to each other.

Again, the principal parts of the cerebral mass, though thus double, are connected across the median plane by medullary bands called commissures, by which each part on one side is united to its fellow on the other side. Thus the great hemispheres (which in reality are not much more than quarter spheres) are connected by the "great commissure" called the *corpus callosum*: the halves of the *cerebellum* (or little brain, occupying the lower and hinder part of the cavity of the cranium) are connected by the *pons Varolii* or *tuber annulare*: and there are other commissures of smaller size. This connection of the corresponding parts of the two side brains no more combines them into a single brain than the two arms are made one by being attached to the same body.

Between the two so-called hemispheres of the brain there lies above a scythe-shaped extension of the membranous covering called the *dura mater*: the point of the scythe is forward, and its median plane is of course vertical. It is called the *falx cerebri.* A large lateral expansion of the *falx*—called the *tentorium*—separates the posterior lobes of the cerebrum from the cerebellum, extending over the latter like a vaulted floor. It protects the cerebellum from the pressure of the hinder part of the cerebrum.* The central hemispheres are separated below by two cavities termed the *lateral ventricles.* There are other smaller cavities called respectively the *third ventricle*, and the *ventricle of the cerebellum.* The last-named is of considerable extent, and occupies the space between the cerebrum, the commissure of the cerebrum, and the *medulla oblongata*, the portions of the nervous mass lying at the base of the cranial cavity, between the cerebrum and the cerebellum.

It should be added that from the upper surface of the convolutions, fibres descend to the *medulla oblongata*, where they form the *corpora pyramidalia* and decussate or cross over from one side to the other. This interesting fact was first established by Drs. Gall and Spurzheim. It follows that the right brain rules the left side of the body, and the left brain the right side. In agreement with this is the fact that if one side of the brain suffers it is the opposite side of the body which is alone affected.

I have said so much respecting the parts of the brain rather that the cases which will have presently to be quoted may be fully understood, than with any idea of giving even in outline an account of the exceedingly complex structure which appears to regulate thought, sensation, and motion.

We have now to consider the evidence tending to show that each of the so-called "hemispheres of the brain" is an independent organ of thought, in the same sense that each eye is an independent organ of vision.

The first point to be noted is that one side of the brain may suffer the most serious mischief, or even be destroyed, without any marked injury to the mental functions.

Dr. Wigan mentions the following case as that which first attracted his attention to the duality of the brain:—'A boy, in climbing a high tree for a rook's nest, missed his footing, and fell on the sharp edge of an iron railway, one of the earliest laid down in this country, and on a different principle from those now in use, the wheel passing in a sort of groove, instead of on the edge of a projection. The side of the iron rail stood up, and was exposed to the friction of the outer side of the wheel, which soon wore it to a sharp edge. The boy fell head-downwards on this; it entered about an inch from the falx and sliced off a large portion of brain, with nearly the whole of the parietal bone; much of the brain being torn and ragged, I pared off the projecting fragments and replaced the mass, not having the slightest hope of his recovery, and only occupying myself with the task of laying on plasters and bandages to appease the anxiety of the friends. The quantity of the brain lost must have exceeded four ounces, but my recollection of the case is vague after an interval of more than thirty years. Having always read that the integrity of both hemispheres was essential to the due exercise of *mind*, I was much astonished the next day to find the patient (a remarkably intelligent lad, of twelve or thirteen years of age) in the full possession of his faculties in as high a degree as at any former period. He did not seem to suffer pain,—had no delirium,—and advanced steadily towards recovery; considerable new growth took place; but of its nature I have no recollection; it was probably fungous; at the end of a few weeks he was so well that, in spite of the remonstrances of his mother, he went into the field to play; became exceedingly heated by this, under exposure to a violent sun, and then walked deliberately into the water to cool himself. The new blood-vessels burst, and he died of hæmorrhage; never having manifested from first to last any loss or perversion of mental power."

It seems impossible to doubt that in this case the part of the brain which was destroyed was large enough and important enough to have seriously affected the mental power had the brain been a single organ. Nay, it would seem probable that just as one eye would be rendered for a while entirely useless by some serious injury, so the whole half of the brain, on the side which had suffered injury, must for a time have been useless. Therefore as the boy showed no loss of mental power, the other half must have been a perfect brain in itself.

Let us consider, however, some cases which seem still more decisive.

(To be continued.)

* Wigan makes the following remarks on the Falx and the Tentorium:—The object of these membranes, which are as tightly stretched as the skin of a drum, seems to be to prevent the mischievous consequences of the concussion of the brain in sudden movements; as jumping, for example—the elastic membrane gives way to the impulse, and thus diminishes the shock. The falx is also of great utility in preventing the pressure of one brain on the other in lying down; and the transverse membrane, called the tentorium, performs a similar office; it forms a kind of tent (whence its name), and covers a deep hollow in the back of the skull, which contains the cerebellum, and thus preserves it from the pressure of the superincumbent mass of cerebrum.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

VIII.

In proof of the closing remarks in the previous paper, that the breath has given the chief name to the soul, we find the Western Australians using the same word, *waug*, for "breath, spirit, soul;" in Java the word *nawa* is used for "health, life, soul;" in the Dakotah tongue *niya* is literally "breath," figuratively "life;" in Netela *piuts* is "breath" and "soul;" in Eskimo *silla* means air and wind, and is also the word that conveys the highest idea of the world as a whole, and of the reasoning faculty. The supreme existence they call *Sillam Innua*, Owner of the Air, or of the All; in the Yakama tongue of Oregon *wkrisha* signifies there is wind, *wkrishwit*, life; with the Aztecs *ehecatl* expressed both air, life, and the soul, and, personified in their myths, it was said to have been born of the breath of Tezcatlipoca, their highest divinity, who himself is often called Yoallichecatl, the Wind of Night.* This identity of wind with breath, of breath with spirit, and thence of spirit with the Great Spirit, which

Sees him in cloud, and hears him in the wind,

has further illustration in the legends of the Quiches, in which the unknown creative power is Hurakan, a name familiar to us under the form *hurricane*, and in our own sacred records where the advent of the Holy Spirit is described "as of a rushing, mighty wind."† In the Mohawk language *atonritz*, the "soul," is from *atonrion*, "to breathe"; whilst, as showing the analogy between the effects of restricted sense and restricted civilisation, Dr. Tylor quotes the case of a girl who was a deaf-mute as well as blind, and who, when telling a dream in gesture-language, said:

* Brinton's "Myths of the New World," p. 51. (Second Edition.)
† Cf. Knowledge, June 1, 1883, p. 321.

"I thought God took away my breath to heaven." Among the higher languages the same evidence abides.

"The spirit doth but mean the breath."

That word *spirit* is derived from a verb *spirare*, which means "to draw breath;" *Animus*, "the mind," is cognate with *anima*, "air;" in Irish, which belongs to the same family of speech as Latin, namely, the Aryan or Indo-European, we have *anal*, "breath," and *anam*, "life," or "soul;" and in Sanskrit, which is the oldest member of that family, or has, at least, best preserved the primitive forms, we find the root *an*, to "blow" or "breathe," whence *anila*, "wind," and in Greek *anemos*, with the like meaning. The Greek *psyche*, *pneuma*, and *thymos*, each meaning "soul" and "spirit," are from roots expressing the wind or breath. In Slavonic the root *du* has developed the meaning of breath into that of soul or spirit, and the dialect of the gipsies have *duk* with the meanings of breath, spirit, ghost. That word *ghost*, the German *geist*, the Dutch *geest*, from a root meaning to blow with violence, is connected with *gust*, *gas*, *geyser*, in Scandinavian, *glösor*, "to pour forth." In non-Aryan languages, as the Finnish, *far* means "soul, breath, spirit, wind"; *henki*, "spirit, person, breath, air"; the Hebrew *nephesh*, "breath," has also the meanings of "life, soul, mind," and *ruach* and *neshamah*, to which the Arabic *nefs* and *ruh* correspond, pass from meaning "breath" to "spirit." The legend of man's creation records that he became a living soul through the breathing of God into his nostrils "the breath of life," and concerning this the Psalmist says of all that live, "Thou takest away their breath, they die, and return unto the dust. As a final illustration, the Egyptian *kneph* has the alternative meanings of "life" and "breath."*

When we pass from names to descriptions, we find the same underlying idea of the ethereal nature of spirit. The natives of Nicaragua, California, and other countries remote from these, agree in describing the other self as air or breeze, which passes in and out through the mouth and nostrils. The Tongans conceived it as the aëriform part of the body, related to it as the perfume to the flower. The Greenlanders describe it as pale and soft, as without flesh and bone, so that he who tries to seize it grasps nothing. The Congo negroes leave the house of the dead unswept for a year, lest the dust should injure the delicate substance of the ghost; and the German peasants have a saying that a door should not be slammed, lest a soul gets pinched in it. In some parts of Northern Europe, when the wind-god, Odin, rides the sky with his furious spectral host, the peasants open the windows of every sick-room that the soul of the dying may have free exit to join the wild chase; whilst both here and in France it is still no uncommon practice to open doors and windows that the soul may depart quickly. Dr. Tylor† cites a passage from Hampole's "Ayenbite of Inwyt," *i.e.*, "Remorse of Conscience," a poem of the fourteenth century, in which the author speaks of the intenser suffering which the soul undergoes in purgatory by reason of its delicate organisation.

The soul is more tendre and nesche (soft)
Than the bodi that hath bones and fleysche;
Thanne the soul that is so tendere of kinde,
Mote nedis hure penaunce hardere-y-finde,
Than eni bodi that evere on live was,

a doctrine clearly due to Patristic theories of incorporeal souls. And a modern poet, Dante Rossetti, in his "Blessed Damozel," when he describes her as leaning out from the gold bar of heaven and looking down towards the earth, spinning like a fretful midge, whence she awaits the coming of her lover, depicts the souls mounting up to God as passing by her "like thin flames." The Greeks and, following them, the Romans, conceived the soul as of thin, impalpable texture, as exhaled with the dying breath, or, as in Homer, rushing out through the wound that causes the warrior's death. In the metaphysical Arabian romance of Yokdhan, the hero seeks the source of life and thought, and discovers in one of the cavities of the heart a bluish vapour, which was the living soul. Among the Hebrews it was of shadowy nature, with echoless motion, haunting a ghostly realm:

It is a land of shadows; yea, the land
Itself is but a shadow, and the race
That dwell therein are voices, forms of forms.

Such conceptions are but little varied; and, to this day, the intelligence of the major number of people who think about the thing at all presents the departing soul as something vaporous, as a little white cloud.

In keeping with such ideas, the belief in transfer of spirit expresses itself. Algonkin women who desired to become mothers flocked to the couch of those about to die, in hope that the vital principle as it passed from the body would enter theirs. Among the Seminoles of Florida, when a woman died in childbirth, the infant was held over her face to receive her parting spirit, and thus acquire strength and knowledge for its future use. So among the Tákahlis, the priest is accustomed to lay his hand on the head of the nearest relative of the deceased, and to blow into him the soul of the departed, which is supposed to come to life in his next child.*

In Harland and Wilkinson's "Lancashire Folk-lore," it is related that while a well-known witch lay dying, "she must needs, before she could 'shuffle off this mortal coil,' transfer her *familiar spirit* to some trusty successor. An intimate acquaintance from a neighbouring township was consequently sent for in all haste, and on her arrival was immediately closeted with her dying friend. What passed between them has never fully transpired, but it is asserted that at the close of the interview this associate *received the witch's last breath into her mouth, and with it her familiar spirit.* The powers for good or evil of the dreaded woman were thus transferred to her companion, and on passing along the road from Burnley to Blackburn we can point out a farmhouse at no great distance, with whose thrifty matron no neighbouring farmer will yet dare to quarrel." When a Roman lay at the point of death, his nearest relative inhaled the last breath; in New Testament story, the risen Jesus breathes on his disciples, that they may receive the Holy Spirit, and the form thus adopted in conferring supernatural grace is still used in the rites and ceremonies of the Catholic Church.

Speculation about the other self could not, however, stop at identifying it with a man's breath or shadow, or with regarding it as absolutely impalpable. These nebulous and gaseous theories necessarily condensed, as it were, into theories of semi-substantiality still charged with ethereal conceptions, but giving embodiment to the soul to account for the appearances of both dead and living in dreams, when their persons were clasped, their forms and features seen, and their voices heard.

Such theories involve a kind of continuity of identity, and often take the form of belief in the soul as a replica

* Jacob Grimm remarks that whilst the more palpable breath, as spirit, is masculine, the living, life-giving soul is treated as a delicate feminine essence. *Soul* is the Icelandic *sála*, German *seele*, Gothic *saiwala*, akin to *saivs*, which means "the sea." *Saivs* is from a root, *si*, or *siv*, the Greek *seio*, to shake, and this choice of the word *saivala* may indicate that the ancient Teutons conceived of the soul "as a sea within, heaving up and down with every breath, and reflecting heaven and earth on the mirror of the deep."

† "Prim. Culture," I., 412.

* Brinton, p. 271.

of the body, and as suffering corresponding mutilation. When the native Australian has slain his foe, he cuts off his right thumb, so as to prevent him from throwing a shadowy spear; the Chinese dread of decapitation, lest their spirits are headless, is well known; but a more telling illustration is that cited by Dr. Tylor, from Waitz, of the West Indian planter, whose slaves sought refuge from the lash and toil in suicide. But he was too cunning for them; he cut off the heads and hands of the corpses, that the survivors might see that not even death could save them from a taskmaster who could maim their souls in the next world. Among advanced nations the same conceptions survived. Achilles, resting by the shore, sees the dead Patroclus in a dream. "Ay me, there remaineth then, even in the home of Hades, a spirit and phantom of the dead, for all night long hath the ghost of hapless Patroclus stood over me, wailing and making moan."* Virgil portrays Æneas, and Homer describes Ulysses, as recognising their old comrades when they enter the "viewless shades," where the dwellers continue the tasks of their earthly life. In Hebrew legend Saul recognises the shade of Samuel when the magic spells of the Witch of Endor evokes it, although the grave of the old "judge" was sixty miles away. The monarch-shades of "Sheol" hail with derision the entrance of the King of Babylon among them. In New Testament narrative the risen Jesus is alternately material and spiritual, now passing through closed doors, and now submitting his wound-prints to the touch of the doubter. In "Hamlet" the ghost is as "the air, invulnerable," yet "like a king" . . .

> . . . that fair and warlike form
> In which the majesty of buried Denmark
> Did sometimes march.

Notions of material punishments and rewards involved notions of a material soul, even pending its reunion with the body at the general resurrection. The angels are depicted as weighing souls in a literal balance, while devils clinging to the scales endeavoured to disturb the equilibrium. In some frescoes of the fourteenth century, on the walls of the Campo Santo, at Pisa, illustrations of these notions abound; the soul is portrayed as a sexless child rising out of the mouth of the corpse, and eagerly awaited as the crown of rejoicing of the angels, or as the lawful prey of the demons. After this it is amusing to learn that extreme tests of the weight of ghosts are now and then forthcoming,† from the assertion of a Basuto divine that the late queen had been bestriding his shoulders, and he never felt such a weight in his life, to the alleged modern spiritualistic reckoning of the weight of a human soul at from three to four ounces! And do not spirit-photographs adorn the albums of the credulous?

THE WESTINGHOUSE BRAKE.

By Trevithick.

(*Continued from page 160.*)

I HAVE already indicated several of the features of the Westinghouse brake, but it remains to detail them specifically in order to show the superiority inherent to the apparatus when compared with other systems.

In the first place, rapidity of action is one great essential in order that a train may be stopped instantaneously. Not only must the effect be felt upon the engine, but throughout the entire train, and that simultaneously. I was considerably impressed by the working of a model which I saw at the works of the company, resembling in every feature a train of sixteen carriages. The moment the air was released from the main pipe the brake cylinders operated, and within 1½ seconds the pistons had reached the limit of their stroke, the whole of them moving together. In actual working the brakes are therefore fully on in 1½ seconds. This results from there being only a small volume of air to release, and that at a high pressure. In the case of a vacuum brake, where there is only a part of the pressure of the atmosphere (10 lb.) to work with, as compared with 70 lb. on the Westinghouse pressure brake, a much larger pipe is necessary in order to apply the brakes with sufficient force to be effective. A large pipe implies of necessity the movement of a larger volume of air. Whereas the Westinghouse is fully applied to a train of fifteen vehicles by the withdrawal of 900 cubic inches of air, at least 27,000 cubic inches have to be moved through the large vacuum-pipe to accomplish a like result. Further than this, the use of auxiliary reservoirs assists in producing an instantaneous application, for without them the rear carriages could only be affected several seconds (fifteen and more) after those in front. The use of the triple valve, which controls the brake cylinder, is, therefore, apparent, and it is most certainly a simple, as well as a highly useful factor, notwithstanding what Sir E. Watkin and other apparently ignorant opponents of the only efficient brake, may say to the contrary.

Another important feature is that the brake is capable of being operated from the guard's van as well as from the engine, and is also capable of being so fitted as to place it under the control of every passenger in the train. The advantage of this is too evident to warrant any enlargement upon it. It will be borne in mind that it operates automatically upon each section of the train, should any of the couplings be accidentally broken.

The fact of a reduction of pressure causing the application of the brake is also an excellent "tell-tale," and ensures the proper maintenance of the whole apparatus. A driver is consequently able to place implicit confidence in the brake, and has no fear of its being unable to operate whenever he may require it. The advantage of this is seen in the ease with which the Great Eastern local traffic, which is reputed to be the heaviest of its kind in the world, is conducted. Where this confidence is not placed, or, worse still, where it is misplaced, delay, if not disaster, is a frequent result. It is no unusual occurrence for the driver of a train fitted with a Clayton brake (which is constructed so as to release the wheels within one and a half minutes), after pulling-up outside a station, to find that he is without the necessary vacuum to apply the brakes at the platform, so that his train goes too far. If this happens at a terminal station, the engine may be impelled violently against the buffer-stops, doing thereby a greater or less amount of damage.

There are, of course, several minor details with which I have not thought it desirable to deal in these articles, the object in view being simply to give an outline of the general arrangement in as popular a form as possible. What I have said in praise of the Westinghouse brake is only a portion of what might be said. The Board of Trade has laid down certain very practical and wise conditions which it urges the various companies to comply with in the matter of brakes; but it seems that there is only one brake which satisfies all these conditions, and this brake has wisely been adopted by the following companies, viz.: the North-Eastern, the London and Brighton, the Great Eastern, the Chatham and Dover, the North British, the Caledonian, the Glasgow and South-Western, the Great North of Scotland, the Rhymney, the West Lancashire, and Eastern

* "Iliad," xxiii., 103. † "Prim. Culture," I., 411.

and Midlands Railway. (It is worthy of note that the vehicles jointly owned by the English and Scotch companies working the three great routes to Scotland—viz., the East Coast, the West Coast, and the Midland Scotch Joint Stocks—are fitted with the Westinghouse automatic brake.) Most of the companies mentioned use the brake very extensively, and the testimony of Mr. T. E. Harrison (engineer-in-chief to the North-Eastern Railway) in his report, previously alluded to, is worth quoting. "There does not appear," he says, "to be any one point in the principle and arrangement of the Westinghouse brake, as now in use, requiring alteration, and it entirely complies with all the requirements of the Board of Trade."

I may add that during three years and nine months there has been an increase in the sales of Westinghouse automatic brakes of 8,276 sets of apparatus for engines, and 49,563 for carriages and waggons, there being altogether on the 30th of April last, 11,553 sets for engines, and 63,065 for carriages and waggons.

It only remains for the public to express a forcible and determined opinion on the subject for the whole of the Companies to adopt this brake. It is better for the public to bring about the desired change, than to resort to Parliamentary coercion; more especially is this the case when it happens that there is only one firm able to do what is required. There are, of course, accidents in which any brake would be useless, such, for example, as the Forth Bridge and the Abergele disasters. The former is too fresh in the minds of the public to need more extensive reference; the latter resulted from some runaway trucks loaded with casks of petroleum making their way down an incline, and meeting with the Irish mail, which was travelling in the opposite direction at full speed. The collision was inevitable, the casks were burst, the petroleum caught fire, and the flames and smoke enveloped the front portion of the train, stifling or burning every person within the carriages.

MORE ABOUT SUNFLOWERS.

By Grant Allen.

In order to answer Mr. Paulson's very interesting and suggestive queries about the sunflower, I think I shall have to write another short article upon the same subject.

The tiny drops of viscid liquid upon the ends of the protective bracts which cover the unopened florets while still in their bud condition consist of a resinous material, which can be collected on the finger in sufficient quantities both to show its thickness and to allow one to experiment upon its gustatory qualities. Its taste is decidedly nasty, and I have very little doubt it acts as a deterrent to destructive insects, which might otherwise burrow their way among the unopened flowers for the sake of the immature pollen, as we know occurs in many other kinds of composites. On cutting open several heads of sunflowers I find many small insects (chiefly beetles and weevils) wandering about among the florets in the male, female, and over-blown condition, but not one among the central unopened buds. I am strongly inclined to suppose, therefore, that the latter owe their immunity from premature rifling in great part to the disagreeable sticky secretion. But I observe also that bees avoid the central disk, which seems such a convenient landing-stage, and concentrate themselves upon the two rings of male and female flowers; and this is obviously beneficial to the plant, since, if they landed first on the centre of the disk, they would carry pollen from the inner male florets to the outer females ones of the same breed, thus defeating the great object of the highest sort of cross-fertilisation—impregnation of the stigma by pollen brought from a totally distinct plant. The resinous secretion may therefore serve a double purpose, first, in protecting the young buds, and, secondly, in compelling bees to alight and visit the flowers in the order most conducive to cross-fertilisation.

The mechanism for the withdrawal of the anthers and style after their functions have been respectively performed is so minutely curious that I feared to describe it in full, lest it should prove tedious to the readers of Knowledge. Since I am asked for it, however, here it is, as well as I am able to explain it.

The style, with its two sensitive stigmatic surfaces folded closely together, is enclosed in the united anther tube, and has numerous small hairs, pointing upwards, on its outer surface. The pollen-sacs open inward, and fill the hollow cylinder thus formed with shed pollen, before the separate florets open. As each floret matures for its first (male) stage, the style pushes upward, inside the anther-tube, and the hairs on its surface drive the pollen to the top of the tube, where it stands in a little heap, as soon as the flower opens. The filaments are sensitive (a fact which can be tested in a manner I will presently describe), and as soon as the proboscis of an insect touches them they contract, thus slightly withdrawing the anther tube, and shedding the pollen over him at the exact right moment to ensure its being employed in fertilising another flower. After the pollen has thus all been shed, the filaments continue still further to contract, apparently by mere fading, till the style protrudes from the top of the anther-sac. The filaments, however, are still so elastic that one can pull them out with the finger almost to the original length. The depression of the anthers into the tube of the corolla seems to be aided in part by the unfolding of the style, which now curves over its two branches, thus displaying the receptive stigmatic papillæ, which catch the pollen and induce it to emit pollen-tubes. If the floret is fertilised by a bee, well and good; if not, the branches of the style bend over until they come in contact with the pollen swept by the hairs of a neighbouring style from a sister floret. They thus secure the second-best sort of cross-fertilisation, that from another flower of the same head. As soon as fertilisation has taken place, the curved branches wither, the style shrinks or shrivels just as the filaments had done before, and the entire mechanism is finally withdrawn within the tube of the corolla. At the same time, the corolla as a whole bends outward at the base, becomes hump-backed as it were, so as to turn away from the centre and thus avoid distracting the attention of the insect visitors. The lobes also bend together slightly, as if to deter the bee from trying these already over-blown flowers. The shrinkage in each case seems to me to be merely due to the usual shrivelling of all parts which have fulfilled their function, but in the filaments it is greatest on the inner surface, so as to make them bow outward. As long as the style and the filaments are still actively required, they are full of juice and vigour; as soon as the pollen is shed and the ovary fertilised, they become at once flaccid and contracted.

In order to observe the sensitiveness of the filaments, take a fully-open sunflower, and select a few florets (without removing them from the head) in the highest perfection of the male stage, when the pollen stands in a little heap at the top of the anther tube. Then, with a needle, or, still better, a soft bristle, remove the pollen gently from the summit of the anthers. You will thus be enabled to observe better the after effect. Next, push the needle or bristle down the corolla tube, and gently irritate the base of the filaments, exactly as an insect would do with its proboscis in searching for honey. You will observe in a moment that more pollen is beginning to exude from the top of the anther tube, its exudation being due to the contraction of the sensitive filaments, which draw down the anthers, and so cause the pollen to be expelled by the hairs on the surface of the style. After continuing the irritation for twenty seconds or so, again brush off the pollen from the top of the tube. You will find that the anthers have now receded somewhat, and that the style, with its branches still closely pressed together, begins to protrude slightly from the summit of the anthers. In other words, you have given the flower its cue for passing from the first or male to the second or female stage. As soon as that cue is once given, the change proceeds apace—the anthers continue to shrink down into the corolla, and the style to open its branches.

The question of the mechanism for ensuring irritability in the filament, I must leave to better microscopists than myself.

This is rather a more technical paper than usual, and I fear some readers may find it difficult of comprehension. But if they will take a sunflower in its prime, and cut it in two, following the description with the living object, I think it will all become quite clear to them.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

(*Continued from page 176.*)

CHAPTER IV.—DETERMINING THE SHAPE OF THE EARTH.

As our observer sets out on his northward journey he sees the earth spread forth as a plane before him in that direction as well as in others; and, therefore, his natural conclusion is that he is about to voyage in a straight line. This, at least, is the assumption on which all his observations must, in the first instance, be grounded.

Let us suppose that an observer travels about 380 miles towards the north before recommencing his observations of the skies; although not very important for the particular observations now to be made, we shall yet suppose that he has taken careful count of time, and has with him the means of measuring time throughout his observations.

He proceeds precisely as at his first station; and, after a similar series of observations, he finds results strikingly similar to those before obtained. He finds the whole heavens rotating in appearance about a fixed axis, with perfect uniformity, and at precisely the same rate as he had noticed when at his former station. But one important difference attracts his attention. He finds that the point about which the stars appear to move (which point he may determine either as before by watching the daily motion of the sun in spring or autumn—for we suppose him to settle for some time at his new post—or by watching the motions of the stars themselves) is higher up above the northern horizon. Measuring carefully the extent of the change, he finds that instead of being about $51\frac{1}{2}^\circ$ the pole is now about 57° above the horizon.

Let us see what this result seems to teach :—

Let A (Fig. 1) be the first station of the observer, B the second, so that A B represents a distance of about 380 miles. Then if the assumption that the observer has been travelling in a straight line is correct, he must draw A P at an angle of $51\frac{1}{2}^\circ$ with A N, and B P at an angle of 57°, these lines of course meeting, and so forming a triangle A P B, whose vertical angle A P B is the difference between 57° and $51\frac{1}{2}^\circ$, that is $5\frac{1}{2}^\circ$.

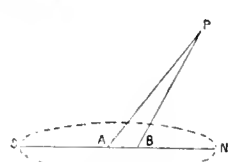


Fig. 1.

Now, before proceeding further, we notice here a source of perplexity.

When at A the observer found the whole of the heavens moving exactly as though they were rotating around the axis A P; and now, when he is at B, he finds them moving exactly as though they were rotating around the axis B P.

It need hardly be said that rotation cannot take place simultaneously around two intersecting axes. Therefore, we must select one of two alternatives. Either we must abandon the notion of a uniform rotation, which seemed in so simple and beautiful a manner to account for observed appearances, or we must give up the theory that in travelling along the earth surface the observer has followed a straight line.

Now about the first of these alternatives, it is easy to form an opinion. We know *certainly* that the line of sight from A to a star traces out the surface of a right cone, having A P as axis. We know with equal certainty that the same is true of the star as seen from B. Hence, in place of the uniform circular motion we deduced before, we require that the star should travel along the complex (and not even plane) curve which is the intersection of two right cones having intersecting axes. But we need not follow out the difficult considerations here suggested; for we can take the case where the cone becomes a plain, and so simplify matters.

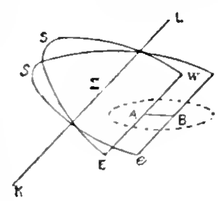


Fig. 2.

Let E S W (Fig. 2) be the path of a star which rises in the east, as seen from A. Then the line of sight from A to this star lies always in the plane E A W S. But the same star, as seen from B, also rises in the east and sets in the west, attaining a lower altitude in the south by 5°.

Therefore its apparent path lies as *e s w* in the plane *e* B *w s*. This plane intersects the plane E A W S in a straight line K L, and it is only by moving along the straight line K L, starting with an infinite velocity from an infinite distance in direction K, travelling with a continually diminishing velocity up to Σ, and thence passing away with a continually increasing velocity to infinity towards L, that the star could appear to move as it actually does when viewed from A and B. The journey from infinity in direction Σ K to infinity in direction Σ L would, according to this view, occupy but half a day, and in some inscrutable manner the star would return in the next half day to its original position, at an infinite distance from us, in direction Σ K. This is altogether absurd and incredible.

Our observer, therefore, finds himself compelled to abandon the theory that he has travelled in a straight line from A to B. But, to make assurance doubly sure, he applies other experiments.

It will be seen at once (from Fig. 1), that if A B really were a straight line, the distance of P could be at once determined, either by a geometrical construction or by calculation. Suppose the observer applies either method, and then makes another journey equal in length to A B, and still due northward; then, renewing his observations of the heavens, he would have it in his power to make a new calculation of the distance of P from A; and if his assumption that he was following a straight path were correct, his new estimate of A P should agree with his former one. But this he does not find to be the case. When he has got to C (Fig. 3), making B C, equal to A B, he finds that the pole of the heavens has risen by exactly as much as it was raised by his former journey. Now, if we draw a line from C to P, we get an angle C P B, which a very brief consideration will show to be larger than the angle A P B—that is, we get P C N larger than our observer actually finds it, so that, as seen from C, the pole has another direction, as C P′ P″, giving the angle C P″ B, equal to the angle A P B.

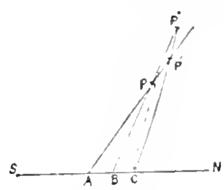


Fig. 3.

But which of the three points P, P′, and P″, is the real pole? They cannot all three be. Yet, if our traveller takes the observations made at A and B, he gets the point P by purely geometrical reasoning; if he takes the observations made at B and C, he gets the point P″ with equal reason; and if he takes the observations made at A and C, he gets the point P′.

He is forced, then, by this second line of argument, also, to abandon the notion that he has been travelling in a straight line.

He has now to consider what his observations require from him. He has first, to get the axis, B P, in Fig. 1, coincident in direction with A P.

He draws A N (Fig. 4) to represent the line on which he set out from A, and he sets up A P at an angle of 51½° to A N. Then he draws at a convenient distance P′ B parallel to A P, and, of course, meeting A N at an angle of 51½°. Now, if he can draw an arc A B, touching A N at A, and having at B a direction (B N′) making an angle of 57° with B P′ then he knows that A B represents very satisfactorily the curved path he must have followed when journeying from A to B. Then again he draws a third parallel, C P″, at the same distance from B P′ that B P′ is from A P; and he makes the arc B C (just as he made the arc A B) so that C N″ may be inclined about 62½° to C P″. This construction makes A B C the arc of a circle, because the circle is the only curve whose tangents (as A N, B N′, C N″) change equally in direction for points separated (as A, B, and C) by equal arcs.

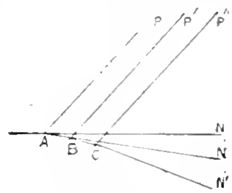


Fig. 4.

The observer is guided, therefore, to the belief that the section of the earth's surface along which he is travelling forms a circle. And he can roughly tell what the size of that circle is. For he has found that A C (Fig. 5) being about 760 miles, the tangent C N″ has fallen away, in direction, about 11° from A N. But if A C L represent the circle of which A C is a part, he knows that lines O A and O C from the centre include the same angle between them as that by which C N″ is inclined to A N.* Hence A C is an arc of about 11°. And therefore the complete circumference of this circle A C L is about $\frac{360}{11} \times 760$ miles, or in round numbers, some 25,000 miles.

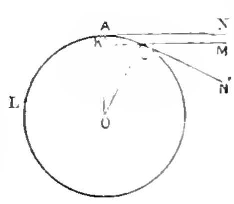


Fig. 5.

* This will perhaps be obvious at once to my readers; but if not, they will easily see its truth by drawing K C M parallel to A N. Then, since O C N″ is a right angle, the angle M C N″ is the complement of K C O. But K O C is also the complement of K C O. Therefore, K O C is equal to M C N″.

This gives to the circle a diameter of about 7,900 miles.

In order, however, to test the justice of this view, our observer first travels farther north. He finds the slow change of elevation of the pole continuing quite uniformly as he continues journeying in that direction. After going as far north as he can, at which time he finds that the pole of the heavens is nearly overhead, he is satisfied that in this direction, at any rate, the circular figure of the path he has followed continues unchanged.

He next returns to A, and commences a series of similar journeys towards the south. These confirm in every respect his theory that the section he is traversing is either actually circular, or does not differ sensibly (so far as his instrumental means are concerned) from the circular form. For every successive distance he travels there appears to be a proportionate depression of the pole. At length the pole sinks to the very horizon, and the relations now presented by the heavens are so interesting that we shall have to consider them attentively.

But first, we must exhibit the general results of our observer's voyages up to this point.

We see from Fig. 6, that even if our traveller's first observations were doubtful on account of the comparative smallness of the changes noticed, yet the great change he now notices—the apparent coincidence of the pole with the horizon—is altogether inexplicable on the assumption that he has been travelling in a straight line. For though undoubtedly by going very far indeed in direction A E he would bring the pole very low down, yet in the first place he would have to travel very much farther than he has actually done, in order that E P might seem horizontal, and in the second, it is absolutely impossible that the heavens should seem to revolve about A P when he was at A, and about a nearly horizontal line E P, when he is at E. On the other hand, we see from Fig. 7, how his uniform progression round the circular arc C B A E would lead to a uniform depression of the polar axis, until at E that axis appeared to lie (as E p) in the horizon-plane of the observer at E.

Fig. 6.

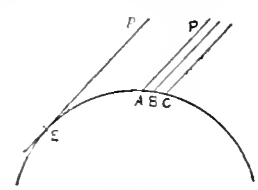


Fig. 7.

And then two things served very strikingly to confirm the views of the traveller. We see from Fig. 6 that on the assumption of the earth being plane, the pole of the heavens P has a distance from points on E C which is comparable with the distances passed over by the observer. This being so, the stars which lay round the axis A P ought not only to change appreciably in brightness as the observer varies his position along E C, but they ought to change in relative position. The polar constellations, for example, could not possibly present the same aspect when viewed from A as when viewed from E. But the observer can detect not the slightest change in the aspect of any one of the constellations he had become familiar with when at A, either in the brightness of the component stars or in their relative position. Now, Fig. 7 accounts perfectly for this. We see all the lines representing the polar axis parallel in position; in other words, the pole is removed to a distance indefinitely great compared with the distances A B, B C, E A, &c. This makes the sphere of the fixed stars very large indeed compared with the arc E C; and while this has been the direct result of geometrical considerations of another sort, it explains at once and simply, the striking fact that, let the traveller journey as he may along distances which seem enormous when counted by miles, he can yet detect no change whatever in the aspect of the several constellations.

(*To be continued.*)

AN ADDRESS TO THE BRITISH ASSOCIATION

(GEOGRAPHICAL SECTION), AT MONTREAL, 1884.

By General Sir J. H. Lefroy, R.A., F.R.S., &c.

THE subjoined extracts from General Lefroy's very able address comprise those portions of it possessing the greatest interest for the ordinary reader, as contradistinguished from the professional geographer pure and simple :—

It is scarcely necessary to do more than allude here to the intimate relations between geography and geology. The changes on the earth's surface effected within historical times by the operation of geological causes, and enumerated in geological books, are far more numerous and generally distributed than most persons are aware of; and they are by no means confined to sea-coasts, although the presence of a natural datum in the level of the sea makes them more observed there. A recent German writer, Dr. Hahn, has enumerated ninety-six more or less extensive tracts known to be rising or sinking. We owe to Mr. R. A. Peacock the accumulation of abundant evidence that the island of Jersey had no existence in Ptolemy's time, and probably was not wholly cut off from the continent before the fourth or fifth century. Mr. A. Howarth has collected similar proofs as to the Arctic regions; and every fresh discovery adds to the number. Thus the gallant, ill-fated De Long, a name not to be mentioned without homage to heroic courage and almost superhuman endurance, found evidence that Bennett Island has risen a hundred feet in quite recent times. Nordenskjöld found the remains of whales, evidently killed by the early Dutch fishers on elevated terraces on Martin's Island. The recent conclusion of Professor Hull, that the land between Suez and the Bitter Lakes has risen since the Exodus, throws fresh light on the Mosaic account of that great event; and to go still further south, we learn from the Indian survey that it is "almost certain" that the mean sea-level at Madras is a foot lower, *i.e.*, the land is a foot higher, than it was sixty years ago. If I do not refer to the changes on the west side of Hudson's Bay, for a distance of at least 600 miles, it is only because I presume that the researches of Dr. Robert Bell are too well known here to require it. Any of my hearers who may have visited Bermuda are aware that so greatly has that island subsided, that great hangings of stalactite, unbroken, may be found dipping many feet into the sea, or at all events, into salt-water pools standing at the same level, and we have no reason to suppose the sinking to have come to an end. We learn from the Chinese annals that the so-called Hot Lake Issyk-kul, of Turkestan, was formed by some convulsion of nature about 160 years ago, and there seems no good reason to reject the Japanese legend that Fusiyama itself was suddenly thrown up in the third century before our era (B.C. 286). These are but illustrations of the assertion I began with, that geography and geology are very nearly connected, and it would be equally easy to show on how many points we touch the domain of botany and natural history. The flight of birds has often guided navigators to undiscovered lands. Nordenskjöld went so far as to infer the existence of "vast tracts, with high mountains, with valleys filled with glaciers, and with precipitous peaks" between Wrangel Land and the American shores of the Polar Sea, from no other sign than the multitudes of birds winging their way northward in the spring of 1879, from the *Vega's* winter quarters. The walrus-hunters of Spitzbergen drew the same conclusion in a previous voyage from the flight of birds toward the Pole from the European side. Certainly no traveller in the more northern latitudes of this continent in the autumn can fail to reflect on the ceaseless circulation of the tide of life in the beautiful harmony of nature, when he finds that he can scarcely raise his eyes from his book at any moment, or direct them to any quarter of the heavens, without seeing countless numbers of wild fowl, guided by unerring instinct, directing their timely flight towards the milder climates of the South.

From Central Africa it is not an unnatural transition to Central Asia, the region next the most inaccessible, and pregnant, perhaps, with greater events. The Russian project for diverting the Oxus, or Amu Darya, from the Sea of Aral into the Caspian, remains under investigation. We learn from the lively account of Mr. George Kennan, a recent American traveller, that there is more than one motive for undertaking this great work, if it shall prove practicable. He states that the lowering of the level of the Caspian Sea, in consequence of the great evaporation from its surface, is occasioning the Russian Government great anxiety; that the level is steadily but slowly falling, notwithstanding the enormous quantity of water poured in by the Volga, the Ural, and other rivers. In fact, Colonel Venukof says that the Caspian is drying up fast, and that the fresh-water seals, which form so curious a feature of its fauna, are fast diminishing in number. At first view there would not appear great difficulty in restoring water communication, the point where the river would be diverted being about 216 ft. above the Caspian; but accurate levelling has shown considerable depressions in the intervening tract. As the question is one of great geographical interest, we may devote a few minutes to it. It is not to be doubted that the Oxus, or a branch of it, once flowed into the Caspian Sea. Professor R. Lentz, of the Russian Académie Impériale des Sciences, sums up his investigation of ancient authorities by affirming that there is no satisfactory evidence of its ever having done so before the year 1320; passages which have been quoted from Arab writers of the ninth century only prove, in his opinion, that they did not discriminate between the Caspian Sea and the Sea of Aral. There is evidence that in the thirteenth and fourteenth centuries, the river bifurcated, and one branch found its way to the Caspian, but probably ceased to do so in the sixteenth century. This agrees with Turkoman traditions. Even so late as 1869, the waters of the Oxus reached Lake Sara Kamysh, eighty or ninety miles from their channel, in a great flood, as happened also in 1850, but Sara Kamysh is now some 49 ft. lower than the Caspian, and before they could proceed further an immense basin must be filled. The difficulties then of the restoration by artificial means of a communication which natural causes have cut off, are (*a*) The disappearance of the old bed, which cannot be traced at all over part of the way; (*b*) The possibility that further natural changes, such as have taken place on the Syr-Daria, may defeat the object; (*c*) The immense expenditure under any circumstances necessary, the distance being about 350 miles, which would be out of all proportion to any immediate commercial benefit to be expected. We may very safely conclude that the thing will not be done, nor is it at all probable that

Russian finances will permit the alternative proposal of cutting a purely artificial canal by the shortest line, at an estimated expense of 15 to 20 million roubles.

There are few particulars in which the best atlases of the present day differ more from those published twenty-five years ago than in the information they give us respecting the submerged portions of the globe. The British Islands, with the fifty and one hundred-fathom lines of soundings drawn round them, seem to bear a different relation to each other and to the Continent than they did before. The geography of the bed of the ocean is scarcely less interesting than that of the Continents, or less important to the knowledge of terrestrial physics. Since the celebrated voyage of H.M.S. *Challenger*, no marine researches have been more fruitful of results than those of the *Talisman* and the *Dacia*. The first was employed last year by the French Government to examine the Atlantic coasts from Rochefort to Senegal, and to investigate the hydrography and natural history of the Cape Verde, Canary, and Azores archipelagos. The other ship, with her companion, the *International*, was a private adventure, with the commercial purpose of ascertaining the best line for a submarine telegraph from Spain to the Canaries. These two last made some 550 soundings and discovered three shoals, one of them with less than 50 fathoms of water over it, between the Continent of Africa and the island. If we draw a circle passing through Cape Mogador, Teneriffe, and Funchal, its centre will mark very nearly this submarine elevation; the other two lie to the north of it. The *Talisman* found in mid-ocean but 1,640 fathoms, among soundings previously set down as over 2,000 fathoms. Our knowledge then of the bed of the Atlantic, and of the changes of depth it may be undergoing, is but in its infancy; and we have only to reflect what sort of orographic map of Europe we could hope to draw, by sounding lines dropped a hundred miles apart from the highest clouds, to be conscious of its imperfection. But this knowledge is accumulating, and whether revealing at one moment a profound abyss, or at another an unsuspected summit: marvels of life, form, and colour, or new and pregnant facts of distribution; it promises for a long time to come to furnish inexhaustible interest.

Canada comprises within its limits two spots of a physical interest not surpassed by any others on the globe. I mean the pole of vertical magnetic attraction, commonly called the magnetic pole, and the focus of greatest magnetic force; also often, but incorrectly, called a pole. The first of these, discovered by Ross in 1835, was revisited in May 1847 by officers of the Franklin Expedition, whose observations have perished, and was again reached or very nearly so by McClintock in 1859, and by Schwatka in 1879; neither of these explorers, however, was equipped for observation. The utmost interest attaches to the question whether the magnetic pole has shifted its position in fifty years, and although I am far from rating the difficulty lightly, it is probably approachable overland, without the great cost of an Arctic expedition. The second has never been visited at all, although Dr. R. Bell, in his exploration of Lake Nipigon was within 200 miles of it, and the distance is about the same from the Rat Portage. It is in the neighbourhood of Cat Lake.

One of the finest feats of mountaineering on record was performed last year by Mr. W. W. Graham, who reached an elevation of 23,500 ft. in the Himalayas, about 2,900 ft. above the summit of Chimborazo, whose ascent by Mr. Whymper, in 1880, marked an epoch in these exploits. Mr. Graham was accompanied by an officer of the Swiss army, an experienced mountaineer, and by a professional Swiss guide. They ascended Kabru, a mountain visible from Darjeeling, lying to the west of Kanchinjunga, whose summit still defies the strength of man.

The reported outbreak of a new volcano in the northern part of West Australia, on August 25, 1883, in connection with the great eruption of the Sunda Straits, has not, as far as I know, been verified; but the graphic description of the natives: "Big mountain burn up. He big one sick. Throw him up red stuff, it run down side and burn down grass and trees," seems to leave little doubt of the reality of the occurrence.

THE ELECTRIC LIGHT IN THE MECHERNICH MINES.*

THE electric-light installation at the Mechernich Mines in its once volcanic Eifel district in Rhenish Prussia, has now had a fair trial for more than three years, and has proved a complete success. The expectation that it would both facilitate the operations and increase their security, has fully been realised, and an extension of the plant is now being carried out. Messrs. Siemens and Halske, of Berlin, undertook the work, which was superintended on their behalf by Mr. Boeddinghaus. An open working 2,000 ft. long, 1,000 ft. wide, and over 300 ft. deep, in which 300 men and 20 horses are continually occupied, was first to be supplied with the electric light. This part of the mine is excavated in steps, the horizontal terraces being provided with rails. Ordinary lamps in globes on poles were out of the question, as blasting operations continue throughout the day, and the shots would soon have made havoc of the lamps. After several trials two powerful lamps, of 3,000 candles each, were erected at the upper margin of the pit, where they were fairly out of the reach of the projected stones; and reflectors were fixed to throw the light down upon the steps. To find the proper positions for these powerful lamps and to avoid too dark shadows caused some difficulty. But the illumination was finally rendered most efficient, and the open pit, with the light playing on the whitish grey rock, affords a fine spectacle. As any interruptions, even for short periods, such as those occupied in renewing the lamp carbons, would be dangerous, the whole plant is double, each lamp receiving its current from a D_2 dynamo. No hitch of any kind has occurred, and the safety of the miners has decidedly been augmented. It was formerly not always possible for the superintendents to see whether the loose mass resulting from the blasting operations had been properly removed, and frequent minor accidents arose from the *débris* falling down upon the miners engaged on the step next below. The work can now be controlled much better than before when petroleum lamps and hand lamps were in use. The cost shows a saving of about 4d. per hour in favour of the electric illumination. The satisfactory results obtained in the open working induced the company to introduce the electric light down in the subterranean galleries. The ore forms little concretions of sand and galena scattered all through the rock; the whole mass has therefore to be brought to day to be disintegrated and sifted, and the mining proceeds in parallel and cross galleries, which are constantly being widened until they become 90 ft. in width, and 70 ft. in height, by sometimes 300 ft. in length. The operations in themselves would not require much light if there was not always danger threatening from loosened pieces of rock. Pitch torches were formerly employed to examine the boreholes and fissures round them after each explosion.

* From *Engineering*.

It was a question whether the arc lamps would answer for this purpose in the smoky atmosphere. For the first experiments, arc lamps of 3,000 and 1,000 candles were used, with the positive carbon in the lower holder. The effect was brilliant, yet the light did not penetrate the white smoke cloud which collects at the upper wall immediately after the shot. But as the smoke settles within ten minutes, it was thought advisable to acquiesce in this interruption of a few minutes, and to use smaller lamps of 350 candles, which proved quite efficient. Of these, there are ten in use, with about 10,000 ft. of lead cable, the cable being partially elastic, as the lamps with their wires have to be removed when the blasting is to take place. The lamps were originally supplied with hexagonal lanterns with obscured glass to protect the eyes of the miners. The glasses were, of course, soon broken, but no complaints are said to have been made about the naked electric lights. The proprietors of the mine have decided upon an extension of the installation.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from page* 130.)

IN all that has preceded, we have, so to speak, taken sight for granted. Before, however, proceeding to examine the phenomena which essentially depend upon the very way in which we see at all—*e.g.*, those of binocular vision and the like—it will be necessary to enter into a little elementary explanation of the structure of the eye itself. The student who may wish to follow this subject out in detail must consult some of the larger textbooks on Human Anatomy. It will conduce to a better appreciation of our description if he will obtain a fresh sheep's or bullock's eye from the butcher.

We shall remark in the outset that the eye-ball is very nearly globular, but the front part (Fig. 25) is more convex than the other portion. Now, excepting this front protuberant part, the eye will be observed to be covered by a

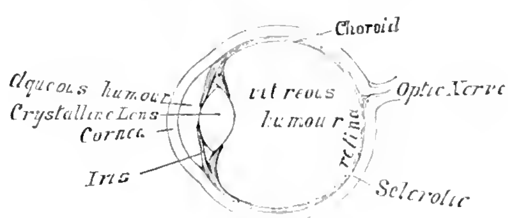


Fig. 25.

thick white membrane called the sclerotic coat, which is popularly known as "the white of the eye." The front of the eye is enclosed by a thick, strong, glassy membrane called the cornea, which suggests the idea of a watch-glass. The light quite obviously passes into the eye through the cornea. From the circle of junction of the cornea and the sclerotic, a kind of opaque coloured plate, with a hole in the middle, separates the front clear part of the eye from the main portion of the interior of the eyeball. It is called the iris, and it is the colour of the iris, which is spoken of as that of the eye, when we talk about blue eyes, grey eyes, brown eyes—and so on. The hole in the centre of this iris is known as the pupil. This appears jet-black, because we look through it at the dark interior of the eye-ball. The function of the pupil is to admit light, and further to regulate the amount of light so admitted. It contracts in the presence of a bright light, and expands in partial darkness—a fact of which the reader may satisfy himself by standing before a looking-glass in a dim light, and watching the pupils of his own eyes when a candle or lamp is suddenly brought near them. The same result may be attained in daylight by shutting the eyes close and opening them suddenly before a mirror. This is all that we can make out from the exterior of the eye. We must dissect it (preferably under water) if we wish to understand its internal structure. Doing so, we shall find that the sclerotic is lined by the choroid membrane, of a dark brown or black colour; as is that again in turn by the retina: the latter being nothing but an expansion of the optic nerve after it enters the eye from the brain. The choroid coat at the front of the eye splits into two layers, one going to form the iris already spoken of, the other taking the shape of a kind of pleated curtain. To this is attached the crystalline lens—an absolutely transparent, double-convex lens, between which and the cornea lies a clear liquid called the aqueous humour, while the greater portion of the cavity of the eye—that behind the crystalline lens—is filled with a transparent, gelatinous substance known as the vitreous humour. Our figure above should make this short description intelligible. From it we gather that the eye consists in effect of an optical instrument, like the camera obscura (Fig. 2, Vol. V., p. 306, and Fig. 20, Vol. VI., p. 46), in which an image formed by the refraction through a combination of lenses of the rays of light emanating from various external objects is projected on to the back of the eye, and being there received on the retina, is conveyed by the optic nerve to the brain. That such an image is formed on the retina, the student may satisfy himself by carefully scraping the back of a bullock's eye (under water) until it becomes thin enough; when, on holding the eye up with the cornea directed to the window, or a well-lighted landscape, a charming little picture of the object towards which it is directed may be seen on the semi-transparent screen to which the hinder part of the eye has been reduced. It will be noted that this image is inverted, and a large amount of unprofitable discussion has arisen as to why we do not see external objects upside-down (as though we had another eye at the back of the first one to view the image formed by that!). The fact is that we do not see anything in the eye, but something wholly external to it. For it is the brain, after all, that sees, and

Fig. 26.

not the eye. Sever the optic nerve, and utter and absolute blindness instantly supervenes; albeit the eye, as an optical instrument, remains intact. In the sensorium we refer any object to the direction in which the light from it reaches the eye. If we have to raise the head, as to view the zenith, we say the object regarded is above us or up; if we have to depress the head, as in looking at the ground, we say that the object is beneath us or down. The so-called "mystery" of inverted vision is then, in reality, no mystery at all. Various illustrations may be found of this reference by the brain (through the optic nerve) of external objects to the direction whence the light they emit or reflect enters the eye. For example, press the corner of the eye with the finger, and a patch of light will appear as existing in the direction of the pressure. Look at the bright sky, preferably through an astronomical telescope, and specks will often be seen floating about, seemingly in the heavens, and travelling slowly downwards. When these assume the appearance of minute transparent spheres, they become a source of annoyance to the observer of small stars in daylight, whose appearance they simulate. They are really extremely minute specks floating in the vitreous humour (Fig. 25). Or the very curious and instructive experiment devised by Purkinje may be tried. It is thus performed: You take a lighted candle into an otherwise totally darkened room; shut the left eye, and hold the candle as close as you can to the right eye (say three inches from it), to the right and rather in front, so as to light up the retina strongly. Keeping the right eye steadily fixed on the opposite wall, you move the candle about into various positions. Now, the glare of the light will soon cause the field to appear dark, and then, as the gentle motion of the candle continues, suddenly there starts into view on the wall a strange ghostly kind of branching net-work, or thing like the upper part of an oak-tree when the leaves are off in winter. This is really an image of the blood-vessels of the retina. They enter the eye at the same point as the optic nerve, and spread out over the sensitive surface of the retina. The candle casts their shadows upon it, and they are projected, and seem to exist on the opposite wall. The words "sensitive surface of the retina," which we have just written, suggest to us to remark that the retina is by no means equally sensitive over its whole area; in fact, that, as we shall immediately see, there is one spot in it which is absolutely blind or insensitive to light, while in another the greatest exaltation of visual perception obtains. In the axis of the eye is situated what is known as the central spot, a thinning or actual depression of the retina. If we look out over an expanse of country without moving the head or eyes, we shall observe certain objects immediately in front of us, sharply and brilliantly defined; but if we attend a little, we shall note that, as we recede from them, either to the right or the left, upwards or downwards, everything becomes gradually less distinct, and with a more imperfect outline, so that at any considerable angular distance from the point of sharpest vision things become blurred and amorphous. In practice, and unconsciously, we shift the eyes, and so successively take in the various details of the landscape, which we fancy we see altogether; albeit, as we have explained, we do nothing of the sort. The central spot, of which we have spoken above, is the seat of the sharpest vision. On the other hand, the place where the optic nerve enters the eye-ball is utterly insensitive to light, and hence is known as the blind spot. Fig. 26 will enable the reader to verify its existence in his own eye for himself. Let him shut the left eye and steadily regard the little cross with his right one, say at a foot or eighteen inches distance. He will see both the cross itself and the dark disc perfectly. Now, let him slowly bring the page nearer to his face, and at a certain point the circular disc will vanish and the paper appear white. At this instant the image of the disc has fallen upon the blind spot of his right eye. As he continues to approximate the paper to his eye, the disc will once again reappear, its image now falling upon another sensitive part of the retina.

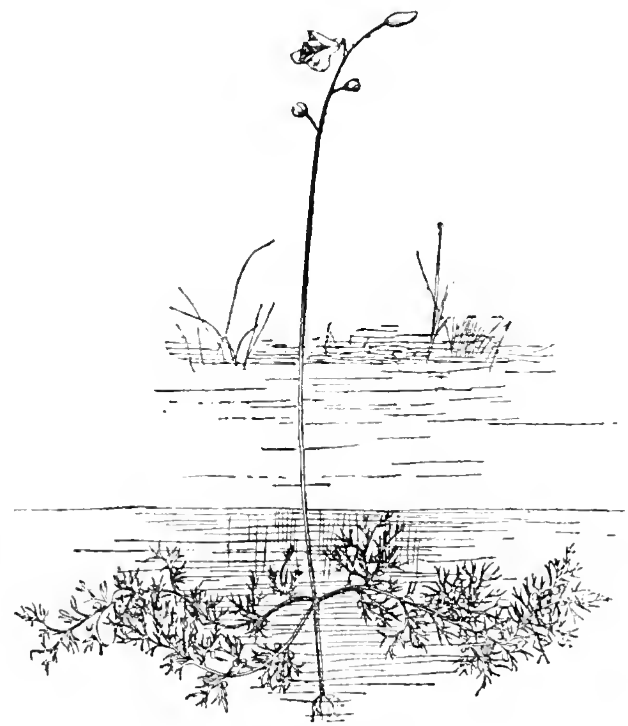
(To be continued.)

Thirty-five years ago the ratio of railway passengers killed in the United Kingdom from causes beyond their own control was one in 4,782,000, while last year it was one in 61,810,000. In 1883 only eleven persons were killed from causes beyond their control. As compared with this, upwards of 200 persons are annually killed in the streets of London.

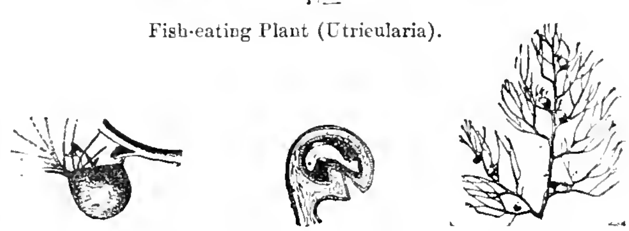
HOW AMERICAN CARP ARE DESTROYED.

THERE is a little plant, common enough in our ponds, and known as the bladder-wort, which has suddenly sprung into importance for breeders of carp. The bladder-wort (genus *Utricularia*) is a rootless plant fond of still water, and usually found floating half in and half out of water, the branching and stem-like leaves forming the submerged float from which rises the flower stem. To the leaves are attached curiously insect-like bladders filled with water, and varying in size in the different species, reaching at times a diameter of one-fifth of an inch.

It was formerly, and with much probability, supposed that these bladders served the purpose of floats; for until a few years ago it was taken for granted that air and not water filled them. It is now known, however, that the bladders serve a more useful purpose than merely to keep the head of the plant above water; they are the digestive organs of the *Utricularia*, and at the same time are so constructed as to form a very ingenious but extremely simple trap for catching food. It is into these bladders



Fish-eating Plant (Utricularia).



A B C

A. Bladder (with small fish caught). B. Longitudinal section of bladder. C. Branch showing leaves and bladder.

that thousands of carp eggs find their unwitting way, together with many insects, crustacea, and other tiny objects, both animate and inanimate.

It is only recently that the *Utricularia* has been accused of destroying carp eggs, but for nearly thirty years it has been known as a receiver of small insects and crustaceans, and it has been known as an insect feeder for at least twenty years. Mrs. Treat, of America, in 1875 gave a full and interesting description of the habits of one species (*Utricularia clandestina*), and Darwin and others, of Europe, studied the habits of other species in Europe and elsewhere.

In its character as an insectivorous plant the bladder-wort might fail to arouse general interest, but as a destroyer of carp it has a commercial as well as botanical and scientific character. The common bladder-wort (*Utricularia vulgaris*) affords the easiest subject for study, inasmuch as its bladders reach the largest size and may be satisfactorily examined with a moderate magnifier.

The bladder is pear-shaped, with an opening at the small end. Around the mouth are antennæ like projections or bristles, which, according to Darwin, are for the purpose of warding off and keeping out insects of too great size. The mouth is closed by a valve which yields readily to light pressure, but offers an immovable barrier to the once captured creature. The utmost strength compatible with such a structure has apparently been attained. The valve is a thin and transparent plate, and, by means of the water behind it, is made to stand out a bright spot, which Darwin thinks may attract prey. Something certainly attracts the tiny denizens of the water, for they swim up to the mouth and crawl into the bladder by the readily yielding door. As there is no seductive secretion here, as in the case of many insect-destroying plants, the great naturalist's surmise is probably correct.

Some of the insectivorous plants, on catching their prey, at once pour out a digestive fluid analogous to the gastric juice of the human stomach, but with the *Utricularia* it is not so. The insects or other food when caught in the bladder are merely captives, and swim about in their confined quarters with eager activity in their endeavour to find an outlet, until asphyxia for lack of oxygen comes on. Even now the plant makes no effort to digest the animal food, but waits patiently until decay takes place, and the animal matter is by putrefaction resolved into fluids which the numerous papillæ lining the bladder can absorb.

Darwin's experiments showed not only that living animals could make their way into the bladder, but that inanimate objects falling on the valve would be engulphed with lightning-like rapidity. With all this information to begin with, it is not strange that naturalists should turn to the bladder-wort to seek a solution for the great destruction of the carp, for the carnivorous plant was known to possess facilities not only for the capture of floating spawn, but even of the newly hatched fish. Examination and repeated experiment proved conclusively that the greedy little bladders were making sad havoc with the fish, and in consequence carp breeders are bidden to open war vigorously on *Utricularia* and all its species. It may seem at a hasty glance that the small bladders can hardly be responsible for any very extensive destruction of eggs or small fish, but the doubters of the ability of insignificant agents, acting together, to produce stupendous effects may be referred to the microscopic rhizopods or the earth worms, each in their own way performing wonderful feats in the way of earth building and earth preserving.—*Scientific American.*

Catalpa Ties.—The catalpa is already in use in the south-west of the United States, to some extent, for railway ties. It is a wood of rapid growth, and yet has shown remarkable durability. In an address before an agricultural society in Ohio, General Harrison, of Indiana, mentioned a catalpa foot-log over a small stream in the Wabash county which had been in use for 100 years, and was still sound, showing no sign of decay.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE SECOND EVENING (*continued*).

"I FIND," says the Marchioness, "the planets are just like us; we cast that upon others which is in ourselves. The Earth says, ''Tis not I that turn, 'tis the Sun;' the Moon says, ''Tis not I that shake, 'tis the Earth;' the world is full of error."

"But I would not advise you," said I, "to undertake the reforming it; you had better convince yourself of the entire resemblance of the earth and the moon. Imagine, then, these two great bowls suspended in the heavens. You know that the sun always enlightens the one half of a body that is round, and the other half is in the shadow. There is, then, one half of the earth, and one half of the moon, which is enlightened by the sun—that is, one half which is day, and the other half which is night. Observe, also, that as a ball has less force after it has been struck against a wall, and rebounds to the other side, so light is weakened when it is reflected. The pale light which comes to us from the moon is the very light of the sun; but it cannot come to us from the moon but by reflection. It has lost much of the force and lustre it had when it came directly from the sun upon the moon; and that bright light which shines directly upon us from the sun, and which the earth reflects upon the moon, is as pale and weak when it arrives there, so that the light which appears to us in the moon, and which enlightens our nights, is the part of the moon which has day; and that part of the earth which has day, when it is opposite to the part of the moon which has night, gives light to it. All depends upon this, how the moon and the earth behold one another. At the beginning of the month we do not see the moon, because she is between the sun and us; that half of her which has day is then turned toward the sun, and that half which has night is turned towards us; we cannot see it then, because it has no light upon it: but that half of the moon which has night, being turned to the half of the earth which has day, sees us without being perceived; and we then appear to them just as the full moon does to us. So that, as I may say, the people of the moon have then a full earth; but the moon being advanced upon her circle of a month, comes from under the sun, and begins to turn towards us a little corner of the half which is light; which is the crescent: then those parts of the moon which have night, do not see all that half of the earth which has day, and we are then in the wain to them."*

"I comprehend you very well," said the lady; "the people in the moon have a month quite contrary to us; when we have a full moon, their half of the moon which is light, is turned to our half of the earth which is dark; they do not see us at all; and they have then a new earth, this is plain. But now tell me how come the eclipses?"

"You may easily guess that," said I; "when it is new moon she is between the sun and us, and all her dark half is turned towards us who have light, that obscure shadow is cast upon us; if the moon be directly under the sun, that shadow hides him from us, and at the same time obscures a part of that half of the earth which is light; this is seen by that half of the moon which is dark: here

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* Fontenelle omits to notice here the varying aspect of the earth to the moon, as rotation turns different parts of her surface moonwards. But he touches on this point in the next chapter.—R. P.

then is an eclipse of the sun to us during our day, and an eclipse of the earth to the moon during her night. When it is full moon the earth is between her and the sun, and all the dark half of the earth is turned towards all the light half of the moon; the shadow then of the earth casts itself towards the moon, and if it falls on the moon, it obscures that light half which we see, which has then day, and hinders the sun from shining on it. Here then is an eclipse of the moon to us during our night,* and an eclipse of the sun to the moon during her day: but the reason that we have not eclipses every time that the moon is between the sun and the earth, or the earth between the sun and the moon, is because these three bodies are not exactly placed in a right line; and by consequence that which should make the eclipse, casts its shadow a little beside that which should be obscured."

"I am surprized," said the Marchioness, "that there should be so little mystery in eclipses, and that the whole world should not know the cause of 'em."

"They never will," said I, "as some people go about it. In the East Indies, when the sun and the moon are in eclipse, they believe a certain devil who has black claws, is seizing on those planets with his talons; and during that time the rivers are covered with the heads of Indians, who are up to the neck in water, because they esteem it a very devout posture, to implore the sun and the moon to defend them against the devil. In America, they are persuaded that the sun and the moon, when eclipsed, are angry, and what is it they will not do to be reconciled with them? The Greeks, who were so refined, did they not believe the moon was enchanted, and that the magicians forced her to descend from heaven, and shed a dangerous juice on the plants? Nay, what a panic were we in, not many years ago, at an eclipse of the sun? How many people hid themselves in their cellars; and all the philosophers could not persuade them to come out 'till the eclipse was over?"

"Methinks," said she, "'tis scandalous for men to be such cowards; there ought to be a general law made to prohibit the discoursing of eclipses, that we might not call to mind the follies that have been said and done upon that subject."

"Your law then," said I, "must abolish even the memory of all things, and forbid us to speak at all, for I know nothing in the world which is not a monument of the folly of man."

(*To be continued.*)

MUSCULAR CONTRACTION AFTER DEATH.†

Dr. Brown-Séquard maintains that fixed and rigid positions after death, speedily ensuing, are due to the last vital act, which has induced a "tonic contraction," and that causes of death which produce sudden dissolutions without pain or excitement may be the means of such a contraction. Assuming this to be true, still the *modus operandi* by which a vital act can leave such a "tonic contraction" after all vital power has ceased is not suggested by him, and we need one step further in the way of enlightenment. Let us see if we cannot take that step now.

In accordance with the observations of Du Bois Reymond, it has been pretty generally accepted that the normal state of even quiescent living muscle is one of electrical tension, and that during muscular contraction the tension diminishes in such a way that as the wave of contraction moves along the muscle it is preceded by a wave of negative variation. This variation is slight for a single contraction, but in those of great rapidity it may become so great as to completely neutralise the galvanometric deflection due to the normal current of the quiescent muscle.

These views have been attacked and sharply criticised, notably by Hermann in 1867, and as lately as 1877 Engelmann has come to Hermann's aid in Pfluger's "Archiv." They maintain that normal muscle-currents do not exist; and that those observed by Du Bois Reymond were due to the unnatural conditions of the muscles examined by him. He, however, has replied to their criticisms with great ability, and his views are now, as already stated, very generally adopted by physiologists. A consideration of these views may perhaps help us to a clearer idea of the position of the headless soldier of Sedan, as shown in Brown-Séquard's figure.

The conditions required, in order that a limb or the entire body should be in a state of rigidity, are simply that the antagonistic muscles, the flexors and extensors, for instance, should be braced at the same moment to full activity, and the rigidity continues so long as the mutual action remains. If this action is not local, but general, such a figure will continue without motion indefinitely, excepting that gravitation may cause it to fall to the ground, if unsupported. But even such a fall would not affect the limbs: they would necessarily retain their position.

Now Du Bois Reymond has shown us that tonic contraction is the *normal state* of muscle fibre, and that relaxation is due to an accession of vital activity through the agency of nerve force. We know well that commonly when life ceases muscular contractility ceases with it. And we can readily see that when death comes as the result of disease or exhaustion, and is attended with suffering, the perturbation of nerve force and of muscle currents must be so great that such a result will surely follow. And as these include death in almost every form in which we ever witness it, we have naturally come to understand that muscular relaxation is its normal attendant and its immediate result. "He bowed his head" is the fearfully expressive term employed when death came on Calvary.

But in the very few instances where death occurs suddenly and without suffering, it seems possible that the instantaneous cessation of the nerve force may leave every muscle fibre in its *normal condition*. If that could be, universal rigidity would instantaneously ensue, and the last position assumed in life would be retained in death. Now, we know that the one cause of all causes which can bring a death into which the element of time does not enter is a wound which obliterates the base of the brain as well as the commencement of the spinal cord. That there is an interval between the cause and effect is doubtless theoretically true, but practically the interval has no existence, for it is infinitesimal. Such a stroke must necessarily be painless, for life (including of course sensation) is abolished at its occurrence. The two chief cases cited by Brown-Séquard are cases precisely in point.

The cannon-ball at Sedan left nothing remaining above the lower jaw. The brain of the soldier at Goldsborough had been swept by a bullet from a Springfield rifle, that struck him in the right temple, while his head was turned toward his right shoulder, and beyond question inclined downward, for his leg had that instant crossed the saddle, and the stock of his own rifle was still on the ground. Following Du Bois Reymond, it is difficult to see how instantaneous rigidity should not ensue in each of these cases; it did ensue, whether our explanation be correct

* Or rather, during the night of the parts of the earth turned moonwards.—R. P.

† From the *Scientific American.*

or not. And with each one the state of support was such that he *could not fall* so long as the rigidity continued.

Many questions and conclusions of intense interest are associated herewith, but for the present we must leave them untouched. W. A. O.

THE INTERNATIONAL HEALTH EXHIBITION.

XIV.—WATER AND WATER-SUPPLIES—(*continued*).

In our remarks upon the "Grant Revolving Ball Water Filter," we drew the attention of our readers to this remarkable contrivance as being one which is peculiarly adapted to the purification of *tolerably* wholesome water, and in doing so provoked a reply from the inventor, who, it is but just to state, has furnished us with ample evidence that the instrument is capable of dealing effectively with even filthy and highly impure waters. We have tested the apparatus, and find the filtrate of our experiments all that could be desired for drinking and for culinary purposes. In cleansing the filter by reversion of the ball, it is somewhat surprising to find, in spite of all theoretical reasoning to the contrary, that the carbon is not *approximately*, but *thoroughly* cleansed, and the operation is so simple that it may be put into action every time that the filter is used, although in reality it does not require such attention more than once or twice daily.

On a large scale, these filters might be fixed with advantage to public drinking-fountains and street-service hydrants, as suggested by the *Home and Colonial Mail*,* when "the policeman on his beat could cleanse them at intervals by merely turning a handle in passing. This handle could be constructed, in filters destined for public hydrants, to allow of its being locked, to prevent damage from mischief."

Type IV.—"The Spongy Iron Filter."—The researches of Prof. Gustav Bischof, which led to the employment of spongy iron as a filtering medium of value, are carefully recorded in the "Proceedings of the Royal Society,"† and one of the most important benefits derived from its use is shown to be due to its destructive action upon organic germs. In his report to the company, Professor Frankland, F.R.S., writes as follows:—‡"Taking into account the extremely bad quality of the raw material at the time of my visit, I consider this result to be eminently satisfactory from a purely chemical point of view; but there is another factor involved in this result which has still greater weight with me in the comparison of the water before and after treatment, viz., the circumstance that the water has been passed through a material which is absolutely fatal to bacteria and their germs. It has been proved by Prof. Bischof § that water which has passed through spongy iron is entirely free from bacterial germs, and by my pupil, Mr. F. Hatton, working in my laboratory, that spongy iron is the only known substance applicable to the treatment of large volumes of water which immediately destroys living bacteria."‖ We need scarcely add that the immunity from zymotic disease, secured through the use of so valuable an apparatus, ought to be a powerful argument in favour of its general acceptance as a household necessity.

The internal mechanism of the filter may be readily understood by a reference to the figure here annexed (Fig. 27), from which it will be gathered that it is entirely different in plan from any of the appliances which we have hitherto noticed. The following description, which has been kindly furnished to us by the company, will enable the reader to gain an insight into its detailed structure:—

"(1) The unfiltered water is supplied by means of ball-cock,

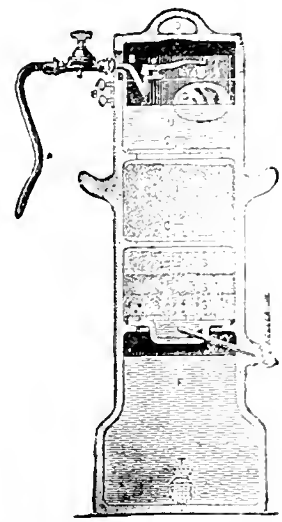


Fig. 27.—Bischof's Spongy Iron Special Ball-cock Filter. B., ball-cock; U., unfiltered water; V., screw-valve; I., spongy iron; S., S′., S″., prepared sand; F., filtered water; T., stop-cock.

B, with glass-ball, G, and screw-valve, V; the latter serves to shut off the water in any emergency. The ball-cock requires no fixing to a wall, but is fastened to the side of the filter-case by screws, R; it is connected with the water-supply or cistern by india-rubber or other tubing, P. The water passes through the several layers of filtering materials, which are enclosed between the perforated plates, C, C′, C″. It is next collected in a small well, or regulator bowl, and thence passes into a tin tube, provided at its outer end with a screw-cap, A. The lateral opening, X, in the side of the tube forms the only communication between the upper part of the filter and the reservoir for filtered water. The flow of water is thus controlled by the size of such opening. (2) The supply of water to this filter should be sufficient to insure the materials remaining covered with water."

Spongy iron is metallic iron in a state of excessively fine division, which renders it sufficiently porous to admit of the percolation of water. It takes the place of the carbon of other filters, and acts virtually in the same way. Apart from its obvious property as a mechanical strainer, it is a chemical purifier. It counteracts lead contamination,* reduces the hardness of water,† and, as we have before noted, is strongly antiseptic as far as organic matters are concerned. Mr. F. Hatton has shown:—‡ (1) "That it acts as a very powerful reducing agent on the carbon compounds composing the organic matter dissolved in water. In some cases marsh gas itself was produced—probably the organic matter was first oxidised to carbonic acid (CO_2), and then the action of the metallic iron on this gas gave rise to marsh gas (CH_4) by the ordinary decomposition of water. (2) The organic nitrogen is in nearly all cases reduced to ammonia."

In its passage, the water dissolves a small quantity of

* July 18, 1884, p. 5.

† "On Putrescent Organic Matter in Potable Water," No. 180, 1877; No. 186, 1878.

‡ Report to the Directors of the "Spongy Iron Water and Sewage Purifying Co.," August 8, 1882.

§ *Op. cit.*, xxvii., p. 258.

‖ "Journ. Chemical Society," xxxix., p. 247.

* "Journal Royal Agricultural Society," vol. xi., part 1, 1875, p. 158.

† "Rivers Pollution Commission," 6th report, p. 220.

‡ "Journal Chemical Society," May, 1881.

the iron, but this is abstracted and retained by the layers of prepared sand underneath. The entire filter is thus composed from below upwards of:—(1) A perforated plate C″, Fig. 27. (2) Fine gravel, S″. (3) Coarse white sand, S′. (4) Black pyrolusite, S. (5) Intermediate perforated plate, C′. (6) Spongy iron, I. (7) An upper perforated plate, C. It thus appears that, as the entire system is constituted by a series of inorganic substances, the liability to decomposition of the filtering medium is entirely dispensed with, and, in consequence, a renewal need not be resorted to more than once in twelve months. The filter may then be taken to pieces, thoroughly cleansed, and recharged, by following the simple directions supplied with each instrument.

TYPE V.—"The Patent Carbon Paper Water Filter." Fig. 28, manufactured by Messrs. S. H. Johnson & Co., of Stratford, London, E., is constructed upon the principle of combining a theoretically perfect mechanical strainer with a chemical purifier of the highest value. Both of these requirements are premised to be but temporarily obtainable, and bearing this in mind the inventors have sought to produce an instrument which shall fulfil all the duties of a perfect filter with the materials at hand, which can be inexpensively and readily renovated.

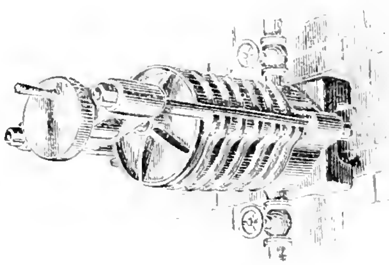


Fig. 28.

Stout filter-paper, into which a quantity of purified animal charcoal (from 10 to 20 per cent. of its weight) has been incorporated, is held within a chambered framework, and operates by means of the pressure in the main-service or household supply pipe. The body of the apparatus consists of a series of apposed compartments, each designed to hold two circular discs of the prepared paper, so that a six-chambered instrument, such as that shown at Fig. 28, would contain twelve of such filtering surfaces.

The unfiltered water passes in at one side, and, after filtration, flows into the supply-pipe under pressure. The substitution of fresh papers is provided for thus:—"The filter can be shut off on both sides from the service-pipe, a small disc run back, and the grooved plates and distance-frames of which the filtering chambers consist can be opened out, and the spent carbon papers changed in the course of a minute or two. When screwed up the machine is again ready for work." The entire arrangement is a novel device, and practically supports the theory upon which it was constructed, and which we have already enunciated.

NEW ZEALAND COAL.—The coal trade of the north island of New Zealand promises to be extensive. Coal is found at the Bay of Islands, where a mine is in full operation. At Whangharei two mines are at present working; at Raglan coal of good quality has recently been found, and at the Mokau a seam of excellent coal is seen cropping out to a great thickness for a distance of between twenty and thirty miles. Besides these places, coal is now being worked to a considerable extent at several points on the Waikato, and a large seam of coal—between 50 ft. and 60 ft. in thickness—on the estate of the late Mr. Foote, on the Maramarua Creek, is expected to become a source of supply shortly.

Editorial Gossip.

A LESS sensational Presidential address than that of Lord Rayleigh to the British Association this year it would be difficult to imagine, and yet it is not without interest for those outside of the comparatively narrow circle of specialists in physics, to whom it primarily appeals. Among the more notable points in it I may refer here to Crookes's masterly discovery of the element Yttrium by the presence of a bright band in the phosphorescent spectra of certain earths, and the proof thence derived of its comparatively wide distribution. The researches, again, of Abney in the ultra-red end of the spectrum, Langley's conclusion (already adverted to in these columns) that the sun would appear of a blue tint if viewed by an eye situated outside of our atmosphere, and the description of Cornu's method of determining whether any given line in the solar spectrum has its origin in the sun or in our own atmosphere must command the attention of all who possess the slightest familiarity with the theory, or practical use, of the spectroscope. Michelsen's final determination, too, of the velocity of light as 186,290 miles per second will be accepted with interest by all concerned in the study of cosmical or astronomical phenomena; while, finally, Lord Rayleigh's brief discussion of the tendency and methods of modern education can scarcely fail to be valuable to a very large number indeed to whom the very British Association itself is but an entity of the vaguest and most shadowy kind.

"THERE was," says the *Book of Nonsense*—

> "There was an old person of Philæ
> Whose conduct was scroobious and wily"—

conduct which apparently finds very sedulous imitation in certain gentry who try to puff themselves in journals weak enough to fall into the trap they set for them. I may select two illustrations of this of which I have had recent experience. The first is that of a so-called "Spiritualistic" paper which has been moving heaven and earth to provoke me into a discussion, with the sole object of getting a gratuitous advertisement in the columns of KNOWLEDGE. Its failure to do so has driven it nearly frantic; but, surely, in vain the net is spread in sight of any bird. The second effort to use this journal comes from a gentleman who has invented something—what, I decline even to hint; but will suppose, for the sake of illustration, that it is an improved hair-pin. Well, the inventor writes to me asking for an appointment that I may see his hair-pin; and goes on to suggest that I should (of course, by puffery) aid him to introduce it into ladies' schools "for our mutual advantage." It affords an instructive notion of the idea which such a person must entertain of the social status, habits, training, and ethics of the editor of a scientific paper, to suppose that he would misuse its pages for the sake of the profit to be got out of selling hair-pins (or anything else) on commission!

I SEE that the 240th minor planet was discovered on the night of the 28th ult. at Marseilles. It is much to be deplored that the astronomers at the Observatory there had not something more profitable to occupy themselves with.

IN addition to the letter printed on p. 206, I have received another from Dr. Kinns, complaining of the paragraph on p. 142, and containing scarcely veiled threats of what he will do if I do not apologise to him. Such threats trouble me but little indeed; but Dr. Kinns—and every one else—is entitled to the most rigid justice; and I am earnestly anxious that he should have it. When a man voluntarily publishes a book, he, *ipso facto*, subjects that book to the most searching, and, if need be, damaging criticism (always supposing such criticism to be *bonâ fide*, and without malice); nor does the patronage of Lord Shaftesbury, or even of the Lord Mayor himself, exempt him from unfavourable comment. To two expressions in the paragraph in question Dr. Kinns takes especial exception. The first is this: "He claimed to have the sanction and support of, *inter alios*, members of the staff of the British Museum, but this was promptly denied and repudiated by more than one leading member of that staff themselves." The members of the staff who do appear to support Dr. Kinns are Dr. Birch and Mr. Pinches; who are, doubtless, excellent judges of the faithfulness of a translation of a cuneiform inscription, but whose authority as astronomers, physicists, geologists, and palæontologists may reasonably be questioned. As for the repudiation by the *Natural Science* staff of the Museum, see Mr. Carruthers' letter in the *Standard* of Jan. 4, 1884, and the mass of correspondence which appeared in that journal, the *Times*, &c., about, and subsequently to, that period, together with Dr. Kinns's replies. The next expression to which Dr. Kinns objects is "crass ignorance," which he alleges is calculated to do him serious injury. As I would not wilfully injure a human being, and assuredly not a total stranger to me, I withdraw that expression entirely, and invite Dr. Kinns himself to substitute for it, in these columns, his own definition of the mental condition of a man who could believe that refraction, in any form whatever, could cause the sun to appear above the western horizon after the rotation of the earth had carried it—not only beneath the observer's feet—but actually to its point of rising 180° distant! I must, in fairness, add that, at the time of my penning these lines the new edition of Dr. Kinns' book has not reached me. Should it do so before going to press, and I find that the astounding statement to which I have just referred has been expunged from it, I will take care to give the fact all the publicity in my power. Dr. Kinns seems to be labouring under the curious hallucination that his private character and personal honour have been attacked. No such utterly baseless charges were ever brought (or would for a single instant have been suffered to have been brought) against him in these columns. It was his judgment as an author, and that alone, which was assailed, in conjunction with the policy of the action of his committee.

Reviews.

Celestial Motions: a handy book of Astronomy. By W. T. Lynn, B.A., F.R.A.S. Second Edition. (London: Edward Stanford, 1884.)—Scarcely two months have elapsed since our first notice of Mr. Lynn's capital little book, and already the first edition is exhausted. In the second, the two or three printer's errors, &c., which we noticed in p. 483 of our last volume have disappeared, all numerical and other detail is brought down to the very latest date, and a diagram of the orbit of the November meteors has been added. Mr. Lynn's tiny volume has honestly earned the success it has met with.

London Water: A Review of the Present Condition and Suggested Improvements of the Metropolitan Water Supply. By A. de C. Scott, Major-General late R.E. (London: Chapman & Hall. 1884.)—When we read on the first line of General Scott's work that, even in 1882, in addition to the supply from private wells, London consumed daily 146,130,000 gallons of water! the vast importance of the subject which he undertakes to discuss is irresistibly forced upon us. He gives us a succinct history of the Metropolitan Water Supply; and shows very plainly in what respects it breaks down; discusses the various schemes proposed for furnishing a supply of pure water—such as Mr. Bateman's for bringing it from South Wales, Messrs. Hemans and Hassard's, for deriving it from the Lake District; Mr. Fulton's, for obtaining it from the Wye, &c., as well as the idea of Messrs. Homersham and Barlow for sinking very deep wells within the area of the metropolis itself. He appears to be pretty definitely of opinion that the monopoly of the Water Companies has been abused, and that the sooner it is destroyed the better. General Scott's book deserves the attention of every water-consumer in London.

Railway Accidents. By Clement E. Stretton. Third Edition. (London: Simpkin, Marshall, & Co.)—This is a carefully-written pamphlet on the cause and prevention of those calamities which occasionally befal us to remind us of the reality of the danger we more or less wilfully place ourselves in day by day. It is notorious that companies have frequently tried to shield themselves behind their servants, and would sometimes have succeeded had it not been for the timely interposition of Mr. Stretton, who, having devoted time and money to the protection of the servant, is acknowledged as their friend. We commend the little pamphlet to the serious consideration of our readers.

The Electrician's Pocket-Book. By E. Hospitalier. Translated, with additions, by Gordon Wigan, M.A. (London: Cassell & Company, Limited, 1884.)—This is second year's edition of a work which is intended to be issued periodically. It is a very useful volume, teeming with valuable information condensed into a small compass. It has the advantage of being very clearly printed, one great feature being the unusual prominence given to the headings of paragraphs. Reference is in consequence made much simpler than it otherwise would be.

Photography for Amateurs. By T. C. Hepworth. (London: Cassell & Co., 1884.)—Mr. Hepworth has done his work honestly and well, and with the exception of that short chapter on the history of photography with which the author of nearly every manual on the subject seems to consider it incumbent on him to begin his book, there is little that is not instructive to the worker, and which may not be read with profit by the amateur.

How to be a successful Amateur Photographer. By W. J. Lancaster, F.C.S. (Birmingham: J. Lancaster & Son.)—Yet another work on Photography! This time by a member of a well-known firm of manufacturing opticians, who tells us nothing about Victor Niepce, Daguerre, nor Fox Talbot, but who plunges at once *in medias res*, and is most eminently practical from beginning to end. He confines his descriptions of apparatus to those forms constructed by the firm to which he belongs; but, as the reader will soon find out for himself, there is no real disadvantage in this. The exceeding cheapness of Mr. Lancaster's pamphlet places it within everybody's reach, and, moreover, enables the intending photographer to sit down and count the cost of his preliminary essay in the art; a consideration by no means to be lost sight of by the beginner of limited means.

Hygienic Bread is a description of the new hygienic bakery of Messrs. W. Hill & Son.

We have also before us *The Practical Confectioner*, *The Journal of Botany*, and *Amateur Gardening*.

Miscellanea.

Mineral wool is, says the *Scientific American*, used for a packing to deaden the sound between floors in buildings, and being incombustible it is now pretty generally used between the floors and ceilings in new houses. Mineral wool is obtained from the slag from blast furnaces, and is produced by throwing a jet of steam against the stream of slag as it flows from the furnace.

The Blenheim Pictures.—"Atlas," in the *World*, gives some particulars in regard to the sale of the Duke of Marlborough's pictures. The agent in the matter is Mr. Davis, of 117, New Bond-street, London. So far he has been most successful in his sales. For four pictures Mr. Davis has obtained for the Duke £140,000, one of the number being the famous Raphael, for which the Government has undertaken to pay £70,000.

Wide Reach of a Tidal Wave.—A correspondent in the Fiji Islands writes that a notable tidal wave reached there on October 6 last, the date of the great tidal wave, 25 feet high, and the eruption of Mount St. Augustin, in Alaska. The tidal wave in Alaska occurred at 8.25 a.m., and that at the Fiji Islands, about 4,500 miles to the south-west, at 11.15 a.m. At the latter place there were three successive waves, with intervals of ten minutes, which, at the ordinary period of low water, reached nearly to the high-water mark. The occurrence of this disturbance of the sea a few hours later on the same day as the eruption of Mount St. Augustin, and the formation of a new island in its vicinity, suggest that the tidal wave at both places proceeded from the same cause.

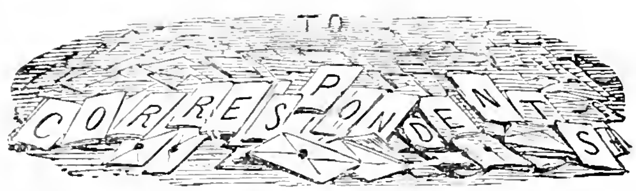
In the Interests of Science.—A contemporary is informed that the *Warsaw Courier* has published a letter from a subscriber in which the writer offers himself as a subject to be experimented upon in reference to cholera. "I am unmarried," says he, "I have no ties of any kind, and no plans for the future. I therefore wish to be of use to humanity by undergoing any experiments which have not yet been tried upon human beings. I seek no reward, but should require to be paid my travelling expenses to wherever I might have to go to be experimented upon, and those of my return journey to Warsaw should I be spared to perform it. I may add that I am twenty-four years of age and in good health." The writer says that communications in answer to this may be sent to "Z. A. K.," care of K. Tsibulski, china and glass dealer, Theatre-place, Warsaw.

Coral-Fishing.—Coral-fishing is largely followed in Algeria, 40,000 to 45,000 pounds of coral, valued at about £38,000, being the yearly production; La Calle is the centre of this industry, and there are employed annually 100 boats and 1,300 men. The coral is obtained by means of a wooden apparatus in the shape of a cross, having in its centre a leaden slug or stone for ballast. Nets, the meshes of which are loose, are hung on the bars of the cross and dragged at the bottom of the sea, among the nooks and crevices of the rocks. These nets, winding about the coraline plant, break up or tear off its branches, which adhere to the meshes. The apparatus is drawn up by the fisherman whenever he thinks it sufficiently laden. There is also a net which is provided with large iron nails, having thus greater force to break the coral, but this apparatus is forbidden to be used.—*Scientific American.*

The Abyssinian tube-well for the entire supply of the town of Hertford has been completed by the contractors, Messrs. Le Grand & Sutcliffe, with most satisfactory results. The size of the tube well is 7¼ in., and at 81 ft. the chalk springs are so abundant that the yield is over 100 gallons per minute, or about 150,000 gallons per day. The pumping, when necessary, can be continued night and day with a very small amount of attention, as the motor is a powerful water-wheel worked by the river Lea. This well affords a further illustration of the fact stated by Mr. Robert Sutcliffe at the recent Water Supply Conference held at the Health Exhibition, that it frequently happens there is abundance of good water to be found on the banks of a river that is no longer itself fit to supply water for dietetic purposes. The total saving of the expense of filtration is also a very important item, which might, to some extent, recompense the London water companies for the expense of obtaining their supplies from sources that need no outlay on this head. The total cost of the tube-well, including cast-iron connections to pump, was under £150, so that the town supplies on this system cannot be considered extravagant.

Efficacy of Vaccination.—In his report of the working of the Homerton Small-pox Hospital, Dr. Gayton supplies us with the most recent, as well as most cogent, proof of the marvellous efficacy of vaccination as a prophylactic, and of the utter ignorance and crass stupidity of the people who are induced by paid agitators to lend their names and their uneducated minds to the contest against vaccination. From January 1 to March 7, 1883, during which time the small-pox patients were treated in the Fever Hospital, 62 cases were admitted; of these, 43 were vaccinated, of whom 3 died, or at the rate of 7·0 per cent.; 12 were doubtfully vaccinated, of whom 3 also died, or at the rate of 25 per cent.; and 7 were unvaccinated, of whom again 3 died, or at the rate of 42·85 per cent. From March 7 to the end of the year, 325 patients were admitted—viz., 237 vaccinated, 30 doubtful, and 58 unvaccinated. Amongst these 17, 5, and 25 deaths respectively occurred, or at the respective rates of 7·02, 16·6, and 43·1. It seems, therefore, that the unhappy child who, by the influence of these foolish people, has been deprived of the benefit of vaccination, runs a risk of death from small-pox more than six times greater than the child who has undergone the harmless operation necessary to preserve him against that disease.—*The Medical Press.*

The Antiquity of Mercury.—A recent writer in the *North China Herald* discusses the part played by mercury in the alchemy and *materia medica* of the Chinese. Cinnabar was known to them in the seventh century before the Christian era, and its occurrence on the surface of the earth was said to indicate gold beneath. Their views on the transformation of metals into ores and ores into metals by heat and other means took the form of a chemical doctrine about a century before Christ, and there is now no reasonable doubt that the Arabian Geber and others (as stated by Dr. Gladstone in his inaugural address to the Chemical Society) derived their ideas on the transmutation of metals into gold and the belief in immunity from death by the use of the philosopher's stone from China. Among all the metals with which the alchemist worked, mercury was pre-eminent, and this is stated to be really the philosopher's stone, of which Geber, Kalid, and others spoke in the times of the early Caliphs. In China it was employed excessively as a medicine. On nights when dew was falling a sufficient amount was collected to mix with the powder of cinnabar, and this was taken habitually till it led to serious disturbance of the bodily functions. In the ninth century an emperor, and in the tenth a prime minister, died from over doses of mercury. Chinese medical books say it takes two hundred years to produce cinnabar; in three hundred years it becomes lead; in two hundred years more it becomes silver, and then by obtaining a transforming substance called "vapour of harmony" it becomes gold. This doctrine of the transformation of mercury into other metals is 2,000 years old in China. The Chinese hold that it not only prolongs life, but expels bad vapours, poison, and the gloom of an uneasy mind.



"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

DAISIES.

[1381]—I never had the slightest desire to exterminate daisies anywhere, and I have not the remotest idea how anybody seized with such an unnatural longing could proceed to gratify his or her wicked and destructive tastes. Perhaps the easiest way out of the difficulty would be for the "Disconsolate Female" to aim at acquiring a more reasonable liking for beautiful natural objects, and to correct the mistaken feeling which prefers an artificially smooth lawn to the graceful variety of self-sown herbage.

Grant Allen.

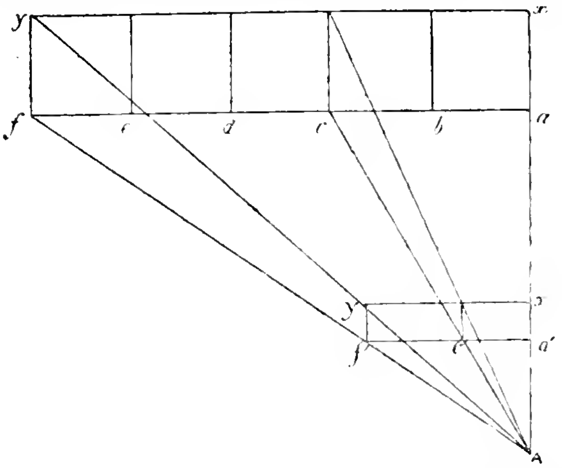
FALSE PERSPECTIVE.

[1382]—It was a grave omission in the elementary works on Perspective not to have pointed out to T. E. (R.) Jones that the appearance of his "Plane of the Picture," and of the lines drawn upon it, are subject to the same laws of perspective as other objects.

For experiment, if he will arrange his row of equidistant and similar posts against a wall, which may be called the "Plane of the Picture," then trace the outline of each on the wall with chalk, and remove the posts, there will remain a perspective representation in harmony with the recognised rules; and which yet, from its parts being at different distances from the spectator's "station-point," will show the same variations from crude regularity as the original objects themselves. R. R.

[1383]—By returning to the charge, T. E. (R.) Jones proves that this question is not yet satisfactorily disposed of. Does not the solution of the difficulty lie in the fact that a picture containing the element of perspective can only be seen properly from one point—which is technically known, I believe, as the "point of station?"

Of course, the post f (in Mr. Jones's diagram) appears shorter than the post a, "because it is more distant"; but its counterfeit presentment in the picture will also appear shorter for the same reason; and, if properly drawn, exactly in the same proportion.



The accompanying figure is intended to represent the posts in perspective. A a is at right angles to $a f$. The post f will then subtend a smaller angle at A than, for instance, the post c. $a' c' f'$ is the ground-line of the posts as represented in a picture. A is still the position of the observer. It will then be seen that the post f' must be represented as exactly the same length as the post c' in order that their *apparent* sizes may correspond with those of f and c; and the line $y' x'$ must be drawn parallel to the line $f' a'$ in order to *appear* to converge as $y x$ and $f a$ appear to do.

Of course, the post a must be supposed to be towards the centre of the picture; but the field of view would never in practice be made to include so large a lateral angle as twice f A a.

J. H. D.

[1384]—In my letter (1359, August 15th) which appeared in Knowledge, I should have added, "If an observer standing at any point on the line A B parallel to $a f$, proceed to move either to his right or left, still keeping on the parallel line, he will observe the effect described.

Perhaps you will kindly allow me to point out (with a view to setting this question at rest) that if any one who doubts what I have said about the false perspective of rectangular solids, will place himself on the pavement in Gower-street, Lancaster-gate, Portland-place, or some similar street where the window and door lines, &c., are sufficiently even, and then walk along the curbstones until he can just catch sight of the houses in a side street opposite, he will have before him (supposing the streets to be at right angles) two sides of a parallelopiped, whose top and bottom edges trend away (or seem to trend away) to their respective vanishing point.

R. (not "T. E.") Jones.

"MOSES AND GEOLOGY."

[1385]—I have only this morning been made aware of your article in Knowledge of Aug. 15, and must say that it has greatly surprised me. You call upon the members of my committee to furnish you with the names of the eminent scientists who have re-examined my work. I herewith send you them, and also enclose copies of their letters, the originals of which I shall be happy to show you at any time, and as you have attacked me so virulently and charged me with "crass ignorance," you will no doubt feel bound in honour to print these letters in full in your next edition.

You state that my ridiculous blunders have been thoroughly exposed. Permit me to say that I have clearly proved in my replies to my antagonists that I have been on all occasions *misrepresented* and *misquoted*, and in most instances it was quite evident that my opponents had not even read my book.

I would venture to think, from what you have written, that you also have not done so. Therefore I have desired Messrs. Cassell & Co. to send you a copy, and I must beg of you, as an act of justice to me and to the whole scientific world, that you will kindly read at least what I have written upon astronomy, after which I am sure you will be led to do your best to neutralise, as far as lies in your power, the article before me. Samuel Kinns.

[I willingly print Dr. Kinns's letter, and those of his "eminent scientists." I read attentively through a former edition of his book, at the time of its appearance; and will re-read the astronomical portion of the present edition with equal care. Meanwhile, I note that in his printed testimonials his sole *astronomical* authority is Mr. W. T. Lynn (he seems, somehow, to have dropped Mr. Dunkin), a gentleman who has written a nice little book or two, and who occupied a subordinate position in the Royal Observatory for some years. Whether Mr. Lynn was responsible or not for the abnormal refraction business, I do not know. If so, singularly little deference need be paid to his opinion as to the logical value of the rest of the book. If, however, names are to be quoted (like texts) as decisive, it might be curious to speculate what Dr. Kinns thinks of the dicta of one of the very greatest astronomers now living, Sir George B. Airy (with whom Mr. Lynn could scarcely be compared, even by Dr. K. himself), as expressed in his "Notes on the Earlier Hebrew Scriptures," published by Longmans & Co. in 1876. One would also, by the way, like to know how far Dr. Kinns's ideas are endorsed by such members of the staff of the British Museum as Sir Richard Owen, Drs. Günther and Woodward, or Messrs. Carruthers, Butler, Etheridge, and Fletcher?—Ed.]

"THE SCIENTIFIC ACCURACY OF THE BIBLE.

"In reference to the correspondence which appeared some few months ago as to Dr. Kinns' work, 'Moses and Geology,' we trust we may count upon your giving insertion to the accompanying letters which have been called forth by the publication of the Seventh Edition, and bear important testimony to the accuracy of the statement of scientific and other facts in the work. We are very desirous that this act of justice should be done to an author who was subjected to the painful ordeal of so much unfair and injurious criticism, to which it was difficult at the time to give a complete answer. We may add that the cordial reception of the lectures and addresses which Dr. Kinns has continued to give in various towns throughout England, bear witness to the esteem in which he is held.—On behalf of the Committee, we are, Sir, very truly yours, Shaftesbury; R. N. Fowler, Lord Mayor; Thomas Chambers, Recorder; R. Payne Smith, Dean of Canterbury; Henry White, Chaplain in Ordinary to the Queen."

"British Museum, London, April 12th, 1884.

"Dear Dr. Kinns,—Having examined the proof-sheets of the Seventh Edition of 'Moses and Geology,' now in the press, we consider the intrinsic merits of the work as very great, and that you have compiled the scientific, historical, and other facts with much care and accuracy.—Trusting that the book may continue to have the success which it deserves so well, we remain, yours most truly, S. Birch, LL.D., Theo. G. Pinches, Department of Oriental Antiquities, British Museum."

"Royal Astronomical Society, Burlington House, Piccadilly, "May 12, 1884.

"Dear Dr. Kinns,—At your request I have examined the astronomical portions of 'Moses and Geology' for a Seventh Edition of the work. Great credit is, I think, due to you for the care, diligence, and accuracy with which you have brought the scientific information up to date, as well as for the thorough revision which the book has now again undergone, rendering it still more worthy of the perusal of those who take an interest in its important subject.—Yours sincerely, W. T. Lynn, B.A., F.R.A.S., late Superintendent of the Calculating Department, Royal Observatory, Greenwich."

"Athenæum Club, Pall Mall, S.W., 21st May, 1884.

"My dear Dr. Kinns,—Having examined the proof-sheets of the geological portion of the Seventh Edition of your work, 'Moses and Geology,' I can testify to your having exercised great care and pains in the arrangement and statement of the facts which they contain.—With kind regards and good wishes, believe me, dear Dr. Kinns, yours truly, H. W. Bristow, F.R.S., Senior Director of H.M. Geological Survey."

"1, Bedford-square, W.C., May 14, 1884.

"My dear Dr. Kinns,—Having gone over the proof-sheets of the Seventh Edition of your book, 'Moses and Geology'—or, rather, that portion of it devoted to the subject with which I am more familiar, the brain and its wondrous nervous connections—I may say your descriptive matter is all that I can desire it to be, lending a charm and a value to the generally instructive character of your work.—Believe me to remain, yours very sincerely,—Jabez Hogg, M.R.C.S., Consulting Surgeon to the Royal Westminster Ophthalmic Hospital; Fellow of the Medical Society, London, &c."

"97, Highbury New Park, May 15, 1884.

"My dear Dr. Kinns,—I have at your request again examined all the Hebrew references in your valuable book, 'Moses and Geology,' and find them quite correct. I humbly believe that you have done immense good by proving the correctness and authenticity of the sacred records, and trusting you will meet with that success which your ardour and pious labour truly deserve, I am, my dear doctor, yours very sincerely, B. H. Ascher, Rabbi of the United Synagogue."

THE BEST FORM OF TRICYCLE.

[1386]—During my tour along the south coast I saw Knowledge, and noticed an article on tricycles. I ride a 36-in. "Merlin," and find it most suitable for my own use; but, having formerly ridden a Coventry "Compressus," I thought how near youn ideal machine it approaches. Having often ridden with the "Compressus," I know there are few machines that surpass it, only that it requires the rider to get a little forward to get additional weight on the driving-wheel going up hill; and for those who care to have two speeds it can easily be applied. But it mainly dismisses the great point of Large *v.* Small Wheels, inasmuch as the large wheels carry the weight at level running, while the small one does the driving.

I think if you would give the machine in question a little study and fair trial, you will be disposed to pronounce it second to none of chain-driven tricycles.

Have you tried the new "Merlin," and what is your opinion of it? H. A.

MIND AND BRAIN.

[1387]—If not encroaching too much on your valuable space, in reply to your editorial note on Huschke's dictum, that the vibrations of ether do not become colour until they are transmitted to the brain." I would rather put it thus:—"The phenomenon of colour is perceived" by the brain, through the eye and connecting nerves, and there transformed into the idea or thought expression —viz., colour. Nevertheless, the phenomenon of colour would still exist or be formed in fact, whether we could see it or not, or whether we called it colour or any other name. So I take Huschke to mean that the vibrations of stimuli, transmitted from within or without to the brain, are there transformed into thoughts or ideas by the self-acting molecules of the brain, whatever names we may give them.

In short, like the vibrations of light are transformed—say by a prism into colours—so are the vibrations of stimuli passing through our nerves and the brain transformed or modified into thoughts or ideas. F. W. H.

[Just so. External stimuli may be "transformed into" thought by the molecular vibration of the brain; but the contention of Büchner and Huschke is that such vibrations *are* thought, which to ordinary minds is simply inconceivable.—Ed.]

THE TERMS "PRIMARIES" AND "SECONDARIES" AS APPLIED TO COLOURS.

[1388]—In a recent issue of Knowledge there was some reference to what have been—under the nomenclature founded on erroneous conceptions regarding colour—termed *primaries* and *secondaries*, or *complementaries*. Colours are still regarded, and spoken of, as if they had external existence. Persons, even those esteeming themselves "scientific," have constantly to be reminded that colours are but sensations, or appearances, excited in us by vibrations of different periodicities. Externally to sense the vibrations which excite all the different sensations of light (colour) in us are simply vibrations without luminosity or colour. "The light is within us." Now, we cannot consistently speak of *primary* and *secondary* sensations. The complementary colours, as they are called, are not the effects of mixed sensations, but of the combined action of different wave lengths. It matters not whether vibrations be produced by the prismatic spectrum or by pigments, it is by means of vibrations alone that vision is effected. Let, for the sake of argument, the wave length of red be represented by 14, and blue by 9; then, if the two vibrations simultaneously affect the same portion of the retina, we shall experience a third sensation of colour—the result of their combined action. Correctly speaking, it is not a colour that has a *complementary*, but a vibration.

In my little work upon "Light" I have expounded the principle of complementary vibrations—a principle which the late Mr. William Spottiswoode pronounced to be a sufficient and complete explanation of the phenomena. But to our point, the prism does not refract colours, but vibrations; externally to the eye, there is, therefore, nothing but differentiated vibratory action, and by this medium all our varied sensations of sight are affected. On a future occasion, if permitted, I will advance reasons why it is also inconsistent that the terms *primaries* and *secondaries* should be applied to differentiated vibratory action. W. Cave Thomas.

[Carrying out the principle enunciated in the above letter in its integrity, I have no business to talk about the object on which I am writing as "a table." What—if I rightly apprehend Mr. Cave Thomas—I ought to say is that I have certain sensations which I call brownness, blackness, hardness, resistances, extension, the scent of Morocco leather, &c., the sum of which make up my concept. I have myself said (in a note to letter 1362, p. 144) that the ethereal vibrations do not become *colour* until they have been transmitted through the eye and optic nerve to the brain; but, alike for the purposes of science and common sense, we treat colours as objective realities.—Ed.]

LETTERS RECEIVED AND SHORT ANSWERS.

The Honorary Secretary of the Cork Literary and Scientific Society is requested kindly to read the paragraph which concludes the first column on p. 62, and which has recently appeared on other occasions in this journal.—E. P. The whole thing is a matter of common sense. Mechanical pressure is admittedly a—or rather *the* —*vera causa* of such a movement, and Faraday's contention was that pressure was innocently exerted by the operators. His apparatus was so constructed that when pressure was applied the index moved, and when such pressure ceased to be applied it remained stationary. With the result you are familiar. Hermann, the conjurer, brings two live rabbits down into the stalls, and, holding them up by the ears in the very midst of his audience, strokes them into one. On the principle of *Parsimonia principiorum*, I find a ready explanation of this in the conjurer's proficiency in sleight-of-hand. Suppose, though, that some one chose to assert that the spirit of (say) Hermann's deceased wife's sister had removed the second rabbit, or incorporated it with the first, and that you or I were to suggest a plan (such as catching the performer by the wrist at a particular stage of the trick) by which the disappearance of rabbit No. 2 was prevented. Are we to be told that because the performer failed to unite the rabbits, our device "leaves the question just where it was? Without the postulate of Parsimony it is migatory, and with that postulate it is superfluous?"—Sidney Woodforde. For the dozenth time I have nothing to add to what I wrote on p. 58 of Vol. V. of Knowledge. I really must beg you (and scores of correspondents who persist in sending me stamped and directed envelopes for private replies) to read, mark, learn, and inwardly digest the sentence in capital letters which concludes the heading of the correspondence columns.—L. G. R. See answer to E. P. above.—C. H. Johns. You will find the lines you quote in Wordsworth's "Tintern Abbey."—The Secretary of the Bow and Bromley Institute is requested to be good enough to read the first reply above.—W. W. S. The "Monthly Notices" of the Royal Astronomical Society are published by Williams & Norgate, London. I do not know the price to the public. All information with regard to the publications of the Liverpool Astronomical Society may be obtained on application to W. H. Davies, Esq., F.R.A.S., 55, Great Newton-street, Liverpool.—Anonymous (Sunderland). Our advertising columns are open to you.—John Hampden. Some one has been hoaxing you. Does not your own common sense suffice to show you that, were the earth flat, no intermediate stations whatever would be needed between Wimbledon and Portsmouth?—Sigma. It appears as though you were incapable of realising the *meaning* of Infinity. How can you possibly add—or subtract—from Infinity, or one infinite quantity from another; or conceive a circle with an "infinite" radius? As for your notions of equating two expressions each of them = nothing; a very old mathematical joke will serve to illustrate where that will land you. Let $a=b$: then $a^2=ab$ and $a^2-b^2=ab-b^2$: or $(a+b)(a-b)=(a-b)b$ or $a+b=b$: *i.e.* $2a=a$ or $2=1$!—C. Frederick Wilkinson.—Thanks for your interesting extract, which is marked for insertion.—Chas. Aldridge. The Editor is nearer to you than you imagine. Your letter will be forwarded.—Erimus. *Does* "every ninth wave rush in with greater volume and force than any of the others?"—Dr J. Murray Moore. How could a star which appeared in Virgo, by any conceivable possibility, reappear in Cassiopeia? A new star did blaze out in Cassiopeia from Nov., 1572, to March, 1574, and Tycho Brahé determined its place with some accuracy. There is a minute telescopic star (No. 129 of d'Arrest's Catalogue) within 1′ of this position, which was discovered to be slightly variable by Hind and Plummer in 1873. There is no record of the appearance of any new star in Virgo, B.C. 4; but that very doubtful authority, the Bohemian astronomer, Cyprianus Leovitius, asserts that he found, in a manuscript, a record of the appearance between Cepheus and Cassiopeia in 945, and again, in the same neighbourhood, in 1264, of a new star, which it has been thought may have been Tycho's. Assuming such conjecture to have been correct, the star should have reappeared in 1880. "Mercator" is wrong, *in limine*, in his dates, and quite obviously ignorant of the very rudiments of astronomy, or he could never have imagined two stars, separated by an arc of more than 120° in the heavens, to be one and the same object.

Our Chess Column.

By MEPHISTO.

"DEAR SIR,—I have been much interested in the game published in this week's KNOWLEDGE. But, on going over the moves suggested as a probable continuation, I cannot see that White can really force the game. I enclose a rough analysis to show you where my difficulty lies. It seems to me that 33. Kt to K7 (ch) is a complete answer to 33. P to Q6. After 32. Kt × Kt, Black has a Rook to the good, and therefore can afford a considerable sacrifice to beat off White's present attack. I tried 33. R × P (ch), but the White King can escape. I cannot see any escape after 33. Kt to K7 (ch).

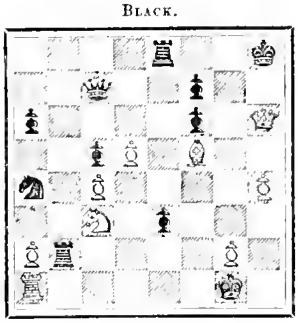
"I think White's best play is to get his B to Q3 *before* playing P to Q6. Thus 33. B to R7 (ch) / K to R sq. 34. B to Q3 (ch) / K to Kt sq. 35. P to Q6. But even then Black may follow with 35. Kt to K7 (ch), and I don't think White can dare capture the Knight. Then, again, if Black can get one more check and then attack the White Queen with Kt, he can safely challenge the exchange, or can sacrifice his Knight to give his Queen time to take the QP and retire to defend KBP.

"Altogether, the position is such a good one, that I think you would interest other readers as well as myself if you would analyse it for us a little further. "W."

We agree with our correspondent that the position is an interesting one. We ought to have been a little more explicit in our remark about 32. Kt × Kt. It is all-important in such critical positions to find the correct way of playing, as without it a sure game may be lost. If in this position 32. Kt × Kt then we must first avoid losing the important B by a ch with Kt on Kt6; we, therefore play 33. B to R7 (ch) / K to R sq. The B being now very well posted, we proceed to 34. P to Q6, which valiant P the Q cannot take on account of a mate in three. But if 34. Kt to K7 (ch) / K to R sq. 35. Kt to Kt6 (ch) 36. K to R2. To avoid the threatened mate in three Black has nothing better than 36. Kt to B8 (ch) 37. R × Kt(*a*) / Q × P (ch) 38. K to R sq. / Q to R2 (best).

Position after White's 32nd move.

BLACK.



WHITE.

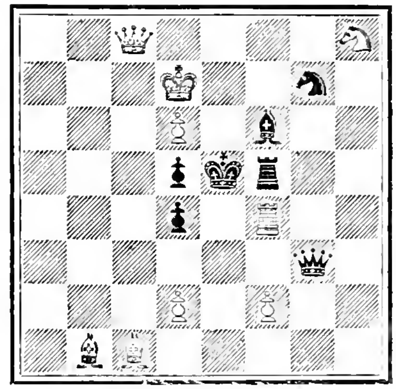
We did not play R to B1 as Black could have replied with Q × R, followed by K × B remaining with two R's against the Q and a better game. Now White cannot do better than play 39. B to Q3 (ch) / K to Kt sq. 40. Q to R7 (ch) / K to B sq. 41. Q to R8 (ch) / K to K2 42. Q × P (ch) / K to B sq. 43. Q × R and White wins.

(*a*) This leads to a win if correctly followed up. A more decisive yet simpler move is 37. K to R3, which wins at once, as Black cannot check with the (Q) on account of B coming on B5 with a check. If Q × P 38. B to Kt6 (ch), K to Kt sq. 39. Q to R7 (ch), K to B sq. 40. Q × P mate, or if Q to R2, the Q mates in two moves on R8.

PROBLEM No. 126.

By I. G.

BLACK.



WHITE.

White to play and mate in two moves.

SOLUTIONS.

PROBLEMS BY T. C., p. 168.

I.

1. B to QB3	1. Q to K Kt2
2. K to B8 (ch)	2. Q × Q
3. B to B7	mate

II.

1. Q to Kt7	1. Q × Q
2. P × Q	2. K to R sq.
3. P to Kt8 (ch) (Q)	mate.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Jas. G. Reeve.—See above letter. Solution incorrect as 1. K to R sq.

Correct solutions received Problem No. 124.—Fred Kingley, J. K. Milne, H. A. N., M. T. Horton, A. W. Overton.

CONTENTS OF No. 148.

NOTICES.

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KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, SEPT. 12, 1884.

Contents of No. 150.

DICKENS'S STORY LEFT HALF TOLD.

A QUASI SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

In reply to H. E., I note that the article on "The Mystery of Edwin Drood," though republished in the Knowledge Library ("Leisure Readings") did not originally appear in Knowledge but in the *Belgravia Magazine*, about five years since: I do not recollect the exact date. In "Leisure Readings" the article is longer by about one-fourth than as it first appeared.* Let me further explain that in speaking of the article in the *Cornhill Magazine* as "rather feeble," I was thinking only of the way in which the writer presents as a mystery which Dickens had been careful to conceal, precisely that which Dickens had been most careful to suggest. In this sense, also, H. E. appeared to me decidedly to place himself in the rank of those "commonplace readers" whose ways Dickens understood so well. Dickens himself, though he may have led Mr. Fildes to think that only "a keen reader" could "ever find out who and what was Mr. Datchery," had as certainly conveyed to Miss Hogarth his fear lest keen readers would find out the real meaning of what he called "the Datchery assumption," and that with that they would recognise the course along which the story was to have advanced towards its end. And Dickens himself, while he knew how much or how little he had consciously left open to the keener among his readers, did *not* know how much he unconsciously left open to those whose ears could take in the music of his prose poetry. I venture to say that to any one possessing this power the general purport of the plot of all Dickens's later novels was made clearer by unconscious suggestions than by any of those indications which Dickens consciously left open to his keener followers.

Before entering on the consideration of what appears to me most obviously to have been Dickens's purpose and meaning in his last story, let me invite H. E.'s attention to the significance of the passage which he quotes from the article "How Edwin Drood was illustrated," in the *Century Magazine* for February, 1884. It disposes in the first place, utterly, of H. E.'s own views, if he admits that the central crime was "never intended by the author to be a mystery,"—which is precisely my contention. And certainly if the true interpretation of Mr. Datchery is that "he is some detective," then no great keenness would be required on the reader's part, for Dickens tells us as plainly as possible that Datchery is *some* detective, though assuredly not an ordinary detective, as H. E. opines. If the character of Datchery is "an assumption," and Dickens spoke of it as such to Mr. Forster and to Miss Hogarth, then apart from all other evidence Datchery *cannot* be a professional detective; and if the "finding out who and what Mr. Datchery was" be important to the elucidation of the mystery, Datchery cannot be Buzzard, the only other character in the story who could *possibly* have assumed the part, except Edwin Drood himself. H. E., I see, rejects as I do the idea that Datchery is Buzzard; and I may remark on this point that any one who could suppose for a moment that Buzzard is Datchery would show such an utter want of appreciation of Dickens's manner and methods, that it would be idle to deal with him by reasoning. Datchery and Buzzard are made by Dickens to be altogether different *men*: Datchery and Drood are made by him to be as unlike as possible in all outside features; and as the great trial through which he had passed would necessarily have changed Drood much in character, Dickens has endeavoured to make Datchery and Drood unlike in manner; but they are as obviously the same *men*, as Hamlet after he has seen his father's ghost is the same as the Hamlet of earlier scenes. There is a quaint humour in Datchery which is seen in Drood and Drood only of all the characters of the story. There is a kindness to old folk and to children, and a power of understanding their ways, which is shown only in Drood (and is in words attributed to him, besides being indicated in action); and lastly there is a wistfulness associated with Datchery's humorous manner which Drood alone of all the characters in the opening part of the story had shown. So that Datchery being by Dickens's own statement an "assumption," could be no other than Drood, even if Dickens had said in so many words that Drood was dead (which in his earlier manner, he would not have hesitated to do, explaining afterwards how that meant only that he was dead in men's thoughts). But it will be noticed that Drood is never once spoken of as dead, either by the author, or by Grewgious, or by Rosa. We have passages suggestive of death, both before and after the attempted murder. We are told that "he never called Rosa Pussy more, never again." Again, after we are told he purposed never to return to Cloisterham, come the words, "Poor youth! poor youth!" and so forth, just as Dickens says that "no such being as Richard Doubledick remained in the world of consciousness," that Vendale's "heart had ceased to beat," and so forth. He does all he can to suggest that the murder has been successful, and lets us know, in fact, that Jasper is full sure it has been successful (and surely Jasper ought to know); but he had been just as careful to impress on his readers the belief that Jonas Chuzzlewit had been successful in murdering Anthony Chuzzlewit, and he lets us know that Jonas was full sure he had been successful; yet neither in one case nor in the other had the murderer's plot succeeded, as he imagined.

With regard to the terrible grief which H. E. considers that Drood unnecessarily caused Rosa, he will find if he reads the story attentively the most remarkable avoidance of any words suggestive that Rosa suffered such grief as she

* It will be found that the greater part of the reasoning presented in this and the following papers on the subject of Dickens's last story is independent of the evidence—itself I think convincing—advanced in the above-mentioned article.

would certainly have felt had Drood been really dead. There is not a word implying that she thinks Drood is dead. And this is so much the stranger that Dickens draws so close, again and again, to occasions for speaking of Rosa's sorrow for Drood. She speaks of Drood to Jasper in the past tense; but that of course she would be bound to do. We hear of her sorrow for Drood in connection with her growing love for Tartar,—and this would be natural whether she thought Drood dead or alive, (but much more natural if, supposing Drood alive, she was sad at the thought that he might still love her though their engagement had been broken off.)—T. F.

But now for what seems to me most obviously to be the course of the story up to the time when its author's pen fell from his hand, and (in general outline only, of course) its intended course thereafter.

Before the attempted murder, the points to be specially noted are these:—

First, the way in which Jasper has arranged for the disposal of Drood's body after the murder. We see him arranging a meeting with Japsea and Durdles, in such a way that all he may do in the way of using Durdles' knowledge may seem to have been suggested by Japsea. (The three wine-glasses, and what is said of them, should be specially noticed.) At this meeting again Jasper cleverly uses his musical knowledge to obtain a means of identifying the various keys carried by Durdles,—a means which neither Durdles nor Japsea would suspect, but Durdles notes (without at the time understanding) what he is doing. He repeats his tone-test soon after, in company with Durdles only. Later, in the "surely unaccountable expedition," we see how Jasper applies the knowledge thus obtained. He drugs the wine which he knows Durdles will drain to the last drop, and when Durdles sinks to sleep, he takes the keys, clinks them again, and in the long hours at his disposal (for the "murmur of the tide of life" is still heard when they enter the Precincts, and it is two o'clock when Durdles at length wakes) he takes impressions of the keys, collects quicklime within the Japsea tomb, and prepares generally for the crime he has planned. That he has been outside is shown, after the author's manner, by his wrath with the Deputy (wrath so fierce that "he seemed like a devil") because "he followed us here to-night" and "has been prowling near us ever since," which would not have mattered had Jasper remained inside the crypt while Durdles slept.

Secondly, we are to note the sadness felt by Drood after his parting with Rosa. Much of the significance of Datchery's conduct later is lost if we overlook this feeling on Drood's part. That it had an important bearing on the later progress of the story, and was meant to be most carefully noted by the more thoughtful and understanding readers, is obvious to all who know Dickens's manner. Follow what Dickens says here, noting that his first words about Drood in the chapter most significantly headed When will these three meet again? (showing clearly that Neville, Drood, and Jasper *were* to meet again): "Edwin Drood passed a solitary day. Something of deeper moment than he had thought, has gone out of his life; and in the silence of his own chamber he wept for it last night . . . the pretty little affectionate creature, so much firmer and wiser than he had supposed occupies the stronghold of his mind. It is with some misgiving of his own unworthiness that he thinks of her, and of what they might have been to one another, if he had been more in earnest some time ago; if he had set a higher value on her; if instead of accepting his lot in life as an inheritance of course, he had studied the right way to its appreciation and enhancement." . . . . Then later,—"He strolls about and about, to pass the time. . . . . It somehow happens that Cloisterham seems reproachful to him to-day; has fault to find with him, as if he had not used it well; but is far more pensive with him than angry. His wonted carelessness is replaced by a wistful looking at and dwelling upon, all the old landmarks. He will soon be far away, and may never see them again, he thinks. Poor youth! Poor youth!"—Later yet,—"Always kindly, but moved to be unusually kind this evening, and having bestowed kind words on most of the children and aged people he has met, he bends down" to the old opium eater, and speaks to her. The conversation should be most carefully followed and compared with the later conversation between the same old woman and Datchery. I could as readily doubt that the same person speaks to her on both these occasions, as I could doubt whether the Moonlight Sonata and the Sonata Pathetique came from the same composer. Apart, however, from the words and manner of Drood and Datchery, consider what is said about them. Compare the words quoted above with these:—"Mr. Datchery pauses as if he were falling into a brown study and couldn't bear to part with"—something—"but he bestows" his gift on the old woman (who is then so dull as to imagine that it is of *this* he is thinking?), "as if he were abstracting his mind from the sacrifice. . . . . John Jasper's lamp is kindled, and his lighthouse is shining when Mr. Datchery returns alone towards it. As mariners, on a dangerous voyage, approaching an iron-bound coast, may look along the beams of the warning light to the haven lying beyond it that may never be reached, so Mr. Datchery's wistful gaze is directed to this beacon, and beyond." Compare the two following few words alone, if the music of each full passage is not easily caught:—

Of Drood, we read,—"*His wonted carelessness is replaced by a wistful looking at and dwelling upon all the old landmarks: he will soon be far away, and may never see them again, he thinks.*"

Of Datchery,—"*As mariners look along the beams of the warning light to the haven lying beyond it that may never be reached, his wistful gaze is directed to this beacon and beyond.*"

That this resemblance, or rather this oneness of tone should have escaped notice I can understand; but that any one whose attention has once been directed to it can fail to see that Drood and Datchery are one, seems to me scarce conceivable. I certainly cannot imagine how any one could suppose the later words applied to a detective employed by Grewgious, or to the stupid and selfish Buzzard.

(*To be continued.*)

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE BOTTOM (*continued*).

The water scorpions are aquatic during the whole of their lives, but the insects we have now to consider pass only their earlier stages in the water, being inhabitants of the air when they have reached the perfect, or imago, form; indeed, the bottom of the pond is, as a rule, much more the theatre of larval than of imaginal life. As we have before intimated, beetles and bugs are almost the only kinds of insects that are strictly aquatic when adult.

We will first take the larvæ of the dragon-flies. The perfect insects, which are sometimes also called horse-stingers, and in Scotland go by the name of "devil's darning-needles," and in America by that of "mosquito hawks," will detain us later on, when we speak of the fauna of the aerial regions just above the pond. Suffice it here to say, that they have four large glassy-looking wings, reticulated with a multitude of nervures, and usually a long, slender body, which has suggested to our Highland brethren the diabolical connection above mentioned. For brilliancy of coloration they easily take a prominent position in the insect world; but their beauty pertains wholly to the adult form. In their aquatic stages they are the dingiest of the dingy, and in many cases are hideously ugly. When you have brought yourself to perform the disagreeable task of hauling out of a dirty pond a mass of slimy weeds and fetid mud, and have deposited it on the bank, you see the mass here and there heaving with the struggles of these ugly brutes as they gradually work their way into daylight and drag their grimy bodies out of the tenacious and unsavoury mess. What a contrast between this sordid life and the gay and brilliant existence of the shiny-winged adult, as it dashes about, glistening in the sunbeams! There are two principal types of these larvæ; one a broad, thickset, clumsy creature, which yields the larger and stouter-bodied dragon-flies, the other slender and carrying some leaf-like appendages at the tail, the immature condition of the most slender and graceful members of the group. Taking first the former of these (Fig. 1), we see a creature with six

Fig. 1.—Larva of Dragon Fly.

straggling legs, which, sprawling out at the sides, would, were it not for their number, be strongly suggestive of affinities to the spider class. The head, when viewed from above, is surprisingly like that of a kitten, the prominent ears of the latter being represented by the equally prominent eyes of the insect; the two short antennæ, too, are suggestive of the kitten's whiskers. Then comes the thorax, with curious ridges like rough bark, and carrying the six sprawling legs and the rudimentary wings, and then the abdomen, broadest a little behind the middle, and exhibiting, especially in its hinder part, periodical contractions and dilatations, the length being lessened at the expense of the breadth. This motion, as might be expected, is a respiratory one. The breathing is performed in a manner as wonderful as it is unique. It is most marvellous what a variety of contrivances there are to enable aquatic insects to perform this important function; we have already referred to the diving-bell arrangement of the water-beetles, the anal spiracle of some of their larvæ, and the lateral leaf-like appendages of others, the long tail-filaments of the water scorpions, and the feathery stars and tubes of the gnat larvæ and pupæ, and now we come to an arrangement totally distinct from all of these. At the extremity of the body there are some stout, spine-like processes, surrounding the terminal orifice of the digestive tube, which is guarded by a valvular apparatus. By muscular effort these spines, which are movable at their base, can be opened out like the parts of a wire egg-whisk, the capacity of the abdomen being at the same time increased; the valves are thus opened, and water rushes in and fills the terminal part of the intestinal canal, and after remaining there a short time, is forcibly ejected by a reversal of these operations. The lining of the last part of the intestine is produced into six double series of folds, whereby its surface is enormously increased. In the interior of these thin folds, great numbers of minute tracheal tubes are distributed. The water, of course, as usual, contains air dissolved in it; and, as it passes over these tracheal tubes, the fresh air with which it is charged can be exchanged for the contaminated supply contained in the tubes, by simple transfusion of the gases through the thin walls of these. As soon as this has been effected, the now useless water is got rid of in the manner above described, but its expulsion frequently serves the additional purpose of effecting locomotion. When the insect is calm and undisturbed, the water is passed out gently, but should it be disturbed or alarmed, a forcible ejection of the liquid follows, and just as a rocket mounts in the air while the gases into which its contents are being transformed by the process of combustion, rush out in the other direction, so the larval dragon-fly is shot swiftly forward as the jet passes out from behind. The jet can be readily observed: if there are particles of matter in suspension in the water, their movements as they are carried along with the stream make the current perceptible; or if the creatures are in a shallow vessel with only just enough water to cover them, the surface will be seen to be violently disturbed at every expiration. The force with which the water can be projected is quite surprising; the most astonishing record comes from over the sea. A lady states in the *American Naturalist* that a larva of a large species, when disturbed, sent out a fine stream of water to the distance of from two to three feet, and continued doing so indefinitely!

These curious beings then progress by a series of jerks or leaps, though, of course, they can crawl as well. Some kinds while jerking themselves forward, assist their efforts by a sharp backward stroke of the legs (though these are not modified for swimming purposes), and finish the stroke by bringing the legs close alongside the body, an action by no means inelegant.

The more slender kinds have an elongated body, which they can move pretty vigorously from side to side as a fish does its tail. They have also three external leaf-like appendages at the tail, which are thin, and are each supplied with a tracheal tube and its branches, the exchange of gases taking place here externally in the same way as in the others internally. These caudal leaves, too, are used to assist locomotion.

But we have yet to consider one of the most remarkable peculiarities of these creatures. If we take a front view of the head, we see the lower part of the face rounded and smooth, with a vertical zigzag line down the centre, and showing no traces of great jaws such as one would expect in so voracious an insect. This is simply because they are concealed by a very curious modification of that part of the mouth which, in insects generally, is called the labium, or lower lip. To examine this structure it is best to take a freshly-killed specimen; this is easily obtained by plunging the creature into *boiling* water, which produces instantaneous death. By aid of a pin or needle we can now easily open out the "mask," as it is called (Fig. 2), and when fully extended, we see that it looks something like a broad-handled ladle, attached by the handle underneath the head. It consists of several joints, the basal one of which is attached to the lower part of the head, or, as we might say, under the chin. Succeeding this is another piece, at the outer angles of which are attached two curved triangular jaw-like pieces articulated to it by one of their angles, and capable of folding inwards till their saw-like edges exactly meet, when the front part of the apparatus forms the bowl of the ladle. When closed, the basal joint is bent backwards, showing as a bluntly-pointed projection, reaching to the base of the

Fig. 2.—Mask of Dragon Fly. *a.* Side View. *b.* Viewed from Above. *c.* The Same, with Jaws Open.

second pair of legs; the next piece is folded back upon this, and the bowl-like part is thus brought close up to the face, which fits into the hollow. When the mask is extended, the real jaws are seen beneath in the usual position. The mask is used somewhat like the raptorial legs of the water-scorpions—viz., to seize a passing insect at a little distance. To accomplish this, it is very rapidly unfolded, darted out with unerring aim, and brought back again into position, thus holding the prey close up to the true jaws.

Dragon-flies do not alter much during their earlier stages. The traces of wings soon appear, even after the first moult or two. When a moult is about to take place, the creature fixes its claws into some support to obtain leverage for its coming struggle, and then, by strong muscular effort, the back of the thorax is split, and the insect crawls out of its case. The cast skins may frequently be seen floating about in ponds. The insects are very voracious, and when other food fails, will not scruple to adopt cannibalism.

(To be continued.)

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XLII.—STIMULANTS AND CONDIMENTS.

Before proceeding further, I must fulfil the promise made in No. 39 to report the results of my repetition of the Indian process of preparing *samp*. I soaked some ordinary Indian corn in a solution of carbonate of potash, exceeding the ten or twelve hours specified by Count Rumford. The external coat was not removed even after two days' soaking, but the corns were much swollen and softened. I suspect that this difference is due to the condition of the corn which is imported here. It is fully ripened, dried, and hardened, while that used by the Indians was probably fresh gathered, barely ripe, and much softer.

Mr. Gaubert (No. 1,373, page 185) asks me whether I think that tea taken in moderation (say two cups in the evening) does any mischief. If he carefully reads No. 40 he will find the answer already given before his question was asked. He offers to relinquish the habit, in spite of the pang, "on the advice of so eminent an authority" as myself. I hope that he will not be so weak as to accept my authority or any other on a question which can easily be answered by common-sense and simple direct experiment. There are cases in which we are compelled to lean on authority, but this is not one of them, and he will see, by re-perusing what I have written on the subject, that I have repudiated mere authority, and appealed to facts that are open to all.

I will reply further to Mr. Gaubert, as in doing so I shall be also replying to a multitude of others, his case being typical. Let any of these repeat the experiment that I have made. After establishing the habit of taking tea at a particular hour, suddenly relinquish it altogether. The result will be more or less unpleasant, in some cases seriously so. My symptoms were a dull headache and intellectual sluggishness during the remainder of the day—and if compelled to do any brain-work, such as lecturing or writing, I did it badly. This, as I have already said, is the diseased condition induced by the habit. These symptoms vary with the amount of the customary indulgence and the temperament of the individual. A rough, lumbering, insensible navvy may drink a quart or two of tea, or a few gallons of beer, or several quarterns of gin, with but small results of any kind. I know an omnibus-driver who makes seven double journeys daily, and his "reglars" are half-a-quartern of gin at each terminus —*i.e.*, $1\frac{3}{4}$ pints daily, exclusive of extras. This would render most men helplessly drunk, but he is never drunk, and drives well and safely.

Assuming, then, that the experimenter has taken sufficient daily tea to have a sensible effect, he will suffer on leaving it off. Let him persevere in the discontinuance, in spite of brain languor and dull headache. He will find that day by day the languor will diminish, and in the course of time (about a fortnight or three weeks in any case) he will be weaned. He will retain from morning to night the full, free, and steady use of all his faculties; will get through his day's work without any fluctuation of working ability (provided, of course, no other stimulant is used). Instead of his best faculties being dependent on a drug for their awakening, he will be in the condition of true manhood—*i.e.*, able to do his best in any direction of effort, simply in reply to moral demand; able to do whatever is right and advantageous, simply because his reason shows that it is so. The sense of duty is to such a free man the only stimulus demanded for calling forth his uttermost energies.

If he again returns to his habitual tea, he will again be reduced to more or less of dependence upon it. This condition of dependence is a state of disease precisely analogous to that which is induced by opium and other drugs that operate by temporary abnormal cerebral exaltation. The pleasurable sensations enjoyed by the opium-eater or smoker or morphia injector are more intense than those of the tea-drinker. Mr. Gaubert tells us that he enjoys his cup "immensely." The gin-drinker enjoys his half-quartern "immensely," as anybody may see by "standing treat" and watching the result. The victim of opium has enjoyment still more immense, and in every case the magnitude of the mischief is measurable by the immensity of the enjoyment.

Again I say that I am not denouncing the proper use of any of these things. There are occasions when artificial stimulants or sedatives cautiously used are most desirable. My condemnation is applied to their *habitual* use, and the physical and moral degradation involved in the slavish dependence upon any sort of drug, especially when the drug operates most powerfully on the brain. To the brain-worker tea is worse than alcohol, because it exaggerates his special liability to overstrain. I can detect by physiognomical indications the habitually-excessive tea-drinker as readily as I can detect the physiognomy of the opium-victim, as may anybody else who chooses to make careful observations.

I must not leave this subject without a word or two in reference to a widely prevailing and very mischievous fallacy. Many argue and actually believe that because a given drug has great efficiency in curing disease, it must do good if taken under ordinary conditions of health.

No high authorities are demanded for the refutation of this. A little common sense properly used is quite sufficient. It is evident that a medicine, properly so-called, is something which is capable of producing a disturbing or alterative effect on the body generally or some particular organ. The skill of the physician consists in so applying this disturbing agency as to produce an alteration of the state of disease, a direct conversion of the state of disease to a state of health, if possible (which is rarely the case), or more usually the conversion of one state of disease into another of milder character. But, when we are in a state of sound health, any such disturbance or alteration must be a change for the worse, must throw us out of health to an extent proportionate to the potency of the drug.

I might illustrate this by a multitude of familiar examples, but they would carry me too far away from my proper subject. There is, however, one class of such remedies which are directly connected with the chemistry of cookery. I refer to the condiments that act as "tonics," excluding common salt, which is an article of food, though often miscalled a condiment. It is food simply because it supplies the blood with one of its normal and necessary constituents, chloride of sodium, without which we cannot live. A certain quantity of it exists in most of our ordinary food, but not always sufficient.

Cayenne pepper may be selected as a typical example of a condiment properly so called. Mustard is a food and condiment combined; this is the case with some others. Curry powders are mixtures of very potent condiments with more or less of farinaceous materials, and sulphur compounds, which, like the oil of mustard, of onions, garlic, &c., may have a certain amount of nutritive value.

The mere condiment is a stimulating drug that does its work directly upon the inner lining of the stomach, by exciting it to increased and abnormal activity. A dyspeptic may obtain immediate relief by using cayenne pepper. Among the advertised patent medicines is a pill bearing the very ominous name of its compounder, the active constituent of which is cayenne. Great relief and temporary comfort is commonly obtained by using it as a "dinner pill." If thus used only as a temporary remedy for an acute and temporary, or exceptional, attack of indigestion all is well, but the cayenne, whether taken in pills or dusted over the food or stewed with it in curries or any otherwise, is one of the most cruel of slow poisons when taken *habitually*. Thousands of poor wretches are crawling miserably towards their graves, the victims of the multitude of maladies of both mind and body that are connected with chronic, incurable dyspepsia, all brought about by the habitual use of cayenne and its condimental cousins.

The usual history of these victims is that they began by over-feeding, took the condiment to force the stomach to do more than its healthful amount of work, using but a little at first. Then the stomach became tolerant of this little, and demanded more; then more, and more, and more, until at last inflammation, ulceration, torpidity, and finally the death of the digestive powers, accompanied with all that long train of miseries to which I have referred. India is their special fatherland. Englishmen, accustomed to an active life at home, and a climate demanding much food fuel for the maintenance of animal heat, go to India, crammed, may be, with Latin, but ignorant of the laws of health; cheap servants promote indolence, tropical heat diminishes respiratory oxidation, and the appetite naturally fails. Instead of understanding this failure as an admonition to take smaller quantities of food, or food of less nutritive value, they regard it as a symptom of ill-health, and take curries, bitter ale, and other tonics or appetising condiments, which, however mischievous in England, are far more so there.

I know several men who have lived rationally in India, and they all agree that the climate is especially favourable to longevity, provided bitter beer, and all other alcoholic drinks, all peppery condiments, and flesh foods are avoided. The most remarkable example of vigorous old age I have ever met was a retired colonel eighty-two years of age, who had risen from the ranks, and had been fifty-five years in India without furlough; drank no alcohol during that period; was a vegetarian in India, though not so in his native land. I guessed his age to be somewhere about sixty. He was a Scotchman, and an ardent student of the works of both George and Dr. Andrew Combe.

While still seasonable I add by way of postscript a receipt for a dish lately invented by my wife. It is vegetable marrow *au gratin*, prepared by simply boiling the vegetable as usual, slicing it, placing the slices in a dish, covering them with grated cheese, and then browning slightly in an oven or before the fire, as in preparing the well-known "cauliflower *au gratin*." I have modified this (with improvement, I believe) by mashing the boiled marrow and stirring the grated cheese into the midst of it whilst as hot as possible; or, better still, by adding a little milk, a pinch of bicarbonate of potash, mixing with the cheese, and then returning this purée to the saucepan, heating and stirring it there for a few minutes to effect the complete solution of the cheese. This dish is not so pretty as that *au gratin* browned in orthodox fashion, but is more digestible.

SHIPS' LIGHTS.

THE following extract from the New Regulations for Preventing Collisions at Sea, which came into force on the 1st inst. (and for which we are indebted to Captain D. Forbes, of Southampton), may be read in connection with letter 1375 (p. 185):—

A ship, whether a steam ship or a sailing ship, employed in laying or in picking up a telegraph cable, shall at night carry in the same position as the white light which steam ships are required to carry, and, if a steam ship, in place of that light, three lights in globular lanterns, each not less than 10-in. in diameter, in a vertical line over one another, not less than 6 ft. apart; the highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character that the red lights shall be visible at the same distance as the white light. By day she shall carry in a vertical line, one over the other, not less than 6 ft. apart, in front of but not lower than her foremast head, three shapes, not less than 2 ft. in diameter, of which the top and bottom shall be globular in shape and red in colour, and the middle-one diamond in shape and white.

The following portion of this article applies only to fishing vessels and boats when in the sea off the coast of Europe lying north of Cape Finisterre:—

(*a*) All fishing vessels and fishing boats of 20 tons net registered tonnage, or upwards, when under way and when not required by the following regulations in this article to carry and show the lights therein named, shall carry and show the same lights as other vessels under way.

(*b*) All vessels when engaged in fishing with drift nets shall exhibit two white lights from any part of the vessel where they can be best seen. Such lights shall be placed so that the vertical distance between shall be not less than 6 ft. and not more than 10 ft.; and so that the horizontal distance between them measured in a line with the keel of the vessel shall be not less than 5 ft. and not more than 10 ft. The lowest of these two lights shall be the more forward, and both of them shall be of such a character, and contained in lanterns of such construction, as to show all round the horizon, on a dark night with a clear atmosphere, for a distance of not less than three miles.

(c) A vessel employed in line fishing with her lines out shall carry the same lights as a vessel when engaged in fishing with drift nets.

(d) If a vessel when fishing becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she shall show the light and make the fog signal for a vessel at anchor.

(e) Fishing vessels and open boats may at any time use a flare-up in addition to the lights which they are by this Article required to carry and show. All flare-up lights exhibited by a vessel when trawling, dredging, or fishing with any kind of drag net, shall be shown at the after part of the vessel, excepting that, if the vessel is hanging by the stern to her trawl, dredge, or drag net, they shall be exhibited from the bow.

(f) Every fishing vessel and every open boat when at anchor between sunset and sunrise shall exhibit a white light visible all round the horizon at a distance of at least one mile.

(g) In fog, mist, or falling snow, a drift net vessel attached to her nets, and a vessel when trawling, dredging, or fishing with any kind of drag net, and a vessel employed in line fishing with her lines out, shall, at intervals of not more than two minutes, make a blast with her fog horn and ring her bell alternately.

A ship which is being overtaken by another shall show from her stern to such last-mentioned ship a white light or a flare-up light.

An "Officer of the Watch," writing to the *Times*, says:—

"In the June number of the *Nautical Magazine*, a letter appeared pointing out the necessity of screening all lights about the decks of ships at sea, except those which are required by the Board of Trade for the prevention of collision, and stating that the Board of Trade surveyors would do well to see that the proper means were at hand for so doing, as the chances of collision would be thereby diminished. On my last homeward passage, in the Bay of Biscay, a large outward-bound steamer was passed between 8 and 10 o'clock one night on our starboard side, and so great was the glare from the lights in her deck saloon (which I took to be lighted by electricity) that her green light was completely outshone, and could not be seen, though well within the range of visibility. I should venture to say that, from the size and speed of the ship, she belonged to one of the finest lines of steamers running, and it seems to me rather strange that those in authority in the managing departments of large steamship companies are not alive to what might be a very fruitful source of collision. Had dense smoke obscured the masthead light of this steamer, the direction in which she was travelling would have been left to conjecture."

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER IV. (*continued from page 196.*)

Of all parts of the earth's surface the Equator is that where the evidences of the real nature of the earth's relations to surrounding space are most convincing. I think it probable that to many of my readers an account of the nature of the diurnal rotation of the heavens, as witnessed from the Equator, may be at once new and interesting.

The north pole, as I have mentioned, has sunk to the horizon when our voyager reaches the equator. Another pole, whose existence had hitherto only been indicated, is now raised from beneath the southern horizon, and lies directly opposite the northern pole. Thus a circle carried from the east point of the horizon through the point vertically overhead, and so down to the western horizon, divides the visible heavens into a northern and a southern half, the motions within one half corresponding exactly to the motions within the other.

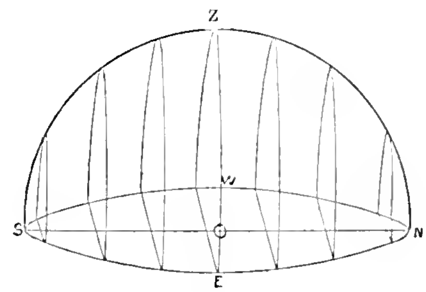

Fig. 1.

In Fig. 1, let O represent the station of the observer, E, S, W, and N, the east, south, west, and north points of his horizon, Z the point overhead, then E Z W represents the course of a star which rises in the east, and the other curves represent the course of stars rising towards the south and north of east. Every star rises straight up from the horizon, and sets equally square to it. Every star, too, is above the horizon, while describing exactly half of its visible course. Further, as the sun is also visible above the horizon while traversing one-half of its diurnal circle—in other words, as night and day are equal — every star which is visible when the sun sets has passed to the west and set there before the sun rises again; and every star invisible when the sun set, makes its appearance above the eastern horizon before the sun rises. In other words, *all the stars upon the sphere of the heavens become visible in the course of a single clear night at any place upon the Equator.** So that the observer can no longer feel any doubt that the earth is limited in all directions beneath the horizon.

Let us consider, then, what our observer has already learned respecting the earth's figure. We shall see that he has obtained enough information to suggest very definite views about the dimensions of the globe on which he has travelled.

His first station was at A (Fig. 2). He travelled northwards to B, and afterwards southwards to C, establishing by the most indisputable evidence the fact that the arc B C is circular, and that the distance of any point upon it from O, the centre of the circle to which the arc belongs, is

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* After carefully considering the appearances thus presented to the observer situated on the Equator, and recognising the convincing evidence these appearances give respecting the true character of the diurnal rotation, the reader can conceive the indignation with which many gallant naval officers who had often crossed the Equator heard one of the paradoxists lecture at Plymouth to the effect that there is only one pole of the heavens around which all the stars circulate in places parallel to the plane surface of the earth. The lecturer, who was as well aware as they were of the absurdity of his views, succeeded in convincing the simpler among his audience, by asserting that in a particular number of the *Times* which he quoted, it was mentioned in the "Naval and Military Intelligence," that a certain naval officer had seen the pole star from the Tropic of Capricorn (23½ degrees south of the Equator). It was in vain for intelligent persons present to assert that this could not be. The lecturer insisted that it was so, and for some time after he left Plymouth, many were actually persuaded that the earth is plane. At length some one was at the pains to turn over the volumes of the *Times* in the Plymouth Library, and then it turned out (as was to have been expected), that the ship from which the pole star had been seen (the fact was merely mentioned as part of log observations), had been indeed 23½ degrees from the equator, *but to the north instead of the south!*

somewhat less than 1,000 miles. He is now at C, and he learns that in all directions beneath the horizon the earth is limited, because he has proved on indisputable evidence that the stars pass round and beneath the earth, and come up again on the opposite side. He cannot as yet be certain what the shape of the unvisited part of the earth may be, and for aught he knows the section he has found uniformly curved along B C may elsewhere be as irregular as the broken curve shown in the figure. But he is far more likely to believe that in reality this section has a uniform figure either perfectly or very nearly circular.

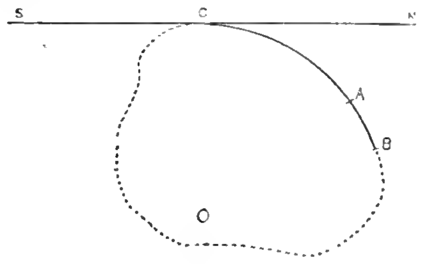


Fig. 2.

Continuing his journey southwards, our observer finds that the north pole of the heavens passes below the horizon, the south pole rising; and now precisely the same rotations which he had observed respecting the North Pole and the motions of the stars around the polar axis, are presented in the southern heavens. As he advances the south pole rises *uniformly*—a relation which, as in the case of the North Pole, shows that he is travelling along a circular arc. He sees the apparent stellar motions continuing as uniformly as before. In fact, the only specific difference in the southern skies consists in the fact that the celestial bodies appear to turn in a contrary direction. This circumstance is noticed in the pages of old Herodotus, who mentions (with some doubt whether it may not be a yarn) that seamen who had passed far southward along the shores of Africa, stated that the sun appeared to move from right to left, instead of from left to right, as with us.

We, of course, who have followed the steps of our observer, as he has progressed southwards, can at once understand why the heavens should seem to move a different way round the pole, and why the sun, as he ascends towards the *north*, appears to travel from right to left, whereas when he ascended from the east towards the *south*, he appeared to travel from left to right. We know that the observer in the southern hemisphere who faces the sun when that luminary is at his highest, and the observer in the northern hemisphere who does likewise are *facing each other*, so that a motion which is from right to left, as seen by one, is from left to right as seen by the other.

(*To be continued.*)

BRITISH SEASIDE RESORTS,

FROM AN UNCONVENTIONAL POINT OF VIEW.

BY PERCY RUSSELL.

IV.

THE Isle of Man is, in some respects, the most remarkable of all the islands of England and Wales, and from Snaefell, the highest of its rugged but majestic mountains, there may be had one of the most splendid panoramic views in all the British isles. Thence, indeed, is commanded at once a distinct panoramic view of a very considerable extent of the coasts of England, Wales, Ireland, and Scotland. That noble estuary the Solway, hallowed by so many legendary and historic associations—Ailsa Crag, the famous Mull of Galloway, and the wild mountains of the vicinity are all prominent features, and compose a scene that can hardly be surpassed for beauty and boldness of land and seascape anywhere. The length of the Isle of Man is $33\frac{1}{4}$ miles, the breadth about $12\frac{1}{2}$, thus bringing every portion within easy pedestrian reach of the sea, and the area is generally computed at 145,325 acres, of which full 50,000 remain virtually in a state of nature. The Calf of Man is a small islet at the south-west extremity, containing only about 800 acres of surface. A chain of veritable mountains extends from north-east to south-west, Snaefell, the highest, being 2,024 ft. above the sea-level. The general scenery is rich in variety, such as most delights the landscape-painter. There are numerous picturesque glens, which seem expressly made for the still life of poetry or romance, and rich undulating tracts of cultivated country, and in fine weather, such a clear atmosphere that the very cornfields when in their full golden glow can be distinctly seen on the adjacent shores. Many beautiful streams rush down from the mountains, and in some of these are excellent salmon-trout, although I am sorry to say that washings from the lead-mines in the interior have in many cases quite destroyed the fish.

Some parts of the interior are boggy, but the glens separating the numerous hills and mountains are frequently wooded with beautiful beech-trees and elder, and the numerous mountain torrents, ending often in beautiful waterfalls, impart a strange charm to the varied landscape. Most of the villages, farm-houses, and churches are embowered in trees, and, for soft rural beauty, the interior of this remarkable island leaves nothing to be desired. The coast is, in many places, of ineffable grandeur, and some of the most formidable precipices are in the immediate neighbourhood of the wild loneliness of harbours, shelving shores, and villages framed in woods, and presenting everywhere quite a material presentment of true pastoral poetry.

Douglas, deriving its name from being at the junction of two streams—the Dhoo (black), and Glass (grey)—lies on the edge of a very picturesque bay. Castle Mona, once the residence of a Duke of Athol, is now a good hotel, and another conspicuous landmark is the Tower of Refuge, built on a rock, for the benefit of shipwrecked seamen. The ancient town is interesting in its narrow streets, but there are comparatively modern marine residences in the recently-built portion, and not only is the living cheap, but the bathing is remarkably good, and the water is singularly free from mud, seaweed, or even shells. The coast north of Douglas is highly precipitous, and what gives beautiful colour in summer to the scenery, is often green with foliage almost to the water's edge. The striking promontory of St. Maughold's Head should be noticed. The well-known town of Peel, formerly called Holm, is remarkable, *inter alia*, for its grotesque and romantic caverns, which resemble nothing so much as sundry of Victor Hugo's poetic flights into the region of the terrible made visible. A small river enters the sea at Peel, and thence once on a time Manx salmon was exported. South of Peel is Brada Head, a truly stupendous pile of black rocks, somewhat like those which give to Spanish Head, close to the Calf of Man, such an imposing appearance. The lead-mines often run here close to the sea, as in Cornwall. The Spanish Headland is very grand, and the masses of rocks off the coast look like piles of huge timbers or regular blocks of masonry all laid ready for rearing some colossal structure, while the prevailing blackness of the cliffs imparts a grim and stern character to what is certainly remarkable scenery.

But to return. One of the great attractions of Peel is, of course, its terrible castle, once the frequent residence and long the formidable fortress of those Lords of Man, the Earls of Derby. The prison vaults under the castle still exist, fearful mementos of what feudal imprisonment meant; and here Elinor Cobham, Duchess of Gloucester, was imprisoned for life. This place is also connected with the old Manx legend of a spectre dog, which it was a very serious matter indeed for any one to encounter. The fine ruins of the Cathedral of St. Germains, built 1245 A.D., should be examined, and the insulated rock on which these remain—Sodor—possesses permanent interest, being, like the historic Iona, the place whence the original savages of the islands first derived some of the lights—very broken they were, in truth—of mediæval knowledge. Sodor, as everybody knows, has puzzled etymologists considerably; some authorities declaring that it is simply derived from Sudureys, which would mean merely the Southern Hebrides, with which the Isle of Man was once associated.

Very great improvements have been effected of late years at the principal ports of the island, and particularly is this the case at Douglas.

I obtained recently some special information on this head from Sir Henry B. Loch, whose beneficent rule will long be remembered by the Manxmen, and who is now the Governor of Victoria, Australia. Sir Henry did much to advance the material progress of the island, and in improving the social and moral state of the people he was ably seconded by Lady Loch. In the space of five years only the tonnage entering Douglas was raised from a value of £100,000 to £500,000, and the splendid sea defence and docks constructed in the harbour are reckoned as among the largest examples of solid concrete at the greatest depth of water in the United Kingdom.

(To be continued.)

NOTES ON COAL.

By Richard A. Proctor.

It has become a question of serious import whether we may indeed look confidently for abundant supplies of coal during many future years, or whether those have been in the right who have told us that before the close of the present century this country must feel the effects of the over-rapid working of our chief coal-fields.

I propose briefly to sketch what is known about the origin of coal, and then to touch on the subject of the supply of this mineral, with special reference to the requirements of our own country.

A mistaken impression is somewhat widely prevalent that, in the coal-fields, we have the remains of ancient forests; in other words, it is supposed that, wherever there was a forest in primæval times, there now exists a coal-field of greater or less extent. In connection with this view, also, the opinion is entertained that the forests now in existence will, in process of time, and after due geological changes, become the coal-beds of future ages.

But although, as we shall presently see, the coal-fields are undoubtedly due to the vegetation of former eras, it is far from being the case that the primæval forests became converted in a general way into coal. Conditions of a peculiar, and to some extent exceptional, character were requisite for the formation of coal-fields. If we consider the evidence given by the coal-fields themselves, we shall see what these conditions were.

The beds or seams of coal form but a small portion of the thickness of the great geological group of strata to which they for the most part appertain. This group is called the *carboniferous*, and not uncommonly "The Coal"; but even where coal is most abundant, it forms only a minute part of the whole mass. Thus it has been estimated, Sir Charles Lyell tells us, that in South Wales the thickness of the carboniferous strata amounts in all to between 11,000 and 12,000 feet (or more than two miles);* "but the various coal-seams do not," according to Professor Phillips, "exceed in the aggregate 120 feet," or little more than one-hundreth part of the whole. In North Lancashire the carboniferous strata occupy a depth of more than three and a half miles, with the same relative disproportion between the thickness of the coal-seams and that of the complete series of strata. Again, in Nova Scotia the coal-bearing strata attain a thickness of more than three miles.† Here no fewer than eighty seams of coal have been counted (seventy-one having been exposed by the action of the sea); but these seams are nowhere more than five feet in thickness, and many are but a few inches thick. Thus it is evident that the formation of coal can have been in progress but for a short portion of the time during which the great carboniferous series of strata was in process of deposition. Throughout by far the greater portion of that time other minerals were being deposited.

It is next to be noticed that under each coal-seam a stratum of older soil exists, in which there are commonly found the roots of ancient trees; while above the coal there is commonly a layer of shale or sandstone, in which not unfrequently the trunks of those trees are found either fallen or still in their original position, and only partly converted into coal. The bark remains, but is transmuted into coal; the hollow of the trunk, decaying long before the trunk gave way, is represented by a *cast* in sandstone. Thus, if we try to picture to ourselves the state of things which existed when such a seam of coal first began to be covered up by the next higher deposit, we see that there must have been trees standing erect above a layer of vegetable matter, the roots of the trees being imbedded in the soil which forms the deposit next below the coal. The vegetable layers may probably have been two or three times as thick as the resulting coal-seam, and were reduced by pressure to their present thickness; but such layers cannot at any time have reached to the branches of the forest-trees. Then the process of deposition began. This can only have happened when some subsidence of the soil had caused it to be submerged to a greater or less depth. We can infer from the depth of the strata overlying the coal-seams that this state of submergence continued in many cases for a long period of time; and it is equally clear that the formation of the vegetable layers themselves must have been a process occupying a considerable time, since tall trees grew before the next submergence took place. So soon as submergence was complete, the tall trees perished and began to decay. The stout trunks above the vegetable layer were broken off and swept away by the

* It is, perhaps, hardly necessary to remark that this depth has not been measured anywhere in a vertical direction. The thickness of the several layers can be measured where they either crop out, or show at the surface, or else come within the range of mining operations; and thus the total depth of the series can be estimated.

† The way in which this has been made known is worthy of notice. In the Bay of Fundy the tides run to an enormous height. The tidal wave can be seen when it is still thirty miles away, advancing with a prodigious uproar, and rising sometimes to the height of more than a hundred feet. These tremendous waves have not only produced a continuous section ten miles long, through the inclined strata, but by their action they sweep away continually the whole face of the cliffs, and bring into view fresh sections year after year.

sea. The forest itself, properly so called, was for the most part thus destroyed. It was the decaying refuse of the forest, intermixed with the lowlier growths, which formed the coal-seam as it now exists. Amongst these were the lower parts of the trunks of the ancient forest-trees. These became converted, like the rest of the vegetable matter, into coal.

But it may be asked how those portions of the trunks which still remain above the level of the vegetable layer are to be accounted for. Are we to suppose that they remained erect after the sea had made its way into the domain of the ancient forest? Many geologists think so; and doubtless the stumps of stout trees might resist for a long time the action of the sea waves. But there seems good reason for believing that, when the submergence first took place, these stumps stood but little above the upper surface of the vegetable layer, or that in many instances the trees were broken off even below that level. Then, as the pressure of the superincumbent layer gradually increased with the layer's increase of thickness, the vegetable matter was pressed down below its former level, and the stumps were left standing above the depressed surface of the vegetable layer. This explains the conversion of the bark of these stumps into coal, since there is every reason to believe that stumps simply left imbedded in sandstone would not change into pure coal.

In passing, I may remark that in whatever way it happened that the stumps of the ancient forest-trees remained standing above the level of the vegetable mass forming the coal-seam, a strange result has followed. The upper part of the stem became filled, as I have said, with sandstone, forming a cast of the interior of the ancient tree; the bark became coal; and outside the bark is sandstone again. Thus there is a mass of sandstone separated from the surrounding sandstone by a tube of coal. This mass is not cylindrical, being larger below than above; so that if in any way the mass ceases to be supported, it falls like a bolt from a gun. But in working the coal-seam the material which had supported the sandstone mass is necessarily removed. Hence the miners look with dread on these coal-pipes, as they are called, which each year cause fatal accidents in the Newcastle and other coal-fields. As Sir Charles Lyell well remarks: "It is strange to reflect how many thousands of these trees fell originally in their native forests in obedience to the law of gravity, and how the few which continued to stand erect, obeying, after myriads of ages, the same force, are cast down to immolate their human victims."

(To be continued.)

NOVEL TRICYCLES.

By John Browning.

(Chairman of the London Tricycle Club.)

THE EMPEROR.

Having obtained one of these very novel machines, I took it to Reigate to give it a thorough trial. On mounting the machine, for the first few minutes' riding my course was somewhat erratic, showing that it requires a little practice in steering. The difficulty was soon surmounted, and I may say at once that the machine is certainly easier to steer that the Humber, and that with experience it is completely under control.

The method of applying the brake by means of the left foot is very peculiar, and at first a rider feels awkward in using it, but this feeling soon wears off. When running down a long hill with varying grades it seems difficult to vary the pressure of the brake with the foot; yet there is a simple method, as I discovered in my second ride, by which this may be done with the greatest delicacy.

Whenever the brake has to be applied continuously for some time, the left foot should be put on the brake-pedal just above the axle, and the right foot on the opposite, or right-hand side of the axle, then a slight lifting action of the *right* foot—that is, a slight decrease in the pressure of the right foot—will cause an increase of pressure on the left foot, and thus the brake can be applied as gently as any hand-lever brake, and the pressure regulated with as much nicety. I agree with Mr. Bennett, who tells me that he has ridden 1,500 miles on the Emperor, that it is desirable that the power of the brake should be increased for the steepest, that is, downright dangerous hills.

The Emperor is a good hill-climber. I have ridden the Woodhatch-hill, out of Reigate on to Earlswood-common, on a machine geared to 52 in., and that without practice and without strain. Some skill is undoubtedly required to ride the Emperor, but what it requires, more than skill, is confidence. It looks and feels a risky thing to do, to put your feet up on the axle when flying a hill, but it is tolerably easy and safe to do it, unless the hill is almost unrideably steep.

The machine is made with 42-in. side-wheels, geared to 52 in. The hind wheel, which is about 30 in. diameter, is the driving-wheel, and is driven by means of a chain. The machine is a front-steerer, both the front wheels moving with the axle for steering. It is, of course, a single driver, but I have not as yet found the driving-wheel slip, either on mud or dust, even when climbing hills. Some contrivance is required for tightening the chain when it becomes slack.

The Emperor can be mounted or dismounted either from the front or behind. I prefer to mount it behind from the pedal, and dismount from the front over the axle.

There is no fear of falling head first out of this machine when descending a hill, as, if the feet are in their proper place on the brake and axle, the rider has an open front before him, and can always come down on his feet.

If the Emperor were made about 5 lb. or 10 lb. lighter—and this might easily be done—and a little more brake power were given, the machine would, I think, take a good position, and soon be a favourite.

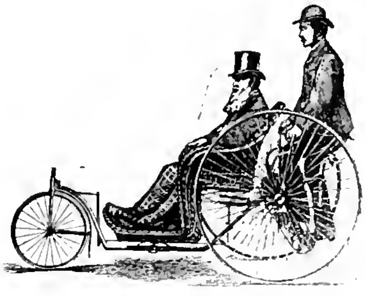
But as back-pedalling can only be performed with one foot, the brake on this machine is all important, and unless the brake-power on the hind driving-wheel can be increased—which I venture to doubt—it will be necessary to apply band-brakes to both the front wheels, which might be done readily by means of a hand-lever; and to this most riders would give the preference.

The Emperor may be obtained of Mr. Brooke Hitching, the tricycle agent of Ludgate-hill, E.C.

THE COVENTRY CHAIR.

A year or more ago I suggested in Knowledge that Sociable tricycles might be employed at country railway-stations to carry passengers and luggage.

Messrs. Starley & Sutton, the manufacturers of the Meteor and the Rover, have brought out a modified tricycle which they call the Coventry Chair. This is intended to supersede the present Bath Chair, which is now generally dragged along at a crawling pace of about two miles an hour at the utmost. The Coventry Chair can be driven easily at a pace of five or six miles an hour. The wheels have india-rubber tyres, and the chair is mounted on tricycle springs; the motion is therefore easy and pleasant. The engraving shows that the invalid sits on a light wicker chair, in front of and below the driver, who pedals behind him.



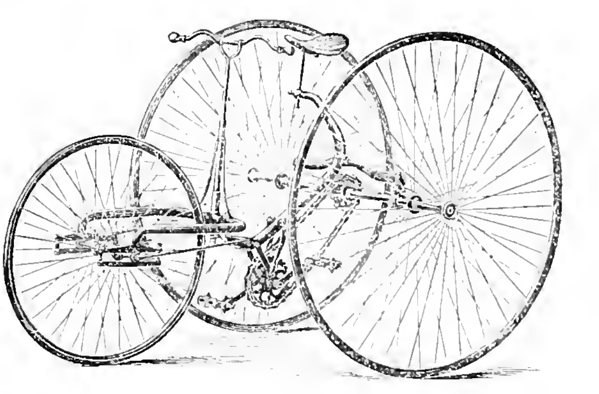
In a trial which recently took place of the Coventry Chair, an untrained workman, with a sitter weighing between eleven and twelve stone in the chair, drove from Coventry to Birmingham, and back—a distance of thirty-five miles—in four and three-quarter hours, including stoppages amounting to thirty-five minutes; the riding time was thus only four hours and ten minutes—a pace of between eight and nine miles per hour.

I expect very soon to see some Coventry Chairs in our sea-side watering-places, and wish the ingenious and spirited inventors success.

I cannot resist the opportunity of pointing out how this machine proves the accuracy of one of my so-called theories that a large amount of weight may be thrown upon the front steering-wheel of a tricycle with advantage.

THE NEW QUADRANT.

Messrs. Lloyd Bros. have kindly shown me a new front-steering Quadrant tricycle, of which I think highly. The machine is very light, weighing only 50 lb. with a brake. It has 40-in. driving-wheels, and a 26-in. front-steering-wheel. Of course, this large steering-wheel has only been rendered possible by the use of the ingenious Quadrant system of steering. The makers have had the courage to throw the weight of the rider on to the steering-wheel and in front of the driving-wheels, and so to dispense with the weight and inconvenience of back-stays to prevent the machine from capsizing backwards. I say they have adopted the correct plan in making a machine which cannot in this particularly dangerous manner be capsized, because I have known of two bad accidents occurring to my own friends, owing to these back stays, which were to prevent accidents, themselves giving way.



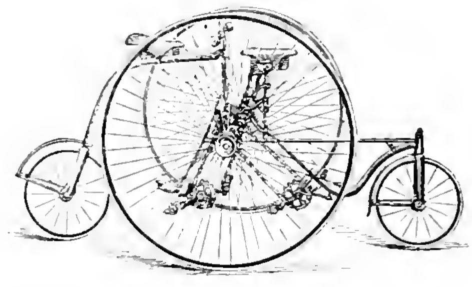
The driving-wheels of this Quadrant are only 40-in. diameter, and it is spoken of by those who have tried it as an exceedingly fast machine. I confess I feel greatly interested in its success, as it embodies every important point in its construction which I have for some time been urging on manufacturers, viz., small driving-wheels, large front-steering-wheel, and the weight of the rider thrown well upon it. Its success would prove, in a machine which can be purchased in the open market, that the advantages of small wheels are not, as has been so frequently asserted, confined to the Humber type of tricycle.

I should exceedingly like to test this new Quadrant well, but the only machine I could get at present is one without a brake, geared to 60-in. Now a 50-in is the very highest gearing I can ride with advantage in a one-speed machine, and I should, therefore, be only trying myself, and not the machine, if I were to take it, as I should do, over a hilly line of country, as I consider this the true method of testing a tricycle.

I anticipate that this will prove the fastest of the front-steering machines, as well as one of the safest.

THE CLUB TANDEM.

The Coventry Machinists' Company have introduced yet another new Tandem. This machine is a good front-steering tricycle, with a movable backbone attached by a joint behind in the centre of the axle. This carries a small wheel and a saddle for a second sitter. The front rider steers, but the machine can be arranged so that either rider can steer, and either rider can now apply the brake.



The riders do not sit so close together as on many Tandems.

By removing three small bolts the Club Tandem can be converted into an excellent front-steering machine for a single rider.

I have had no experience in riding this machine, though I have been on one, but I do not see how it can fail to perform well.

THE INTERNATIONAL HEALTH EXHIBITION.

XV.—WATER AND WATER-SUPPLIES—(*continued*).

TYPE VI.—"Chamberland's" Filter.—Amongst the interesting group of exhibits in the French Court, under the direction of the distinguished professor of the École Normale, of Paris, there are a few examples of this type of filter open to inspection. It has been specially designed for laboratory work, and consists of a hollow cylinder closed at one end, made out of biscuit china; probably a hydrous silicate of alumina and lime passed through a preliminary or biscuit furnace. The water is forced to percolate through the walls of this comparatively dense material, and, in doing so, becomes divested of even the minutest germs, such as *Bacilli*, &c.; and, so thoroughly does it accomplish its work, that M. Pasteur has relied upon it for water in his experiments upon the culture of the lower forms of life.

TYPE VII.—Maignen's "Patent Filtre Rapide." We have reserved this type of filter for our final example, inasmuch as it will help us to explain in detail what a thoroughly good household filter ought to be. Water suitable for drinking and cooking should be free from taste and smell, yet so aërated and cool as to become refreshing. It is needless to say that it ought also to be not only free from harmful matters, but more, its administration should be beneficial. The commonest impurities that are met with in waters are adventitious particles derived from the earth or its atmosphere; they are more or less of appreciable dimensions, and include such matters as the silt and other detritus of streams, and organic matter, both living and dead. There are also other impurities of a less evident nature, derived from both living and inert matter dissolved in the water; so that the requirements of a perfect filter are twofold: it should be an efficient mechanical strainer as well as a chemical separator. Nor is this all; it must conform to the peculiar senses of man; to his organs of taste, his eye, and—if the truth must be written—to his pocket.

We insist at the beginning that the domestic filter shall be "a thing of beauty," even though it be made of such a homely substance as brown stoneware. Placed upon the sideboard, chiffonier, or other stand, the tap should be at a convenient distance from the surface of the table, so as to permit of the easy insertion of a tumbler beneath it, as shown at Fig. 29. Such pedestals, we are glad to find,

Fig. 29.—Maignen's Refrigerating Stand, with "Filtre Rapide" and Ball-valve attached.

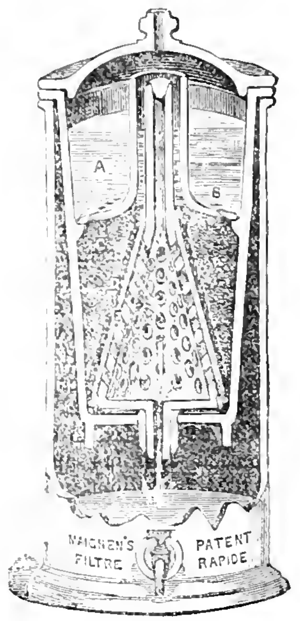


Fig. 30.—Sectional view of the "Filtre Rapide." A, unfiltered water; B, screen; C, granular "*carbo calcis*"; D, powdered "*carbo calcis*"; E, asbestos cloth; M, filtering frame; R, reservoir.

are supplied by Mr. Maignen; and we notice with pleasure that he has turned the pedestal to account to serve as a "refrigerating stand," Fig. 29, where the filtered water is made to pass through a non-oxidisable tin pipe imbedded in ice—a most delightful luxury for the summer months.

The filter-case ought to be constructed in such a way as to permit of being taken to pieces, and the shapes of the component parts such as to allow of their being easily and thoroughly cleansed. It is but our duty to state that Mr. P. A. Maignen must always be associated with this most important advance in the structure of filter-cases as its originator, and we may point to Fig. 30 as substantially a perfected model. We need not here enter into a detailed explanation of Mr. Maignen's filter-case, as we have already done so in a former issue. Those of our readers, however, who cannot have access to our previous brochures, and who are desirous of learning something more about Mr. Maignen's filter-case than the pictured description, Fig. 30, would do well to write to him for a copy of his excellent pamphlet on the filtration of water.* We may observe, however, that the filtering mechanism consists of a funnel, M, Fig. 30, the expanded portion of which is pierced by many circular apertures; that *over* this an asbestos cloth is fitted; and that the filtering medium is deposited uniformly over the *whole* of this surface. The idea of the asbestos cloth and perforated funnel has, we find, been taken advantage of by another manufacturer, but, most unfortunately for him, he has reversed the funnel and made a kind of a bag of it; over the hollow cone the asbestos cloth is tied, and the perforations in the funnel are elongated slits; hence it is obvious that the filtering surface is only partially available, and the filtered water is not properly aërated, as in the filter-case Fig. 30, where the stem of the funnel, suitably plugged with cotton wool, to prevent the entry of disease-germs, allows a stream of purified air to enter the reservoir of filtered water underneath.

The asbestos-cloth surface is undeniably Mr. Maignen's invention; it is of such a nature, that a very fine powder, such as the "*carbo calcis*," enters into association with it in such a way as to form one of the most perfect strainers known. The cloth is subjected for a prolonged time to an intense heat, so as to thoroughly purify it ere it is sent out with the filter, and in order to cleanse it after continued use, Mr. Maignen directs that it ought to be washed, and then roasted before a clear fire; this can be done in any kitchen.

The filtering medium is termed *carbo calcis*, because it is made of pure carbon and pure lime, combined by the patented process. It is in such a fine state of division that it has been estimated that one square inch, $\frac{1}{8}$ inch thick, contains over 200,000 square inches of adhesive or straining surface. Thus, when spread over the asbestos cloth, it ought to be capable of preventing the passage over of even the smallest germs — *e.g.*, excessively small *Micrococci* measure only about $\frac{1}{25000}$ inch in diameter, and other *Bacteria* and *Bacilli* are proportionately larger; even the *flagella* of *Bacterium termo*, *i.e.*, the whip-like terminal appendicular organs of motion of the organism, measure $\frac{1}{204700}$ inch in breadth.†

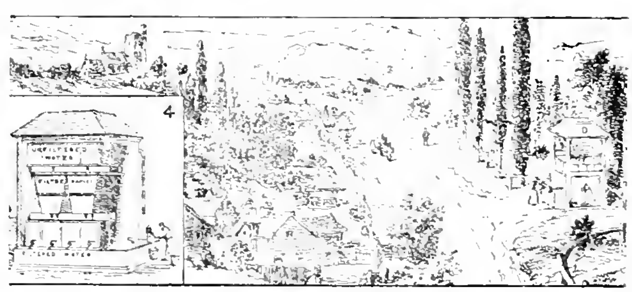


Fig. 31.—A Village Filter House.

Over the fine layer of powdered *carbo calcis*, D., Fig. 30, a quantity of granular *carbo calcis* may be placed, as at C, Fig. 30; this does not only arrest the coarser impurities in

* "Water, Preventable Disease, and Filtration." By P. A. Maignen. 22 and 23, Great Tower-street, London, E.C., 1884.

† Dallinger, "Monthly Microscopical Journal," London, vol. xiv. p. 105.

the water, but prolongs the efficacy and speed of the filtration. As a chemical reactor, *carbo calcis* is equal, if not superior, to any other medium of its kind. It removes iron, lead, sewage poisons, and even ammonia and sulphuretted hydrogen. It also reduces the hardness of water to an appreciable extent. As soon as it becomes foul, it may be replaced by a fresh charge at a trifling cost, and thus entirely overcomes the objection to the use of organic carbon as a filtering agent.

The requirements of a good drinking water are that it shall be tasteless, odourless, colourless, cool, and refreshing; that, in order to be so, it shall be aërated with purified air or carbonic acid gas; and that it shall neither be too hard nor too soft, and be free from all septic or other deleterious impurities. The filter that can modify foul water which is alike disagreeable to the eye, nose, and mouth, and which, when it enters the alimentary system, becomes dangerous, and endow it with all the qualities of good, wholesome water, and which, moreover, is within the reach of the humblest cottager, needs no word of commendation —it speaks for itself. Such a filter is Maignen's.

It is not, then, a matter for astonishment that the Executive Council have deemed the "Filtre Rapide" worthy of the place they have assigned to it, and visitors to the Exhibition may now drink freely from the fountains without any fear of being injured thereby. Mr. Maignen has informed us that he has recently furnished the "Nile Expedition Commission" with 800 filters. Each instrument is capable of purifying from ten to twenty gallons per hour, measures 18 by 12 by 10 inches, and weighs only 16 lb. Two buckets are telescoped round the filter, one furnished with a long strap to draw the water from the river, and the other placed under the filter to receive the purified water. We believe that Sir Peter Lumsden has also taken a few of these valuable travelling companions with him to Afghanistan. Doubtless the merits of the Filtre Rapide will soon make it a universal favourite, when the village smithy may be flanked on one side by its rural "Filter House" (Fig. 31), and water companies seek its aid to give us better water.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE SECOND EVENING (*continued*).

"BUT what do you think," said she, "of the people in the moon; are they as fearful of an eclipse as we are? It would be a good jest to see the Indians there up to the neck in water; that the Americans should believe the earth angry with them; the Greeks fancy we were bewitched, and would destroy their plants; in short, that we should cause the same consternation among them, as they do here."

"And why not?" said I. "I do not doubt it at all; for why should the people of the moon have more wit than we? What right have they to affright us, and not we them? For my part, I believe that since a prodigious company of men have been, and still are such fools to adore the moon, there certainly are people in the moon that worship the earth, and that we are upon our knees the one to the other."

"But sure," said she, "we don't pretend to send any influences to the moon, and to give a crisis to her sick; if the people have any wit in those parts, they will soon destroy the honour we flatter ourselves with, and I fear we shall have the disadvantage."

"Fear it not, madam," said I; "do you think we are the only fools of the universe? Is it not common for ignorance to spread itself everywhere? 'Tis true, we can only guess at the folly of the people in the moon, but I no more doubt it, than I do the most authentick news that comes from thence."

"What news comes from thence?" said she.

"That which the learned bring us," I replied, "who travel thither every day with their tubes and telescopes; they will tell you of their discoveries there, of lands, seas, lakes, high mountains, and deep abysses."

"I fancy, indeed," said she, "they may discover mountains and abysses, because of the remarkable inequality; but how do they distinguish lands and seas?"

"Very easily," said I; "for the waters letting part of the light pass thro' them, send back but a very little, so that they appear afar off like so many dark spots*; whereas the lands being solid, reflect the whole light, and appear to be more bright and shining. The illustrious Monsieur Cassini, a most compleat astronomer, has discovered something in the moon which divided, then reunited, and sunk in a kind of well: we may very probably suppose this was a river. Nay, they pretend to be so well acquainted with the several places, that they have given them all names: one they call Copernicus, another Archimedes, another Galilæus: there is the Caspian Sea, the Black Lake, the Porphyrite Mountains; in short, they have publish'd such exact descriptions of the moon, that a very almanack-maker will be no more to seek there than I am in Paris."

"I must own, then," said the Marchioness, "they are very exact; but what do they say to the inside of the country? I would very fain know that."

"'Tis impossible," I replied; "the most learned astronomers of our age cannot inform you. You must ask that of Astolfo, who was carried into the moon by St. John. I am going to tell you one of the agreeable follies of Ariosto, and I am confident you will be well pleased to hear it. I must confess he had better have let alone St. John, whose name is so worthy of respect; but 'tis a poetical licence, and must be allowed. The poem is called 'Orlando Furioso,' is dedicated to a Cardinal, and a great Pope has honoured it with his approbation, which is prefixed to several of the editions. This is the argument: Orlando, nephew to Charlemain, runs mad because the fair Angelica prefers Medore before him. Astolfo, a knight-errant, finding himself one day in the terrestrial Paradise, which was upon the top of a very high mountain, where he was carried by his flying horse, meets St. John, who tells him, if he would have Orlando cured, he must make a voyage with him into the moon. Astolfo, who had a great mind to see new countries, did not stand much for entreaty; and immediately there came a fiery chariot, which carried the apostle and the knight up into the air. Astolfo, being no great philosopher, was surprised to find the moon so much bigger than it appeared to him when he was upon the earth; to see rivers, seas, mountains, cities, forests, nay, what would have surprised me too, nymphs hunting in those forests; but that which was most remarkable was a valley where you might find anything that was lost in our world, of what nature soever—crowns, riches, fame, and an infinity of hopes; the time we spend in play and in searching for the philosopher's stone; the alms we give

* It is interesting to find Kepler's notion that the dark parts of the moon are seas prevailing after Cassini's time.—R. P.

after our death, the verses we present to great men and princes, and the sighs of lovers."

"I know not," said the Marchioness, "what became of the sighs of lovers in Ariosto's time, but I fancy there are very few of them ascend to the moon in our days."

"Ah, madam," replied I, "how many does your Ladyship send thither every day? Those that are addressed to you, will make a considerable heap; and I assure you the moon keeps all safe that is lost here below. Yet I must tell you, Ariosto does but whisper it, though every thing is there, even the donation of Constantine, (the Popes have pretended to be masters of Rome and Italy by virtue of a Donation which the Emperor Constantine made Sylvester; and the truth is, nobody knows what is become of it.) But what do you think is not to be found in the moon? Folly; all that ever was upon the earth is kept there still; but in lieu of it, it is not to be imagin'd how many wits (if I may so call them) that are lost here, are got up into the moon; they are so many vials full of a very subtile liquor, which evaporates immediately, if it be not well stopp'd; and upon every one of these vials the names are written to whom the wits belong; I think Ariosto has heap'd 'em upon one another a little confusedly; but, for order sake, we will fancy 'em plac'd upon shelves in a long gallery. Astolfo wondered to see several vials full, inscribed with the names of persons whom he thought considerable for their wisdom. To confess the truth, I begin to fear, since I have entertained you with these philosophical and poetical visions, mine is not very empty: however, 'tis some consolation to me, that while you are so attentive, you have a little glass full, as well as your humble servant. The good knight found his own wits among the rest, and, with the apostle's leave, snuffed it all up his nose, like so much hungary-water; but Ariosto said he did not carry it far; it returned again to the moon a little after.

> *——The love of one fair Northern lass,
> Sent back his wit unto the place it was.

"Well, he did not forget Orlando's vial, which was the occasion of his voyage; but he was cursedly plagued to carry it, for heroes' wits are naturally very heavy, and there did not want one drop of it. To conclude, Ariosto, according to his laudable custom, addresses himself to his mistress in the following beautiful verses:—

> Fair mistress, who for me to Heaven shall fly,
> To bring again from thence my wandering wit?
> Which I still lose, since from that piercing eye,
> The dart came forth that first my heart did hit:
> Nor of my loss at all complain would I,
> Might I but keep that which remaineth yet;
> But if it still decrease, within short space,
> I doubt I shall be in Orlando's case.
>
> Yet, well I wot where to recover mine,
> Tho' not in Paradise, nor Cynthia's sphere,
> Yet doubtless in a place no less divine,
> In that sweet face of yours, in that fair hair,
> That ruby lip, in those two star-like eyes,
> There is my wit, I know it wanders there;
> And with my lips, if you would give me leave,
> I there would search, I thence would it receive.

"Is not this very merry? To reason like Ariosto, the safest way of losing our wits is to be in love; for you see they do not go far from us, we may recover 'em again at our lips; but when we lose 'em by other means—as, for example, by philosophising—whip, they are gone into the moon, and there is no coming at 'em again when we would."

"However," said the Marchioness, "our vials have an honourable station among the philosophers, when 'tis forty to one but love fixeth our wits on an object we cannot but be ashamed of. But to take away mine entirely, pray tell me, but tell me seriously, if you believe there are any men in the moon; for methinks hitherto you have not been very positive."

* Sir J. Harrington's translation of "Orlando Furioso," lib. 36.

(To be continued).

Editorial Gossip.

A curious illustration of the impossibility of abolishing social distinctions reaches me from the other side of the Atlantic. In an article on "Second-class Cars," in the *Railway Review* (a journal published in Chicago), I read:—

> No matter how much we may ignore, theoretically or politically, the existence of class distinctions as something foreign to our system of government, they do exist, nevertheless, as rigorously and as unavoidably here as anywhere else, and in the relations of business they have got to be dealt with as such.

Just so; for, as Horace wrote some 1,900 years ago, "Naturam expellas furcâ, tamen usque recurret." You may decree that one man shall be as good as another (and, according, the Irishman's addendum is the venerable Joe Miller, "A grate dale betther too!"), yet people will no more meet universally on an equality than oil and water will unite in a bottle. You will never get the possessor of birth, cultivation, and refinement to consort freely with the vulgar and illiterate man, if you shout "Liberty, equality, and fraternity" until you are black in the face; and the suggestion (from a purely business point of view) to establish second-class carriages in the greatest Republic in the world affords pretty convincing proof that it is as impossible, by legislation, to equalise men's social relations as it is the length and shapes of their noses.

I was, I confess, much interested to read extracts from Knowledge in the *Hindu Excelsior Magazine*, a monthly Madras journal, conducted—and very ably conducted, too—by a native gentleman, Mr. R. Sivasankara Pandiah, B.A. It is pleasant to find that words penned primarily for Englishmen are read with appreciation by those who, though of different race and creed, and separated from us by so many thousands of miles of land and water, are yet our friends and fellow-subjects.

Every one who has an interest (and who has not?) in the condition of our Lunacy Laws, should read the remarkable series of papers, "My Experiences in a Madhouse," which began in the *Pall Mall Gazette* for Aug. 27.

From some further particulars of the balloon of MM. Renard and Krebs which have been received, it would appear that its lifting power in excess of the entire weight was but small, and that the weather was "presque calme." It remains to be seen what progress can be made against a gale of wind—or even a stiff breeze. I fear that the problem of aërial navigation is not yet solved.

I have received the Presidential address (on Psychology) of the Hampstead Naturalists' Club, and am glad to find that excellent Local Association in so flourishing a condition.

The *Citizen* states that since the removal of the Natural History Collections from the British Museum to South Kensington the number of daily visitors has diminished from 2,500 to about 1,000.

AN APOLOGY TO DR. KINNS.

I INTIMATED, on p. 201, my earnest anxiety that justice should be done to Dr. Kinns. I now hasten to render it. Having carefully read through the edition of his book just published, from beginning to end, I feel that, differing, as I do, from him in the inferences he draws from his facts, I can the more willingly, and with the less bias, bear testimony to the entire accuracy of the very large number of scientific facts which he has brought together. A paragraph on abnormal refraction which appeared in the only edition of "Moses and Geology" that I had previously seen (and upon which I placed an interpretation repudiated by Dr. K.) has been expunged from the present one; and I can only frankly express my regret that I should have brought a charge of ignorance, which a simple perusal of the volume before me suffices amply to refute. I do not know whether it is necessary to reiterate here that I never did—as assuredly I never intended to—make the very slightest insinuation against Dr. Kinns's personal character, honour, or veracity. They have been as unassailed in these columns as they are unassailable.

Reviews.

SOME BOOKS ON OUR TABLE.

Suggestions for Establishing Popular and Educational Museums. By Thos. Laurie. (London: Laurie.)—In this pamphlet Mr. Laurie offers suggestions for the establishment of local museums of science and art, which may be studied, not without profit, by those interested in popular education. His ideas as to the collection of objects illustrating the local industry of the place in which the museum is situated seem good, and he further gives a list of anatomical and physiological models, works of art, wall charts, &c., which he considers should form part of every collection established for educational purposes.

Hospital Sunday and Hospital Saturday. By Henry C. Burdett. (London: Kegan Paul, Trench, & Co.) 1884.—Mr. Burdett finds grave fault with the administration of the funds collected on what are known as Hospital Sunday and Hospital Saturday—especially with the latter. All who are anxious that the very large sums of money gathered on these days should be applied to the greatest advantage to the alleviation of sickness and suffering, should study the pamphlet whose title heads this notice.

Children's Dress. A Lecture delivered in the Lecture-room of the International Health Exhibition by Miss Ada S. Ballin. (London: W. Clowes & Son.)—This eminently practical lecture may be commended to the serious consideration of the parents of all young children. That our present unscientific mode of clothing them gives rise to imperfect development, disease, and even death, can unhappily hardly be denied; and those who wish to see their youngsters happy and healthy can scarcely expend sixpence more profitably than in the purchase of the instructive pamphlet before us.

Text-book of Practical Solid or Descriptive Geometry. By David Allan Low. Part II. (London: Longmans, Green, & Co., 1884.) This is the second volume of the work, concerning the previous part of which we were able to speak so favourably on p. 97. The commendation which we bestowed upon that we are equally able to extend to the conclusion of Mr. Low's really excellent book. We have, however, one fault to find with it, and that is that its author persists in that most unscientific solecism, the use of ″ for inches. ″ means seconds of arc and nothing else, and it is as legitimate—or as illegitimate—to employ it to indicate a measure of length, as it would be to use £ as the symbol for a gallon.

We have also on our table *Cassell's Popular Gardening*, *The Book of Health*, *The Library of English Literature*, *European Butterflies and Moths*, *Cassell's Household Guide*, *The Countries of the World*, and *The Franco German War*, *Longfellow's Poems* (illustrated), all published by Cassell & Co.; *Pitman's Musical Monthly*, a surprisingly cheap and useful publication for musical amateurs of limited means; *Water Supply to Villages and Rural Districts*, by E. Bailey-Denton, C.E., B.A.; *The Journal of Botany*, *Bradstreets*, *The Railway Review*, *The Tricyclist*, *Society*, *The Index*, *Our Monthly*, the *Hindu Excelsior Magazine*, and the *Syllabus of the Day and Evening Classes of the Mason Science College for 1884–5.*

THE FACE OF THE SKY.

From September 12th to September 26th.

By F.R.A.S.

SPOTS and faculæ continue to appear in sufficient number on the Sun's disc to render the daily scrutiny of his surface almost certainly productive of interesting results. The configuration of the night sky may be gathered from Map IX. of "The Stars in their Seasons." A minimum of Algol ("The Stars in their Seasons," Map I.) will happen at 2h. 43m. a.m. on Sept. 25th. At 3 p.m. on the 19th, Mercury comes into inferior conjunction with the Sun, and is of course but poorly placed indeed for the observer about this time. He may, however, probably be caught as a morning star about the time when these notes terminate. Venus is still a most striking and brilliant object in the morning sky, rising as she does between 1 and 2 a.m. during the next fortnight. In the telescope she presents the phase of the Moon in her last quarter. She attains her greatest elongation (46° 5′) west at noon on the 21st. Neither Mars nor Jupiter is yet in a position for observation. Saturn, however, rises before 10 p.m. on the 12th; and just after 9 o'clock at night by the 26th. He is still to the north of ζ Tauri ("The Stars in their Seasons," Map I.) Uranus is for the present removed from the ken of the observer, as is Neptune too. The Moon is new on the 19th, and she does not enter her first quarter until 21 minutes past 10 o'clock in the morning of the 27th. She will only be fully observable during the last three days of the interval which our notes cover. During that period she will occult two stars at moderately convenient hours. We gave the particulars of the first occultation a fortnight ago on p. 182, but repeat them here. On the night, then, of September 12th, the Moon, before rising, will have occulted the 6½th mag. star BAC., 1930. Later, after she has risen, the star will reappear from behind her dark limb at 11h. 14m., at an angle from her vertex of 220°. The second occultation will occur on Sept. 25, when the 6th mag. star 29 Ophiuchi will disappear at the dark limb of the Moon at 5h. 28m. p.m., at a vertical angle of 126°; reappearing at her bright limb, at an angle of 258° from her vertex at 6h. 41m. p.m. When these notes begin the Moon is in Taurus, but at 7 o'clock this evening she will pass into the extreme north part of Orion. Twelve hours later, *i.e.*, at 7 o'clock to-morrow morning, she will have crossed this strip of sky and entered Gemini. It will be 10 p.m. on the 14th before she quits Gemini for Cancer, and in Cancer she remains until noon on the 16th, when she crosses its boundary into Leo. Travelling through the last-named constellation, she descends into Sextans at 3 p.m. on the 17th, re-emerging in Leo at 3 o'clock the next morning. She finally quits Leo for Virgo at 4 a.m. on the 19th. Her passage through Virgo occupies until noon on the 22nd, at which hour she crosses the boundary into Libra. At 1 p.m. on the 24th, she enters the narrow northern strip of Scorpio, which she has traversed by midnight. She then passes into the southern part of Ophiuchus, where she continues until 10 p.m. on the 26th. At this hour she crosses into Sagittarius, where we leave her.

The oldest college in the United States (with the exception of Harvard), viz., William and Mary College, Virginia, has been compelled to close its doors, having but one student at the beginning of the present school year. It was founded in 1693, and has had amongst its eminent *alumni* Washington, Randolph, Tyler, Breckenridge, and General Scott.—*Athenæum.*

Miscellanea.

WE are pleased to learn that Mr. Charles Welsh, who spent the first seven years of his business career with the late Mr. Henry S. King, has become a member of the well-known firm of Griffith & Farran (henceforth to be styled Griffith, Farran, & Co.), publishers, St. Paul's-churchyard. On the death of Mr. Griffiths in 1877, Mr. Welsh went into the service of the firm, and by his skill, energy, and good judgment contributed very materially to the great extension of business which it has of late years enjoyed.

THE ELECTRICAL RESISTANCE OF ICE.—The resistance of ice has been measured by M. G. Foussereau. He says he determined the resistances of ice made from distilled water by taking for electrodes two thin cylindrical and concentric plates of platinum. He found the resistance became 15,000 times greater at the moment of congelation. The specific resistances varied from 4,865 megs. at − 1° C. to 53,540 megs. at − 17° C. "I found also," he says, "that the resistance of ice varies with the nature of the water from which it is made. A sample of town water 65 times better conductor than the distilled water previously mentioned gave ice conducting 30 or 40 times better."

AXLE BREAKAGES IN GERMANY.—The report of axle breakages in 1883 on the railways in the German Union shows a total of 157, against 181 in the previous year. Of those breaking last year 122 were iron and 35 steel. One of these axles had been running 35 years, three more than 30 years, 10 more than 25 years, and 35 more than 20 years. The average life of those whose age was known was a little less than 15 years. Three of the broken axles were under passenger cars, 100 under freight cars, 35 under tenders, and 19 under locomotives. On the average they had run more than 200,000 miles each. The causes of the breakages are given as follows:—Defects in material, 17; defective manufacture, 2; an old crack which could not be detected, 39; an old crack which could have been detected, 49; collisions, 3; derailment, 1; hot journals, 10; unknown, 36.

SIR RICHARD OWEN'S "History of British Fossil Reptiles," which has been upwards of forty years in preparation, is now at length ready for publication by Messrs. Cassell. On the preparation of the 268 plates with which the volumes are enriched great labour and attention have been lavished. The edition consists of 170 copies only (each copy being signed by Professor Owen), and no further number can be produced, as the plates from which the illustrations have been printed have been destroyed. The publishers are anxious to give an opportunity to the chief libraries of the kingdom of acquiring the work. Among the original subscribers were many distinguished men who are now dead, such as the Prince Consort, the Duke of Buccleuch, the Earl of Derby (the grandfather of the present earl), Sir P. de Malpas Egerton, Sir J. J. Guest (the father of Lord Wimborne), Henry Hallam, Sir Robert Inglis, Sir William Jardine, Professor Lindley, Sir Roderick Murchison, Bishop Wilberforce, Chief Baron Pollock, Professor Sedgwick, Dr. Whewell, Sir F. Thesiger, and Lord Wrottesley.—*Athenæum.*

WEAR OF ENGLISH COINS.—More than eleven thousand pounds sterling worth of silver is wasted every year in the course of the circulation of crowns, half-crowns, florins, shillings, and sixpences. One hundred sovereigns of the date of 1820, which were weighed in 1859 by Mr. Miller, showed a loss in weight through the wear of circulation which was estimated at £1. 6s. 7d. Mr. Miller some years ago made a number of precise experiments, from which it was ascertained that £100 worth of sovereigns lost £3. 9s. 8·4d. of their value in a hundred years. Similarly, £100 worth of half-crowns lost £13. 11s. 8·8d.; £100 worth of shillings, £36. 14s. 3·1d.; and £100 worth of sixpences lost £50. 18s. 9·8d. in value, or more than one-half in the hundred years. It will be noted here with regard to the silver coins that the less the value the greater the amount of wear. These lesser coins are, of course, most used, and so, in the case of a sixpence, a century's wear reduces it to less than half its original value.

BRAZILIAN DIAMOND MINES.—The diamond beds of Bahia and Minas Geraes, in Brazil, are very similar in character as regards the minerals composing them and their plateau form, or situation on watercourses. A new bed has been recently opened on the Rio Pardo, in Bahia, which presents some differences to those hitherto known in Brazil. The country around is low and marshy, and covered with forests. The working of these forests has led to the discovery of the diamonds, which are found in a white clay along with beds of decomposed leaves. The deposit appears of modern formation. The minerals of the clay accompanying the diamond are, according to M. Gorceux, quartz, silex, monazite, zircon, disthene, staurotede, grenat, almandine, corindon, and some oxides of iron. There are no oxides of titanium, or tourmalines, as is frequently the case in diamond beds. The clay appears to be from its character and situation the debris of the granite mountains bordering on the Bahia coast.

THE ELECTRIC LIGHT IN SOUTH AFRICA.—The Diamond Fields *Advertiser*, in noticing a meeting to be held at Kimberley, for the purpose of deciding as to whether the electric light shall continue in public use or not, says:—"As applied to Kimberley the light has been an unqualified success, and has been a great boon to the inhabitants as regards both the convenience and security of night travelling in and around the town. To how great an extent the safety of our streets has been enhanced it would be difficult to estimate. But some idea may be formed from the fact that outrages are seldom reported, and that the thoroughfares are more free from danger. This has been so marked that it has been well said that each lamp is equal to ten policemen. When fires occur at night, as is most frequently the case, very little looting takes place, because any irregularities of this kind are now so easily detected that gentlemen whose activity would otherwise lead them to secure the goods for their own benefit, instead of trusting to the salvage, do not care to run the risk when the silver rays of an electric lamp are radiating around them. The company has never gone thoroughly into the matter of lighting the mines, theatres, clubs, churches, and private houses, but this could easily be done by the adoption of incandescent lamps, and there can be no doubt but that the results would prove to be of a highly satisfactory nature."

THE PROGRESS OF NEW YORK.—In 1771 the population of the city of New York was a little over 21,000; and in 1786, three years after the close of the revolutionary war, it had 23,614 inhabitants. The several censuses taken during the past 100 years exhibit the marvellously rapid strides which New York has made toward her present imperial position. In 1790, however, the population was little more than it was in 1771; but by 1800 it had risen to 60,515. The remaining censuses are thus given:—1810, 96,373; 1814, 95,518; 1820, 123,706; 1825, 166,086; 1830, 202,589; 1835, 270,089; 1840, 312,710; 1845, 371,223; 1850, 515,547; 1855, 629,906; 1860, 813,669; 1865, 726,384; 1870, 942,292; 1875, 1,041,886; and 1880, 1,206,299. On only two occasions has the enumeration shown a decrease from the figures of the preceding census. The first time was after the war of 1812, and the second after the Civil War. The population of New York city has doubled six times within a century—doub ing, on an average, once in every 17 years. In other words, the New York of to-day is 64 times as large as the New York of 100 years ago. The rate of increase in the country at large is insignificant beside that of the metropolis. In 100 years the population of the United States has multiplied itself by 16, but the population of New York has increased at four times that rate. At the rate of increase shown by the last 25 years alone—a rate diminished by the decline of American commerce and the influence of the Civil War—there are children now nursing who will behold a New York city containing no less than 10,000,000 inhabitants.

A RETURN is published containing the gross receipts and the working expenses of the twelve chief railway companies during the first six months of this year, as compared with the corresponding period of last year. The gross receipts of these twelve companies for the whole six months are £25,609,075, a diminution of nearly £20,000 since last year; the working expenses are £13,748,990, an increase of nearly £80,000. The net receipts, therefore, £11,880,985, this year, are less by nearly £100,000 than those of last year. The following six companies show an increase in net receipts since last year:—London and Brighton has increased from £455,193 to £457,289; South-Eastern, from £469,129 to £486,136; Great Eastern, from £673,373 to £746,259; London and South-Western, from £559,295 to £573,012; Lancashire and Yorkshire, from £802,325 to £831,782; Great Northern, from £722,057 to £734,767. On the other hand, six companies have diminished in net receipts. Manchester, Sheffield, and Lincoln, from £459,109 to £441,622; London, Chatham, and Dover, from £242 989 to £242,248; North-Eastern, from £1,594,955 to £1,470,997; Great Western, from £1,875,216 to £1,869,769; Midland, from £1,668,450 to £1,653,882; and London and North-Western, from £2,437,380 to £2,353,222. If now we look to the proportion that working expenses bear to gross receipts, we shall find that this year the expenses of the twelve companies, taken together, have slightly increased from 53·4 to 53·7 per cent. of the gross receipts. If we take each company separately, we shall find the working expenses bear the following proportion to the gross receipts:—Great Northern, 58·9; London and South-Western, 57·7; London, Chatham, and Dover, 57·2; Great Eastern, 55·4; Lancashire and Yorkshire, and London, Brighton, and South Coast, 54·5 each; Midland, 53·4; Manchester, Sheffield, and Lincoln, 53·2; North-Eastern, 51·3; South-Eastern, 52·3; London and North-Western, 52·1; Great Western, 51. In each case the percentage is given.

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

SHOOTING STARS AND METEORITES.

[1389]—It seems to have been formerly assumed, without inquiry, that shooting stars and meteorites are identical. It is not, therefore, very surprising that subsequent investigators, finding that there were no sufficient grounds for this assumption, should have concluded that they were wholly distinct. This, for instance, is the opinion of the distinguished Astronomer Royal for Ireland, Dr. Ball. It seems to me that this is going too far in the opposite direction, but I rather write to elicit your opinion and that of some of your distinguished correspondents than with a view of expressing a strong opinion of my own. Dr. Ball thinks that the shooting stars which enter our atmosphere are vaporised before they reach the earth. This is probably true of some of them. Others, I should think, from the angle at which they strike our atmosphere, shoot through it without vaporisation (though perhaps heated so as to become luminous), and emerge with little alteration on the other side. But supposing that the shooting star is vaporised, what becomes of it afterwards? It can hardly be supposed to form a permanent addition to our atmosphere, for the heat required to vaporise it will no longer exist after its motion is arrested. The most natural result would seem to be that the vapour thus created should solidify in fine dust (seeing that the vapour must be very rare when generated) and fall on the earth in that condition. And this, perhaps, may be the origin of some of the dust-showers which have been attributed to terrestrial volcanic agency. But though, of course, the vaporisation of the shooting star, as it is called, would increase the resistance to its motion, considering the great speed of these bodies it might fail to arrest it altogether. The vapour might continue to move, get clear of our atmosphere, and solidify again outside of it. In this, however, it is evident that its orbit would be materially altered. The earth's attraction and the resistance of the atmosphere would coerce it to travel in a new course quite distinct from its former one, and in much nearer proximity to our earth. The same observation would apply to a shooting star which had passed through a section of our atmosphere without vaporisation. Its proximity to us and the resistance of the portion of the atmosphere which it encountered would alter its course materially, and even perhaps make the earth rather than the sun the centre round which it moved for the future. This might occur though the star had not actually entered our atmosphere, or had not entered it far enough to become luminous. The shooting stars, whose orbits were thus altered by the earth's attraction, would approach it more closely in their subsequent visits, and their motion would experience further retardation at each collision with the atmosphere; and in this way it seems to me that they might finally drop to the earth without being heated to luminosity at the time of the actual contact. They would, moreover, before this period arrived, cease to be identified with any particular group of shooting stars. They would have wandered so far from the original course of the Leonids, the Perseids, or the Andromedes, to which they had once belonged, that their origin could no longer be distinctly traced. But that genuine shooting stars—highly incandescent bodies—have fallen to the earth at certain times can hardly, I think, be doubted. Thus the "fire-ball" whose course Dr. Ball traces in his treatise on astronomy must, I think, have fallen into the sea not far from the Scilly Isles, and it seems to have presented all the prominent characteristics of a shooting star. Why, then, should we seek for the origin of meteorites in volcanoes on the earth or the moon if shooting stars which have been once brought under the influence of the earth's attraction, and thus diverted from their former orbits, will account for them?

W. H. S. Monck.

BRILLIANT METEOR—SILENT LIGHTNING.

[1390]—On the 3rd of July, 1884, a very brilliant meteor was seen all over eastern Ontario and northern New York. I was at a pic-nic at the time. The sun had set, but there was plenty of light in the sky. The meteor nearly followed the equator from east to west. Its colour was bluish white, and it suddenly burst like a rocket when about 20° above the horizon. It looked so close, that my first impression was that one of our party had let off a firework. After bursting, a line of light about 8° long marked the latter part of its track for fully fifteen minutes. It was at first straight, but gradually broke up into a serpentine shape, like so much smoke.

From comparison with its apparent track, as seen at other places, it appears to have passed over the northern part of the State of New York.

Last summer I was travelling in Nebraska and Colorado during very thundery weather, and several times noticed flashes of lightning in clouds almost overhead, without any sound following. On one evening in particular these silent flashes in a cloud at an altitude of about 60° were almost continuous for nearly an hour.

While in Nebraska I witnessed a hailstorm which completely destroyed all the crops over a tract seven miles by two. The stones were the size of large plums, and were driven nearly horizontally by a violent wind. This happened on the evening of a very hot, still day.

Musafir.

DEAN SWIFT AND THE SATELLITES OF MARS.

[1391]—In connection with "Simplex's" quotation from Swift anent the Martian moons, may I be permitted to give a rough version of M. Flammarion's racy comments on the same subject in "Les Terres du Ciel" (Paris: 1884). Having quoted from "Gulliver," as "Simplex" does, the brilliant Frenchman proceeds;—"Here truly is fiction singularly like truth. The prophets of the Bible were never so clear about Christ, and in inspiration Swift is the superior of Daniel and of Jeremiah. Something for weak-kneed theologians to think over. Had some archæologist found an inscription to that effect in the ruins of Egypt or Assyria, those who venerate the past would not fail to have concluded that our ancestors had optical instruments of enormous power. However, it is certain that neither Kepler, nor Swift—nor Voltaire, who writes to the same effect in his delightful "Micromegas"—had seen the Martian moons, and that theirs was merely a happy thought. We, in our turn, might conclude that Uranus had 16 satellites and Neptune 32; but it is likely that here reasoning from analogy would lead us astray from the truth."

Arthur Mee.

[In so far as M. Flammarion's argument is directed to showing that the coincidence between the mention of a previously unsuspected fact, and the subsequent discovery of its objective existence, may well be a mere coincidence and nothing more, it is quite legitimate. I protest, however, against one, at least, of his illustrations as irrelevant. To wantonly and offensively attack what has been, and is, held sacred by some of the best and wisest men the world has yet seen, is neither science nor common sense.—Ed.]

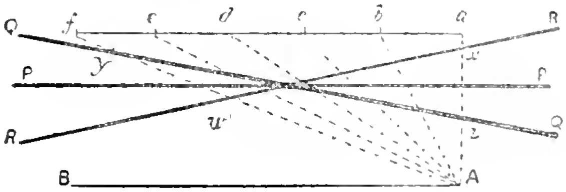
FALSE PERSPECTIVE.

[1392]—I perceive that the rudiments of perspective still engage the attention of your correspondents.

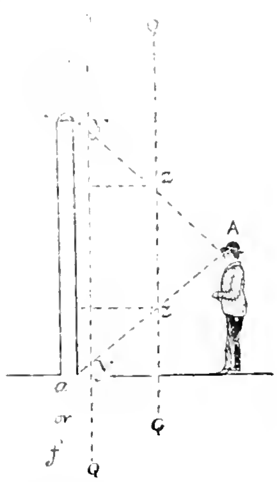
Their opposed views may be grouped into two classes. To one order of minds there appear—firstly, an object; secondly, an eye to see it with; and, thirdly, a mental picture. The physical picture is like Banquo's ghost, not discernible by two people in one place at one time. To the other order of minds there is a fourth factor in the case—namely, a physical picture outside the eye, not at all to be confounded with the mental picture within.

Letter 1359 in your No. 146 illustrates the triple factor system exceedingly well. T. E. (R.) Jones contemplates certain posts as external objects, and acknowledges certain appearances or seemings to the inner consciousness. For instance, he says "the post at *a* will appear taller," &c.; but he has no word to say about the relation of the appearances to the physical picture, considered as a stubborn fact, equally objective and external to the eye, with that other external matter which artists call the subject of the picture.

Your correspondent's strong line A B cannot be the picture, because it does not intercept any lines of light travelling in directions between the posts and the observer at A. Adopting his illustration as regards the posts, I will superadd three different illustrations of the fourth factor in the case, and its influence. As the upright posts show only as points on the ground-plan, so does the upright plane of the picture show only as a mere line. I will, in the first place, show it at P P; *a*, *b*, *c*, *d*, *e*, and *f* being the posts, and A the observer, agreeably to your correspondent's intention. Under these circumstances former correspondents have already threshed out the subject. I may refer especially to letter 1341, from J. Bacon (Knowledge No. 142). But other positions Q Q, R R for the plane of the picture will equally answer the condition of intercepting the rays of light *a* to A, and *f* to A.



Let me examine the result of assuming Q Q to be the position of the plane of the picture, with the help of the accompanying vertical section. Here A being the observer, the several posts coincide with another in place on the section; or stated otherwise, the last post, *f*, hides all the others. The several rays of light, A*a*, A*b*, A*c*, &c., on the plan, are shown in section leading from foot and top of



post to A. Set off the distance *a z* from the plan horizontally on the section from the post *a*. This shows the part of the plane of the picture Q Q whereon the post *a* should be drawn. It is at Z Z on the section, being bounded by the rays of light *a* A. Also set off the distance *te y* from the row of posts as obtained from the ground-plan upon the section. This gives us at *y y* the length upon the plane of the picture which will be occupied by the image of the post *f*. Thus, with the assumption of a plane of the picture P P in parallel perspective (as in letter 1341) the posts should be drawn of equal height; 2ndly, with the assumption of Q Q as the place of the plane of the picture, the post *f* should be drawn as at *y y*, much longer than the image *z z* of the nearer post; and, 3rdly, it would be equally easy to show that with the assumption of R R as the place of the plane of the picture, the image of the further post *f*, at *x* in R R, would be shorter than the image of the nearer post *a*, at *x* in R R. The results of this third assumption alone agree with the three impressions of your latest correspondent. I cannot dispute the impressions on his inner consciousness; I am only showing the geometry of a drawing to be placed outside the physical eye. An Old Draughtsman.

LIFE.

[1393]—Reading in the *Times* of Sept. 2 the Rev. W. H. Dallinger's lecture on Life, I am tempted to ask him why, like Tyndall, he is unwilling to go beyond no life without antecedent life, and therefore close the door to further inquiry? The object of science is to discover (if possible) the origin of all things our senses can take cognizance of, the elements out of which all matter is built up, and, in my opinion, something that at present the human senses are unable to take cognizance of, inasmuch as hey are only to be found in what we call space, immediately they are subjected to *any* influences. They love their elemental condition, and form combinations out of which all things are built up.

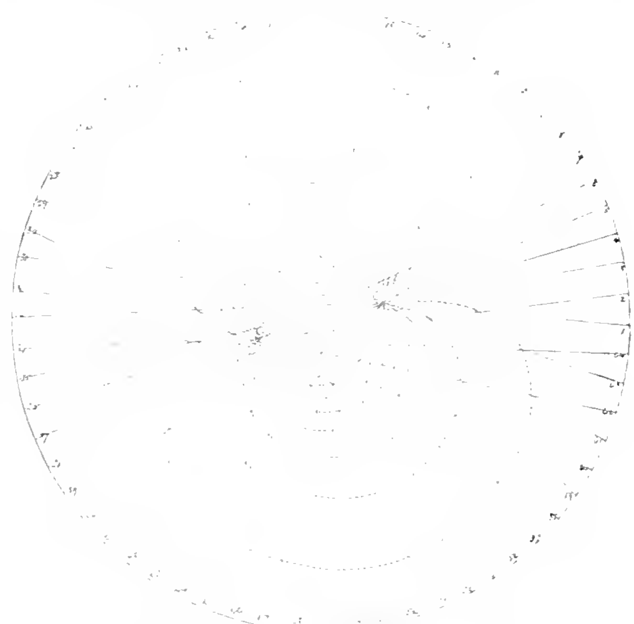
I once before ventured to suggest the origin of the vital spark, and I should like to ask the Rev. W. H. D. if any violence is done to the principle of evolution by asserting that there is a moment of time when the substance of conception springs into animation. I therefore take it that there is no necessity to ask for matter, other than that we already know of, but have only to investigate the special condition of matter out of which life springs.

A non-Y. Z.

THE CURVES ON A BICYCLE WHEEL.

[1394]—An interesting optical effect may be observed by anyone with ordinarily good sight who watches a bicycle passing rapidly by him. Looking carefully at the driving-wheel as it approaches, he will see a number of shadowy curves above and below the axle. These change their figures slowly until the instant of passing, when they shift position suddenly, and again gradually alter as the machines recedes. The *rationale* of these curves seems to be that they are the optical effect of the apparent intersections of the spokes, the appearance being rendered continuous by the rapid rotation of the wheel. The spokes of a bicycle, it will be remembered, are not, like those of an ordinary carriage wheel, carried out to the circumference from a central point, but spring alternately from drums at opposite sides of its plane, thus forming a cage of two cones base to base.

When the eye is situated anywhere except in the plane of the wheel, or the line of the axle, the two sets of spokes appear to intersect, each spoke from the nearer drum crossing (in general) a number of the spokes which spring from the remoter drum.* If the spokes are numbered consecutively round the circumference of the wheel, all the odd numbers belong to one drum and all the even numbers to the other. The intersections nearest to the circumference are those of consecutive spokes, and it will be found, on plotting down their points of intersection, that they all lie on two loops, one above, the other below, the axle, and both springing sharply from the two drums. In like manner, the intersections of each spoke with the third in order from it (1 and 4, 3 and 6, 5 and 8, &c.) determine two loops which lie entirely within those first mentioned. The intersections of spokes separated by four (1 and 6, 3 and 8, &c.), give rise to the third pair of curves, and so on, until when the intersecting spokes are widely separated the number of intersections in either semicircle



will be too small to define the form of the curve. Now the manner in which the rotation of the wheel helps to make these curves optically continuous seems to be as follows:—When the wheel

* It will be easily seen that, although two sets of n lines intersect in n^2 points, when the lines proceed from fixed points, and are not produced beyond those points, the number of actual intersections cannot exceed $\frac{n^2}{4}$, however large may be the wheel.

revolves, each pair of spokes is brought into the position occupied an instant before by another pair. If, then, the intersection of two spokes gives rise to *any* appearance, the revolution of the wheel will cause that appearance to become a continuous curved line. The effect of the apparent intersection is, of course, to shut out from sight a portion of the further spoke; and, if the edge of the latter be brightly illuminated, this occasions a very definite optical effect. It is to this eclipse of the bright edge of the remoter spokes that these optical curves must be ascribed.

The mathematical investigation of these curves is not without interest, and will afford a useful exercise to the student who desires to find the equation. We shall not enter into the details of the work, but merely indicate some of the results at which we have arrived.

Considering the visible appearance as projected on the vertical plane, it will be found that the curves traced on that plane are of the fourth degree, that they are divided into two loops by the perspective trace of the axle (which accounts for the change of position as the machine passes the eye), and that the projections of the two points from which the spokes spring are singular points on the curves. Lastly, any curve of the system may be generated as follows:—Given a point, a line, and a circle, the curve is the locus of a point such that the product of its distances from the point and line bears a constant ratio to the square of the tangent drawn to the circle. A. St. John Clerke.

THE WICKED FLEA.

[1395]—To exterminate the pestilence that walketh as well as the one that hoppeth by night, I have found nothing so efficacious as to pepper the mattress finely with dry bleaching powder, which is best carried in a bottle. Take care not to let any stay in lumps, as it rots clothes. City Bee.

PARKGATE.

[1396]—Having lived at Parkgate for over two years, I beg to doubt Mr. Percy Russell's opinion (expressed in Knowledge No. 147) as to the fitness of the estuary for a haven for commercial fleets. Half-way across there is a large sandbank, which very, in fact most, often is not covered by the tide, and consequently a fishing-boat left in its neighbourhood is perfectly safe without an anchor.

Parkgate now is far from being a watering-place, or competing as such. The cause of its decay is, I believe, twofold—(1), that the channel of the Dee has changed from the Parkgate to the Welsh side of the estuary. (2) The obnoxious smells coming across the river from the Kent chemical works. Parkgate, however, has its attractions, and nothing could be pleasanter than a night's shrimp-fishing in Bill Smith's boat round Hilbury Island, and never were shrimps so good as those fresh from the boiling-pot on deck.

Certainly, Parkgate, from a picturesque point of view, is unique, and the old adage, "All on one side, like Parkgate," is literally true, even down to the curious railway-station. F. W. T.

LETTERS RECEIVED AND SHORT ANSWERS.

F. Cowley.—Your request almost amounts to one that I should give you the catalogue of a small library. You had better get Doctor Brewer's "Reader's Handbook," Lemprière's "Classical Dictionary," Bohn's "Dictionary of Classical Quotations," Todhunter's books on Trigonometry and the Differential and Integral Calculus (see also lessons on the former in these columns), Cassell's "Latin Grammar," Delille's "French Grammar," &c. How can I possibly tell what book Mr. George Augustus Sala recommends?—Captain D. Forbes. Many thanks; utilised elsewhere.—Scientist. There is no such thing as an "art of writing with special reference to scientific work." My own experience of the caligraphy of men of science induces me to imagine that it ranges from moderate badness down to practical illegibility.—Berks. Your informant was either a knave or a fool; most probably the latter.—Quidam. Every discovery of an additional three weeks' supply of coal in this country possesses both popular and scientific importance, in view of the fact that the total amount of coal-bearing strata beneath these islands is limited.—Ne Sutor ultra Crepidam. What a pity you don't take your own motto to heart. I congratulate you on your champion. Were I to print the author's name, even you might admit that he requires no instruction in the subject you refer to.—G. W. N. "Popularising Astronomy" is a subject with which certainly more than one member of our staff is competent to deal.—Charles Froebel. Much too metaphysical for these columns.—Vega. Jevon's "Elementary Lessons in Logic," and "Studies in Deductive Logic," both published by Macmillan & Co., ought to suit you. The best *small* volume on elementary geology is Page's "Advanced Text-Book," published by Blackwood.—Arcturus. Kindly consult Vol. IV. of Knowledge, pp. 68, 84, 100, 116, and 139.—Harold Rowntree proposes to get to the North Pole of the earth by submarine navigation. I presume that Mr. Rowntree is aware that icebergs have been seen rising between 200 ft. and 300 ft. above the sea, and that something like eight times their visible mass must have been submerged. Has he provided against running into the base of one of these stupendous floating islands? He will explain the design of his vessel to any one who may care for such explanation.—Faciebat. M. Mouchot ought to win one of the *Tit-Bits* prizes. I have not read Mr. J.'s article, and your extract is not too intelligible in the absence of the context; but, of course, the tremulous motion of objects in landscape, viewed in blazing sunshine, is more perceptible in the distance, because they are seen through a long stratum of heated air. Every ray of the sun which reaches the earth brings actinic power with it.—H. W. Parr. See paragraph at the bottom of col. 1, p. 62.—R. G. Your coincidence is of much too commonplace a character to justify me in occupying space with it.—George S. Gibbs. I cannot reprint letters to other journals.—Lerryn. Professor Clifford died at Madeira on March 3, 1879. It is absolutely and utterly false that he joined the Church of Rome before his death. See pp. 24, 25, and 26 of Vol. I. of his "Lectures and Essays," published by Macmillan.—Nemo. There is a table of semidiurnal arcs in Chambers's "Mathematical Tables," by the aid of which the approximate time of rising may be found of any star whose declination and time of southing are given.—H. B. L. The proceedings of the Learned Societies are practically all purchasable by the public, though, as a rule, not in numbers, but in volumes. Single numbers, however, of the Journal of the Royal Microscopical Society may be bought at Williams & Norgate's, and volumes of the R.A.S. "Monthly Notices" of the same publishers. I do not know the name of the publishers of the Geological or Linnæan Society's transactions.—A Well-Wisher (Burra-Burra, S.A.) Without reprinting an entire paragraph verbatim here, I may mention that what Mr. Jago says is, that alum possesses the power of arresting the action of the gluten of damp flour on its starch, prevents the decomposition of starch, and bread from becoming sour or mouldy. Your complaint about numbers forwarded to the publishers. Thanks for friendly expressions.—Algernon Bray points out that the mere labour of the production of a magic cube is less than is supposed (especially when the root is a prime number). Letter forwarded.—H. A. B. The book from which you quote is a mere compilation, destitute of the slightest scientific authority. The difficulty about the Equation of Time seems wholly of your own creation. On November 2 in this year the Sun will south in London at 11h. 43m. 41s. a.m., as shown by a clock indicating Greenwich mean-time, and will set there at 4h. 29m. p.m., as shown by the same clock.—Commentator. Oh, good gracious! It is related that after a Devonshire parson had stated in a sermon that Commentators did not agree with him, a farmer waited on him with a present of a basketful of potatoes, saying, that as his spiritual pastor had intimated "that common 'taturs didn't agree with him, he had brought him a basket of his best kidneys, which he hoped he would find more wholesome." I am a little afraid that the readers of Knowledge would cry out for something "more wholesome" after the few columns into which your communication would print.—W. Hepworth Collins. The writer of the letter of which you enclose a cutting is not responsible for his actions, and to print it would do him more harm than good.—John W. Staniforth is exercised about the dynamics of a briar-root pipe; which, floating on the sea about half-a-dozen yards from the shore, of course bowl upwards, remained sensibly in one spot, and for a quarter of an hour rotated from east to west about north round its stem as an axis. Its moment of inertia would of course operate in rendering the direction of its motion persistent.—Dr. E. South. I cannot say offhand who was the first person to point out the unsoundness of Olbers's idea, but each fresh discovery of an asteroid, and the manner in which they are grouped, adds to the accumulated mass of proof that they can never have been united in a single body. Are you aware that the nodes of their orbits lie in all parts of the ecliptic?—Arnold T. Reed. Professor Jevons was entirely correct; the moon's (so-called) "changes" have *nothing* to do with the weather in any shape or way. If the "marble" is composed of carbonate of lime, it will attract the lime in the water to itself, for a pretty obvious chemical reason. The best book on electrical measurement, at a moderate price, is "Kempe's "Handbook of Electrical Testing."—A. G. White. I do not myself know the Table of Pythagoras, and am many miles from a copy of Peacock's "History of Arithmetic," in the *Encyclopædia Metropolitana*, the likeliest place to find an account of it.

Our Whist Column.

By Five of Clubs.

THE LAST TRICKS.

SKILL at Whist is chiefly shown as the last few tricks are made. The steady conduct of the hand according to sound principles, and with careful attention to the fall of the cards, leads to a satisfactory (or the best available) position at the close, and the attentive player can usually tell precisely what that position is. But to take advantage of good points in the position, or to avoid threatened loss, requires other qualities than (as a rule) have been sufficient for the earlier conduct of the hand. The play is now like that of a double-dummy game. Only a trick or so may perhaps depend on correct strategy at this stage; but a game or a rubber may depend on that trick.

The chief points arising at the close of a game are these:—(1) The right of choice of cards to throw away to winning cards either of the enemy or of your partner; (2) placing the lead; and (3) what may be regarded as a combination of both points, the recognition of the necessity which sometimes arises for throwing away a winning card or an extra trump—playing what is called (after Deschapelles) the *grand coup*.

Necessity for care in choosing the right card or cards to throw away to tricks won by partner or the adversaries, may arise in several ways, and a case of this kind may be simple or difficult according to circumstances. Thus you have a card which would be a certain winning card if you had to lead it, which yet is of no value to you because the suit is certain not to be led. In this case you throw it away without hesitation. Again you may have to choose between throwing away a trump (to a suit already trumped higher by the enemy) or a certain or possible winning card in a plain suit, yet though this seems like the *grand coup* the question may be one of extreme simplicity, from the consideration that the trump will certainly be of no use to you (being at once drawn by the enemy if retained) while the good plain-suit card may take a trick. Again the choice between two good cards to throw away may be a little more difficult, because you may be in doubt which of the two suits will be eventually led; or of two second-best cards, you may doubt which to throw because while you are certain that one or other of the best cards to those suits must be discarded by the enemy you cannot tell which it will be. Or lastly, the question may be of discarding guarding cards, and you may be in doubt which of two suits must be most carefully guarded.

It is impossible to lay down rules here, since each case must be dealt with as it arises, and the number of cases is legion. Nothing but great care and attention can save you from losing tricks at the end of several of the hands played in the course of an evening by discarding from the wrong suit. But when, by carefully following the fall of the cards, you know where the command in each suit lies, and also where small cards which will have to be led are situate, you generally have a tolerably easy problem towards the end of the game, in selecting which cards to throw away and which to retain.

Skill in throwing the lead is akin to Whist memory, in that it comes to be instructive with practice. A good player feels, when he holds a major tenace, for example, that he must throw the lead so that the holder of second best guarded shall have to play before him; while when the major tenace is against him he feels, without any occasion for thinking about it, that the holder of that tenace must, if possible, be made to play before him.

There are often simple cases of throwing the lead, in which, nevertheless, the average player frequently blunders, if not on every occasion which arises:—Thus leader holds the major tenace and a small card against the minor tenace and a small card, in trumps or in a plain suit after trumps are extracted. In nine cases out of ten the average player, even though he has seen enough to know how the matter stands, leads nevertheless the best card, transferring the adversary's minor tenace into major tenace, through which he has to lead, losing therefore both the remaining tricks. It is so obvious that in such a position the small card should be led, that it seems hardly worth while to notice the point; yet we see tricks lost in this way repeatedly; of course, by leading a small one, even though the trick may be made by the adversary's small one, yet as he has to lead from his minor tenace you make two tricks.

One sometimes hears a weak player explain that he could not lead a particular card because he knew an adversary would take the trick, though this may be just what he should have done to save the game. You know, suppose, that the player to your left has the winning Spade, the second best and two small Clubs, you holding a small Heart, the major tenace in Clubs, and a small Spade (trumps all out); you know, further, that your partner has the best Heart and three small Clubs, the adversary to your right having only small cards, so that he can get no lead. You want three tricks to save or to win the game. Under these circumstances if you lead a Heart, your partner makes a trick in Hearts, and must then lead a Club through your tenace; you make a trick in Clubs, and the remaining two tricks go to the enemy. But now suppose that you had led a Spade. Your adversary to the left takes the trick, by which you lose nothing, as he must have taken it anyhow. But now he has to lead a Club; and, however he leads, you make two tricks in Clubs, lead your small Heart, and give a third trick to your partner.

The *grand coup* consists in throwing away a trump or a winning card in order that you may not escape a lead, where leading would lose you a trick. Suppose for instance in the case just considered, that your opponent to the left either knew his partner had the second best Spade, or else that the game could not be saved unless he had that card. Then if before the ninth trick he had thrown away his winning Spade, retaining say a small Heart or Club—it matters not which—he would have played the *grand coup*, saving the game if his partner *could* make the Spade trick, and in any case taking the only course to save it. For now, if you lead the Spade and the trick falls to opponent on your left, then whether he leads a Club or a Heart your tenace in Clubs must be led through, and the guarded second best Club on your left must make another trick. Even if it so turns out that you yourself have the best Spade after your opponent on the left has discarded his winning one, he loses nothing. He makes a trick in Clubs, anyhow.

Put yourself in his position, and see how the *grand coup* in this case comes to be played:—

B holds

Diam.—3. Clubs—5, 4, 2. Hearts Q.

Y holds	Clubs—Kn, 7, 3 Hearts—5 Spades—Q	*Z* holds	*Diam*—Kn Clubs—6 Hearts—6, 3 Spades—9 *or* 8.

A holds

Diam.—Q. Clubs—Q, 9. Hearts—4. Spades—8 *or* 9.

You are *Y*; Diamonds are trumps; *A* leads Diamond Q; and you know how the above cards lie, all but the position of the Eight and Nine of Spades. How shall you play? If you discard Heart Five, or Club Three, *A* leads his small Spade, you make the trick, and make no more. If on the contrary you discard the winning Spade, then, however *A* plays, your Club Knave will eventually make, so that you have lost nothing; while if *A* holds the smaller Spade of the two left, you gain a trick, and your partner wins the trick, (since *A* cannot escape leading his Spade).

The *grand coup* is commonly understood to mean the throwing away of a useless trump, either by under-trumping your partner, or by trumping a trick which he has already won. If you have the major tenace and a small card in trumps, and a plain card (winning or not), while your right-hand adversary has the minor tenace only, or the second best guarded in trumps, the possession of that small trump may force you to lead from your major tenace, in which case, of course, the adversary will make a trick. But if you can part with that small trump, without losing a trick in doing so, your tenace will be lead up to, and every trick be made.

The games which have appeared in past numbers of Knowledge illustrate many interesting cases of end-play, coups, &c.

*** The instructions for play which have appeared in past numbers of Knowledge will shortly be published in book-form for reference; and hereafter about two games monthly will be published in these columns.

The Mosquito's Instrument of Torture.—It appears that in the "bill" of the little beast alone there are no fewer than five distinct surgical instruments. These are described as a lance, two neat saws, a suction-pump, and a small Corliss engine. It appears that when a "skeeter" settles down to his work upon a nice tender portion of the human frame, the lance is first pushed into the flesh, then the two saws, placed back to back, begin to work up and down to enlarge the hole, then the pump is inserted, and the victim's blood is siphoned up to the reservoirs carried behind, and finally, to complete the cruelty of the performance, the wretch drops a quantity of poison into the wound to keep it irritated. Then the diminutive fiend takes a fly around just to digest your gore, and makes tracks for a fresh victim, or if the first has been of unusual good quality he returns to the same happy hunting-ground. The mosquito's marvellous energy, combined with his portable operating chest, make him at once a terror and a pest.—*Sportsman.*

Our Chess Column.

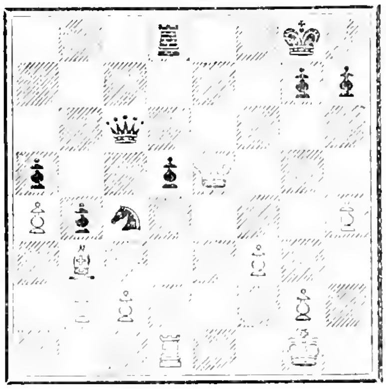
By Mephisto.

PROBLEM No. 127.

Ending from Actual Play.

Amateur.

Black.



White.

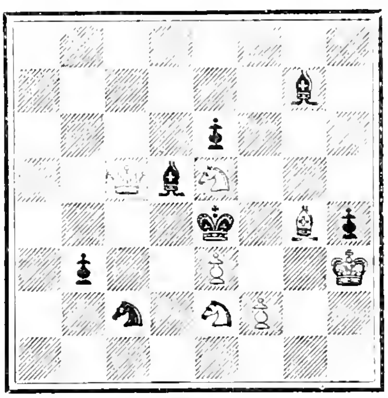
Mr. Robey.

White to play and win.

No. 128.

By Clarence.

Black.



White.

White to play and mate in two moves.

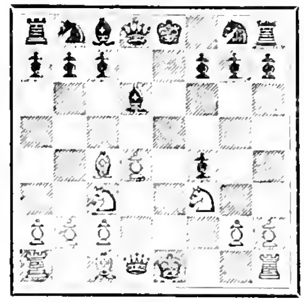
GAMBIT DECLINED.

Of all the openings the Gambits lead to the most lively games. By advancing 2. P to KB4, on the second move, White temporarily abandons this P, but he is compensated for the sacrifice by obtaining a speedy development of his pieces, and a correspondingly strong attack. It is undoubtedly true that, both for recreation and study, Gambits are invaluable sources of enjoyment and instruction. Nevertheless, occasions may occur when it will be found desirable to decline the Gambit, as that course undoubtedly leads to a safer and easier line of play; as, for example, when meeting a stronger player or when receiving odds. In the latter case, especially, it is desirable to avoid Gambits, for, as we have shown some time ago, it is positively suicidal to accept certain Gambits when receiving the odds of QKt.

After 1. P to K4, P to K4, 2. P to KB4, Black can decline the Gambit by playing 2. P to Q4 at once, or as follows:—2. P × P. 3. Kt to KB3, P to Q4. White would not gain any advantage by playing 4. P to K5, as Black could defend his P by P to KKt4, and White could never bring the KB to bear upon KB7, the chief support of the Gambit attack. If, on the other hand, 4. P × P, Black can now play 4. B to Q3, which will give him an even and safe game, or he may play 4. Q × P. 5. Kt to B3. Here the tyro is exposed to a danger which he ought to know, in order to be able to avoid it. If now 5. Q to K3 (ch), K to B2, White now threatens to win the Q by playing B to Kt5 (ch), followed by R to K sq. Black, of course, can prevent this by playing B to Q2 or Q to Kt3, but in either case he will have a difficult game to play, while White will soon bring his R to K sq. and K to Kt sq. Instead of the (ch) with the Q after 5. Kt to B3, Black will do better to reply with 5, Q to Q sq. Whatever White does, Black ought to be able to hold his own. If 6. P to Q4, B to Q3, 6. B to B4.

The position now requires a little attention. Of course, 6. Q to K2 (ch) for Black would not be good, on account of K to B2 threatening R to K sq., or if 6. Kt to B3, then 7. Q to K2 (ch), if Q interferes. White takes the Black Q, compelling the K to retake, with an unfavourable position. 6. Kt to K2 would be worse still, for White would immediately play 7. Kt to K5, Castles. 8. Q to R5, with a won game. But Black may play 6. P to KR3. 7. Castles. Kt to K2. 8. Kt to K2, P to KKt4, with a good game.

Black.



White.

Although this is, in reality, an accepted Gambit, yet it avoids all the well-known Gambit attacks, and Black plays P to KKt4 under more favourable conditions. Black must now seek to develop his game; for that purpose the following moves may serve:—B to KKt5, P to QB4, Q to Kt3, &c. Castling on the Q's side would give Black a great advantage.

(To be continued.)

Through Farringdon-street Junction of the Metropolitan Railway 1,800 trains pass in twenty-three hours every day. There are four lines of rails, used by the Metropolitan, Great Northern, Midland, London, Chatham, and Dover, and Metropolitan Extension Companies. The total number of passengers conveyed over our railways in 1883, exclusive of season-ticket holders, was—first-class, 36,387,177; second-class, 66,096,784; third-class, 581,233,476; total, 683,718,137; and season-ticket holders, 180,000,000. Of minerals there were conveyed 189,485,612 tons; of general merchandise, 76,897,356 tons; number of miles run by passenger trains, 139,545,464; number of miles run by goods and mineral trains, 129,351,774; total miles run, 268,897,236; miles of railways, 18,668; number of persons employed, 367,660.

Contents of No. 149.

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CONTENTS OF No. 151.

OUR TWO BRAINS.

By RICHARD A. PROCTOR.

(*Continued from page* 190.)

IN the remarkable case which closed the last portion of this article, one side of the brain had been so severely injured that one might fairly have expected the mental faculties would have suffered if the brain is to be regarded as a single organ. Just as the proper work of an eye cannot be done when one half of the eye is seriously injured, nor the proper work of an arm if the upper or lower arm is seriously injured, or the muscles on one side or the other of the arm be torn or lacerated, so if the two sides of the brain form but a single organ injury to one side must in the most marked degree affect the power of the brain to perform its proper work. Yet here was a case where one side of the brain was so injured that manifestly the whole of that side must have been disabled: yet the boy was able to think as well as before, to move about with his customary freedom of action, to do all in fine which he had been able to do before he received the injury.

In passing I note that there have been many remarkable cases of the same kind, proving as much as this case did, but not more. Among these cases, I may cite one not so widely known as it deserves to be,—the case of the boy McEvoy, who was killed by an accident in a saw-mill at Paterson, N.J., somewhere about the spring of the year 1876, if I remember rightly. In that case, the boy had stooped under the revolving saw, and partially rising, his head came against the saw which cut through his hat into the skull, so deeply that while one end of the opening was only a little above the right eyebrow, the other end was close to the crown of the head. In gauging the wound the doctors were able to extend an instrument more than an inch within the inner surface of the skull, near the middle of the long gash. It was expected that the boy would be dead before he reached the hospital; but not only did he survive the journey, but he was able to talk and was apparently in full possession of his faculties a few hours after the accident occurred. He lived till the fifth day, and his death then was sudden and unexpected, due apparently to inflammation caused by the presence of fragments of the torn hat within the wound. During the last two days, the doctors who before had had no hope of the boy's recovery, took a sanguine view of the case. He was certainly in full possession of his mental faculties up to within a few hours before he died. Unfortunately the boy's mother would not allow a *post-mortem* examination to be made, so that it was impossible to say how deeply the saw had really penetrated into the boy's brain.

In the next case cited by Dr. Wigan, it was found during *post-mortem* examination of a patient of his own that one hemisphere of the brain was entirely gone. Yet the patient, a man about fifty years of age, had conversed rationally and even written verses, within a few days of his death. The evidence here is more decisive than in either of the cases just considered; for in those cases one-half of the brain though seriously injured was yet not destroyed and one might imagine that some of the functions of that half might continue to be discharged, severe though the injury was. But where one hemisphere was found to have been entirely absorbed before death, it is impossible to explain the possession of reasoning powers within a few days of death, unless we suppose one-half of the brain sufficient for the full exercise of the mental faculties.

But the following case is still more remarkable:—

A gentleman came to the celebrated Dr. Conolly, under the following circumstances. He had applied a very strong embrocation to the cheek for some ailment there, and an inflammatory disease had been caused by its action. This disease spreading through the eye orbit had affected the brain, and when he applied to Dr. Conolly the case was in reality hopeless. By slow degrees the disease prevailed. A *post-mortem* examination showed that one hemisphere of the brain was "entirely destroyed—gone, annihilated—and in its place," says Dr. Conolly, "a yawning chasm." "All the man's mental faculties were apparently quite perfect." His nurse (and landlady) whom alone he permitted to attend upon him, declared that his mind was clear and undisturbed to within a few hours of his death. "He had a perfect idea of his own awful situation, and his landlady—having been gradually accustomed to the sight of horror—was alone allowed to come near him. He would not even permit his own sister or other relatives to witness his frightful condition."

Dr. James Johnson mentioned to Dr. Wigan the case of a gentleman who came under his care, "who retained the entire possession of his faculties to the last day of his existence, yet on opening his skull, it was found that one cerebrum was reduced by absorption to a thin membrane—the whole solid contents of one half of the cranium, above the tentorium, absolutely gone." This gentleman showed no sign of mental weakness, but he was subject—it will not be much wondered at—to epileptic fits.

In the next case to be considered, it was made clear on a *post-mortem* examination that the only active part of the brain had been the right cerebrum. The convolutions of the left cerebrum were in so diseased a state that when the brain was removed from its case a large quantity of serous liquid escaped from the left side, and the mass was reduced to one-third its former amount, and to about one-fourth that of the right side. In this case there had been partial paralysis of the right side, showing how the left brain governs chiefly the motor system of the right side of the body. This partial paralysis had existed from childhood; and the paralysed members were wasted and atrophied. But the intellectual faculties were entire, the patient possessed the use of his senses, and was able to walk with the help of a stick.

In Cruveilhier's "Anatomie Patho'og'que du C rps

Humain," from which the previous case is cited, there is a plate representing the right cerebrum entirely destroyed by apoplexy; yet the owner of this half-destroyed brain, "jouissait de toute son intelligence."

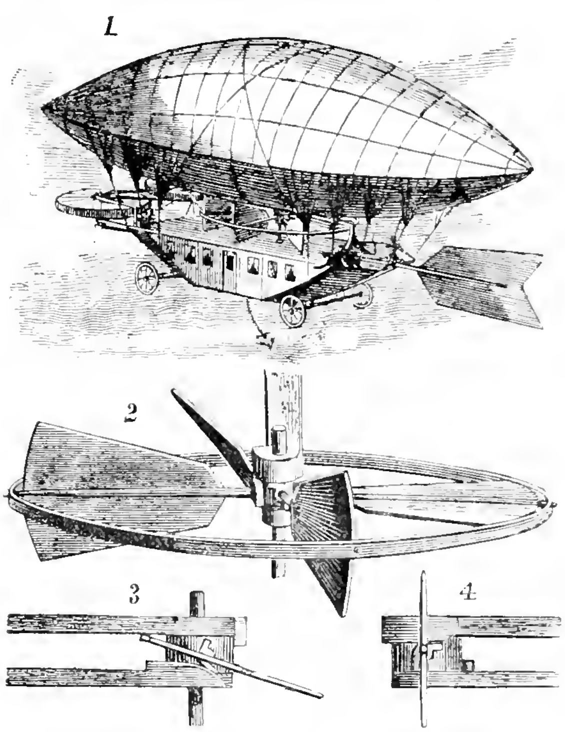
It is singular that Cruveilhier, in dealing with this and similar cases, speaks of the intelligence remaining unimpaired, with so little emphasis as to show that he had not paid special attention to the circumstance. Yet surely nothing can be more thoroughly inconsistent with the belief that the brain is to be regarded as a single organ, in this sense, at least, that the various portions of it are all essential to its complete action.

The same is the case with other writers,—as for instance with Dr. Abercrombie, who describes a case in which there was a frightful cavern in the right side of a man's brain, yet the man preserved his intelligence entire until the very moment of his death,—without dwelling in the slightest degree on the conclusion to which such a case seems inevitably to point.

(To be continued.)

AN AËRIAL PROPELLER.

THE accompanying engraving represents an aërial propeller recently patented by Mr. M. H. Depue, of Homer, Ill. The propeller, Fig. 2, has a rim and hub in



which are journaled radial blades; each journal of each blade being provided with two transverse arms in the same plane. The main rudder for guiding and controlling the machine is shown in the right side of the perspective view. Upon each side, at the other end of the balloon, is a rimular rudder used to raise and lower the machine when balanced in the air, thereby avoiding the necessity of throwing out ballast or letting out gas. The under part of the balloon, next to the car, is made straight, thereby giving the propeller more power, and the car a better shape for the other attachments. When the car descends, it alights upon small wheels, which prevent scraping and sliding on the ground. Figs. 3 and 4 show the hub of the wheel and the frame and a single paddle or blade in different positions.—*Scientific American.*

PLEASANT HOURS WITH THE MICROSCOPE.

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

THOSE who live near heaths should at least examine the three most common sorts, if they are in a region that does not grow the rarer kinds. Ling, *Erica*, or *Calluna vulgaris*, is very widely spread all "over Central and Northern Europe to the Arctic Circle, and westward to the Atlantic, from Labrador down to the Azores." So says Bentham in his "Handbook of British Flora." Generally growing in this country where furze is plentiful, the two plants, with their contrast of golden yellow and purplish-pink, varying to nearly white, give a glow of beauty to the landscape. The most obvious thing to notice with Ling, or Common Heather, is the profusion of flowers on the same stem, arranged tier above tier. This is handy for the bees, and they take some time before they have exhausted the treasures of a single spike. The little flowers have both calyx and corolla deeply cleft into four lobes, which open rather widely, and, with the help of a little magnification, show the projecting pistils closely surrounded by groups of anthers, with little white tails, standing out in a more or less horizontal circle. The disposition of the flowers is also horizontal, with a tendency of the styles to turn upwards. A pocket-lens will show that the easiest way for a bee to thrust in its long tongue is below the pistil. In doing this, it touches the little anther tails, which act as levers, and spread out the anthers so that their pollen falls upon the insect.

The best way to display the ling flower under the microscope is to fix one quite upright in a bit of beeswax in the middle of a glass slide. The wax, about half the size of a peppercorn, should be softened by heat, but not melted, and the stem of the flower held in a pair of forceps and pressed into it. The object can be illuminated with a lieberkuhn—a very useful instrument, though somewhat out of fashion—or with a bull's-eye lens, or, as I prefer in such cases, by a side silver reflector, mounted on a stand with universal motions, like those given to the bull's-eye. A three-inch objective is a sufficient power, and if the observer's eyes are a *pair*, and not, as is frequently the case, two odd ones of different focal lengths, a binocular instrument is advantageous. As soon as a bee retires from one flower it goes to another and rubs upon its stigma some of the pollen it previously received. In the course of its operations it will impregnate different flowers on the same stem, and also others on different plants. There are a great number of contrivances amongst plants to secure cross-fertilisation, and when these are adapted to make insects the pollen-carriers the flowers are called *entomophilous*, distinguishing them from those fertilised by wind-borne pollen, which are named *anemophilous*.

Viewing the ling flowers with a good pocket-lens, or as just described, it is easy to see two rows, or whorls, which both look like corolla segments. The outer one is the calyx, coloured like the inner one, the corolla, and the four calyx-looking green leaflets are bracts.

If the observer, after becoming familiar with the ling flowers, examines the Scotch heather, *Erica cinerea*, also called purple heather, it will be noticed that its leaves are larger than the former, the plant bigger, and the flowers much fewer, and at the top of the stems. Each flower, instead of opening with wide clefts in the corolla, is a close, egg-shaped bag, with a small round mouth and star-shaped lips, through which the stigma slightly protrudes, and partially closes the way. Of similar structure is the elegant pink or cross-leafed heath, which has a tuft of nodding flowers at the top of its slender stem. At first sight it does not appear why botanists call it "cross-leafed" (*Erica tetralix*), but if one of the whorls is snipped off with fine scissors and fixed upright in the wax, it will be seen that the four leaves

Fig. 1.—Erica vulgaris.

Fig. 2.—Anther of Ling (F, filament; *t*, tails).

form a cross, and that at the base of each one is a scale with a ruby glandular swelling at its base. The marginal hairs on the leaves are also worth notice. An insect like a bee could not thrust a tongue into these little bottles without rubbing against the stigma, which is viscid when the flower is ready for fertilisation, and as the invading instrument goes further, it opens the ring of

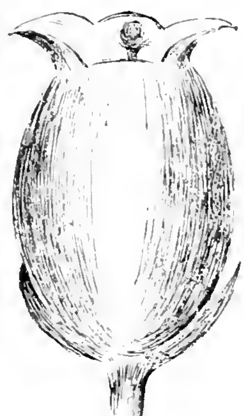


Fig. 3.—Cross-leaved heath.

anthers and receives their pollen. To watch the process, a bee should be caught in an inch-wide test-tube. This is easily done by holding the tube close to the entrance of the hive, and corking up the first bee that walks into it. A sprig of the heath should then be inserted, and, after the creature has exhausted its anger by rushing about, and buzzing in the tube, it settles on the flower, and thrusts its tongue down among the anthers. The one before me, as I write, cannot reach the bottom of the flower-cup. Removing the pink heath, I replace it with a sprig of ling, which seems to please the insect, and it forages diligently from flower to flower, easily reaching the bottom. This process is watched with a 1½-in. lens, the lowest of a set of three, as the opticians sell them in tortoiseshell mounts.

The bell of the cross-leaved heath should be opened by removing one side or the upper half, which can be done with needles. This discloses the round, green, ribbed ovary the pinkish style, and green stigma, with the group of tailed anthers below it. Fig 1 shows the form of the ling flower with its open corolla; Fig. 2, one of its tailed anthers; Fig. 3 represents the elegant bell of the cross-leaved heath; and Fig. 4, the same, more magnified and with the upper part torn away to show the pistil, surrounded with the group of tailed stamens.

I frequently find a species of thrip in the flowers of the ling, in its larval and mature states, and I cannot discover

Fig. 4.

that it does the flower any harm. It can suck the nectar without piercing the corolla, and that food does not appear to yield the material that forms the pitchy excrement of the greenhouse plague, which does as much harm by depositing this stuff as by its feeding upon the chlorophyll.

STATISTICS OF BARATARIA.

By Grant Allen.

I.

BARATARIA is an island in the Utopian Ocean, containing a population of one thousand adult persons, of whom five hundred are males and five hundred females. All these five hundred couples are newly married; they have just been planted as a colony on the island; and the Director-General of Statistics is now engaged in drawing up some interesting calculations as to their probable natural increase during the next five or ten generations.

I must apologise at the outset for this very abrupt method of plunging *in medias res*: but if one wishes to expose a fallacy, there is no better way of going to work than by reducing it at once to its simplest elements. Now, there are a great many rampant fallacies about races and populations at present implicitly current in the world at large, which, perhaps, may best be met by positing the simple and easily comprehended case of the island of Barataria.

People generally get rather confused when they come to talk about twenty or thirty millions; they can hardly fail to grasp the issues really involved when it is a mere question of a poor little thousand. Let me add, also, by way of preface, that I am not going to trench upon the debateable ground of the Malthusian problem. My object is ethnical and historical alone, not political or economical.

It is obvious that if every one of these married couples were to have two children apiece, one a boy and one a girl; and if all these children were to grow up, without a single death or misadventure; and if all of them were then to marry, the population on the whole would remain exactly stationary. True, there would be just one apparent increase to double after the birth of the new pair into each household; and the normal number of the population would ever afterwards be two thousand, instead of one: but in each subsequent generation there would always be a thousand children born; and the sum of parents and children would never greatly exceed or fall short of the round two thousand. For simplicity's sake it may be added that in Barataria the children are usually born when their parents are thirty, and the parents themselves usually die in their sixtieth year.

But, as a matter of fact, an average of two children to each family will not, of course, suffice to keep the population of the island from positively dwindling. Out of every thousand children born in Barataria, as in England, 150 die during the first year, 53 during the second year, 28 during the third year, and so forth. By the time they were all 21, and therefore marriageable, only 657 out of the original thousand would be left, of whom 331 would be young men, and 326 young women. Some of the men would, of course, of necessity have to remain bachelors, so that instead of five hundred couples, as at the beginning, we should only have 326 couples to recruit the population in future. It results that at this rate the population of Barataria would go on decreasing in the proportion of nearly two-fifths at each generation; and as we must make some small allowance for couples who do not wish to marry, we may fairly say that it would become practically extinct in seven generations. Roughly speaking, the decrease in the number of married couples would be to 300 in the first generation, 180 in the second, 108 in the third, 63 in the fourth, 36 in the fifth, 21 in the sixth, and 12 in the seventh. By that time it would be impossible to carry it on much further without an importation of fresh blood from outside to renew the impoverished stock.

It is clear, then, that an average of two children in each family will be quite insufficient even to keep up the population to a fixed standard. Indeed, if we are going to allow for infant mortality, we must put the average at more than three; and if we reckon the chances of invalids, bachelors, old maids, and other casualties, we must put it as high as four. In other words, the population of Barataria will not keep stationary even, I take it, unless each married couple on the average has as many as four children. In that case, a generation will consist of 2,000 children, of whom 1,314 will reach maturity. But of these only 652 will be girls; and allowing 152 out of that number (not an excessive estimate) for weaklings, nuns, old maids, and girls who die unmarried, we get back exactly to our original 500 couples.

This looks a startling conclusion, but it is, nevertheless, a pretty certain one. If the married couples of Barataria have only two children apiece, their population will decrease with surprising rapidity. If they have four apiece, it will barely remain stationary. If they want it to increase perceptibly, they must have five apiece or more.

Observe, too, that as some families will have only one, two, or three children each, there must be some which have more than four, even to keep the inhabitants of the island up to the fixed number. Families which have less than four children from one generation to another, are families that are gradually dying out. They represent the decadent element in the total population. Families that have more than four children are families that are gradually gaining ground. They represent the progressive element in the population. After a few hundred years, the population will consist of their descendants alone, or almost alone. As a matter of fact, so high is the real average of early death, of celibacy, and of other checks, that even five children are not enough to keep a population up to its normal level, under the circumstances of western Europe.

But the average fertility of married couples in real life, either in Barataria or in England, is something greatly in excess of this modest estimate of five children apiece. And it does not remain fixed, as I have here supposed, no matter at what age the women marry: it varies greatly with the age at the date of marriage. Dr. Matthews Duncan has shown that when women marry at seventeen they have on an average nine children each (I omit decimals, which after all are far from lively to look at, and seldom affect the practical result), when they marry at twenty-two they have seven, at twenty-seven they have six, and at thirty-two they have four and a half. Even this last comparatively high average is not, in the actual state of England, sufficient to keep up the population to its normal level. Mr. Galton has very ingeniously shown, in his "Inquiries into Human Faculty," that if all the women of a race were to marry at the age of twenty-nine, there would be a steady decrease in the number of their descendants from one generation to another. Let us put his case a little more concretely than he has done by applying it to two different classes which go to make up the population of Barataria.

Half the married couples with whom we have stocked the island are Europeans, and the other half are negroes. Now, we find in this particular case that our negro mothers usually marry at twenty (on the average), and our white mothers at twenty-nine. The result will be that our negro mothers will produce about eight children apiece, and our white mothers about five. This, however, does not in itself sufficiently express the rate at which the negroes will gain upon the whites; for while the average length of time between one generation and another among the blacks will be twenty-seven years, among the whites it will be thirty-six. In other words, not only will the negresses be absolutely more fertile, but their generations will follow upon one another with far greater rapidity: so that at the end of any given time—say, a century—the blacks will have gained doubly upon the whites—first, by greater number of births to each mother; second, by greater number of generations to the given time.

Mr. Galton's figures enable us to see exactly how fast these two causes of relative increase and decrease would tell upon the total population of our island. Let us start with 100 white mothers and 100 negresses. After 108 years (the least common multiple of 27 and 36) the number of female descendants who themselves become mothers would have risen to 175 among the negresses, while it would have sunk to 61 among the whites. At the end of the next equal period, namely, in 216 years from now, the number of negro mothers would be 299, while that of white mothers would only be 38. After the third period had lapsed (in 324 years) the number of black mothers would have increased to 535, while the white mothers would have dwindled away to 23. By that time, close intermarriage among the whites would have begun to work out their complete destruction, and in a very few years more the blacks would have completely supplanted them. Out of the two equal races with which we originally peopled the island, the one race would have quintupled itself, and the other race would have utterly died out, simply owing to the fact that the women in the one case married early, while in the other case they married late.

So far, I have taken it for granted that both the races will keep quite distinct. But in real life, it is quite impossible to put two races in close contact with one another, and yet prevent constant intermarriage or its practical equivalent. Do what you will, the two races *will* get mixed. Take an example where pride of race and prejudice are at the very worst; where one might naturally imagine that intermixture would be hardest and tardiest; where the very name of miscegenation is scouted and detested. In Jamaica, the total population in 1881 was in round numbers 560,000. Out of these, only 14,000 were white. But what effect had this small body of whites had in leavening the total population of the island? It seems incredible, but the brown people (mulattoes, quadroons, &c.) the mixed offspring of the two races, numbered over 100,000. Roughly speaking, one may say there were 450,000 blacks, 14,000 whites, and 100,000 of mixed parentage. Nothing could better show how absurdly impossible is the attempt to ensure purity of race where two distinct populations occupy the same district. And when one gets such close intermixture, the problem of separating between the two races becomes after a time absolutely insoluble.

(*To be continued.*)

THE WORKSHOP AT HOME.

By a Working Man.

SUPPOSE that in Fig. 12 (p. 155) the ends, *t*, *t* (*e*), instead of being of the form there shown, had been made of the shape *t* in Fig. 15, and that the opening into

Fig. 15.

which they fit, instead of having parallel sides, as seen from the top, were formed as at *s* in the figure above, we should have what is known among joiners as a rudimentary form of the "dovetail" joint, one of the commonest employed in joinery and cabinet-making. *t*, in Fig. 15, is called the "pin," and *s* the "socket." Before proceeding to a de-

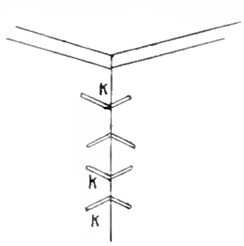


Fig. 16.

tailed description of the way of making the joint, I may advert to a kind of imitation of it, known as "mitre and key," which is used in the trays of dressing-cases and the like, and which is a good deal stronger than it looks. Fig. 16 illustrates it. It represents one side and part of the end of a small box or tray. The two pieces of board are first "mitred" (*i.e.*, planed at an angle of 45°), and joined with glue. Subsequently, two or three cuts, as shown at *k k*, are made with a saw alternately upwards and downwards, and slips of very thin wood glued and driven into them, the projecting pieces being removed when the glue is cold. I shall presently have something to say about the way of cutting mitres, as the mitre-joint is a very common one in picture-frames, &c. To return now to our dovetail, Fig. 17 representing the ordinary form of it. The dovetails,

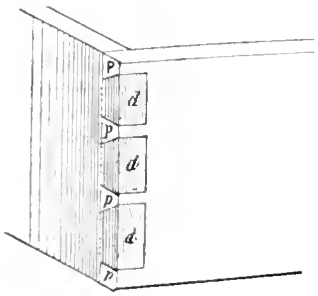
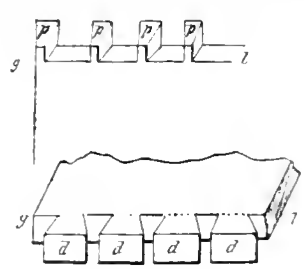


Fig. 17.

d, appear on the front of the box, drawer, or other piece of work; and the pins are cut very much smaller, in order that they may show as little as possible. They are made first. The workman as often as not marks them out with his eye, but the amateur had better do so by measurement. The wood being first properly planed up and squared, the marking-gauge (Fig. 8, p. 154) is set to the thickness of the board, and both the sides and ends of the box marked in both sides as at *m m*. The two end-pieces should be at least twice as thick as the intermediate ones. A, Fig. 18, shows how the pieces are marked; they are cut down to the gauge-line *g l*, with the tenon-saw (Fig. 2, p. 154) and the intermediate wood removed with the chisel. Note that in cutting towards the *bottom* of the intervals between the pins, the flat face of the chisel is held next the solid thickness of the board, and the tendency should be rather to leaving the outside edges on *g l* higher than the middle than otherwise. This insures a closer joint. To the same end the pencil lines marking the pins should be left visible in sawing. Having thus cut out our pins neatly, we lay the second piece of wood down on our bench or table, and setting the pin-piece upright upon it, with the pins in their intended places, and with their thicker ends on the gauge-line, or towards the inside of our box or drawer, we pass a thin, sharp bradawl along the two



Figs. 18 and 19.

sloping sides of each of them, and so mark out their shapes. Then, as before, we put the end or dovetail pieces upright, and with our tenon-saw saw along their gauge-lines, leaving them just visible. Finally, we remove the little piece of wood with the aid of a chisel, and our dovetail piece, as shown in Fig. 19, is complete. Fig. 17, above, shows how these two pieces mutually fit together. The beginner will be careful to leave both pins and dovetails full large, in order that the joint may be a tight one; but they obviously must not be *too* large, or they will split the wood when driven home. Assuming, then, that we have got a sufficiently tight-fitting joint, the pins and hollows between the dovetails are brushed over with thin hot glue, and then the parts are replaced, a mallet being used to drive the pins home, as quickly as may be, and the whole affair put aside for twelve hours or so, until the glue has set.

When a box is being made, it is evident that there will have to be four sets of pins, with their corresponding dovetails.

The dovetail is a joint of such importance and in such common use, that I recommend the amateur mechanic to practise it on waste bits of deal for the sake of attaining proficiency in it.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER IV. (*continued*).

When our observer has pushed his way as far south as he can, at which time the southern pole of the heavens will be nearly overhead, he will have completed his survey of that particular section of his abode; and having satisfied himself that it is a semicircle (wanting only two short arcs at each end, which he has been prevented from traversing by the difficulty which enormous icebergs have opposed to his progress) he returns to his first station to commence explorations in new directions.

He first sets out towards the east—in other words, keeping the pole of the heavens continually on his left hand.

He finds now no change whatever in the aspect of the heavens, and if he were not very watchful he might be led to suspect that there was nothing to be gained by pursuing his researches in this direction.

But our observer *is* very watchful. He has set forth to determine the earth's figure, and he means to master the problem, if it can possibly be done.

As before, he has taken with him an accurate chronometer, one which will not only enable him to measure the rate at which the heavens rotate, when he is stationary at any place upon his route, but to compare the aspect of the heavens at any instant with the aspect which they present at the place he started from. In other words, he has a chronometer which will enable him to know exactly how many hours and minutes have passed since he left home, let the interval which has elapsed be long or short.

Now, in his former journey his chronometer, or rather this particular quality of his chronometer, did not serve him much. He found no change either in the uniform character of the celestial motions, or in their rate; and, further, he found that on any day a star reached the highest point of its path at exactly the same time as it would have done when watched from his first station.

But in this second journey this is not the case. When he is stationed at any place the heavens rotate precisely at the same rate as before; but, while he is travelling, the heavens seem to rotate faster. In other words, according to the distance he travels towards the east he finds the heavens farther advanced than he knows they appear to persons at his original station. For example, when he has travelled about 430 miles towards the east, he finds that a particular star reaches its highest point in the north about forty minutes sooner than as seen by his friends at home.

It is clear that this was to a certain extent to have been expected. As he is travelling towards the region from beyond which the stars seem to rise, he might naturally expect to see them rise sooner. But as he has already convinced himself that the stars are at a distance incomparably exceeding the distances he has travelled, he knows that by travelling in a straight line he could not produces such changes as he observes.

For example, suppose that A (Fig. 3) is his first station, W A E the east-and-west line, S A N a part of the earth's circular section in a north and south direction. If at A, a star is in the south, as at *s*, at B the star will appear towards the west of south, or advanced towards its setting, or in direction B *s*. But as *s* has been shown to be very far off indeed, the angle A *s* B would be very small, whereas it really amounts to about 40 minutes' motion; that is, to about 10 degrees.

It is clear that if his second journey is like the first, along a circular path, the observed change will be readily explicable, because his horizon would then be continually changing, and instead of having to assume a change of place in the star, he could explain its observed change of direction, as due to a change in the direction of the north-and-south line, by which he estimates the star's

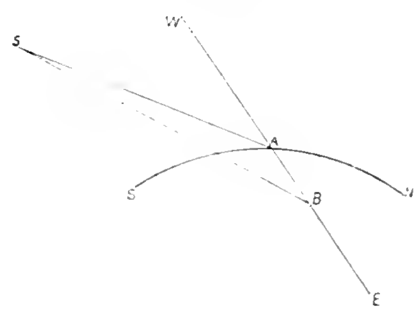


Fig. 3.

position. The change is one which it would be by no means easy to illustrate satisfactorily, because in reality the horizon plane is shifting in a rather complex manner. But the attentive reader cannot fail, I think, to understand the accompanying illustration.

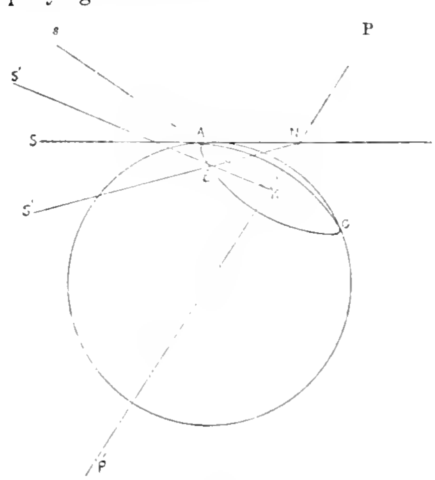


Fig. 4.

Let A, Fig. 4, be the first station of the observer, S A N the north-and-south line, P P′ the direction of the earth's polar axis, K A s at right angles to P P′, the direction in which a star that rises due east is seen when due south. Then, as the traveller sets off square to N A S, and keeps on travelling in a direction square to the line drawn (as S A N is) to the axis P P′, it is clear that he travels in a plane square to the axis P P′. Let A B be the arc he traverses round K, then N B S′ is his new north-and-south line, and K B s' the new direction of the star when due south. Thus the angle s K s' is that by which the star comes sooner to the south. A B then, the path of the traveller, measures the angle he has traversed round K. But we have seen that that angle is about 10°, where A B is about 430 miles. Hence, *if* the new path of the traveller is a circle, it has a circumference of 36 times 430 miles, or 15,480 miles—that is, a radius of about 5,000 miles.

Our traveller continues his journey, and finds that there *is* a uniform change corresponding to a uniform increase of the angle A K B, as he travels uniformly onwards, and he concludes that the path he follows is therefore a circle about K. Nay, he can continue his journey until he comes quite round to A again, and he thus finds that that circle has a circumference of about 15,500 miles, as his first observations promised.

Thus he learns that a second section of his dwelling-place is circular, and this at once suggests that he is living upon a sphere, because the sphere is the only figure whose sections are all circular.

We shall now see how he completes the demonstration as the earth's globular figure, and then, with a brief sketch of the less perfect demonstrations commonly found in treatises of astronomy, and a few comments on some phenomena which have seemed to throw doubt on the theory that the earth is globular, this chapter on determining the figure of the earth will be completed.

(*To be continued.*)

DICKENS'S STORY LEFT HALF TOLD.

A QUASI SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from page* 210.)

TO return to the events preceding the attempted murder. It has been arranged, we note thirdly, that Mr. Grewgious is to dine with Rosa on Christmas Day. As an essentially methodical man, he would probably make the journey on Christmas eve, arriving perhaps at Cloisterham late in the evening. He might even have gone to the Crozier (the orthodox hotel), afterwards visited by Mr. Datchery. Certainly Mr. Grewgious was at Cloisterham early on the 25th, but how early we are not told. Rather strange, I take it, that we see nothing of Mr. Grewgious till late on the evening of the 27th, nearly three days after the attempted murder, and that *then* he comes only to speak to Jasper in a tone which would be utterly brutal unless Mr. Grewgious were absolutely certain that Jasper was the murderous villain to whom all the trouble was due. This tone, which Mr. Grewgious maintains not only throughout the scene with Jasper but to the last, could not possibly be based on such suspicions as Rosa would have conveyed to him (in any case). From no one but from Jasper himself or from Drood, could Grewgious have derived that sure information which would alone cause a rigidly just, though angular man like him to treat Jasper as he did.

So much for some of the points preceding the attempted murder. (These and other matters are more fully dealt with in my article in *Leisure Readings*.) Let us now turn to what is related in connection with that event.

It is clear, in the first place, that Jasper is careful to drug his victim; we have seen how he drugged Durdles, carefully watching how the drug took effect, and in what way the victim passed from under its influence. It was probably after Drood's return from his walk with Neville to see the effects of the storm, that Jasper persuaded him, in what Drood called his moddley-coddleying way, to take a warm drink before going out to watch the effects of the storm from the tower.

It is clear, secondly, that Jasper's first attack on Drood was made with "the large black scarf of strong close-woven silk," which he probably pretended to round his victim's throat to keep him from the cold, but (having him once so held) drew suddenly tighter, and hauling Drood to the edge of the tower, cast him down to "that stillest part which the cathedral overshadowed," and on which he had gazed so intently when on his expedition with Durdles. But Drood struggles so that "some stones on the summit of the great tower" are "displaced" (by the storm, the people think next day); as he falls, the fierce wind mercifully drives his body against the sculptured face of the tower, to which he clutches, breaking his fall. (For though, we learn afterwards, when Jasper goes through the scene again under the influence of opium, there was "no struggle, no consciousness of peril, no entreaty," yet was there *something* which, in his many visions of the event before it happened, he had *never seen*. "I never saw *that* before," he says.) Falling to the roof, Drood clutches the lead covering, a part of which is carried away, rolling up as more and more yields with his weight. (The strength of the wind, supposing nothing were indicated by what is said about the roof, would have sufficed to carry Drood from the direct downward course to the slant roof, still further breaking his fall.) But when Jasper descends, after looking down (as he afterwards tells us) on the body of his victim, he finds Drood apparently dead, strips from the body the watch, chain, and breast-pin, which can alone, as he thinks, resist the corroding action of the quicklime, and casts it into the tomb prepared for it, locking the door of that tomb and of the crypt, and hastening to his own room.

So much we can guess, and indeed so much Dickens may be said to tell us. I take it that then (as in Dickens's striking story, "The Signalman"), the dream-voice which Durdles had heard the preceding Christmas Eve is heard in reality Durdles lying drunk in the precincts, and unnoticed by Jasper, hears, after Jasper has retreated, a terrible scream (but not, this time, "the howl of a dog"), and making use of his wonderful power of determining what lies inside stone walls, detects just what he had described during the "extraordinary expedition,"—inside Mrs. Japsea's tomb, "Something betwixt us, sure enough, some rubbish left in that same six-foot space," and opening the tomb finds that rubbish to be quicklime, into which has been hastily flung the body of Drood, his face fortunately protected by the strong silk shawl with which Jasper had intended to throttle him.

We may suppose that Durdles dragged the body out of the tomb and out of the crypt, and was there presently assaulted first and helped afterwards by the impish Deputy. They carry the body away—perhaps to the Traveller's Rest, where as Drood came to himself he would be taken, all draggled and lime-stained as he was, for one of Durdles' workmen, who "doing what was correct by the season," had fallen into a heap of quicklime and narrowly escaped death. Durdles himself, being drunk, would readily have supposed that the lime "had been left in that six foot space by Durdles's men," and that the man he had rescued from it was one of them. Or Grewgious, disturbed from his rest at the Crozier, may have been by when the body was taken out, and have seen to its removal to the Travellers' Rest, there first finding who it was, and taking due measures to keep the matter hidden—possibly at the suggestion of Drood himself—until a scheme for the punishment of Jasper had been devised. Durdles and the Deputy would be easily bribed to secresy. Note in passing, as a rather striking piece of evidence respecting Drood's whereabouts on Christmas morning, that Datchery alone of all the characters of the story, knows the nickname by which the Deputy is called at the Traveller's Rest. "Halloa, Winks," he says; and Deputy seems surprised. "I say," he remonstrates, "don't yer go a-making my name public," explaining how the name was given to him, and what it means. It is certainly suggestive that Datchery should know of a name which the Deputy says "the travellers give me" ("give" being here in the past tense). It may be pointed out as entirely inconsistent with this that when Mr. Datchery first meets, or seems first to meet, the Deputy, Datchery asks his name, and the Deputy says "I don't owe yer nothing; I never seen yer." For clearly Drood's question is quite consistent with his having seen the Deputy before (apart from which his disguise has to be considered), and of course the Deputy would not recognise him in his entirely changed aspect.

Now let us consider what follows the disappearance of Edwin Drood.

In the first place, we find that after the impeachment (I use Dickens's own word) of Neville Landless, Jasper employs Christmas Day in preparing measures for making as widely known as possible how much he himself is troubled about Drood's death, and how grievously he suspects Neville. Doubtless the whole of that day Jasper took care to be in the sight of men as much as possible. He had not got rid of the watch and pin then, for, when found, the watch had run down, and it was wound at two on the afternoon of Christmas Eve, so that it would run till late on the evening of Christmas Day. Jasper, then, cast the watch and breast-pin into the water on the night of the 26th or 27th, for during the daytime on the 26th and 27th he was with the river-searchers. As the watch was bright enough to catch Crisparkle's eye in the running water on the morning of the 28th, I take it that it was probably flung into the weir, or rather carefully placed where it might be seen, not earlier than the night of the 27th, on which point we shall presently note further evidence. That stress was to be laid on this point is shown by the way in which attention is directed to the winding of the watch at two, and in which the jeweller's opinion is probed. He is made to say that he is positive it had never been rewound, a strange thing to say, seeing that no man, jeweller or otherwise, could be positive on such a point, though Dickens (who had some rather strange ideas as to what an expert might infer) may very well have supposed that such a matter might be determined. It is clear we are to take it as provable that the watch was put in the weir after the evening of the 25th.

It seems to me probable that immediately on learning of the attack on Drood, Mr. Grewgious sent for Buzzard, to keep watch on Jasper's movements, and that Jasper was followed when he went to the weir to place Drood's watch, chain, and breast-pin there. We shall see that there is other reason for supposing that Buzzard was early employed to keep Jasper in view.

(*To be continued.*)

EMIGRANTS' PROSPECTS IN AMERICA.

FROM AN ENGINEER'S POINT OF VIEW.*

By W. R. Browne, M.A.

The first thing which strikes an engineer in approaching Canada is the overwhelming abundance and cheapness of timber. It is not merely that, as the steamer sweeps up the magnificent reaches of the St. Lawrence, the eye takes in mile after mile of virgin forest which nobody has touched or seems to think worth touching; where the only sign of man's presence, beyond fishermen's huts scattered thinly along the shore, is that here and there a few thousand acres have been devastated by bush-fires, leaving a rich carpet of scrub a perfect "fireweed," with white skeletons of dead firs standing out of it by thousands. It is still more of a shock to find in Quebec that the "side-walks" are composed of nothing but 3-in. planks, cut to length, and roughly spiked together on beams, side by side; and that the new "Dufferin Promenade," and even some of the streets, are roughly paved with the same material. Whenever there is a job to be done of any kind, it would seem that a Canadian's first idea is to cut down a tree to do it with. It does not need the large rafts of logs anchored off Point Lewis—the suburb on the opposite shore of the St. Lawrence to Quebec—to impress on the mind the immense extent of the lumber trade in Canada. Down a single river—the beautiful St. Francis, along which the Grand Trunk Railway is carried from Richmond to Sherbrooke—I was told that some forty million logs are floated every season. And the warfare goes on unremittingly, without any thought, or as yet apparently any need of thinking, whether it may at last be carried too far. True, things are not as they were in the early days, when fences were made of walnut wood, and valuable timber, in itself worth many times the fee simple of the land it stood on, was felled and left to rot, or burnt for firewood. Now every stick got within manageable distance of a railroad has a definite value, and is worth saving. But still there is no thought of replacing what has been taken away. The ground whence the trees have been removed is either brought into cultivation, or nature is left to repair her damages as best she may.

It does not take long to form a conviction that Canada, from the engineer's point of view, is a very unpromising field. Agriculture, in which the timber track may be included—since trees are, after all, only one form of produce—is the one great staff of the country, and Canadian agriculture needs very little help from the English engineer. To begin at the beginning. Take the process of reducing a tract of forest land to culture, as explained to me by a veteran in the art, and let us see how far English machinery comes, or can come, into the operation. A Canadian bush in summer is almost an inland forest carpeted with weeds and flowers and grasses, rich with abundant but not impenetrable underwood, and thickly studded with fair-sized trees, yielding more or less valuable timber. These trees have mostly English names—elm, beech, ash, poplar, cherry, &c.; but though probably cognate species, are very seldom identical. When such a bush as this is to be cleared, the first requisite is obviously to fell the trees. Here it might appear that the tree-cutting machine

* From the *Engineer*. This article, says our contemporary, possesses a melancholy interest. It was intended to be the first of a series of papers to be written by Mr. Browne, as our special correspondent with the British Association. It is the last he ever wrote, and the announcement of his death reached us by telegraph, while his manuscript was still on the Atlantic.

exhibited not long ago might find employment, but—not to speak of difficulties in getting it to work on the right spot—it is sufficient to observe that two French lumbermen, each with a good axe, will fell a spruce, 2 ft. in diameter in ten minutes. It is likely to be a long time before machinery can compete with hand labour of such quality and on such work. The trees—with the exception of saplings 6 in. in diameter and less, which are cut even with the ground—are hewn down, so as to leave stumps about 3 ft. high, which form very unsightly objects in all new clearings. The reason for this will appear shortly. The trees so felled—unless burnt as they lie, which was often the practice in early days—are hauled off the ground by gangs of lumbermen—"teamsters," earning 40 dols. a month—and taken to the saw-mill, or brought down to the nearest river, and launched in vast rafts down the stream to cities and civilisation. This takes place, of course, in the winter, and as soon as spring has fairly set in, the preliminary operations are completed by setting fire to the weeds, scrubs, saplings, &c., and reducing the whole, together with the larger stumps, to charred fragments and ashes. The ground is then immediately sown, as it best may, with wheat, and grass seed is scattered in at the same time. The wheat is cut in the "fall," generally yielding a fair crop; the stubble is crushed down by the snow in the winter, and the grass springs up in the following spring. After three or four crops of hay have been got, the ground becomes "pasture," and is browsed by cattle for a space of some five or six years more. By this time the smaller stumps are rotten, and can be drawn out of the ground by a team of horses or oxen. Between the large stumps which still remain it is possible to plough, and the ground may now be brought into ordinary cultivation, generally on the four-course system. In three or four years more the large stumps are amenable to the same treatment. They are drawn accordingly, with more or less difficulty, and the last vestige of the primeval bush has disappeared.

Now, in the whole of the above operations it is obvious there is very little which can claim the aid of the engineer. Even ordinary agricultural implements—reapers or ploughs—are hardly applicable so long as the stumps remain to cumber the ground. It is true that, as I was told, a sanguine Scotchman, some years ago, proposed to use traction engines for the purpose of drawing these stumps, without waiting for their decay. He even induced people to find money for the purpose—for what purpose will not people find money, if it be only absurd enough?—but the practical results were as might have been expected. Stumps are, as a matter of fact, often raised by means of screw tackle, mounted on a strong waggon bed, and worked by horses; but this is a very rude affair, needing nothing in the way of expensive machinery. Even when the last stump is drawn, and the land has got into the full swing of cultivation, although the resources of modern agricultural engineering may be brought into play, it is not from Great Britain that they will be drawn. Canadian farmers will have nothing to do with English implements, which they consider altogether too heavy and unsuited for their work. They prefer the lighter, cheaper, and handier machines made in their own country or in the United States; and if you urge the cost of repairs, they reply that almost all the parts being in duplicate, there is very little difficulty in replacing them. The same applies to the saws and wood-working machinery as required for the lumber trade; while in general engineering the differences in practice between the two countries are sufficient in almost all cases to determine the choice.

(*To be continued.*)

ELECTRO-PLATING.

By W. Slingo.

XI.

Let us now turn our attention to the deposition of copper upon iron, &c. Very many interesting and pleasing effects may be produced in this way, more especially if the copper film is subsequently coated with another of one of the more precious metals—gold or silver.

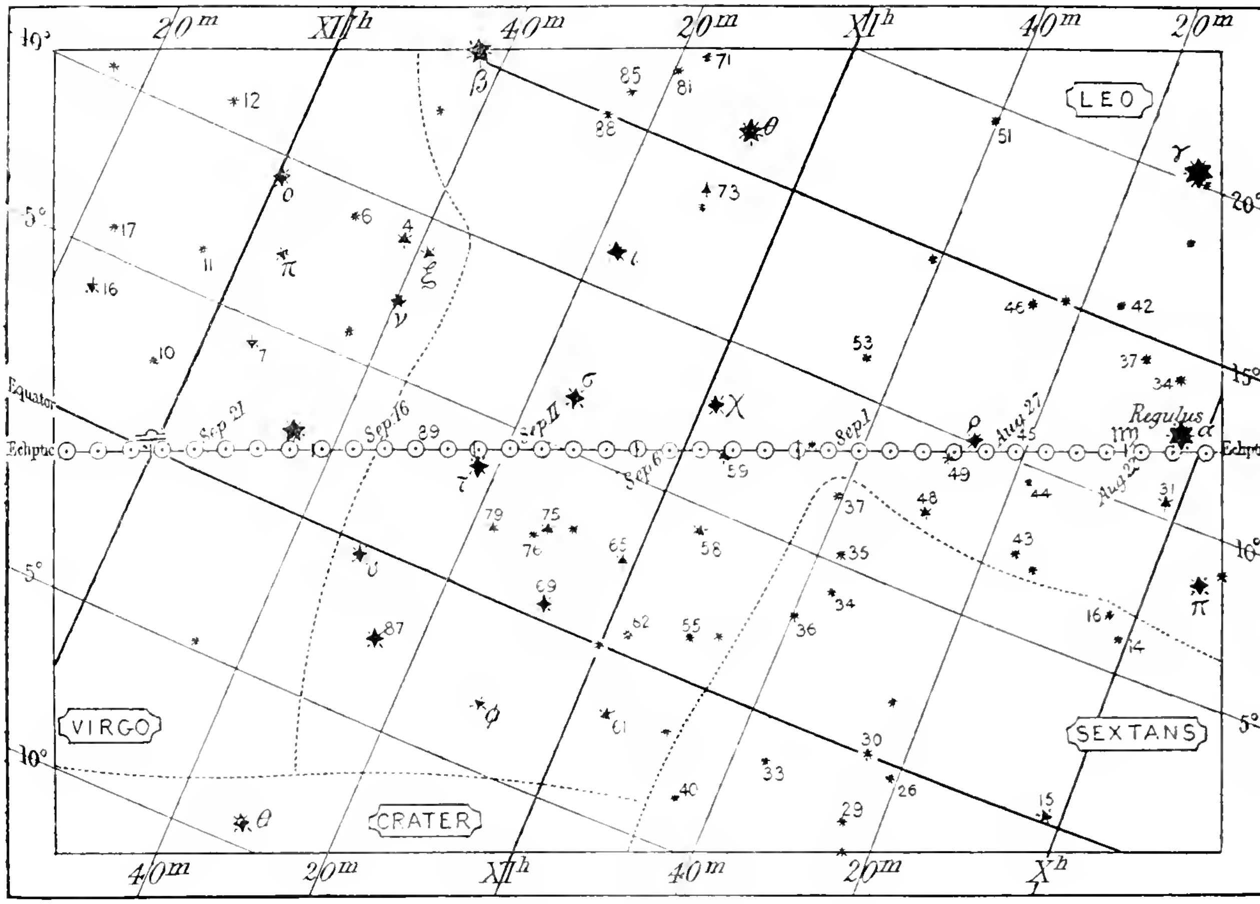
The iron must not be placed directly into the bath, otherwise the deposit will only occur in places, if at all. The surface of an iron object is never chemically clean, hence the necessity for the preliminary treatment. A particle of grease is highly pernicious, but is easily removable. This is accomplished by washing in a strong caustic alkali solution, consisting of sodic or potassic hydrate (caustic soda or caustic potash), dissolved in water, with the addition of a little fresh slaked lime. After remaining in the clear solution for some time, the iron object is removed, and well washed with clean water. The iron surface has besides a more or less copious supply of other foreign matter, which is removed by placing in a vitriol solution made by mixing together a pound of sulphuric acid and a gallon and a half of water, adding two or three ounces of hydrochloric acid to remove the more obstinate impurities. It will be found that this "pickle" will remove all the injurious matter likely to be met with. Were we to immerse in the bath an impure surface, the probability is that local action would ensue, considerably to the detriment of the deposit. After remaining in the pickle for some little time the iron is removed and well scrubbed with sand and water. Any foreign particles that may have been loosened, but not removed by the acid, are thus torn away and a good surface results. The student might, by way of experiment, prove the effect of an imperfect surface, using a small iron object, such as an old key, in a small quantity of solution. This solution should, however, be subsequently thrown away.

The object to be coated is then attached to the negative electrode, and placed in the bath. The solution differs from that used to precipitate copper upon a plumbago or silver surface. Two ounces of sulphate of copper are dissolved in boiling soft water, and after allowing to cool, four ounces of carbonate of potash are added, and two or three ounces of strong ammonia solution. After a time, about six ounces of cyanide of potassium are gradually added, until the blue colour disappears. It is anticipated that some difficulty will be experienced in procuring the cyanide, in consequence of its highly poisonous properties, but it may be obtained in the same way that other poisons are procurable. After allowing to stand for some time, the clear solution is poured off, the precipitate which has formed being left behind.

The object is kept in the solution until a thin but perfect deposit is obtained, when it is removed and placed in the acid solution employed in previous experiments. The reason for this is that in acid solutions, iron, zinc, and other metals are assailable, whence the use of the cyanide solution. When, however, a thin deposit has been procured, there is no longer any necessity to use the cyanide solution, as the object is to all intents and purposes a copper one. It is noticeable that, iron being a good conducting metal, the resistance of the object is very much less than that offered by a substance of a non-conducting nature, coated with plumbago or any other conducting material.

Other solutions might be used, but the above appears to be the best, and answers very well.

Hitherto a pitch-lined wooden bath has answered all



Day Sign for the Month.

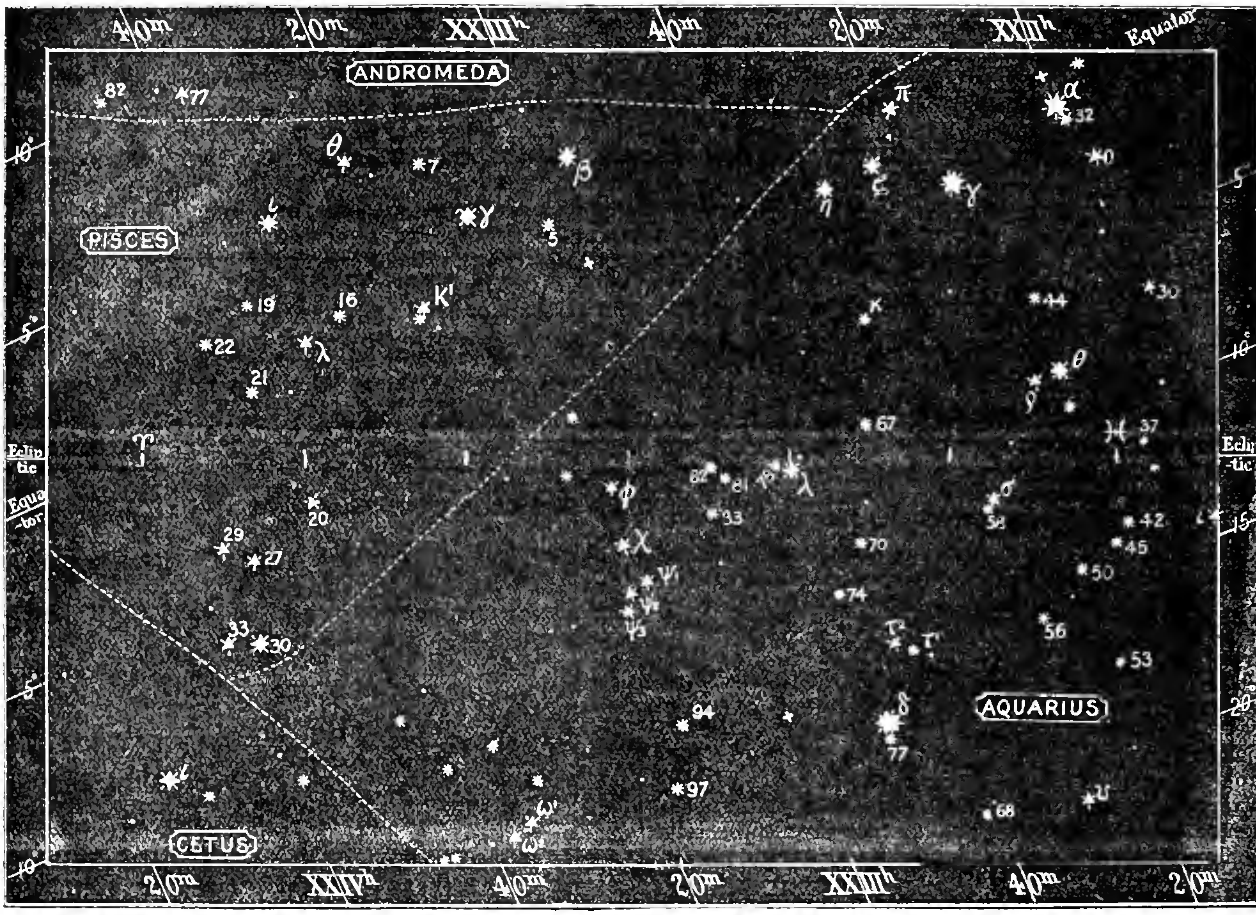
purposes, but when using the cyanide solution a more obstinate material must be substituted. For small objects earthenware pans are useful, but for larger ones enamelled iron is a better material.

The process for coppering zinc is very similar. The metal is first freed from grease by immersion in the alkaline solution, and then placed into a vitriol solution, composed of ½ lb. of sulphuric acid to a gallon of water, no hydrochloric acid being necessary. The remainder of the process is the same as that for depositing on iron, and for like reasons.

To deposit a film of copper upon a glass object, a coating of gutta-percha (dissolved in turpentine) is first applied, to enable the plumbago, which is next brushed over, to adhere. When any difficulty is found on applying the plumbago another process may be resorted to. A pound of tallow is melted and added to two ounces of caoutchouc and a pound of asphalte dissolved in a pint of turpentine. The mixture, after being well stirred, has added to it a solution consisting of an ounce of phosphorus dissolved in fifteen ounces of bisulphide of carbon. When thoroughly mixed, the object is dipped in it, or a small quantity is brushed over the surface. The object is then dipped into the nitrate of silver solution (referred to on page 152), next into a vessel of clean water, and subsequently into a solution of chloride of gold. After being again washed it is allowed to dry, when, the wire being attached, it is placed in the bath, the solution being the same as that referred to in previous articles.

The surface of the copper on being removed from the bath is usually very bright, the appearance, however, being speedily impaired by exposure. Consequently the copper is generally lacquered or bronzed. A fair copper tint may be easily imparted by warming the deposit, and then applying pale lacquer with a camel-hair brush. In bronzing, different colours are produced according to the object operated upon. A brown finish may be imparted by moistening the object with water slightly acidulated with nitric acid, and, after allowing it to dry, heating it gradually until the required shade is produced. If the object require relief, a dark brown film is in this way produced, and then the prominences are brightened by rubbing them with a piece of cloth or leather which has been dipped into liquid ammonia.

These effects, however, are liable to fade, but more permanent effects may be obtained by bronzing. A deep brown tone is produced by rubbing a little rouge, mixed with a small quantity of a weak solution of chloride of platinum, over the copper with a soft brush, and allowing the coating to dry. Another brush, a little harder than the first, is then applied briskly until the necessary brightness is obtained. Variations in depth of colour may be produced by rubbing the bronze off the more prominent parts of the object. A black bronze surface is produced by dipping the object repeatedly in a weak solution of chloride of platinum, or by mixing a small quantity of the chloride with rouge, and then rubbing the mixture over the object with a soft brush, and afterwards with a harder one. Ammonia may be used to lighten the projecting portions of the surface, which should, by the way, be heated before the powder is applied.



Night Sign for the Month.

ZODIACAL MAPS.

By Richard A. Proctor.

We give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

THE BRITISH ASSOCIATION OF SCIENCE.

Lord Rayleigh's opening address occupied nearly an hour and a half in its delivery. In his opening remarks he mentioned that for more than fifty years the Association held its gatherings in various towns in the United Kingdom, there being few places of any importance which were not visited. Not being satisfied, they sought to conquer new worlds, hence the present meeting in Montreal. When first proposed the project was looked upon with disfavour, as once the thin edge of the wedge was admitted there was no telling to what it might lead. The British Empire being so rapid in its development, there was a prospect of such out-of-the-way places as London and Manchester no longer being able to claim a visit of the Association except as a concession to the susceptibilities of the English. Whatever objections were at first felt were soon overcome by the prospect of the magnificent opportunity of members of the Association becoming better acquainted with the Queen's dominion in this part of the world. He then referred to the loss sustained to science by the death of W. Siemens. The speaker then reviewed the striking advances made of late years in the production and application of electricity upon a large scale, and also touched upon the inventions of the telephone and phonograph.

THEORETICAL ACOUSTICS.

In referring to theoretical acoustics he said: Progress has been steadily maintained, and many phenomena which were obscure twenty or thirty years ago have since received adequate explanation. If some important practical questions remained unsolved one reason is they have not been definitely stated. Everything in connection with the ordinary use of our senses presents peculiar difficulties to scientific investigation—some kinds of information with regard to their surroundings are of such importance to successive generations of living beings that they have learned to interpret indications which, from a physical point of view, are of the slenderest; we are in the habit of recognising without much difficulty the quarter from which a sound proceeds, but by what means we attain that end has not yet been satisfactorily explained. It has been proved that when proper precautions are taken we are unable to distinguish whether a pure tone as from a vibrating tuning-fork held over a suitable resonator comes to us from in front or from behind. This is what might have been expected from an *à priori* point of view, but what would not have been expected is that with almost any other sort of sound, from a clap of the hands to the clearest vowel sound, the discrimination is not only possible, but easy and instinctive.

In these cases it does not appear how the possession of two ears helps, though there is some evidence that it does, and even when sound comes to us from the right or left the explanation of the ready discrimination which is then possible with pure tones is not so easy as it at first appears. We should be inclined to think the sound was heard much more loudly with the ear which is turned towards than the ear that is turned from it, and that in this way the direction was recognised; but if we try the experiment we find that at any rate with notes near the middle of the musical scale the difference of loudness is by no means so very great. The wave lengths of such notes are long enough in relation to the dimensions of the head to forbid the formation of anything like a sound shadow in which the averted ear might be sheltered.

LANGUAGES AND MATHEMATICS.

In concluding, reference was made to the place the dead languages hold in general education, and the opinion expressed by some that it was monstrous that they should continue to hold such a position. He did not take up an extreme position, but doubted whether an exclusively scientific training would be satisfactory. Where there is plenty of time and a literary aptitude, he could believe that Latin and Greek might make a good foundation. It was useless to discuss the question upon the supposition that the majority of boys attain either to a knowledge of languages or to an appreciation of the writing of ancient authors. The contrary is notoriously true, and defenders of the existing system usually take their stand on the excellence of its discipline. From this point of view there is something to be said. The laziest boy must exert himself in puzzling out a sentence with grammar and dictionary, while instruction and supervision are easy to organise and not too costly. But when the case is stated plainly few will agree that we can afford to entirely disregard results. In after-life intellectual energies are usually engrossed with business, and no further opportunity is afforded for attacking the difficulties which block the gateways. Mathematics, especially if not learned young, are likely to remain unlearned. He would not further insist upon the educational importance of mathematical science, because with respect to them he would probably be supposed to be prejudiced, but of modern language he was ignorant enough to give value to his advocacy. "I believe," said he, "that French and German, if properly taught—which I admit they rarely are at present—would go far to replace Latin and Greek from a disciplinary point of view, while the actual value of the acquisition would, in a majority of cases, be incomparably greater. In half the time usually devoted without success to the classical languages most boys could acquire a really serviceable knowledge of French and German history, and a serious study of English literature, now shamefully neglected, would also find a place in such a scheme.

SCIENCE AND MATERIALISM.

"There is one objection often felt to a modernised education, as to which a word may not be without use. Many excellent people are afraid of science as tending towards materialism. That such apprehension should exist is not surprising, for unfortunately there are writers, speaking in the name of science, who have set themselves to foster it. It is true that among scientific men, as among the other classes, crude views are to be met with as to the deeper things of Nature, but that the life-long belief of Newton, of Faraday, and of Maxwell is inconsistent with the scientific habit of mind is surely a proposition which I need not pause to refute. It would be easy, however, to lay too much stress upon opinions of even such distinguished workers as these. So far as the opinion of a scientific worker may have a special value, I do not think that he has a claim superior to that of other educated men to assume the attitude of a prophet. In his heart he knows that underneath the theories he constructs there lie contradictions which he cannot reconcile. The higher mysteries of being, if penetrable at all by human intellect, require other weapons than those of calculation and experiment. Without encroaching upon grounds appertaining to the theologian's and philosopher's domain, natural science is surely broad enough to satisfy the wildest ambition of its devotees in other departments of human life and interest.

"True progress is rather an article of faith than a rational belief, but in science a retrograde movement is, from the nature of the case, almost impossible. Increasing knowledge brings with it increasing power, and, great as are the triumphs of the present century, we may well believe that they are but a foretaste of what discovery and invention have yet in store for mankind. Encouraged by the thought that our labours cannot be thrown away, let us redouble our efforts in the noble struggle. In the Old World and in the New recruits must be enlisted to fill the places of those whose work is done. Happy should I be if through this visit of the Association or by any words of mine a larger measure of the youthful activity of the West could be drawn into this service. The work may be hard and the discipline severe, but the interest never fails, and great is the privilege of achievement."

LIEUT. GREELY'S WELCOME.

As Section E. was about proceeding to business a couple of tall gentlemen of very unassuming appearance entered the room. One of the strangers, a dark-looking gentleman with a short black beard and side-whiskers, seated himself just inside the door of the antechamber, where he was immediately surrounded and welcomed in an expressive manner by Sir Henry Lefroy and other members of the committee. Sir Henry in welcoming Lieut. Greely said that he, as well as all geographical and scientific men of Great Britain and the whole of Europe, had followed with great interest the efforts made to effect the release of his party, and hailed with the keenest delight their rescue. Lieut. Greely, in reply, remarked that he was delighted at being invited to the British Association, and in attending, and only hoped that he could do more than he would be able to. He would, of course, connect himself with the geographical section principally, and would contribute some of the results of the expedition. In reply to Sir Henry's inquiries, Lieut. Greely stated that the meteorological observations have not been reduced. In an animated manner he proceeded to speak of some of the work done by the expedition. One of the most interesting results will be the comparison of the swinging of the pendulum at the furthest point north reached with that at Washington. He explained that although most of their instruments had to be abandoned, the pendulum apparatus, which weighed 90 lb., was brought back, and has been sent to Washington, where it has been reswung, and comparisons will be made. He remarked, with evident pride, that he had told his party that pendulum was a very important instrument, but that if one man of the twenty-five complained he would immediately abandon it. None would hear of this, and a very important comparison is thus rendered possible. Speaking of the observation of the temperature, he stated that the lowest temperature ever recorded was experienced in February last, when the mean temperature was 50 deg. below zero.

AMERICAN VEGETATION.

Among the most interesting papers read before the British Association, at Montreal, was one by Prof. Asa Gray, on the "Characteristic Features of North American Vegetation." He said that when the British Association met for the first time on this side of the ocean, it was not to be wondered at that a corresponding member of the association for a quarter of a century should be present to read a paper to the naturalists of Section D. He presented certain outlines of the flora of Canada and the United States as distinct from those in England or the Atlantic coast. The first impression made upon a visitor would be the similarity to the flora of England, many of the plants being almost the same. As one proceeds westward and southward, the differences become more marked. While an agricultural people displaced the aborigines of New England, the flora of Europe also gradually supplanted the plants of the red man. Many of the common plants of the Old World sprang up in the farms, and fields, and roadsides as civilisation proceeded. At almost every step in America the English botanist meets with well-known plants which have found their way from American to English soil. The Virginia creeper, rhododendron, and other well-known plants in England are of American origin. Turning from similarities to differences, an observant botanist on the Atlantic coast would be struck by the liberal number of trees and shrubs to be seen in this section of the country in comparison with England or Scandinavia. The wealth of this flora is an obvious one. The most interesting contrast between the eastern section of the American continent and Europe is the large number of tropical flowers which the heat of the American summer permits to grow in northern latitudes. There are also in this section many of the Arctic plants which remained behind after the glacial period had passed away; the same plants are also to be found in Japan and China, but are wholly wanting in Europe. Europe was at one time much similar to Greenland, which is now undergoing a period of extreme glaciation fatal to flora. In Europe also the glacial period had destroyed many types of flora which had escaped in America. The Arctic flora of America is significant; a few species are found on the cool shores of Lake Superior, the shores of Labrador, and certain mountain summits in the Appalachian mountains.

THE INTERNATIONAL HEALTH EXHIBITION.

XVI.—WATER AND WATER-SUPPLIES—(*continued*).

In conclusion of our remarks upon the supply of water for domestic purposes, we now propose to give a few simple directions for the benefit of those of our readers who may desire to test their drinking water, so as to be able to decide for themselves whether it is wholesome or unwholesome.

In collecting a sample for scrutiny, one ought to be extremely careful to thoroughly cleanse the vessel used in gathering. A medium-sized glass test-tube or beaker, repeatedly washed, at least three times, with pure distilled water, obtainable from any chemist, may be taken as chemically clean. The sample of water placed in this test-tube ought to be colourless, and free from floating particles, however minute; otherwise it must be regarded as unsuitable. Our senses would probably pronounce the water scathless, and yet it may be highly impure. Its harmful qualities usually arise from the nature of the soil through which it has passed, and the reservoirs, if any, in which it has been detained. It is further liable to be contaminated by its passage along delivery-pipes and its storage in cisterns; hence we find that amongst the injurious products which it may take up, a few are more prevalent than others, and, indeed, are regarded exclusively as the sources of annoyance to the householder. Of these, the presence of—(α) Dissolved or other organic matter in undue proportions may at once be detected by the use of Wanklyn's standard solution of permanganate of potash and potash. Add one or two drops to a test-tube full of the water; if the violet colour of the reagent remains unchanged except in intensity, and does not throw down any sediment even after a lapse of about twelve hours, the water may be looked upon as free from organic matter. If the water is only slightly contaminated, the violet hue will disappear gradually, but foul water will change the violet immediately into a faintly perceptible yellowish brown. The ordinary permanganate test, however, is apt to be vitiated by the presence of harmless nitrous acid, or protoxides of iron, to which it gives up oxygen as readily as it does to albuminoid organic matters. The water ought not therefore to be condemned solely after this test, although it may with justice be looked upon with suspicion. (β) The presence of lead dissolved from service-pipes, especially by waters from non-calcareous regions, may be immediately detected by the addition of one or two drops of a solution of ammonium sulphide to a test-tube full of the water; lead poisoned water will instantly turn brown or dirty in colour; good water will merely diminish the intensity of the yellow ammonium sulphide. (γ) Excess of iron may be demonstrated by the addition of a few drops of a solution of ferro-cyanide of potassium, by which the water will become greenish-blue, more or less markedly according to the degree of contamination. (δ) Too much lime in solution can be shown by the addition of a drop of ammoniac oxalate, when a dense white precipitate will follow. Of course, the less lime there is the less will resultant milkiness be. Ammoniate oxalate also precipitates strontium and barium from solutions, but as these substances do not usually occur in drinking waters they may be disregarded.

All the above-mentioned tests may be carried out by any person of ordinary intelligence,* and will suffice to show the character of the water-supply, and enable the householder to take precautionary measures, if necessary. In all cases, however, where the tests given fail to satisfy the consumer, or to create a suspicion that his supply is unwholesome, we would strongly recommend him to call in the assistance of an analyst, and to apply to the company or supplier for redress. We have shown, in our consideration of the subject of filtration, how extremely bad water may be rendered wholesome; let us hope that those of our readers who are interested in this question, upon which the welfare of thousands of their fellow-beings depends, may be induced to try the few experiments we have just noted, to test their own drinking-water, and, if they find it defective, to select one of the types of filter we have described, to see what it will do for them. We shall be glad to hear of and report their results in future.

* Mr. Maignen, of 22 and 23, Great Tower-street, E.C., supplies a box containing test-tubes, re-agents, and directions, for this purpose.

THE SOFTENING OF WATER.

Our inquiries into the necessary properties of potable water led us to refer to its softness only incidentally. We have shown that the value of water for the table and the kitchen does not depend essentially upon its hardness or softness. That a very hard water (from 14 to 16 degrees) is undesirable, cannot be disputed; the fur in kettles and the delicate mucous membranes of the human alimentary canal would alike rebel against its extensive employment. On the other hand, we gave as an instance the sad experiences of one of our correspondents, whose parishioners suffered from lead-poisoning, indirectly due to the very soft water of his district. Taking all things into consideration, we deem it advisable that a water, to be thoroughly wholesome for the majority, ought to contain a certain amount (from 5 to 7 degrees or thereabouts) of hardness. The softening processes employed by the water companies of hard-water districts, added to effective filtration, such as that insured by the use of Maignen's "Filtre Rapide," does not leave anything to be desired in a supply of good and pure water for drinking and cooking.

But let us turn for a moment to other branches of the household; we would find not only the laundress and scullery-maid up in arms against us, but we ourselves would feel disposed to admit that they are not unreasonable in their outcries, when we rise to wash with hard water. These inconveniences, however, are but trivial when compared with the serious drawbacks which present themselves to the engineer and manufacturer in a supply of moderately hard water. It would seem somewhat contradictory to state that it is not the hardness *per se* which is objectionable, but rather the presence of the ingredients which cause that hardness. Yet it is easy to show that when the water is merely treated so as to remove hardness without eliminating the causes thereof, such as the introduction of anti-crustation compounds, little or no good follows. As the supply of rain water is a most fluctuating quantity, it cannot be relied upon; and as distilled water cannot always be procured in sufficiency without enormous expenditure, the engineer and manufacturer are forced to look to springs, wells, and rivers for their supplies of water, and to contend against *temporary* hardness, due chiefly to the carbonates of lime and magnesia, and to a less degree to iron, alkaline earths, chloride of calcium, alumina, silica, and silicates; and *permanent* hardness which arises from the presences of the sulphates of lime and magnesia.

In steam-boilers these various products are deposited, and become a constant source of anxiety, in the form of hard incrustations and granular deposits. The former have to be periodically chipped away, or else the boiler would soon cease to act as such, owing to the bad conductivity of the incrustation layer; and if things are neglected still further, the metal plates become heated to redness, the overlaying deposit cracks, the cold water comes suddenly into contact with the red-hot surface, an enormous volume of steam is generated, and the inevitable consequence is a serious explosion. The periodical chipping off of the deposit, too, gives rise to a proportionate wear and tear, which obviously would be saved by the use of water freed from dissolved salts. The granular deposits also help to disturb the tranquillity of the engineer, by wasting his fuel, for they raise the boiling-point of the water in which they are dissolved; and when deposited they have a nasty habit of shifting along the convection currents in the boiler to some inconvenient or dangerous position, where they may behave in a manner analogous to the incrustation explosion. Even where this is provided for by the shape of the boiler, whereby they are forced to occupy some spot protected from the fire, they are prone to blow over as a fine dust along with the steam into the pipes, or even into the cylinders, and then cause dreadful havoc amidst slide-valves and other internal working parts of the engine.

The manufacturers of woollen goods, bleachers, dyers, and others, are all well aware of the evil influences of hard water. It wastes their soap, and keeps their fabrics rough and insusceptible to after-processes. Tanners find that it blocks up the pores of their skins with carbonate of lime, which impedes the subsequent treatment of dyeing the leather, and, by rendering it prone to damp, results in the production of an inferior, unstable article. Sugar refiners, brewers, and distillers are equally alive to the disadvantages of hard water, for not only does it retard the processes of their manufactures, but renders them inferior in quality, and adds to their expense by undue wear and tear of machinery.

In our next communication we shall have occasion to draw the attention of our readers to some of the most valuable and recent advances which have been made in this important branch of the water-supply question, advances which, we are glad to say, are well represented at the Exhibition.

DR. KINNS AND HIS FRIENDS.

In order to remove any possible misconception in connection with Dr. Kinns, I would add to what I said on p. 222, that the testimony of Dr. Birch and Mr. Pinches to the entire accuracy of his *historical* facts is, of course, that of two eminent members of the staff of the British Museum. As Dr. Kinns never professed that they testified to his *scientific* facts, I cannot myself conceive how any suspicion of untruthfulness could ever have been attached to him, whose title to respect is so thoroughly testified to by the names of his committee.

I think that I ought perhaps to add, too, that my description of Mr. Lynn as having "occupied a subordinate position in the Royal Observatory" may have given an inadequate idea of the status of a gentleman who was not only Superintendent of the Altazimuth, but also of the Calculating Department at Greenwich for many years. As an authority on the facts of astronomy, Mr. Lynn is unimpeachable. To him, it will be remembered, is mainly due the reclamation for Cassini of the discovery of the chief division in Saturn's ring, which had been erroneously attributed to Ball ever since the time of Dr. Kitchiner.

And I may further say that, in expressing my dissent from the action of Dr. Kinns's committee, I did so before the reperusal of his work, "Moses and Geology," which has led me to note its perfect accuracy. I therefore now withdraw all I then stated of an unfavourable character, and wish both them and Dr. Kinns God-speed!

Having thus endeavoured to set myself right with all concerned, I am glad to find, by the accompanying note, that Dr. Kinns and his committee are satisfied with my *amende honorable.*—Acting Ed.

To the Editor of Knowledge.

The College, Highbury New Park, 15 Sept., 1884.

Dear Sir,—Permit me to express, on behalf of my committee and myself, our thorough appreciation of the honourable and gentlemanly manner in which you have withdrawn all the unfavourable statements you inadvertently made in reference to ourselves in one or two of your previous editions.—With much esteem,

I am,

Yours most truly,

Samuel Kinns.

Editorial Gossip.

It is with sincere regret that I learn, through a correspondent, of the death of that well-known amateur astronomer, Mr. John Birmingham, of Tuam, which happened on the 7th instant. Mr. Birmingham's name first came before the scientific world as the discoverer, on May 12, 1866, of the wonderful temporary star which blazed up in the constellation Corona. Subsequently we hear of him as an observer of meteor showers. He would then seem to have devoted much attention to the subject of red stars, examining many of the objects in Schjellerup's catalogue for variability. He was also an excellent selenographer, and did good service to science by accurate comparisons of portions of the lunar surface with Schmidt's Great Map, and those of Lohrmann. The work, however, with which his name will be most imperishably connected is his "Catalogue of Red Stars," published in the year 1877, in the "Transactions of the Royal Irish Academy." Avowedly compiled from materials supplied by Schjellerup, Secchi, Huggins, Schmidt, Vogel, Webb, &c., this has ever since been regarded as the standard work on the subject on which it treats. It was but too tardily rewarded by the presentation to Mr. Birmingham of the Cunningham medal of the Royal Irish Academy in January last. He was engaged in his observations of red stars and in the revision and supplementing of his lists up to a very recent period. His lamented death creates a real void among the few workers in his special department of astronomical research.

The compositor has made a violent assault on my English in the first paragraph of the "Editorial Gossip" on p. 221, where the words in parentheses should read: "(and, according to the Irishman's addendum in the venerable 'Joe Miller')."

The result of an enormous mass of work lies before me in the shape of the "Bombay Magnetical and Meteorological Observations, 1879-1882." The voluminous tables it contains are supplemented by diagrams showing the variations of magnetic declination, horizontal force, &c., graphically; and hence in an impressive manner. Mr. Chambers may well be congratulated upon the results of the excellent observations taken under his supervision at Colába.

Another illustration of the wisdom of the aphorism, "Never prophesy unless you know," reaches me in the shape of the announcement of the dismal failure of the (so-called) steering balloon of Captains Renard and Krebs, on the occasion of its second trial on the 12th inst. Instead of the "presque calme" weather in which the first experiment was conducted, a stiffish breeze seems to have been blowing on this occasion, and the balloon—after the fashion of other balloons—simply drifted with it, and had to be towed back to Meudon! Try again, *MM. les aéronauts.*

Reviews.

Dynamo-Electric Machinery. By S. P. Thompson, B.A., D.Sc. (London: E. & F. N. Spon.) With the best efforts of Kempe, Sprague, Prescott, Hoskier, and now that of Prof. Thompson, Messrs. Spon are going the right way to get unto themselves the best reputation in electrical circles. Prof. Thompson is perhaps the highest authority we have on dynamos, in practice as well as in principle, and therefore his latest work is sure to be well read. One would almost think that with the flood of books already published on this portion of electrical science, together with the stagnation apparently existing in the electric lighting industry, the demand for another volume would be insufficient to warrant the venture, were it not that the author has chosen a line for himself far and away superior to any other previously adopted. He is not satisfied with general descriptions prefaced by a voluminous dissertation on the history of dynamical electricity, but plunges almost immediately into the subject and carries the reader well through it, embracing all that is at present known of the principle, construction, and government of dynamos and motors. The result is the best work that has yet appeared on the subject.

A Catalogue of Known Variable Stars, with Notes and Observations. By J. E. Gore, M.R.I.A., F.R.A.S., &c. Reprinted from the Vol. IV., Ser. 2, of the "Proceedings" of the Royal Irish Academy. (Dublin: University Press, 1884.)—So far as we have been able to test Mr. Gore's Catalogue, it is an absolutely exhaustive one of all the stars at present certainly known to be variable. The Catalogue proper contains a list and description (in their order of Right Ascension) of 191 stars. In eleven sequent columns it gives the Catalogue number, the star's right ascension, its declination, its change of magnitude, its mean period in days, the epoch of its maximum, the epoch of its minimum, the name of its discoverer and year of its discovery, and finally, in certain cases, remarks on individual peculiarities. This is followed by notes on various objects in the Catalogue, which are both valuable and interesting; in fact, the work summarises our entire existing knowledge of the variable stars in a way upon which it would be difficult to improve. Considering the number of amateurs willing and competent to pursue the observation of the mysterious bodies of which Mr. Gore's volume treats, we think it a pity that so valuable an aid to such observation as he has supplied should be locked up in the archives of a learned society. Astronomers ought to be afforded an opportunity of purchasing such a Catalogue as this.

Sanitary Arrangements of Dwelling-houses. By Mark H. Judge, A.R.I.B.A. (London: Sanitary Assurance Association. 1884.)—Anyone and everyone who contemplates a visit to the Health Exhibition, with a view to obtaining information on the mechanical details of sanitation, may lay out a shilling on Mr. Judge's book very profitably indeed. For what he has done is simply to give a short description of all the various kinds of house drains, closets, soil-pipes, baths, lavatories, waste pipes, sinks, cisterns, *et id genus omne*, which possess any special merit, in the Exhibition at present open at South Kensington. Just as the "Academy Notes" are confined to the chief pictures of the year, so our author's pamphlet points out all that is best worth seeing in connection with sanitary appliances; with, though, an occasional reference to some contrivance conspicuous for its faulty principle, as a foil to more scientifically devised ones. To those who merely go to the Show to eat and drink and hear the bands play, this pamphlet will possess but small interest. To those who visit it as a *Health* Exhibition, Mr. Judge will be found a trustworthy guide.

The number of visitors to the International Health Exhibition on Monday was 55,971, raising the total since the opening to 2,753,027, and thus passing the total number of visitors to the Fisheries Exhibition last year, which was 2,703,051. The Health Exhibition has been open 112 days; the Fisheries was open for 147 days. The daily average up to the present of the former is 24,580, that of the latter during its entire term was 18,388.

Miscellanea.

A curious barometer is said to be used by the remnant of the Araucarian race which inhabits the southernmost province of Chili. It consists of the cast-off shell of a crab, which, from its curious application, is called the "Barometro Araucano." The dead shell is said to be extremely sensitive to atmospheric changes, remaining quite white in fair, dry weather, but indicating the approach of a moist atmosphere by the appearance of small red spots, which grow both in number and in size as the moisture in the air increases, until finally, with the actual occurrence of rain, the shell becomes entirely red, and remains so throughout the rainy season.

To Remove Foreign Bodies from the Eye. — Before resorting to any metallic instrument for this purpose, Dr. C. D. Agnew (*American Practitioner*, May, 1884) would advise you to use an instrument made in the following manner: Take a splinter of soft wood, pine or cedar, and whittle it into the shape of a probe, making it about the length of an ordinary dressing probe. Then take a small, loose flock of cotton, and laying it upon your forefinger, place the pointed end of the stick in the centre of it. Then turn the flock of cotton over the end of the stick, winding it round and round, so as to make it adhere firmly. If you will look at the end of such a probe with a two-inch lens you will see that it is quite rough, the fibres of cotton making a file-like extremity, in the midst of which are little interstices. As the material is soft, it will do no harm to the cornea when brushed over its surface. When ready to remove the foreign body, have the patient rest his head against your chest, draw the upper lid up with the forefinger of your left hand, and press the lower lid down with the middle finger, and then delicately sweep the surface in which the foreign body is embedded with the end of the cotton probe. When the foreign body is lodged in the centre of the cornea it is most important not to break up the external elastic lamina, for if you do opacity may follow, and the slightest opacity in the centre of the cornea will cause a serious diminution in the sharpness of vision.

A Distilling Insect.—Livingstone met with a wonderful distilling insect in Africa on fig-trees. Seven or eight of the insects cluster round a spot on one of the smaller branches, and these keep up a constant distillation of a clear fluid like water, which, dropping to the ground, forms a little puddle. If a vessel is placed under them in the evening, it contains three or four pints of fluid in the morning. To the question, whence is this fluid derived? the natives reply, that the insects suck it out of the tree, and naturalists give the same answer. But Livingstone never could find any wound in the bark, or any proof whatever that the insect pierced it. Our common frog-hopper, which before it gets its wings is called "cuckoo-spit," and lives on many plants in a frothy spittle-like fluid, is like the African insect, but is much smaller. Livingstone considers that they derive much of their fluid by absorbing it from the air. He found some of the insects on a castor-oil plant, and he cut away about twenty inches of the bark between the insects and the tree, and destroyed all the vegetable tissue which carried the sap from the tree to the place where the insects were distilling. The distillation was then going on at the rate of one drop in every 67 seconds, or about five and a half tablespoonfuls every 24 hours. Next morning, although the supplies of sap were stopped, supposing them to come up from the ground, the fluid was increased to one drop every five seconds, or one pint in every 24 hours. He then cut the branch so much that it broke, but they still went on at the rate of a drop every five seconds, while another colony of the insects on a branch on the same tree gave a drop every 17 seconds.—*The World of Wonders.*

Intelligence of the Oriole.—On the western side of Central Park, very near 103rd-street and Eighth Avenue, stands a row of elm-trees, difficult to approach on account of a heavy growth of syringa bushes around them. On a branch of one of the trees, about 16 ft. from the ground, a pair of Baltimore orioles set to building a nest a few weeks ago. They chose the extreme end of the bough, with evident intention of making it a hazardous experiment for any bird-nester to attempt to molest them. But in their excess of caution they appeared not to observe what the few persons whose eyes were keen enough to see the first labours of the little architects saw—that the branch was much too slender to support so large a nest as the oriole builds. When the nest was about two-thirds finished the birds saw their mistake. The branch had bent so low that it was getting perilously near the grass. Work was at once stopped, and the builders sat close together for a long time, and seemed to be discussing the situation. Finally, they flew side by side to a bough about 15 in. over the one on which their nest was, and, leaning over, inspected the distance. They seemed to be satisfied, and, though it was growing rapidly dusk, the birds flew away in opposite directions. In the morning it was found that they had firmly secured their habitation, and prevented the branch from bending lower, by passing a piece of white string, which they had found somewhere in the park, over the upper bough, and fastening both ends of it securely to the edges of the nest. The building then went rapidly on, and the orioles are now engaged in hatching their eggs. Very few persons have seen the nest, and there is a fair prospect that their skill and ingenuity will be soon rewarded by a brood of young orioles.—*New York Sun.*

A Mountain of Alum.—Mr. G. M. Shaw, of this city, has just returned from a month's trip to the Gila River country, in the south-western portion of Socorro County, where he went with Messrs. Brown and Bergen to survey and report on the recent alum discoveries there, which have been located by a company of Socorro citizens. Mr. Shaw reports almost a solid mountain of alum over a mile square, some of the cliffs of which rise to an elevation of 700 ft. above the river bed. Most of the alum is in an impure state, and tasting very strongly of sulphuric acid, but of which there seems to be an inexhaustible quantity. Some of the cliffs, however, show immense quantities of almost pure marketable alum. This alum-find, Mr. Shaw tells us, is on the Gila River, about two miles below the fork of the Little Gila, and four miles below the Gila hot springs. Mr. Shaw reports numerous hot springs in that section, most of them gushing out of the rocks that form the river banks, some of them hot enough to cook in, and most of them too hot to hold the hand in. The main hot springs referred to above are reported to have effected wonderful rheumatic and other cures. The country is abundantly watered and wooded, and is covered with the finest of grass. The Gila is full of trout and other fish. Game, while still moderately plentiful, has been mostly scared away from the region of the hot springs by professional and other hunters, as well as ranchmen, who are beginning to locate in this difficult-to-get-at section of the Gila. At present the only way to get into this section is with pack animals over a precipitous trail of several miles, waggons having to be abandoned in the gorge of the Little Gila on the North Star Road, about two miles from the hot springs and about seven miles from the alum find, going from Socorro or from the Black range. By the way of Silver City and Georgetown wagons are abandoned on "Sapio" Creek, with about eighteen miles of pack animal trail to the hot springs. Mr. Shaw being an amateur photographer also, invariably carries his "outfit" on his surveying trips, combining pleasure with business, and bringing back with him photographs of all objects and scenes of interest that he meets with on the way. He brings back from this trip over sixty photographs of the Gila country, among which are a number of exterior and interior photographs of some interesting cliff-dwellers' ruins he encountered in a cave about four miles west from the hot springs.—*Socorro Bullion.*

American Engineering Models for a Japan University.—The Imperial University of Tokio, Japan, reorganised in 1860 as the successor of the old Imperial Observatory, founded in 1744, is evidently pushing forward in that full accord with the spirit of modern progress which the Japanese Government has shown in so many ways since the old exclusive barriers were broken down. A notable instance of this is found in a recent order for models, sent by the authorities of the Tokio University, to be built at the engineering school-shop of Vanderbilt University at Nashville, Tenn. The order embraces the following:—A model of wrought-iron highway truss bridge, 6 feet in length, to be built in brass; a small working compound steam-engine, with expansion gear and reversible gear; a small working iron turbine waterwheel, with water governor and sluice-gate; two differently constructed cast-iron models of steam-engine pistons with metallic packing rings; a working model of engine's slide valve and expansion valve with adjustments and appliances for indicating the relative positions of piston and valves at any part of the stroke; a working model of a surface condenser for a compound engine; a working model of an improved pendulum governor for steam-engine, with adjustment for regulation of throttle-valve. The order for the truss bridge was accompanied by working drawings in blue print, but the other pieces are to be designed as well as constructed at the Vanderbilt University. The work will be commenced at the school-shops with the opening of the fall session, and will afford the best of practice for the engineering students, of whom the class is so large that it is proposed to make duplicates of the articles ordered, that one set may be kept. Instruction at the Tokio University is in Japanese, except in the Schools of Law, Chemistry, Engineering, Polytechnics, and Mining, in which the instruction is in English. The School of Engineering is under the charge of Prof. J. A. L. Waddell, an American engineer.—*Scientific American.*

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

TEA AND COFFEE.

[1397]—I quite corroborate the statements of Mr. Williams with regard to the imbibition of tea and coffee, and the manner in which they affect the constitution. For years I was accustomed to drink freely of both; it had become, of course, quite a habit, and one not easy to shake off. Three months ago I left off drinking both, and, although I missed them at first (suffering from frequent headaches and irritability), I now, and for the last two months or more, have never felt better in my life or more fit for mental labour. I always drink hot milk in place of these unnecessary stimulants, and I know of no better restorative after any kind of work. The boiling of the milk destroys any germs that might exist in it. Tea or coffee after dinner in the evening always had the effect of keeping me awake at night, thus showing the powerful way in which they act on the systems of some people. I believe stimulants of all kinds to be quite unnecessary, excepting in certain cases of illness. As for mustard, cayenne pepper, and such-like condiments, I do not think it advisable to let the coats of one's stomach be subjected to sensations that one's tongue can scarcely endure.
C. Carus-Wilson.

FIGURE PUZZLE.

[1398]—I have met with the following figure puzzle; can any of your readers solve the same?

Let	A B C D E F	equal the number.			
Then	B C D E F A	will be three times the original number;			
	C D E F A B	,,	double	,,	,,
	D E F A B C	,,	six times	,,	,,
	E F A B C D	,,	four ,,	,,	,,
	F A B C D E	,,	five ,,	,,	,,

E. Sidder.

FALSE PERSPECTIVE.

[1399]—If I do not trespass too much on your space and patience, I shall be glad if you will kindly insert the following in answer to your correspondent, "J. H. D." (No. 1386.)

If an object at A appears smaller than a similar one of equal size at B, *because* it is further off, so likewise, and for the same reason, will it appear smaller than B when it is moved to *b*.

The painter must depict things as they *appear to the eye;* it is for the sculptor to represent them as they exist in nature.
R. Jones.

[1400]—I suppose that "R. R." and "J. H. D.'s" explanations will convince R. Jones that the accepted method of drawing horizontal lines parallel to the picture plane is correct. Many beginners in perspective and persons unacquainted with the subject entertain his idea. The example which R. Jones gives in his letter, No. 1384, is one that is sometimes called parallel perspective, which, like all perspective, supposes the eye to be fixed and directed at right angles to the picture plane, the picture being limited to the base of a cone, whose apex at the spectator's eye is an angle of 60°. If he will look at the street under these conditions, he will observe no perceptible trending away of the horizontal lines, parallel to the picture plane. On his principle, the vertical lines would also seem to vanish, skywards or earthwards, according as his position was low or high. He may rest assured that if either the horizontal or vertical lines have vanishing-points, they are at an infinite distance, and that there is no more occasion to represent any inclination than there is to consider the rays from the fixed stars other than parallel. As soon as he turns his eye up or down the street, the picture plane, which is at right angles to the central visual ray, moves round too, the horizontal lines are no longer parallel to it, and the street is then in angular perspective, and the top and bottom edges trend away to their respective vanishing-points in the horizontal line.
Eye-Witness.

[1401]—In case no one else has replied to Mr. T. E. Jones's letter in your number of August 15, I would point out that his reasoning is defective. According to his argument the projection of the line of posts, if produced both ways, would converge both to left and right, the line of tops, thirdly, forming an angle at the centre, and we should have a case of a projection of a straight line on a plane consisting of two straight lines meeting at an angle, which is impossible. The real fact is that, in the case supposed, where the axis of sight is at right angles to the plane of the line of posts, the latter all actually appear to the eye to be of the same length equidistant. This follows as a geometrical consequence of the plane of projection being parallel to the plane of the object. Anyone can verify this by examining a photograph of a building in which the camera has been pointed square to its front, as it were. It is only when the camera (or the eye) is turned obliquely to the line of posts that their distances diminish in proportion, and their parallel lines converge.
Musafir.

Canada, 29th August.

CLEMENTS' WEATHER CYCLE.

[1402]—As I found the node-cycle of the moon did not quite satisfactorily account for the recurrence of rainfall at London, I combined the apse-cycle with it, obtaining a 10·3 years' cycle by finding the product of one-fourth of each of these cycles, the moon's orbit and the nodes and apses of 18·6 and 8·85 years respectively being divided into four well-marked portions. And as this combination-cycle somewhat imperfectly accounted for the London rainfall, I combined with it the London tide-cycle, which I had just accidentally discovered, thereby changing the 10·3 into a 20·35 years' cycle, by multiplying by 1·98 the fourth of 7·92 years, the time occupied by the tidal revolution. This $20\frac{1}{3}$ years' cycle accounts for the London rainfall so satisfactorily that there is little or nothing further to be desired. In fact, the nodal and apsal cycles account for the general terrestrial rainfall, and the local tidal cycle satisfactorily accounts for the local variations. As the successive position of these cycles can be determined with absolute precision for the future as well as the past, the rainfall at London and elsewhere can be predicted with much certainty for any number of years in advance. From this cycle we may obtain a multiple cycle of 61 years, and the intervening cycles of 30·5, 40·7, and 50·9 years, with a sub-cycle of 10·175, or nearly 10·2 years. From the $20\frac{1}{3}$ years' cycle, it will be observed that the wet and dry years, together with those of an average rainfall occur in the same part of the cycle respectively with great regularity. For instance, $10\frac{1}{6}$, $20\frac{1}{3}$, $30\frac{1}{2}$, $40\frac{2}{3}$, $50\frac{5}{6}$, 61, and $71\frac{1}{6}$ respectively, added to the wet year 1821, give the wet years 1831, 1841, 1852, 1862, 1872, 1882, and 1892, and, deducting the same figures successively from the present dry year, 1884, we obtain the dry years 1874, 1864, 1854, 1844, 1834, 1823, and 1813. with a similar result any year may be taken and the additions or deductions made. Coming to the near future, it may be seen from the diagram that the years 1894 and 1895 will correspond with 1873 and 1874, and that the years between will be dry or mean except 1885, 1889, and 1892. In fact, the weather in England repeats itself every 61 years, and I have verified this repetition down to the commencement of the Christian era.
Hugh Clements.

[I insert Mr. Clements's letter without possessing the slightest faith in his system. But *ars probat artificem,* "the proof of the pudding is in the eating." He makes definite vaticinations of rainfall and drought, and it only remains to be seen whether they are fulfilled or not.—Ed.]

AËRIAL LOCOMOTION.

[1403]—Your recent articles treating on air-navigation I have read with great interest. Still, I think you have omitted the most important name in the list of those credited with aiding the problem of flight to a solution. I refer to Charles Darwin, and instance his observations on the condors of South America given in his "Naturalist's Voyage Round the World," written nearly half a century ago.

I entirely agree with you in holding that the possessor of "vague notions" about how birds fly is not likely to lead to good results in aërostatics, and you will doubtless agree with me in thinking that very *precise* and *correct* notions on that subject might well be invaluable.

It is obvious that every notion in regard to flying now the property of man has been derived from the birds. Had it not been for the flapping birds no one would ever have adopted the notion of using active force, such as muscular, steam, or any other known to us, to urge his way into the unresisting air.

This was done by Darwin in the book above quoted; and it is a constant astonishment to me that no Englishman has seen the significance of his observations, and, as a consequence, placed the human race in the air.

The condor is a strong bird, some fifteen feet in alar dimensions, weighing twenty pounds, and having a stomach capacity for five pounds of carrion. Darwin says it cannot flap itself off of the ground, but has to run into the air: and if surprised before having time to indulge in a short foot-race, is easily captured.

What chance, then, is there for a man to flap himself into success when the best specialised animal extant in this direction is unable to do it? Man has no specialisation in that direction, and weighs four times as much.

Darwin goes on to say that this bird, once in the air, moves with astonishing grace and ease, traversing the air at will in any direction, without flapping at all! He is emphatic on the point of rigidity of pinions, and I submit that, coupling these two facts, they far outweigh in value all experiments tried by man in this field.

For they show that with the large, heavy birds "flapping," or, in other words, active force, is not a factor in flight, and the whole question is shifted to other grounds, and the usual conception of "flying" completely changed. It becomes possible, with the light thus shed upon the problem, to throw it into a proposition of general terms, which may be thus stated:—

Flight is the result of the distribution of weight and position in relation to atmospheric air. If Darwin has rightly stated the facts, that is about the state of the case. Active force is eliminated. So far as the bird is concerned, it simply *does nothing*, and for *doing nothing* a man is as admirably specialised as any creature on earth. Whatever bugs, bees, and beetles may do in the way of flapping—however humming-birds, tomtits, kestrels, kites, and other small fry manage to get about—is beside the question. There is nothing discoverable about them which man may hope to imitate. But if Darwin is right, there most surely is about a condor, and because he so clearly observed and recorded these facts, I suggest that you should have admitted him into the circle of the promoters of aërostatics.

Every item of advance mentioned which may buttress hopes for successful flight is fully anticipated by this English naturalist fifty years ago. He pointed out that a body weighing 25 lb., with a certain distribution of weight in given dimensions, is sustained in air, and translated in any direction, with or against the wind, and in opposition to gravity, without the employment of any active force whatever. 'Tis true that this fact needs an explanation. But bear in mind that an *explanation* is all that it does need. The *fact*, there is no doubt about, and why the experts of a country able to produce a Darwin have not long ago supplied that explanation is humiliating. J. LANCASTER.

Chicago.

MIND AND BRAIN.

[1404]—In reference to the assertion of Professor Büchner, in "Force and Matter," that the molecular change or vibration in the brain, which accompanies every thought, *is* thought itself, I venture to ask the following question:—What is the power which *determines the nature* of such molecular changes; *compelling* the brain itself, by what we call an effort of will, without the aid of the association of ideas, to evolve, at one instant, a thought (*e.g.*) respecting theology; at the next, one in classics or mathematics; at a third attempt, on some wholly different subject. Must there not, in fact, be some controlling power, distinct from the brain itself, which uses the brain as its instrument in the production of thought, and thus effects the molecular changes?

To me it appears indisputable that Professor Büchner mistakes effect for cause. S. F. B. PEPPIN, Vicar of Herrington.

[Mr. Peppin's is a query so pertinent that I insert his letter at length.—ED.]

SHOOTING STARS.

[1405]—I see by Letter No. 1389 of your issue of the 12th inst., Mr. W. H. S. Monck thinks that certain shooting stars, after vaporisation in our atmosphere, may solidify again outside it, while others may pass through it, without being reduced to meteoric dust. Further, that these bodies may, in future, revolve round the earth as a centre, instead of round the sun. If such be the case, and if Saturn's rings consist of an infinite number of small satellites, the earth, I take it, would by this time be provided with a similar appendage, visible to man, unless the myriads of meteors so revolving, which must have accumulated in the course of ages, could be present without reflecting light. If this be impossible, the inference is, I submit, that none escape disintegration, or, if they do, their orbits are not so affected as to make them play the part of satellites to our planet. EYE-WITNESS.

SHIPS' LIGHTS.

[1406]—Having lately commenced to take KNOWLEDGE, in monthly parts (I am sorry I did not commence sooner) I read with much pleasure your able article headed "Sent to the Bottom."

I have hundreds of times felt keenly what you say in that article, viz., that the present system of signals at sea tells little or nothing even when they are seen, and they ought to be so arranged as to tell us everything that can be told by signals about the position of ships and the courses they stand upon.

Going along among a lot of vessels, steam and sail, going in different directions *in daylight*, we can thread our way easily as long as every one keeps the steering rules, because we can see exactly which way every vessel in sight is heading, but the moment darkness sets in uncertainty "reigns supreme," although the weather may be clear enough for us to see all the lights within our limits. Many a time in crowded waters I have stood on deck the whole night with my teeth set, and my heart in my mouth most of the time—especially when I had charge of a sailing vessel—where I had not the power to stop and reverse, seeing a number of lights about me which told me but a mere fraction of what was necessary for me to know, in order to go along safely.

If those at the head of affairs were to turn their attention to such matters as these, their praiseworthy efforts to diminish the loss of life at sea would, in my humble opinion, be crowned with more success than any other way they can take. Let them, by legislature or otherwise, give us ships so constructed and equipped as to give us a fair chance to avoid danger, and the instinct of self-preservation will do the rest.

It is, indeed, surprising, as you say, that matters are allowed to proceed for a single month without change.

Your plan, in my opinion, is so simple, that any one with brains enough to make him fit to take charge of a vessel for a "watch" can master it in half-an-hour, and the sooner the present system is unlearned the better. M. P.

S.S. *Prydam*, Aug. 3, 1884.

PRINCE KRAPOTKINE'S CAT.

[1407]—The question being to what extent a cat is affected by her reflection in a mirror, Prince Krapotkine writes to the *Revue Scientifique* that his cat of fourteen months old, which he has reared during his imprisonment, when he perceives his image even in a hand-glass, will assume a serious air and endeavour to touch it with his paw. Then, meeting the surface of the mirror, he makes for the back of it, evidently fancying another cat is behind a pane of ordinary glass. If the mirror be withdrawn he will follow it up until he assures himself there really is no other cat behind; and then he walks off, and will pay the matter no further attention. This cat does not mew to have the door opened, but stands on his hind legs, and shakes the latch with his fore-paws. He knows the prison-bells, such as those for rising in the morning, and the various meals. When the well-known prisoner takes his evening walk up and down his room, the cat goes through all sorts of antics, and makes a lot of little purring noises to obtain a game of hide-and-seek, with which he is not pleased unless his master takes his turn in hiding too. He understands a few words. When he wants to play with his string, if asked, "What do you want? Food? A drink?" (*manger, boire,*) he gets huffed and walks away; but the moment the word "string" (*ficelle*) is pronounced, he makes two little sounds which clearly mean "Yes." J. O'N.

RAILWAY ACCIDENTS.

[1408]—I have read with very great interest the valuable details relating to continuous brakes and railway accidents which have appeared in your columns, and I am extremely glad to see this important subject so fully discussed. There is no doubt that the general public does not understand the most important point in the whole matter. The usual opinion appears to be that "a brake must be a good train-stopper." The fact is, an efficient continuous brake is required not only to be a first-rate train-stopper in ordinary every-day use; but, what is far more important, it must be a self-acting, life-saving appliance, in case of accident similar to the one at Penistone. It is quite useless to suppose that the locomotive engine, railway rolling stock, or permanent way, can ever be made free from defects and consequent failures. During the first half of the present year no less than 568 tyres, 171 axles, and 181 rails failed, and 28 cases occurred of passenger trains, or parts thereof, leaving the rails, by which 7 persons were killed and 51 injured. When we consider that the fearful disaster at Penistone was caused by the breaking of one axle, the fact that no less than 171 axles broke in six months becomes a matter for serious reflection. Axles may be made of the finest materials by the very best of makers, yet flaws may and do grow, which neither the closest examination nor care can detect. In the same way rails break without giving any warning or showing any previous flaw. Under these circumstances the great question is, What can be done to mitigate or counteract the disastrous effects of these failures of material, and render them as harmless as possible? To this question there is and can be but one reply—viz., the adoption of a life-saving appliance in the form of a quickly-acting automatic continuous brake. An express train running at sixty miles an hour passes over a space of 86 feet per second. If the brake can be instantaneously applied, the train runs but a few feet before the retarding power comes into full operation; but in the case of a slowly acting system, which takes six or eight seconds, the train runs four or five hundred feet before the brake power can be brought into action, and this simply means that the train is dashing along at full speed, perfectly out of control, at a time when a quickly-acting system would have very materially reduced the speed and minimised the danger and risk. As long ago as August, 1877, the Board of Trade issued a circular to the railway companies, in which the essential conditions to a good brake were clearly laid down. The most important condition is that the brakes are, "in case of accident, to be instantaneously self-acting." To fulfil this, the brake must be what is known as automatic. A "simple" brake has no store of power, it is only used when required to make a stop, and there is always the fear that when it is required it will be found wanting; and again, even if it be once applied it comes "off" of itself, as was the case at Penistone, just at the very moment when most necessary to prevent the train running down the embankment.

The General Report to the Board of Trade upon the accidents during the year 1883 has just been issued, and shows that nine accidents were due to want of continuous brakes, five to the want of quickly-acting continuous brakes, seven to continuous brakes on the trains not being connected with the engine, two to the guards not being able to apply the continuous brake; whilst in eight instances the action of automatic or other continuous brakes are reported to have done good service in either preventing the collisions altogether or in reducing the shock occasioned thereby. The accident near Lynn on Wednesday is a very important case in point. A train ran off the line; the Westinghouse automatic brake brought it to rest without the loss of a single life. Had this train been provided with a brake which did not fulfil the Board of Trade conditions, a serious disaster must have followed. Such facts require no comment. CLEMENT E. STRETTON, C.E.,

Leicester, Sept. 8. Hon. Mem. A.S.R.S.

COINCIDENCES.

[1409]—When on ten days' leave at Agra, during the rains of 1875, I actually dined at mess one night with Smith, Jones, Brown, and Robinson. Only nineteen men sat down to mess. Brown was the General commanding the division, Jones was his Brigade-Major, Smith was an officer of the 55th going through the garrison class. I forget who Robinson was, but, as if to make the coincidence complete, Robertson, of the Central India Horse, was also present.

At the same time I noticed another coincidence in connection with three uncommon surnames and multiples of nine. It was as follows, the names being those of three European officers, the regiments three Bengal infantry ones to which the officers respectively belonged:—*Regiment*, 9th B.I., 18th B.I., 27th (?) or 36th (?) B.I. *Officer*, Capt. Toke, Capt. Toker, Dr. Stoker. With the increase in the number of the regiment there was an addition of a letter to the root name. C. W. S. D.

THE BEST FORM OF TRICYCLE.

[1410]—In reply to your correspondent "A. H." (1386), I regret that I have not seen or heard of a tricycle known as the Coventry Compressus. It may well be that after more than 300 machines have been brought out I may have missed one. The only machine I have heard of as the Compressus was one made by Moore, of Kennington Park. This was a convertible, with *two* front-steering wheels. It had good points, among which were these: that it was very safe from capsizing, and it was a two track machine. I do not think this make of machine can now be purchased.

I have not cared for any of the Merlin Tricycles, but as many different forms of machine have been brought forward under that name, I do not know which form "A. H." refers to.

JOHN BROWNING.

LETTERS RECEIVED AND SHORT ANSWERS.

E. R. I do not possess Mr. Wright's book, and, in the absence of the context, speak with some hesitation. If, though, we take a crystal of Iceland spar and tilt it in a certain direction, a dot of ink or a spot of light, as viewed through it, appears double; but as we turn the crystal the two images, after separating to a fixed distance, begin to approach, and ultimately coincide. This being understood, if we view the two images through a second crystal in a certain position, each of such images suffers duplication, giving four. If, now, we turn crystal No. 1 round until *its* images are fused into one, this one becomes only two in the second crystal, and on the second crystal assuming a proper position the two images in it become, as in the first case, united in one.—A. Z. For "the full meaning" of Protoplasm and Bioplasm you must consult the works of Professors Huxley, Haeckel, and others.—C. DONOVAN. Thanks for proffered articles, but Ferrier and others have conclusively shown that the Phrenology of Gall and Spurzheim is absolutely baseless. See Carpenter's "Mental Physiology," Bastian's "Brain as an Organ of Mind," &c.—NATH. ALCOCK. If you like to send a short *précis* of your views on the subject of the "Colours of Tropical Man," I shall be glad to print it, but I cannot merely reproduce what has appeared in contemporary columns.—JOHN HOWELL. Thanks; but such a poem as you forward is wholly unsuitable for these columns. —T. BROWN. "The Stars in their Seasons" is published by Longmans & Co., London.—J. O. LINDSAY. Many thanks.—GUERY. Such halos as you describe round the moon are caused by the refraction of her light through a mass of minute ice-spicules, formed in the region of the cirro-stratus clouds some 20,000 ft. high. If you measure the angular diameter of such halos, you will find that they generally have a radius of about 22°. The brush-like appearance may have been caused by more opaque intermediate clouds of small size intercepting the moon's light, in a way akin to what happens when—as the country people say—"the sun is drawing water."—DR. E. GROTH. Forgive me if I say that I cannot spend an hour or two in plodding through my astronomical bookshelves. I may just ask you (after taking down a very few books at random) to see Newcomb in "Monthly Notices of the R.A.S.," Vol. XXI., p. 55, and the same author's "Popular Astronomy;" also Beckett's "Astronomy without Mathematics." I have a much more detailed mathematical disproof of Olbin theory somewhere, but I am unable to light upon it just now.—THANKS. The colours produced by absorption are not simple, and the chances are that your "blue" glass was of a purple tint. The eye, too, is far from being achromatic. To definitely answer your question the lantern-glass should be examined by the spectroscope. No doubt particles of sand or dust might be compressed into solid blocks by pressure; but no theoretical answer can be given as to the amount of that pressure, which must be the subject of direct experiment.—ANONYMOUS. Do you seriously suppose that I am going to notice a tract which speaks of men of eminence and honour in the medical profession as "the real wire-pullers—the Simons, Corys, Seatons, and similar discredited and mischievous blunderers"? If blatant abuse were argument, Anti-Vaccinators must have had it all their own way long enough ago.—BOREAS. No one replied to your query, and I was unable to do so myself. I cannot believe that your *jeu-d'esprit* would be any more successful in eliciting information.—JAMES SHONE. If you refer to page 137 of the previous (5th) volume, you will find there an almost complete answer to your question. I have every faith in the institution, and am fully assured that every honestly competent pupil may rely upon securing good employment, more especially if foreign service is agreeable. You might, however, learn this and more by paying the place a visit.—Dr. J. G. DAVEY sends me a pamphlet intended to show (from mesmeric experiments!) that Gall and Spurzheim's phrenological system of mapping the brain is the only true one; and that the experiments of Ferrier, &c., and the opinions of all the most eminent modern psychologists are worthless. He must not be angry with me if I say that he has wholly failed to convince me of this.—D. SUTHERLAND Thanks, but rather outside the range of subjects embraced by this journal.—F. MINTER. Will be resumed in due season.—T. COMMON. I would gladly insert your really admirable letter; but if you only knew what piles of (unprinted) correspondence the subject has brought, you would pity as readily as you would excuse me.—W. T. LYNN. You are perfectly right. The "if" was, at least, as ridiculous as it appears in either of your illustrations. See this week's "Gossip."—C. E. S. The "Bab Ballads" originally appeared in *Fun*.

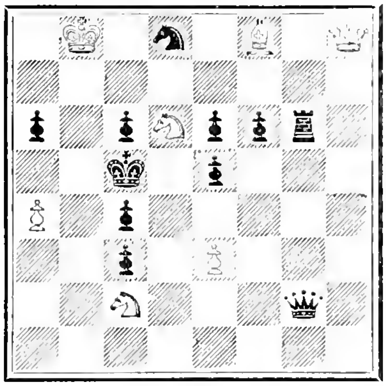
Our Chess Column.

By Mephisto.

PROBLEM No. 129.

By I. G.

Black.



White.

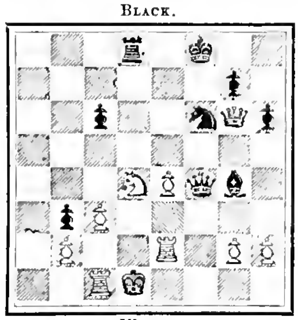
White to play and mate in four moves.

VIENNA GAME, PLAYED AT ST. LOUIS, U.S.A.

White. Dr. Zukertort.	Black. Mr. Max Judd.
1. P to K4	P to K4
2. QKt to B3	B to B4
3. P to B4	P to Q3
4. Kt to B3	KKt to B3
5. B to B4	Castles (a)
6. P to Q3	P to B3
7. Q to K2	P to QKt4
8. B to Kt3	P to QR4
9. P × P	P × P
10. Kt × KP (b)	P to R5
11. B × P (ch)	R × B
12. Kt × R	K × Kt
13. B to Kt5	P to Kt5
14. Kt to Kt sq.(c)	P to R3
15. B × Kt	K × B (d)
16. Q to R5	Q to Q5
17. R to B sq. (ch)	K to K2
18. Kt to Q2	B to K3
19. Kt to B3	Q to K6 (ch)
20. K to Q sq.	Kt to Q2 (e)
21. R to QB sq.	Kt to B3
22. Q to Kt6	R to KB sq.
23. R to K sq. (f)	Q to B5
24. P to Q4	KB × P ? (g)
25. Kt × B	B to Kt5 (ch)
26. R to K2 (h)	R to Q sq.
27. Q × KtP (ch)	K to K sq.
28. Q to Kt6 (ch)	K to B sq.
29. P to B3	P to Kt6 !
30. P × P	P × P

Position after Black's 30th move.

Black.



White.

31. K to K sq. (i)	Q × R (ch)
32. K to B2	Q to B5 (ch)
33. Kt to B3	B to R4 (j)
34. Q to B5	Q × Q
35. P × Q	R to Q4
36. R to K6	R × P
37. R × P	K to Kt2
38. R to Kt6	B to B2
39. K to K sq.	R to QR4
40. Kt to Q4	R to R7 ? (k)
41. Kt to B5 (ch)	K to Kt3
42. Kt to K7 (ch)	K to Kt2
43. Kt to B5 (ch)	K to Kt3
44. Kt to K7 (ch)	K to Kt2 (l)

Drawn.

NOTES.

(a) An innovation, giving quite a novel turn to the opening. The authorities all, we believe, advise 5. QKt to B3.

(b) Involving the sacrifice of the two minor pieces for the Rook and two Pawns, and giving rise to a very animated game.

(c) White could have sacrificed this Knight, too, and subsequently recovered the piece, but Black would have remained with a fine game, *e.g.*, 14. R to KB sq., P × Kt. 15. B × Kt, P × B. 16. Q to R5 (ch), K to Kt2. 17. Q × B, P × P. 18. R to QKt sq., P to R6 ! &c. But, in any event, would not 14. Kt to Q sq. have been better than the text play ?

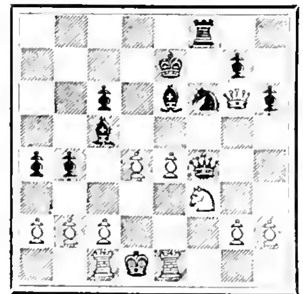
(d) Forced, on account of the threatened check at R5.

(e) 20. P to Kt6 looks very promising just here.

(f) If 23. Q × KtP (ch), R to B2. 24. Q to Kt3, when 24. Kt × P, followed by K to Q sq., appears to give Black a most powerful attack.

(g) We believe Black had a forced win here by 24. Kt to Kt5, instead. Suppose 24. Kt to Kt5. 25. P × B (or A), R to Q sq. (ch). 26. Kt to Q2, Q × Kt mate. If 26. K to K2, B to B5 mate.—(A) 25. Q × KtP (ch), R to B2. 26. Q to Kt6 (best), Kt to B7 (ch). 27. K to K2, B to B5 (ch). 28. K × Kt, B × QP (ch). 29. R in, B × R mate. If 26. Q to R8, then B to B5 wins off-hand.

Black.



White.

(h) Best. 26. Kt to B3 would lose by 26. R to Q sq. (ch). 27. K to K2, R to Q7 (ch). 28. K to B sq., B × Kt. 29. Q × P (ch), K to K3! and wins.

(i) Black threatened Kt × P, to which there would be no saving response.

(j) Mr. Judd correctly observes that 33. B × Kt was best here.

(k) 40. R to R8 (ch), instead, was the correct continuation, as Mr. Judd shows in the following variations: 40. R to R8 (ch). 41. K moves, R to QKt8. 42. Kt to B5 (ch), K to Kt3. 43. Kt to K7 (ch), K to Kt4. 44. P to R4 (ch), K × P. 45. R × Kt, R × P (ch) with a good chance to win.

(l) If the K go to Kt4, the P checks.—*Times Democrat.*

SOLUTION.

Problem No. 126. By I. G., p. 208.

1. Q to B3, P × Q	2. P to Q4 mate
Q × Q	2. Kt to Kt6 mate
K × R	2. Q × Q mate
R × R	2. Kt to B7 mate
Kt to K3	2. R × R mate, &c.

ANSWERS TO CORRESPONDENTS.

**** Please address Chess Editor.*

W. Horvat.—In Problem 124, if 1. B to B3, Q to QKt2, then 2. Q to Kt8 (ch), Q to Kt6 (ch). 3. Q × Q mate.

S. B. C.—In Problem 126, if 1. P × Q, B moves, and there is no mate.

Correct solutions received: Problem 126, Donna, H. A. N., W., Uncle John, G. W. Thompson, M. T. Hooton, W. H., E. Ridgway, Arthur Rutherford, A. W. Overton. Problem, No. 127: H. A. N., W. Problem, No. 128: A. W. Cunard, W. H. B. Hope, Geo. W. Thompson, H. A. N., W.

Contents of No. 150.

NOTICES.

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PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, SEPT. 26, 1884.

CONTENTS OF No. 152.

THE CHEMISTRY OF COOKERY.

BY W. MATTIEU WILLIAMS.

XLIII.—THE COOKERY OF WINE.

IN an unguarded moment I promised to include the above in this series, and will do the best I can to fulfil the promise; but the utmost result of this effort can only be a contribution to the subject which is too profoundly mysterious to be fully grasped by any intellect that is not sufficiently clairvoyant to penetrate paving-stones and see through them to the interiors of the closely-tiled cellars wherein the mysteries are manipulated.

I will first define what I mean by the cookery of wine. Grape juice in its unfermented state may be described as "raw wine," or this name may be applied to the juice after fermentation. I apply it in the latter sense, and shall use it as describing grape juice which has been spontaneously and recently fermented without the addition of any foreign materials, or altered by keeping, or heating, or any other process beyond fermentation. All such processes and admixture which affect any chemical changes on the raw material I shall describe as cookery, and the result as cooked wine. When wine made from other juice than that of the grape is referred to it will be named specifically.

At the outset a fallacy, very prevalent in this country, should be controverted. The high prices charged for the cooked material sold to Englishmen has led to absurdly exaggerated notions of the original value of wine. I am quite safe in stating that the average market value of rich wine in its raw state, in countries where the grape grows luxuriantly, and where, in consequence, the average quality of the wine is the best, does not exceed sixpence per gallon, or one penny per bottle. I speak now of the newly-made wine. Allowing another sixpence per gallon for barrelling and storage, the value of the commodity in portable form becomes twopence per bottle. I am not speaking of thin, poor wines, produced by a second or third pressing of the grapes, but of the best and richest quality, and, of course, I do not include the fancy wines, those produced in certain vineyards of celebrated châteaux, that are superstitiously venerated by those easily-deluded people who suppose themselves to be connoisseurs of choice wines. I refer to the ninety-nine and nine-tenths per cent. of the *rich* wines that actually come into the market. Wines made from grapes grown in unfavourable climates naturally cost more in proportion to the poorness of the yield.

As some of my readers may be inclined to question this estimate of average cost, a few illustrative facts may be named. In Sicily and Calabria I usually paid at the road-side or village "osterias" an equivalent to one halfpenny for a glass or tumbler holding nearly half-a-pint of common wine, thin but genuine. This was at the rate of less than one shilling per gallon, or twopence per bottle, and included the cost of barrelling, storage, and inn-keeper's profit on retailing. In the luxuriant wine-growing regions of Spain, a traveller halting at a railway refreshment station and buying one of the sausage sandwiches that there prevail, is allowed to help himself to wine to drink on the spot without charge, but if he fills his flask to carry away, he is subjected to an extra charge of one halfpenny. It is well known to all concerned that at vintage-time of fairly good seasons, in all countries where the grape grows freely, a good cask is worth more than the new wine it contains when filled; that much wine is wasted from lack of vessels, and anybody sending two good empty casks to a vigneron, can have one of them filled in exchange for the other. Those who desire further illustrations and verification should ask their friends—*outside of the trade*—who have travelled in Southern wine countries, and know the language and something more of the country than is to be learned by being simply transferred from one hotel to another under the guidance of couriers, cicerone, valets de place, and other flunkies. Wine-merchants are "men of business."

Thus the five shillings paid for a bottle of rich port is made up of one penny for the original wine, one penny more for cost of storage, &c., about sixpence for duty and carriage to this country, and twopence for bottling, making tenpence altogether; the remaining four shillings and twopence is paid for cookery and wine-merchant's profits.

Under cookery I include those changes which may be obtained by simply exposing the wine to the action of the temperature of an ordinary cellar, or the higher temperature of "Pasteuring," to be presently described.

In the youthful days of chemistry the first of these methods of cookery was the only one available, and wine was kept by wine-merchants with purely commercial intent for a considerable number of years.

A little reflection will show that this simple and original cookery was very expensive, sufficiently so to legitimately explain the rise in market value from tenpence to five shillings or more per bottle.

Wine-merchants require a respectable profit on the capital they invest in their business—say ten per cent. per annum on the prime cost of the wine laid down. Then there is the rental of cellars and offices, the establishment expenses—such as wages, sampling, sending out, advertising, losses by bad debts, &c.—to be added. The capital lying dead in the cellar demands compound interest. At ten per cent. the principal doubles in about seven and one-third years. Calling it seven years, to allow very meagrely for establishment expenses, we get the following result:—

					£	s.	d.	
When	7	years old the tenpenny wine is worth			0	1	8	per bottle.
,,	14	,,	,,	,,	0	3	4	,,
,,	21	,,	,,	,,	0	6	8	,,
,,	28	,,	,,	,,	0	13	4	,,
,,	35	,,	,,	,,	1	6	8	,,

Here, then, we have a fair commercial explanation of the high prices of old-fashioned old wines; or of what I may *now* call the "traditional value" of wine.

Of course, this is less when a man lays down his own wine in his own cellar in obedience to the maxim "Lay down good port in the days of your youth, and when you are old your friends will not forsake you." He may be satisfied with a much smaller rate of interest than the man engaged in business fairly demands. Still, when wine thus aged was thrown into the market, it competed with commercially cellared wine, and obtained remarkable prices, especially as it has a special value for "blending" purposes, *i.e.*, for mixing with newer wines and infecting them with its own senility.

But why do I say that *now* such values are traditional? Simply because the progress of chemistry has shown us how the changes resulting from years of cellarage may be effected by scientific cookery in a few hours or days. We are indebted to Pasteur for the most legitimate—I might say the only legitimate—method of doing this. The process is accordingly called "Pasteuring." It consists in simply heating the wine to the temperature of 60°C =140° Fahr., the temperature at which, as will be remembered, the visible changes in the cookery of animal food commences. It is a process demanding considerable skill; no portion of the wine during its cookery must be raised above this temperature, yet all must reach it; nor must it be exposed to the air.

The apparatus designed by Rossignol is one of the best suited for this purpose. This is a large metallic vat or boiler with air-tight cover and a false bottom, from which rises a trumpet-shaped tube through the middle of the vat, and passing through an air-tight fitting in the cover. The chamber formed by the false bottom is filled with water by means of this tube, the object being to prevent the wine at the lower part from being heated directly by the fire which is below the water chamber. A thermometer is also inserted air-tight in the lid, with its bulb half-way down the vat. To allow for expansion a tube is similarly fitted into the lid. This is bent syphon-like, and its lower end dipped into a flask containing wine or water, so that air or vapour may escape and bubble through, but none enter. Even in drawing off from the Pasteuring vat into the cask the wine is not allowed to flow through the air, but is conveyed by a pipe which bends down, and dips to the bottom of the barrel.

If heated with exposure to air, the wine acquires a flavour easily recognised as the "goût de cuit," or flavour of cooking. By Pasteur's method, properly carried out, the only changes are those which would be otherwise produced by age.

These changes are somewhat obscure. One effect is probably that which more decidedly occurs in the maturing of whisky and other spirits distilled from grain—viz., the reduction of the proportion of amylic alcohol or fusel oil, which although less abundantly produced in the fermentation of grape juice than in grain or potato spirit, is formed in varying quantities. Caproic alcohol and caprylic alcohol are also produced by the fermentation of grape juice or the "marc" of grapes—*i.e.*, the mixture of the whole juice and the skins. These are acrid, ill-flavoured spirits, more conducive to headache than the ethylic alcohol, which is proper spirit of good wine. Every wine-drinker knows that the amount of headache obtainable from a given quantity of wine, or a given outlay of cash, varies with the sample, and this variation appears to be due to these supplementary alcohols or ethers.

Another change appears to be the formation of ethers having choice flavours and bouquets; *œnanthic ether*, or the ether of wine, is the most important of these, and it is probably formed by the action of the natural acid salts of the wine upon its alcohol. Johnstone says:—"So powerful is the odour of this substance, however, that few wines contain more than one-forty-thousandth part of their bulk of it. Yet it is always present, can always be recognised by its smell, and is one of the general characteristics of all grape wines." This ether is stated to be the basis of *Hungarian wine oil*, which, according to the same authority, has been sold for flavouring brandy at the rate of sixty-nine dollars per pound. I am surprised that up to the present time it has not been cheaply produced in large quantities. Chemical problems that appear far more difficult have been practically solved.

THE ELECTRO-MAGNET.

By W. Slingo.

(*Continued from p. 175.*)

As I intimated in a previous article, an electro-magnet is not necessarily a straight one. In fact, it may be made to almost any pattern, although naturally the shape and dimensions should be kept within certain bounds to ensure the greatest attainable efficiency. Inasmuch as electro-magnets are rarely used except where transitory effects are requisite, they are generally made in one or other of the many possible modifications of the so-called horse-shoe shape. The object is to get the two poles near each other, so as to influence a piece of iron placed across

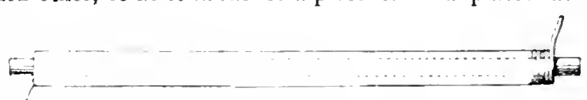


Fig. 1.

them. In Fig. 1 we have the general form of an elementary electro-magnet, in which one end of the iron core becomes a north pole and the other a south pole. It is manifest that if with this we wish to exert the greatest possible amount of attraction of which it is capable we must utilise the two polar forces. The piece of soft iron best adapted for this would be curved in shape, the segment of a circle with one extremity on each pole. This, however, would constitute an awkward armature, more especially where it is required to be light and capable of moving freely. When, therefore, it is permissible to utilise both poles of the electro-magnet, it is bent into a more or less perfect U shape. Fig. 2 represents

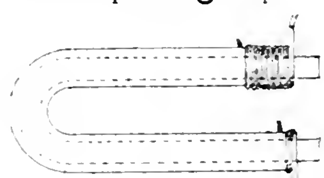


Fig. 2.

what we might get by bending a simple bar magnet. We rarely, however, see a horse-shoe-magnet so constructed. In the first place, a horse-shoe-magnet is manifestly only intended for use at close quarters, because at even a short distance, the two polarities become more nearly equidistant, and we very soon reach a point where they are practically equal, and where they, being opposite, neutralise each other. Now it will be remembered that in the preceding article it was demonstrated that when experimenting with bar magnets, a magnet wound as depicted in Fig. 3 gave greater results (at short distances) than did a magnet wound as shown in Fig. 1, the quantity of wire and of iron being in each case identical. For this reason, then, even if no other were available, wire is not

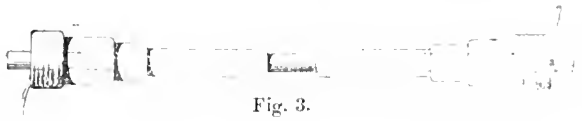


Fig. 3.

wound over the bend of the core. This applies almost as forcibly when the wire is wound evenly over the two ends of the core, the centre remaining bare, as shown in Fig. 4 (where A represents the soft iron armature). Another, although, perhaps, a less important reason for not covering the centre of the bent core is the difficulty that would be experienced in winding, on account of the larger surface on the outside as compared with the inside of the bend, a difference which would obviously increase with every additional layer of wire.

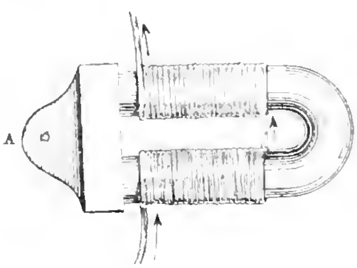


Fig. 4.

Unless the armature is particularly small, the two "legs" of the electro-magnet are rarely bent so as to make the poles approach each other, as in the case of permanent steel magnets. They are simply bent parallel, great care being taken to ensure the greatest degree of softness. The core of an electro-magnet should never be of steel, or even of hard cast-iron, because of the much lower magnetic capacity these materials possess as compared with good, soft iron. In hammering a piece of iron rod to form the bent core, there is a strong tendency to hardening, and as little hammering as possible should be resorted to, the bend being more efficiently produced by heating the iron to redness, when the metal becomes, naturally, much more workable. In any case, after the proper shape has been attained, the iron should be heated to redness, embedded in charcoal or placed in a clear fire, and then withdrawn and allowed to cool gradually, or, better still, left in the fire until it dies right out. The greatest efficiency at short distances is produced when the wire is coned towards the extremities—in fact, when the magnet has the appearance of being a bent form of that shown in Fig. 3.

As stated above, electro-magnets are not often called into requisition when only a single pole is required. When such a magnet, however, is necessary, it is well to use a long core, winding the given quantity of wire over one end of it, as shown in Fig. 5. The reason for this is, that a

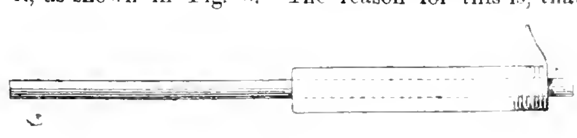


Fig. 5.

greater magnetic concentration is produced, or, in other words, the poles are separated by a greater distance, and the one to be used is therefore counteracted to a much less degree by the more distant opposite pole. It must not be forgotten that while the one end is inducing one condition in a neighbouring piece of iron, the opposite end is producing exactly the opposite state of affairs, and the resulting condition of the iron is an expression of the difference between the two inductive tendencies.

This fact may easily be demonstrated by passing a current through a coil of wire over, say, a thin 6-in. rod of iron, and after noting the strength, place the coil over the small end of a poker and again passing the current through it. If the quality of the iron and other conditions are identical, the poker will show a much greater effect than the short piece of iron. A coil or bobbin of wire for these experiments may be easily made. Procure a sheet of rather stout foolscap or other paper, and laying it on a hard, smooth surface, such as that of a drawing-board, place a ruler or other cylindrical rod about three quarters of an inch in diameter across one end of it. Then roll the paper tightly round the rod *once*, and gum thoroughly the remainder of the upper surface of the paper. Next roll the whole sheet over the rod, squeezing as much gum as possible into the pores of the paper, and forcing out any that may remain unabsorbed. When the sheet is fully wound, secure it with string, and place it on one side for an hour or two, letting it dry thoroughly. When assured that it is dry, press two cardboard or thin wooden discs, about three inches in diameter, over the ends of the paper cylinder. I have found cardboard answer very well. It may be made rigid by binding a little string round the cylinder, *outside* the cardboard, and then saturating the string more or less completely with gum, wax, &c. When this is done, remove the string which was used to hold the paper together, and withdraw the ruler. The result will be a thin but very rigid tube, with an excellently smooth inner surface. The space between the discs or cheeks may next be filled with five or six layers of stout, cotton-covered, copper wire, care being taken to insure that the winding is continuous, as previously pointed out. The winding should be done as carefully and evenly as possible. Kinks and bends in copper wire may be readily removed. If allowed to remain they give to the coil an unsightly appearance, besides uselessly taking up valuable space. Of course, the two ends of the wire should be brought out. The inner one may be passed through a small hole in one of the cheeks near the cylinder. When finished, soak the coil thoroughly, in melted paraffin wax to insure insulation, to maintain rigidity, and to exclude moisture. The appearance of the coil may be improved by painting it with sealing-wax varnish, which may be made by dissolving some shellac in methylated spirit, and adding a very small quantity of vermilion to the solution. For the present purpose the varnish may be made by dissolving a little ordinary sealing-wax in the spirit, although the common wax is not to be so highly commended for insulating purposes.

Such electro-magnets as the one illustrated in Fig. 4 are almost invariably adopted for electric bells and other similar purposes; but in telegraphic and kindred apparatus another plan is resorted to, a reference to which we must defer for a fortnight.

Melted Lead in the Eye.—A curious case of accident from a fragment of melted lead solidifying on the surface of the eye without injuring it was recently brought before the Bordeaux Society of Anatomy and Physiology by Dr. Perrier, who showed that the immunity of the eye from burning was really due to the "spheroidal state." The melted jet of lead was at a higher temperature than 171° Cent., the temperature necessary to produce the spheroidal state; hence, when it arrived at the surface of the eye it vaporised the moisture of the latter. When it had cooled below 171° Cent. the lachrymal secretion prevented the metal from scorching the ball.

FLIGHT OF A MISSILE.

By Richard A. Proctor.

I HAVE been asked whether the method by which I treated the movement of a body projected vertically from a point on the equator—regarding such a body, from the moment when its flight began, as moving in space under the attraction of the earth, and therefore in obedience to Kepler's laws—can be extended to any missile projected in any direction from any part of the earth's surface. I see no reason why the method should fail, or even why there should be any difficulty in applying it. Let us, however, inquire.

Let O, the point from which a missile is projected, lie in latitude λ, and let O X be part of a latitude-parallel and O Y part of the meridian ; O Z vertical.

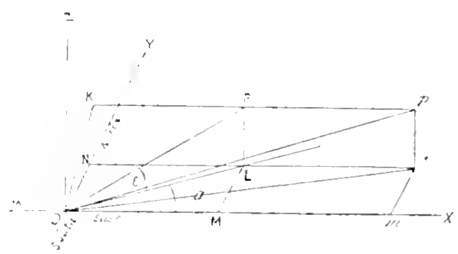


Fig. 1.

Suppose the missile to be projected from O in direction O P with velocity v, at an elevation ϵ ; and draw P L perpendicular to the plane Y X (part of the earth's surface, appreciably, near O) join O L, and draw L M, L N perpendicular to O X and O Y respectively. Let angle L O X = a.

Suppose now that the length O P represents the velocity v ; then P L represents the vertical velocity of the missile, or $v \sin \epsilon$; O L represents the horizontal velocity, or $v \cos \epsilon$; O M is the velocity in direction O X, or $v \cos \epsilon \cos a$; and O N is the velocity in direction O Y or $v \cos \epsilon \sin a$. But we have to consider also the velocity in direction O X on account of the earth's motion of rotation, which the missile shares with the earth's surface at the moment of projection, and retains thereafter, subject of course to such influences as may thereafter be brought to bear on it. Call this velocity u for convenience (we know that it is represented by the circumference of the parallel of latitude though O divided by the period of rotation, or is $2\pi r \cos \lambda \div P$, where r is the radius of the earth in feet and P the number of seconds in a sidereal day). Then if we represent u by M m, O m represents the true velocity of the missile in direction O X, or $v \cos \epsilon \cos a + u$.

Complete the parallelogram O N l m, draw l p parallel and equal to L P, and join O p, then O p represents the actual velocity of the missile in space, referred to the earth's centre. (Of course the missile shares the motion of the earth around the sun, of the solar system in space, &c., &c., but in considering its flight above the earth's surface we need take no account of these parts of its motion). Call this velocity V.

Join p P which is parallel to U and produce to meet the plane Z Y in K and join O K ; then since p K is parallel to l N, it is at right angles to the plane Z Y and O K p is a right angle. Hence $Op^2 = OP^2 + Pp^2 + 2\,P\,p.PK$ or

$$V^2 = v^2 + u^2 + 2uv \cos \epsilon \cos a.$$

This gives us the actual velocity of the missile. We know its actual inclination to the earth's surface, *viz.* the angle p O l, from the relation

$$\sin p\,O\,l = \frac{p\,l}{O\,p} = \frac{v \sin \epsilon}{\sqrt{v^2 + u^2 + 2\,u\,v \cos \epsilon \cos a}} = \frac{v \sin \epsilon}{V}$$

Knowing V we can determine the major axis of the orbit on which the missile begins to travel, as follows :—

Put M = moon's mean velocity in her orbit, in feet per second.

m = number of seconds in a sidereal lunar month.

D = the moon's mean distance } from earth's centre,
d = missile's mean distance } in feet.

Then by a well-known corollary from Kepler's third law, we have

$$d : D :: V^2 : M^2$$

and
$$M = \frac{2\pi D}{m}$$

Thus
$$d = \frac{DV^2}{M^2} = \frac{(v^2 + u^2 + 2\,u\,v \cos \epsilon \cos a)m^2}{4\pi^2 D}$$

Hence we have all the details necessary for the precise determination of the path of our projectile, neglecting the effects of atmospheric resistance.

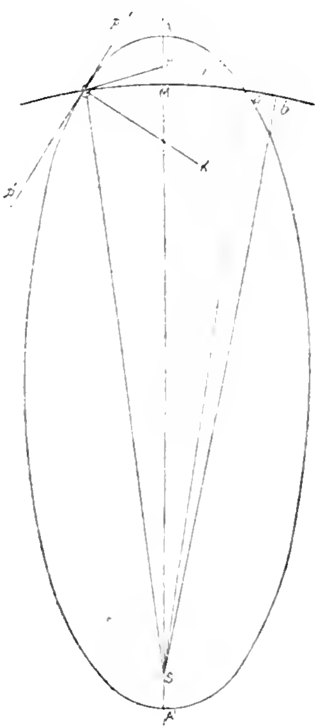


Fig. 2.

Thus, suppose we have in Fig. 2 a section through the earth's centre and the line O l of Fig. I. Let S be the earth's centre, O p the true course of the missile (O p of Fig. 1). Join O S, produce p O to p', and draw O K perpendicular to $p\,p'$. Then as S is one focus of the elliptical orbit O A A′ of the missile, the other focus lies in direction O H, so drawn that angle p O H = angle S O p'. But angle S O p' is equal to the angle K O M since each is the complement of S O K. Hence

angle p O H = angle K O M = comp. of angle p O M.

And since S O + O H = A A′ = $2d$

$$OH = 2\,d - SO = 2\,d - \text{earth's radius} = 2\,d - r$$
$$= \frac{(v^2 + u^2 + 2\,u\,v \cos \epsilon \cos a)m^2}{2\,\pi^2\,D} - r$$

This assigns the position of H ; and H S being thus given, while A A′ is known, we have the position of A, and the whole of the path O A a.

Having, however, thus shown that, given the velocity and elevation of a particle and the latitude of the point of projection, the actual path (apart from atmospheric resistance) may be dealt with precisely like the path of a body in space around a centre of attraction, I forbear to deal thus with any given example, simply because there would be no particular use in working out a problem of the sort. The student who cares to do so may thus deal with such a problem, noting that D and m are given in all tables of lunar elements, r is known, u for a given latitude is also known, while v and ϵ are supposed to be given.

(To be continued.)

EDUCATION.

At no period of our national history has education assumed the vital importance which now attaches to it. Compulsory as it now is in every rank of life, the man who would even hold his own in the present day cannot, and must not, be contented with the acquisition of the minimum of knowledge; for assuredly the "survival of the fittest" in the immediate future means that of the possessor of the most varied and best-digested information. We write at the beginning of the educational year, when many hundreds or thousands of young men are commencing a career at the Universities, hospitals, &c., &c., which is either to make or mar them; to produce citizens who shall contribute to the honour, dignity, and intellectual and material advancement of their native land; or to turn out failures, who can only act as a clog and a dead-weight upon it. That the study of the classics, with that refining influence which they have exercised upon so many generations of English gentlemen, and of mathematics, with the incomparable mental gymnastics which they supply, will ever be superseded as essentials, it would be idle to suppose. What, though, we would insist upon here is the paramount necessity of supplementing them by a competent acquaintance with natural and physical science. No man, towards the end of this nineteenth century, can be said to be "throughly furnished" who is unfamiliar with the most recent results in physics and biology; for the value of a knowledge of science can hardly be over-estimated. In its very lowest aspect, the power it confers of increasing our material prosperity might well commend it to those whose first question would be, "Does it pay?" But for its application to mechanical and industrial pursuits we could assuredly never have attained that proud pre-eminence among nations which is the glory of every patriotic Englishman. In a higher point of view, though, the earnest student will appreciate the benefits it confers, not only as a means of mental training, but for the habit of mind which it induces of loving truth for its own sake, and humbly pursuing it in the confidence that whithersoever it may lead us, it will be into safe and pleasant pastures. And, in the highest point of view, is not the theologian more indebted to science than he is unfortunately always willing to confess? No one can fail to contrast the ancient view of the Deity as (what Matthew Arnold calls) "a magnified, non-natural man," a mere tribal ruler, with the immeasurably enlarged conception of the Almighty Lord of the universe enjoyed by the modern student of astronomy, who stands humbled and appalled before majesty so infinite, that he trembles at the very conception of it. If, then, we have not claimed too much for science as an essential element in education—as assuredly we have not—we need not reiterate our earnest advice to the student by no means to neglect it. Even as a means of recreation, he will find it delightful. We are the more encouraged to urge this from the success which our own endeavours to present sound and accurate scientific information—"plainly worded and exactly described"—have met with. From Canada, from New Zealand, from Burmah, from South America, and from the Cape do we receive testimony that our efforts to popularise the knowledge of nature is appreciated. We would fain hope that our fellow countrymen at home may learn widely to value such knowledge, too; and by sedulous study of the marvels by which they are surrounded, supply themselves with one of the most potent weapons available in the battle of life.

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE BOTTOM (*continued*).

Scattered about here and there over the bottom of a clear pond may often be seen a number of dark and more or less cylindrical objects lying horizontally. A little watching will reveal the fact that they are living, for they will be seen slowly moving about over the bottom, and, perhaps, presently climbing the stem of some aquatic plant. Fishing some out with a net, we find that each consists of a cylindrical tube made of various materials, and inhabited by a sort of caterpillar furnished with six legs on the anterior part of its body. They are caddis-worms, or case-worms, but, notwithstanding the name, they have only a very remote connection with the true worms, being the larval forms of the order *Trichoptera*, *i.e.*, the caddis-flies or water-moths.

It is not an easy matter to extract the living occupant from its abode by mere pulling, though it is not in any way attached thereto. In such an animal as a snail, whelk, or winkle the difficulty of extracting the mollusc arises from the fact that it is fastened by strong muscular adhesion to the shell it constructs, but the caddis larva, like the marine tube-worms, merely builds up a case round itself for protection, and is not in any way organically united with it. But by means of certain hooks at the end of its body, it can, like a hermit crab with the molluscan shell it has appropriated, resist very successfully any attempts to drag it forth, and will even suffer itself to be pulled in twain rather than relax its hold. An application of boiling-water, however, at once kills the little tenant, and we can then easily draw out its corpse and examine the case at leisure. Should it be desired to extract the animal alive, it must be attacked from the rear. The case is open at both ends, the hinder aperture being the smaller of the two. The head of a pin inserted at this opening and pushed gently forward will so startle the grub as to cause it to relax its hold and advance a little in the tube; a few more gentle "prods" from behind and it completely evacuates its fortress, without damage to itself or injury to its case, into which it will be ready to return at the first opportunity. On slitting open the case we find that the inside is beautifully lined with a tough, thin, papery substance, which is smooth enough, whatever may be the irregularities outside. This material, like the silk of the silkworm, is produced by the insect as a gummy secretion which hardens immediately on exposure.

The nature of the external adornment will depend upon the species we have secured, and upon the materials that may happen to have been obtainable by the larva. Small bits of stick, rushes, roots, or fibres, blackened by long soaking in the water, and completely water-logged, grains of sand or small stones, the leaves of trees or fragments of aquatic vegetation, the seeds of rushes or other plants growing by the water side, and the shells of fresh-water mollusca, both dead and living—these are some of the principal materials employed, their exact nature and arrangement being different in different species, and sometimes in the same species at different ages. Some will cut little shreds of vegetable matter, all of the same length, and arrange them side by side in a spiral manner with wonderful regularity; others will take whole leaves of poplar, willow, and other trees, and attach them flatly to the case. Some will select small stones, and stick them on with great dexterity, forming a tube which reminds one forcibly of the exquisite structure made by the marine worm *Arenaria belgica*, which occurs not unfrequently on our sandy seashores. Others will strengthen their tube with very fine grains of sand, making a case in shape like an elephant's tusk. Some will select straight bits of stick or rush, and place them longitudinally, when they will sometimes project far beyond the ends of the caselike handles; others, using the same materials, but in shorter pieces, will place them transversely, putting each piece tangentially to the surface, so that the ends form a perfect *chevaux de frise* round the case, which, if looked at down its length, reminds one of a stocking carrying set after set of the needles with which it has been knitted. But unquestionably the most interesting are those that are adorned with shells. Caddis-worms are excellent conchologists, and by obtaining a number of their cases you may get together a very respectable collection of fresh-water shells. Sometimes you get the same shell throughout, when the case is often extremely elegant and symmetrical; but frequently you may find five or six species on one case, and then, if the shells are very dissimilar, of course the symmetry of the structure is destroyed. The most elegant are those formed of the smaller species of *Planorbis*, flat, spirally coiled shells, something like tiny snakes rolled up. Of these elegant little objects sometimes as many as fifty specimens go to adorn a single caddis case. Then there are the smaller kinds of *Limnæa*, conical, spirally-twisted shells of delicate texture, one or two of which may sometimes be found filling up odd corners, while, projecting here and there, like so many excrescences, may perhaps be seen the stouter and broader shells of *Bythinus*, the mouth of which is closed by a sort of trap-door. Again, we may find the much smaller and more depressed spiral shells of *Valvata*, which, with the spires all turned inwards, sometimes compose almost the whole case, and, lastly, stuck in here and there wherever there is room, the simply conical abodes of the tiny fresh-water limpets belonging to the genus *Ancylus*. But, besides all these, there are the shells made up of two similar parts hinged together—bivalves, as they are called—belonging to the genera *Sphærium* and *Pisidium*: sometimes a single valve is used, but more frequently the pair, especially of the very common species called *Sphærium corneum*. This is a tolerably bulky shell, and often exceeds in diameter the case which it adorns, so that if three or four of them are used on one case, it acquires a very irregular form. It is not always dead shells that are chosen; very frequently living molluscs are made use of just as they are, though their consent to the arrangement does not appear to be sought, and the plans of their life must be greatly interfered with by this unceremonious attachment. Mr. McLachlan, the historian of the European Trichoptera, says that he has seen the wing-cases of water beetles sometimes mixed with other things as ornaments to the cases, and even the cases of other and smaller caddis-worms, and that, too, while they still contained their inhabitants. The means of attachment of all these objects is the same silky secretion that lines the tube.

The operations of the insect in the construction of its domicile are very interesting, and may be watched by any one who will take the trouble to eject one from its dwelling and provide it with materials for the formation of another. The two following instances are from the records of the continental observers, Meyer and Pictet. The first refers to the formation of a vegetable case. A larva, deprived of its case, seized a piece of reed, and bit off from it a portion of the requisite length; then, cutting a slit in one side, it crawled in and closed up the rent with silk and vegetable débris, and there was the case, fully made. When pieces of reed too short for the case were intentionally given to it, it pieced them out to the required length by cutting off fragments of leaves and attaching them to one end. The other refers to the formation of a mineral case. The larva collected two or three smooth stones of moderate size, and made a low arch by fastening them together with silken threads; then placing itself under this arch, it took up one stone after another, and, with its feet, fitted them in as carefully as a bricklayer would lay his bricks, attaching them to the neighbouring stones when satisfied as to their position. The stones were always placed smooth side inwards. In this way it took between five and six hours to complete the case.

If the case should be made too long, pieces are cut off till the right length is obtained. As not only the length, but also the width of the case, is always suited to the size of the animal, it becomes interesting to inquire how the provision is made for growth in diameter; as the creature grows, each new circle added at the anterior extremity is made of rather larger diameter, thus giving the whole tube a somewhat conical shape; then the smaller end is cut off, and so by repeated additions to one end and subtractions from the other, the case is always the right size, and thus one can understand how it is that a caddis which begins life with a leafy case may, perhaps, end it with a stony or shelly one, and that too without ever quitting its tenement. Some species do not seem to be at all particular as to the materials they use, but others are so fastidious that they will rather go unclothed (which, of course, means speedy death) than adopt the wrong material.

The cases hitherto referred to are free, and the larva drags its abode about with it as it crawls slowly along with just so much of its body projecting from the case as carries the three pairs of legs. But many, especially of the smaller species, and those that live in very rapidly-running water, make cases which are attracted to stones, and consist of oval, irregular masses of fragments of stones. Some, again, live in company under a common covering of vegetable *débris* fastened together with silken threads, while others form on the surface of large stones silken canals covered with slime and mud. These latter are supposed to be, to a great extent, carnivorous, feeding on other aquatic larvæ; but the larger kinds are, as a rule, vegetable feeders, eating the leaves of various water plants, which, when adult, they devour entirely, beginning at the edge, but when young they satisfy themselves with the tender green parts between the veins of the leaf, which are more suited to their juvenile capacities than the tougher veins themselves. They will, however, take to animal food when necessary, and will even, on occasion, turn cannibals.

(To be continued.)

MR. BIRD, the chess-player, has in the press a tract in which he propounds and analyzes an early variation of the commonest opening, which has for some years been associated with his name. The publisher will be Mr. Wade, of Tavistock-street.—*Athenæum*.

NOTES ON COAL.

By Richard A. Proctor.

(*Continued from p. 217.*)

WE see, then, that coal-seams are the remains of ancient vegetable layers, formed underneath the trees of the ancient forest. But it is not to be supposed that every forest in those old times spread its shade over a mass of decaying vegetable matter, until the time should come when the mass should be covered over with shale or sandstone. In order that coal-seams should be formed, it was necessary that the forest region should be so abundantly watered as to form a forest swamp, like the cypress-swamps of the Mississippi. Yet again, it was necessary that during the fresh-water inundations which helped to accumulate the vegetable matter round the roots of the ancient forest trees, no mud should be carried into the swamps. As Lyell says, "One generation after another of tall trees grew with their roots in mud, and their leaves and prostrate trunks formed layers of vegetable matter, which was afterwards covered with mud, since turned to shale. Yet the coal itself, or altered vegetable matter, remained all the while unsoiled by earthy particles." This is a fact which seems at a first view altogether perplexing; but, as nearly always happens with the more perplexing features of any natural enigma, geologists have been led by this difficulty to the interpretation of the enigma. It is to this very fact that we owe the most trustworthy information yet obtained respecting the process by which coal-beds were originally formed. The solution is due to the same eminent geologist from whom I have already quoted the statement of the difficulty. "The enigma," he says, "however perplexing at first sight, may, I think, be solved by attending to what is now taking place in deltas. The dense growth of reeds and herbage which encompasses the margins of forest-covered swamps in the valley and delta of the Mississippi, is such that the fluviatile waters, in passing through them, are filtered and made to clear themselves entirely before they reach the areas in which vegetable matter may accumulate for centuries, forming coal if the climate be favourable. There is no possibility of the least intermixture of earthy matter in such cases. Thus, in the large submerged tract called the "Sunk Country," near New Madrid, forming part of the western side of the valley of the Mississippi, erect trees have been standing ever since the year 1811–1812, killed by the great earthquake of that date; lacustrine and swamp plants have been growing there in the shallows, and several rivers have annually inundated the whole space, and yet have been unable to carry any sediment within the outer boundaries of the morass, so dense is the marginal belt of reeds and brushwood. It may be affirmed that generally in the "cypress-swamps" of the Mississippi no sediment mingles with the vegetable matter accumulated there from the decay of trees and semi-aquatic plants. As a singular proof of this fact, I may mention that whenever any part of a swamp in Louisiana is dried up, during an unusually hot season, and the wood is set on fire, pits are burned into the ground many feet deep, or as far down as the fire can descend without meeting with water; and it is then found that scarcely any residuum or earthy matter is left. At the bottom of all these "cypress-swamps" a bed of clay is found, with roots of the tall cypress, just as the under-clays of the coal are filled with *stigmaria*—the roots of the ancient forest-trees called *sigillaria*.*

It will be seen that the circumstances here considered dispose of the theory—once a favourite one with many geologists—that the coal-seams were formed of vegetable matter (the rubbish of decayed forests) which had been carried by rivers into estuaries, and there formed into vast natural rafts. It was supposed that such rafts, sinking to the bottom, became after awhile covered with a layer of sand or mud. The uprightness of the tree-stumps, however, as compared with the position of the coal-beds—that is to say, their position square to these beds—should of itself have disposed of the theory referred to.

Yet, on the other hand, there is great difficulty in understanding under what circumstances the alternate rising and sinking of the level of these delta-swamps, or morasses, took place during the enormously long period of time which must have been occupied in the formation of the carboniferous groups with a thickness amounting in some places to nearly four miles. We see, for instance, that in the case of the Nova Scotia coal-fields there must have been eighty-one distinct submergencies. Now there is nothing remarkable in the mere circumstance that the same part of the earth should have been above and beneath the sea-level through many successive alternations. Geology has long taught that in nearly every part of the earth this must have happened; but that throughout so many as eighty-one such changes those conditions should have been repeated which are necessary for the formation of coal-beds is indeed a most remarkable circumstance. We have, on the one hand, the indications of a surprising degree of subterranean activity, for whether the land sank or the sea rose, there must have been a great oscillation of the earth's crust. But, on the other hand, we see that the great swamps must have retained their horizontal position unaltered for long periods of time. The growth of a forest is not the work of a few years, nor could the accumulations of vegetable matter have been formed quickly. As Lyell says, we have "evidence of the former existence at more than eighty different levels"—overlying levels, be it noticed—"of forests of trees, some of them of vast extent, and which lasted for ages, giving rise to a great accumulation of vegetable matter." Under what condition must the earth's crust have been when such processes were possible? To this question, as yet, geology has given no satisfactory answer. There are considerations, however, which seem at least suggestive of a solution of some of the difficulties here presented.

(*To be continued.*)

Mr. Mackay, of the Royal School of Mines, is announced to give introductory (free) popular scientific lectures at the Highbury Institute, on Sept. 25 and 30. Mr. G. Hawker, too, commenced a series on the "Harmony of Form, as Applied to the Decorative Arts," at the City of London College, on Tuesday evenings. Particulars in the College prospectus.

* It is not quite certain to what type of vegetation these trees belonged. They were formerly supposed to be tree-ferns, but some are found to have had long straight leaves, unlike those of ferns. The reader will probably remember that, after describing the *sigillaria*, the author of "Vestiges of Creation" describes the *stigmaria* as a distinct plant. "Among the most remarkable of the leading plants of the coal era, without representatives on the present surface, are the *sigillaria*, of which large stems are very abundant, showing that the interior has been soft, and the exterior fluted, with separate leaves inserted in vertical rows along the flutings; and the *stigmaria*, a plant apparently calculated to flourish in marshes or pools, having a short, thick, fleshy stem, with a dome-shaped top, from which spring branches of from twenty to thirty feet long." These branches were, in reality, the roots of the *sigillaria*. The mistake is a very natural one, since the coal-seam actually separates the trunk of the tree from its roots. Some, however, have since been found attached to the base of the tree-stumps.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p. 221.*)

"For my part," said I, "I do not believe there are men in the moon: for do but observe how much the face of Nature is changed between this and China; other visages, shapes, manners, nay, almost other principles of reason; and therefore between us and the moon, the alteration must be much more considerable. In the lands that have been lately discovered, we can scarce call the inhabitants men; they are rather animals of human shape, and that too sometimes very imperfect, almost without human reason: he therefore who will travel to the moon, must not expect to find men there."

"What sort of people are they then," said she.

"Troth, madam," said I, "I know not; for put the case that we ourselves inhabited the moon, and were not men, but rational creatures, could we imagine, do you think, such fantastical people upon the earth as mankind is? Is it possible we should have an idea of so strange a composition, a creature of such foolish passions, and such wise reflections; allotted so small a span of life, and yet pursuing views of such extent; so learned in trifles, and so stupidly ignorant in matters of the greatest importance: so much concerned for liberty, and yet such great inclinations to servitude; so desirous of happiness, and yet so very incapable of attaining it? The people in the moon must be wise indeed to suppose all this of us. But do we not see ourselves continually, and cannot so much as guess how we were made? So that we are forc'd to say the gods, when they created us, were drunk with nectar, and when they were sober again, could not chuse but laugh at their own handy-work."

"Well, well," said the Marchioness, "we are safe enough then, they in the moon know nothing of us; but I could wish we were a little better acquainted with them; for it troubles me that we should see the moon above us, and yet not know what is done there."

"Why," said I, "are you not as much concerned for that part of the earth which is not yet discovered? What creatures inhabit it, and what they do there? for we and they are carried in the same vessel: they possess the prow, and we the poop, and yet there is no manner of communication between us; they do not know at one end of the ship who lives, or what is done at the other; and you would know what passes in the moon, which is another great vessel sailing in the heavens, at a vast distance from us."

"Oh," said she, "as for the earth, I reckon it all as good as discovered, and can guess at the people, tho' I never heard a word of 'em; for certainly they all resemble us very much, and we may know 'em better whenever we will, let them stay where they are, 'tis only going to see 'em; but we cannot get into the moon if we would; so that I despair of knowing what they do there."

"You would laugh at me," said I, "if I should answer you seriously; perhaps I may deserve it; and yet, I fancy, I can say a great deal to justify a ridiculous thought that is just now come into my head; nay, to use the fool's best argument, I'll lay a wager I make you own (in spite of reason) that one of these days there may be a communication between the earth and the moon, and who knows what great advantages we may procure by it? Do but consider America, before it was discovered by Columbus how profoundly ignorant were those people? they knew nothing at all of arts and sciences; they went naked, had no other arms but a bow and arrows, and did not conceive they might be carried by animals; they looked upon the sea as a wide space, not for the use of man, but thought it was joined to the heavens, and that beyond it was nothing. 'Tis true, after having spent whole years in making hollow the trunks of great trees with sharp stones, they put themselves to sea in these trunks, and floated from land to land, as the wind and waves drove them. But how often was their trough overset, and they forced to recover it again by swimming? So that (except when they were on the land) it might be said they were continually swimming; and yet had any one but told 'em of another kind of navigation, incomparably more perfect and useful than their own, that they might easily pass over that infinite space of water, that they might stop in the middle of the waves, and, in some sense, command the winds and make their vessel go fast or slow, as they pleased—in short, that this unpassable ocean should be no obstacle to their conversing with another different people, do you think they would have believed you? And yet at last that day has come, the unheard-of and most surprising sight appears, vast great bodies, with white wings, are seen to fly upon the sea, to vomit fire from all parts, and to cast on their shores an unknown people, all scaled with iron, who dispose and govern monsters as they please, carry thunder in their hands, and destroy whoever resists them. From whence came they? Who brought them over the sea? Who gave to them the disposal of the fire of heaven? Are they gods? Are they the offspring of the sun? for certainly they are not men. Do but consider, madam, the surprise of the Americans; there can be nothing greater, and, after this, shall any one say there shall never be a communication between the moon and the earth? Did the Americans believe there would ever be any between them and Europe, 'till they saw it? 'Tis true, you must pass this great space of air and heaven, which is between the earth and the moon; but did not those vast seas seem at first as impassable to the Americans?"

"You rave, I think," said she.

"Who denies it, madam?" says I.

"Nay, but I will prove it," says she; "I do not care for your bare owning it. Did you not own the Americans were so ignorant that they had not the least conception of crossing the sea? but we, who know a great deal more than they, can imagine and fancy the going through the air, tho' we are assured it is not to be done."

"There is somewhat more in it than fancy," I replied, "when it has been already practis'd; for several have found the secret of fastening wings, which bear them up in the air, to move them as they please, and to fly over rivers, and from steeple to steeple. I cannot say, indeed, they have yet made an eagle's flight, or that it does not cost now and then a leg or an arm to one of these new birds; but this may serve to represent the first planks that were launch'd on the water, and which were the very beginning of navigation. There were no vessels then thought of to sail round the world in; and yet you see what great ships are grown by little and little from those first planks. The art of flying is but newly invented; it will improve by degrees, and in time grow perfect, then we may fly as far as the moon. We do not yet pretend to have discover'd all things, or that what we have discover'd can receive no addition; and therefore, pray let us agree there are yet many things to be done in the ages to come."

"Were you to live a thousand years," said the Marchioness, "I can never believe you will fly, but you must endanger you neck."

"I will not," replied I, "be so unmannerly as to contradict a fair lady; but tho' we cannot learn the art here, I hope you will allow they may fly better in the moon: 'tis no great matter whether we go to them, or they come to us; we shall then be like the Americans who knew nothing of navigation, and yet there were very good ships at t'other end of the world."

"Were it so," said she, "the people in the moon would have been here before now."

"All in good time," said I; "the Europeans were not in America, 'till at the end of some thousand of years; so long were they in improving navigation to the point of crossing the ocean. The people in the moon have already made some short voyages in the air; they are exercising continually, and by degrees will be more expert; and when we see 'em, God knows how we shall be surpriz'd."

"It is unsufferable," said she, "you should banter me at this rate, and justify your ridiculous fancy by such false reasoning."

"I am going to demonstrate," said I, "that you reproach me very unjustly. Consider, madam, that the world is unfolded by degrees; for the antients were very positive that the torrid and frigid zones were not inhabitable by reason of their excessive heat and cold, and in the time of the Romans the general map of the world was but very little extended beyond that of their own Empire, which, tho' in one sense expressed much grandeur, in another sense was a sign of as great ignorance. However, there were men found both in very hot and in very cold countries, so that you see the world is already increased. After that, it was thought that the ocean covered the whole earth, except what was then discovered. There was no talk then of the antipodes, not so much as a thought of 'em; for who could fancy their heels at top and their heads at bottom? And yet, after all their fine reasoning, the antipodes were discovered. Here's now another half of the world starts up, and a new reformation of the map. Methinks this, madam, should restrain us, and teach us not to be so positive in our opinions. The world will unfold itself more to us hereafter; then we shall know the people in the moon as well as we do now the antipodes. But all things must be done in order. The whole earth must be first discovered, and till we are perfectly acquainted with our own habitation, we shall never know that of our neighbours."

"Without fooling," said the Marchioness, looking earnestly upon me, "you are so very profound in this point that I begin to think you are in earnest, and believe what you say."

"Not so, neither," said I, "but I would show you how easy it is to maintain a chimerical notion, that may perplex a man of understanding, but never convince him. There is not any argument so persuasive as truth, which has no need to exert all its proofs, but enters naturally into our understanding; and when once we have learned it we do nothing but think of it."

"I thank you, then," said she, "for imposing on me no longer, for I confess your false reasoning disturbed me; but now I shall sleep very quietly, if you think fit to go home."

(*To be continued.*)

The Amsterdam Exhibition. — Messrs. Ransomes, Sims, & Jefferies, have been remarkably successful in this exhibition, having won the first prize, a prize of honour, value £40, for the best steam thrashing machine; four first prize gold medals and two silver medals for ploughs, and the gold medal for the best haymaker, and the gold medal for the best horse-rake. They have thus achieved the highest honours at the above exhibition.

DICKENS'S STORY LEFT HALF TOLD.

A QUASI SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from page 236.*)

Next let us notice again the singular delay in the appearance of Mr. Grewgious on the scene. At the latest he would hear of the supposed murder on Christmas Day about noon. He would be deeply moved on Drood's account. The disappearance of the light-hearted but withal generous boy whom he had so easily persuaded to be thoughtful and considerate, would have horrified such a man as we know Grewgious was. But the horror would have been intensified, and accompanied by deep sorrow and earnest sympathy for the fair young girl whom he loved both for her own sake and for her mother's. Recollecting that already once in her young life she had had a terrible and sudden loss, he would have felt how fearful a trial and how great a sorrow the death of young Drood would be to her, and how much more overwhelming even than his death the mysterious disappearance which seemed to tell of some terrible tragedy. We can understand that Grewgious would at first be scarcely able to leave the poor girl,—if he knew no more than the rest of Cloisterham about the disappearance of Edwin. All that Christmas Day he might have stayed with her, though even that would have seemed strange when it was so clearly his duty to make inquiries, and therefore to appear upon the scene where Jasper was so active. That he should have stayed all the 26th and the greater part of the 27th, neglecting for nearly three days so manifest a duty—he who was duty personified—is out of all likelihood, nay utterly impossible.

Jasper, of course, would not be apt to notice this. He was away most of the time. He thought nothing of Grewgious, or if he thought of him at all regarded him with something of the contempt felt by Jonas Chuzzlewit for the man who eventually brought him to justice. (There are in fact some marked points of resemblance between Nadgett and Grewgious.) When Grewgious *did* meet Jasper, his first thought would have been to inquire what news there might be about the disappearance. But he comes to tell Jasper about Drood's separation from Rosa. So little is he an adept at deception that he does not express the horror he would naturally have felt, had he only heard of Drood's disappearance, but simply says, "This is strange news." It is Jasper who, being ever on the watch to seem the thing he is not, says, "Strange and *fearful* news," to which Mr. Grewgious answers nothing, but stood smoothing his head and looking at the fire. He is not at all anxious to hear news from Jasper. After a time, the latter asks, "How is your ward?" surely a question to move Grewgious deeply. But he simply answers, "Poor little thing; You can imagine her condition,"—an evasive reply utterly unlike Grewgious's natural manner. Again it is Jasper who resumes the conversation. "Have you seen his sister?" "Whose?" asks Grewgious, with a curtness, and a cool slow manner, as he moves his eyes from the fire to his companion's face, which "might at any other time have been exasperating." Jasper answers, "The suspected young man's." Grewgious asks, "Do you suspect him?" "I don't know what to think. I cannot make up my mind." "Nor I," says Mr. Grewgious.

Now, supposing Mr. Grewgious to know no more than he is supposed to know, but that Rosa had communicated to him her suspicions of Jasper,—and (what is more) had persuaded him that those suspicions were well founded—

this tone with Jasper could be understood, at least in a man less upright and just than Grewgious. But we know (for we are told as much afterwards) that Rosa is half ashamed of these suspicions and has communicated them to no one. Grewgious has less reason than any one in Cloisterham to suspect Jasper on his own account. It is *absolutely impossible* that he can have any information justifying his cruel tone with Jasper, except from Drood himself, in such a way as I have suggested. Had Drood been really murdered, and in some other way—as through Durdles or Deputy—Grewgious had discovered as much, he would have engaged at once in searching out for evidence, and would have had Jasper kept at least as closely under survey as Neville Landless already was.

Absolutely nothing but certain knowledge that Jasper is a murderous villain, combined with knowledge equally certain that Jasper is not a murderer in fact, can explain the conduct of Grewgious in this interview, or indeed to the end. How this happened to escape the notice of so many who have read the story I do not know; but there can be no doubt on the subject. Nor have I yet met any one of average keenness of intellect who has not at once admitted, when the significance of Mr. Grewgious's conduct has been pointed out to him, that it can be interpreted in no other way. He knows Jasper to have been a murderer in intent; but he knows Drood to be alive in reality: and assuredly he can have learned either fact from no one but from Drood himself.

That, knowing so much, Mr. Grewgious would suffer poor little Rosa to imagine Drood slain, and on her account, a sorrow which must have killed her outright (no one seems to have noticed this, either) is simply incredible. Undoubtedly she knows Drood to be alive; but as certainly Grewgious has not told her who has assaulted Drood. She learns from Grewgious, before Cloisterham knows anything about it, that Drood has been the victim of a terrible and slaughterous attack, but has been saved as by a miracle; and she has had it earnestly impressed upon her that she is not to show by word or deed that she knows of Drood's safety. Later she is to wear mourning for him, as dead. But Mr. Grewgious keeps carefully from her the knowledge that the man who loves her so hatefully is the man who would have slain her once affianced lover, still loved as a dear brother.

What then does Grewgious mean when he says that he cannot make up his mind about Neville Landless? The answer is obvious. He can of course say nothing to Jasper implying that he is sure Landless is innocent. But he can truthfully say he has not made up his mind about him. For he has not yet decided whether to take Landless into his confidence or not. He knows that to one of Neville's impatient temper the scheme of vengeance planned between himself and Drood would be difficult to work. But on the other hand he feels that the suspicions under which Neville must labour will be very hard to bear, though lasting perhaps but a short time. He cannot well take Cris Sparkle into his confidence on this point. Eventually it would seem that he decides to let Neville remain for awhile under a cloud, but carefully watched lest harm should befall him. We know that he eventually arranges that Neville Landless shall have rooms close by his own, where probably Buzzard keeps watch (relieved occasionally, as we find, by Mr. Grewgious himself) over the doings of Jasper in this particular direction.

(*To be continued.*)

ERRATUM.—In col. 2, p. 247, for "Olbin theory," read "Olber's theory."

POST-MORTEM ATTITUDES.

DR. BROWN-SÉQUARD has recently published an interesting paper* upon the post-mortem preservation of the attitude that the subject presented at the very moment life ceased. In giving these facts, the principal object of the author was to seek the cause of the phenomenon; but he arrived at the conclusion that a solution of the question cannot be reached in the present state of science.

If this delicate problem embarrasses the learned physiologist, I certainly have not the pretension to offer in this place a satisfactory solution. My only object is to point out a few facts of a special nature that Dr. Brown-Séquard did not allude to. As these are capable of throwing light upon certain points of the question, and of thus helping its solution, I have thought it worth while to make them known.

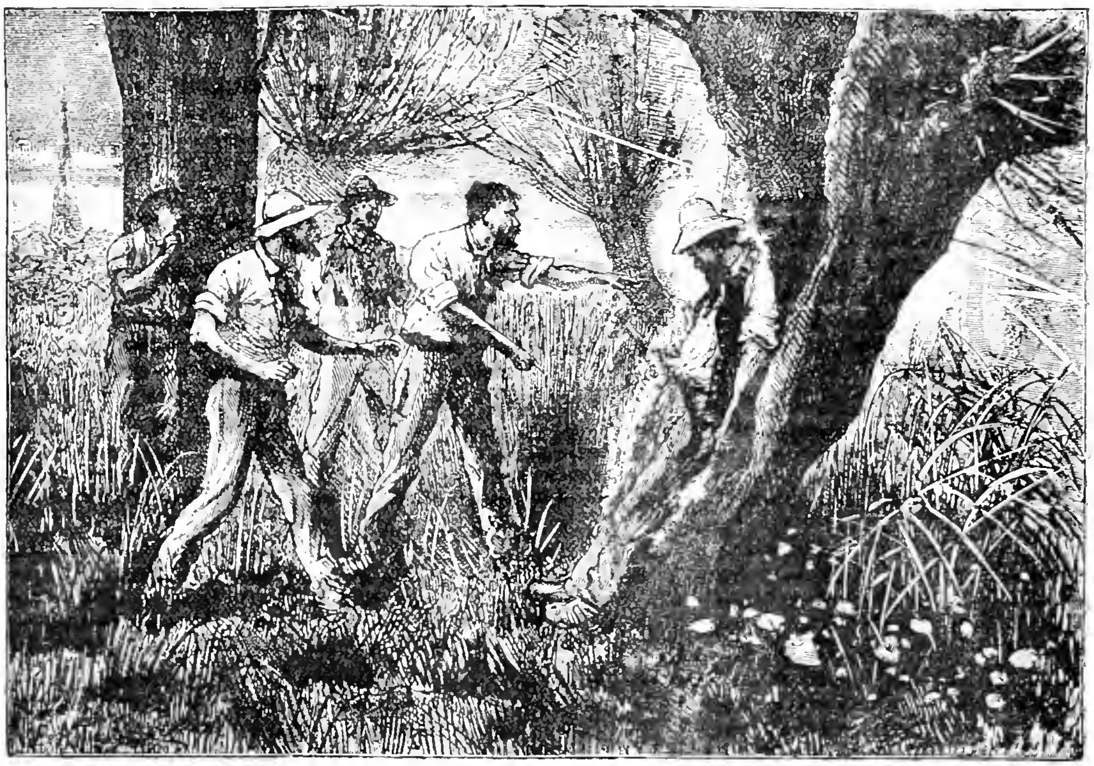
In order that this phenomenon of the preservation of the last attitude may manifest itself, a few peculiar conditions are necessary, the principal of which appears to be a violent, instantaneous, or quick death. But such a condition very often occurs without a preservation of the attitude being observed; and, on another hand, cases are likewise cited where death seems not to have been instantaneous, nor even very quick (relatively at least), such as the case of a wound in the thigh. There has also been invoked, as an active cause, the moral influence exerted upon the subject in cases where death was not instantaneous, or at least in those in which the subject has had a knowledge or quick perception of the danger that menaced him. Without any explanation of the immediate cause—the starting-point of this instantaneous action of the nervous system—the thing itself has been designated as *sideration*. Now, in pointing out the causes of death that have given rise to a preservation of the attitude, Dr. Brown-Séquard has omitted to mention the cases in which this expression of *sideration* can be applied in all its fulness, properly and not figuratively, and that is in those cases in which death has been caused by lightning.

Such cases are quite numerous, and some details have been ascertained that may throw a light upon the question. I shall, in the first place, cite the most remarkable observations.

1. One of the oldest facts is related by J. B. Cardan, who published a work upon lightning at Lyons, in 1633. Eight farm hands had taken refuge under an oak, in order to protect themselves from a storm, and to eat their lunch. A peal of thunder was heard, and the eight persons, struck dead by lightning, remained in the position that they were occupying. One of them was holding a glass, and another was putting some bread into his mouth, without any modification of the facial expression having occurred.

2. The preceding fact left some doubts, and there has been a disposition to believe it an exaggeration, but another and identical one was afterward reported by a Protestant pastor, Butler, who was a witness of it. On July 27, 1691, at Everdon, ten harvestmen took refuge under a hedge upon the approach of a storm. Soon afterward a thunderbolt fell and killed four of them, who remained immovable, and as if petrified, in the very attitude that they had at the time. One was holding between his fingers the pinch of snuff that he was about taking. Another was holding on his knees a dead dog which he was caressing with one hand and offering a piece of bread to with the other. A third was sitting with his eyes wide open and his head turned in the direction of the storm.

* KNOWLEDGE, No. 145.



3. Abbé Richard relates that the proctor of the Seminary of Troyes was returning upon horseback, when he was struck by lightning. A brother, who was following him, not having perceived it, thought he was asleep because he saw him tottering. Upon trying to awaken him he was found to be dead.

4. Another and analogous case is likewise related in the funereal annals of lightning. A priest was struck while upon horseback, without the animal being injured. The latter continued his accustomed route, and reached home with the dead horseman, who still preserved his attitude. The distance thus traversed was about two leagues.

5. On May 9, 1781, at about three o'clock, the lightning struck the door of the chapel of the Commandery of St. John, near which a woman and three children had taken refuge. The woman, who was seated in front, was suffocated without changing attitude, as was also one of the children.

6. On August 14, 1793, a man, surprised by a storm in the environs of Dover, took refuge with four horses in a thicket. A thunderbolt having fallen, the four horses and the man were killed, with the peculiarity that the latter remained seated.

7. On Sunday, July 11, 1819, the Church of Chateauneuf (Lower Alps) was struck by lightning during divine service. A large number of persons was struck (82 wounded and 9 killed). The peculiarity to be pointed out is, that all the dogs that were in the church were found dead in the attitudes that they previously had.

8. At Vic-sur-Aisne in 1838, three soldiers, in the midst of a violent storm, took shelter under a linden, when, by the same stroke of lightning, all were instantaneously killed. Moreover, all three remained standing in their original position, just as if the electric fluid had not touched them. Their clothing was intact. After the storm, some passers by who saw them, having spoken to them without getting any answer, approached and touched them, when they all fell into a heap of ashes.

9. In the month of July, 1845, four inhabitants of Heilz-le-Maurupt, near Vitry-le-François, took refuge, three of them under a poplar and one of them under a willow. Soon afterward, the one who was under the willow, and leaning against it, was struck by lightning. A bright flame was issuing from his clothing, but he did not appear to see it. "You are burning! Don't you see that you are burning?" cried his companions (see engraving). Upon running to him they found he was a corpse.

10. An animal forms the subject of this observation, which was made after a winter storm, in January, near Clermont. A goat was struck by lightning and immediately killed. It was found standing upon its hind legs still holding a green branch in its mouth.

11. A young woman, the wife of a miner of Ricamarie, had gone to visit her family at Saint Romain-les-Athenx, taking with her her four-months-old child. It was on July 16, 1866, and she was alone in the house during a storm. When her parents returned from the field, a sad spectacle awaited them, for the young woman had been killed by lightning. She was found on her knees in a corner of the room, with her face concealed in her hands. She bore no trace of a wound. The child, which was lying on the bed in the room, had been but slightly touched by the electric fluid.

12. I have related the preceding observations in chronological order, but I terminate with one, nevertheless, that should have come first. It is narrated by Quintus Curtius (lib. viii., cap. iv.). Alexander the Great was traversing Asia, and spreading ruin on his way. When he reached the region now called Bokhara, his army was assailed by a frightful cyclone. This terrible tempest carried off nearly a thousand men—soldiers, sutlers, or valets. It is said that some of these were found leaning against the trunks

of trees, and seeming to be still alive and talking with each other, in the same situation in which death had overtaken them.

The observations which precede seem to us to furnish some useful information in regard to some points of the question. Thus, a perception of danger is not necessary to explain the influence exerted upon the subject. The case of the soldier observed at Beaumont, near Sedan, seems to be demonstrative. He was not conscious of danger, by reason of the quick and unforeseen action of the bullet. This cause most certainly cannot be invoked in case of death through lightning. It is perfectly demonstrated by numerous observations that the subjects thus struck have not and cannot have any apprehension of their imminent danger. The person who is struck by lightning not only does not hear the noise of the thunder, the propagation of which is relatively slow, but he has not even any perception, any warning of the flash, whose rapidity is proverbial. Death is instantaneous, and the subject has not experienced the moral influence that results from a perception of danger. We have particularly related the cases that comprise animals (obs. 7 and 10). These could not have had any such apprehensions. It is remarkable to see that *all* the dogs were struck, and that all preserved their attitude in the occurrence at Chateauneuf, while the number of human victims was proportionately much less. None of these latter, moreover, preserved the attitude that he had at the moment of death. In obs. 6 a man preserves his position and remains seated near four dead horses that did not maintain *their* attitude. In obs. 1 we see that *all* the individuals exposed to the action were killed, and *all* (to the number of eight) preserved their attitude. In the second case four out of ten were struck, and the six others do not appear to have been influenced by the electric fluid. In short, all those that were struck dead preserved the last attitude of life.

Cases of lightning stroke are unfortunately quite numerous, but the number of those in which a preservation of the attitude has been observed is relatively limited. Although there are no comparative figures upon which an exact proportion can be established with certainty, it nevertheless appears that they are more frequent after lightning stroke than after other modes of sudden death.

Let us further remark that in cases of death by lightning, with a preservation of the attitude, it has been found that no external lesion exists (obs. 11) upon the body of the victim, and no autopsy has shown what point was thus influenced without any apparent contact. Perhaps no peculiar alteration could have been found in the essential organs of life; and it is especially in such cases that we may employ the expression *sideration* in all its acceptations.

The peculiar circumstances that accompany death by lightning may acquire (as they have done) a certain importance from a medico-legal point of view. But I have not to concern myself with that here, my only object having been to point out a few interesting facts, whence we may draw some useful data for the study and solution of this question of post-mortem preservation of the last attitude of life.—Dr. J. Rouyer, in *La Nature*.

An illustration of the way in which a coefficient like 0·000006, the coefficient of expansion of steel, may become a big thing with a few degrees and long lengths, has been seen on the new Midland line between Irchester and Sharnbrook, recently opened for goods traffic. The rails were laid during winter time, and insufficient room was left for expansion; consequently the summer heat lately expanded the rails to such an extent that the road burst out of line. Traffic had to be at once stopped, and the permanent way altered and properly spaced.

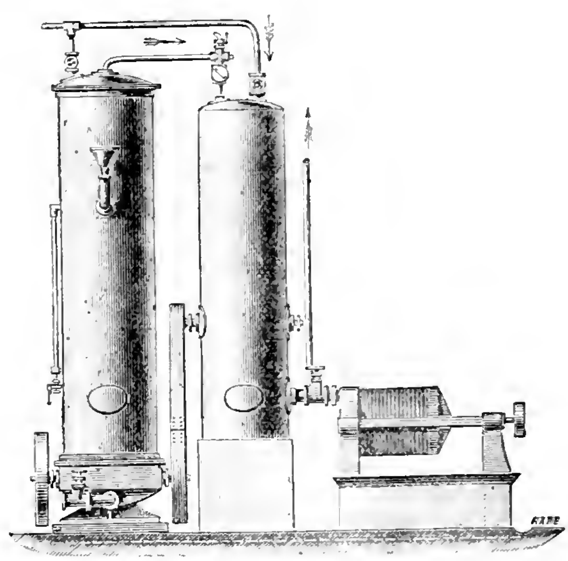
THE INTERNATIONAL HEALTH EXHIBITION.

XVII.—THE SOFTENING OF WATER—(*continued*).

In our last communication we pointed out that although very soft water is in many instances undesirable, it is of the first importance to the vast majority of manufacturers and engineers. The uses to which softened water can be put are so varied and extensive that the subject has claimed and received the attention of many competent and active workers. We have shown that in order to be of practical value, softened water ought to be freed from all mechanical as well as dissolved impurities, and that these results are to be attained not only by a successful system of straining, but by chemical means in addition.

In 1781, a paper was read to the Literary and Philosophical Society of Manchester by Thomas Henry, F.R.S., in which he gave an account of his process for purifying sea-water by the use of quicklime; he referred also to the value of that reagent in the preservation of common water. It was not until 1838, however, that a patent process for the softening of water was instituted. Muriate of zinc, subsequently acted upon by salts of soda, was employed to precipitate the impurities from water.

Later on, in 1841, Dr. Thomas Clark, the Professor of Chemistry at the University of Aberdeen, patented the well-known process with which his name will always be associated. He published a complete description of it in the Journal of the Society of Arts on the 16th May, 1856. Clark's process takes advantage of the solubility and insolubility of lime in the two conditions in which it becomes associated with carbonic acid gas.



The Porter-Clark Apparatus. In operation at the International Health Exhibition (400 gallons per hour).

The vast formations of limestone, chalk, and other calcareous rocks of hard water districts consists of lime in the form of a carbonate. The percolation of water, such as ordinary rain-water charged with carbonic acid gas through calcareous strata, results in the removal of the carbonate by its solution as a bicarbonate, aud gives rise to a hard water. To remove that hardness it is obvious that a separation of this extra quantity of carbonic acid would leave the lime once more in the character of an insoluble carbonate, and this is exactly what happens when lime water is used.

Lime is made by burning ordinary limestone or chalk in a kiln; almost all the carbonic acid gas is driven off and lime remains behind. The process of burning cannot always be fully completed, and individual cases are liable to differ slightly from one another, so that only approximately pure lime is produced. Now this lime is soluble in water, but, for the reasons just stated, it will not entirely dissolve; hence, in making the solution, it is advisable to use a slight excess of lime. A solution thus prepared may then be added to the hard water, when the carbonic acid of the dissolved bicarbonate will react on the lime of the lime-water, and leave the original bicarbonate of the hard water in the form of an insoluble carbonate; at the same time the soluble lime of the lime-water takes up the liberated carbonic acid, and becomes also changed into an insoluble carbonate. Thus, two quantities, both of them insoluble, are separated, and sink to the bottom of the vessel as a fine white precipitate of microscopical crystals of carbonate of lime, leaving the water practically soft and fit for ordinary use. The process has the great advantages of being extremely simple, adequately reliable, and comparatively inexpensive. It has been estimated that a bushel of lime, weighing about fifty-six pounds, and valued at 4½d., can make four thousand gallons of very strong and clear lime-water, capable of softening about ten times that quantity of hard water of the nature of the London district supply.

That Clark's process is amply adequate to the supply of a valuable water may be gathered from the following quotation of results, which indicates the reduction in hardness attained by its employment:—

"The Porter-Clark Process," by J. H. Porter, 1884, p. 4.

Canterbury	26·3 to 4·9
Caterham	21·2 „ 4·4
Tring	26·3 „ 3·2

The most serious objection to the process, however, is, that when carried out on an extensive scale, the reservoirs must be large and very costly. The precipitation of the carbonate of lime, too, is, at most, extremely tardy in action, and its accumulation in the tanks a most undesirable item. All these drawbacks have been remedied in the modified system known as the "Porter-Clark Process," which is now being exhibited at South Kensington in Stand 1,231, situated in a special building in the grounds, outside the Western Gallery. An interesting pamphlet* has been written upon the subject by Mr. Porter, in which much valuable information is recorded. It is there shown that the Porter-Clark process provides for the treatment of large quantities of water within a small area; that the supply can be regulated under continuous pressure at any desired rate per hour, and that the filtering machinery used is so constructed as to secure a purification of the filtrate, and a prevention of subsequent contamination, through the layer of precipitated carbonate of lime, which, in its turn, can be easily removed. The chemical reaction, too, is facilitated by the continuous agitation of the water with the re-agent, and we may fairly congratulate the inventor on having successfully overcome the many obstacles to the effectual working of a system of water purification which needs but to be known to be highly appreciated and generally adopted.

We hear that it is proposed to publish by subscription the "Vital Statistics of the late Dr. William Farr" in an octavo volume of some 450 pages. All interested in this very important posthumous work of our famous English statistician should communicate with Mr. E. White Wallis, the Secretary of the Sanitary Institute of Great Britain, 74a, Margaret-street, Regent-street, W.

* "The Softening and Purification of Hard Waters," by John Henderson Porter, A.I.C.E., 1, Tudor-street, London, E.C., 1884.

Editorial Gossip.

In no way can the amateur astronomer do a more immediate public service than by supplying correct time to a district far from a post-office to which it is flashed by telegraph; and possessors of small transit instruments may pick up a profitable "wrinkle" or two in connection with this from the perusal of an article on taking time observations in the current number of that capital little American serial, the *Sidereal Messenger.*

And while mentioning the *Sidereal Messenger*, the number of which I have just spoken also contains an account of a remarkable apparition on the evening of July 30, ult., of a narrow, thin, white cloud, like a comet's tail, which seems to have crossed the sky in a somewhat similar manner to (though not in the same direction as) the strange fusiform magnetic or auroral cloud observed in England by Mr. Rand Capron and others, on Nov. 17, 1882. It was seen at Atlantic City, New Jersey.

Believers in the influence of sun-spots on the weather may note that while we have enjoyed great and exceptional heat here during the present summer, it has been one of the coldest known for many years in Constantinople, where the mean temperature for July and August has actually been three degrees below the average. Presumably they have the same sun in Turkey that we have in England. There have further been some splendid spots and groups of spots on the sun's face during the past few weeks, although the (official) period of maximum has passed.

The strange and beautiful sunsets, or rather "after-glows," still continue. In connection with the persistence of this phenomenon it is noteworthy that on the very clearest days a strange kind of haze still surrounds the sun; in fact, while in the opposite quarter of the heavens the sky is of the most vivid cerulean blue, for many degrees around the sun is a very faint, but semi-opaque, veil, which becomes at once visible on hiding the sun with the hand and regarding the neighbouring region. A valued friend and correspondent of great eminence in the scientific world suggests the question whether this "mutton broth" (as he calls it) is really atmospheric at all, in fact, whether it may not be cosmical and a true appendage of the sun? If so, yet another explanation would seem to be possible of our wondrous evening skies than that afforded by Krakatoa dust.

Many people fondly hoped that the discovery by Dr. Koch that the "comma bacillus" was invariably presen in (and was, in fact, the active agent in the production of) cholera, had brought us in sight of the means of combating that ghastly scourge. Unfortunately, Surgeon-Major Lewis, of the Army Medical School at Netley, who has been investigating this question at Marseilles, has come to the conclusion that the "comma" is neither more nor less injurious than any other microbe; so that we are landed very much where we were before the commencement of Dr. Koch's researches.

Vaccination in the Army and Navy.—A return, showing the efficacy of vaccination, has been issued, entitled "Small-pox (Army and Navy)." In 1882 the annual strength of the army was 174,557, and the number of deaths from small-pox was five, or in the ratio of 0·3 per 1,000. The number of men entering the service that year was 26,120. In the navy a similar excellent result was noticeable. In 1882 the mean strength was 57,067; the number of deaths two, or a proportion of 0·3 per 1,000; and 6,998 men entered in the year. As every man who enters her Majesty's services is compelled to submit to vaccination, these figures, if submitted to persons of ordinary intelligence, and not to rabid anti-vaccinators, would be absolutely convincing.—*Medical Press and Circular.*

Reviews.

BIBLE FOLK-LORE.*

By Edward Clodd.

BUT a few years ago such a book as this, which will probably fall as a *brutum fulmen*, would have brought down the anathemas alike of Archbishops and local preachers on its author, and have been put on the Index of every Little Bethel library. When Dean Milman published his very harmless "History of the Jews," he withheld his name, and with a sound decanal instinct, for its orthodox readers were shocked when they found Abraham described as an Arab Sheik. Well for such timid souls that they have gone where the wicked Kuenen and Goldziher cannot trouble them, or the author of "Rabbi Jeshua" disturb their abiding calm by his resolution of well nigh every venerated name among patriarch, king, and prophet into solar phenomena.

Books like Dean Stanley's "Jewish Church," Baron Bunsen's "God in History," and Ewald's great but inconclusive work, paved the way for the application of the same scientific criticism to the Hebrew Scriptures which has been applied with such success, in the removal of difficulties, to cognate early histories of other races.

The epoch-making book in this matter is Kuenen's masterly "Religion of Israel," since it marks the nearest approach to the settlement of questions as to the age, sources, and general credibility of the documents which comprise the Old Testament. Following him, came the less sober work, so far as its speculations were concerned, of Dr. Ignaz Goldziher's "Mythology among the Hebrews," which thus, on its outside, challenged M. Renan's now generally discredited dictum that "The Semites never had any mythology."† Goldziher was, however, moderate in his application of the solar theory to the explanation of the historical books of the Bible, as compared with our author, whose cock-sureness (the term is Shakspearean) awakens a feeling of irritation almost fatal to any calm consideration of his book. The effect, as with Cox, Gubernatis, and others of the school, can only be to lessen the force of the inherently sound elements in the theory, and to deepen the resulting scepticism about its validity, when it explains everything so completely that it may mean anything else just as well.

"Bible Folk-lore" is crammed with information, though this is not always well digested. It has throughout evidence of much learning, gathered with no small labour, and the matter is often, as in the opening chapter, where the seasonal changes in Syria are described, presented in a picturesque and vigorous style. But the unsoundness of some of the etymological speculations, as *e.g.*, where the author asserts that, "Osiris is the Sanskrit Asuras, the 'breathing one'"; Isis is Ushas, "the dawn"; Horus, the Indian Hari, "the golden one, son of God" (p. 52), excites distrust in regard to the rest; and the choice of title is unfortunate, for it is only here and there (pp. 131, 143, 183, &c.) that the subordinate subject of folk-lore is dealt with. The book seeks to cover the field embraced by Jewish and early Christian history; to discover what proportion of the mythical, illustrated by similar myths in more ancient writings, has entered into the record of that stretch of time, and the title and sub-title should have changed places.

Although the pages of this Journal are properly closed to the discussion of theological topics, Knowledge would strangely belie its title if it did not, in the recognition that a science of man is possible, set before its readers from time to time some account of the results at which historical critics, dealing with the Old Testament as with any other ancient document, have arrived concerning the sources and character of its contents. The light shed, more especially on its earlier portions, by comparing them with kindred legends in other sacred books; the bringing out of correspondences which point to the common origin of the whole, or to the borrowing of the many from one primitive source; the assignment of the several influences from without which profoundly affected Jewish belief, and re-shaped and coloured the narratives which embody it; these are of the utmost value as guides along the tortuous path by which we would track the emergence of the Hebrews and their fellow-Semites from the mythopœic and polytheistic stage.

Apart from the existing ignorance on these matters, one feels that the decay of Bible-reading—for the fact is undoubted—among the intelligent classes nowadays is much to be regretted. There is always a large section of people who read for edification, but with these we are not concerned. It is in the neglect of the Bible as a venerable record of human experience and speculation concerning the unseen; as preserving poetry which yet moves us like a solemn chant; as embalming the beauty and vigour of our English tongue before the hardening influences of classic terms; as a great literary force, that it is to be deplored people do not know their Bibles. One has only to read the masters of felicitous style and happy illustration, like Huxley, Clifford, and Matthew Arnold, to see whence is due the inspiration of sonorous word and stately figure which moves through their writings.

Any abstract of the contents of "Bible Folk-lore" would extend over some pages, and it must suffice to illustrate the author's conclusions by a few examples. As the names of twelve antediluvian patriarchs and the related myths are said to correspond to the natural phenomena of each month, he sees in this group the legend of the year. Cain and Abel are the day and night. Cain, as the sun, producer of corn and wine, is the foe of Abel, the night-vapour, whose fleecy clouds are flocks on the horizon, and when the sun slays him, and his dark-red blood stains the morning sky, the murderer wanders like Indra and other sun-gods, "in eternal vagabondage." In the legend of Jubal we have the music of heaven made by the winds and the thunder, and in that of the Deluge, with which the cycle of legends ends, the author, after comparing it with variants of the Flood-tales, finds that "Noah, in his coffer of evergreen wood, like the Persian Yima in his paradise, represents the hopes of the coming spring, when, the winter floods over, he emerges with the seeds of plant and animal life. Abraham, Isaac, and Jacob, "the sun-heroes of the three seasons," into which the Accadians and other peoples divided the year, are triads corresponding to solar and meteorological deities of India, Assyria, &c., and the names of the celebrated twelve sons of Jacob, from Reuben to the "wintry Joseph" and Benjamin, indicate their astronomical origin. The destruction of the cities of the plains is the eternal battle of the heavens, localised by the sterile aspect of the dreary region round the Dead Sea.

It is quite refreshing, after all this, to learn that "the immigration of the Semitic tribes into Lower Egypt before 2,000 B.C. is a well-known fact," but the author hastens to state his conviction that Moses is a sun-myth. He is found, like the new-born Horus, in his local cradle; he appears as sun-god to give laws from Sinai, and on Nebo sinks to his rest in the west. All the plagues of Egypt

* "Bible Folk-Lore: an Essay in Comparative Mythology." By the author of "Rabbi Jeshua." (London: Kegan Paul, Trench, & Co. 1884.)

† "Les Sémites n'ont jamais eu de mythologie."

have reference to the darkness and the sunset; "the children slain before the infant sun appears are probably the countless stars who are swallowed up by the sun at his rising." Passing to the heroic period, the destruction of Jericho's walls is the moon-city whose cloud-buildings fall in the fair moonlit night. And as the twelve months have their mythical symbols in the patriarchs, and the signs of the Zodiac in Jacob's sons, so the four seasons have theirs in Joshua, Barak, Abimelech, and Jephthah; the story of Samson, in the undoubted solar incidents of which our author is on solid ground, summing up the cycle of the year. And the ground is firm, too, in his discussion of the nature aspects which lie thinly veiled behind the Semitic gods, the ghastly character of the sacrifices to which show the fear of the unknown, unmeasured powers of the universe which possessed the hearts of the warlike sons of the desert. On the *vexata quæstio* of the origin of the Jehovah cult the author has much of interest to say, but he is in error, if the authority of Mr. Page Renouf is to be recognised, in identifying the Nuk-pu-Nuk of the Egyptians as the exact equivalent of "I am that I am." * Even if slaying the slain, he is, however, doing good service in refuting M. Renan's untenable theory of a monotheistic instinct in the Semitic race, for the records of the various members of that family show that their mode of religious development has, speaking broadly, been identical with that of other races. That it has been parallel is not pretended, for allowance has to be made for different conditions inducing different phases; but this is not contradictory, rather is it confirmatory of the general doctrine that the type of religion is largely determined by physical conditions producing subtle variations. Speaking of the influence of the Persian religion on Jewish belief, the author remarks, "Strange indeed is the irony of religious history which has led us to consider the idea of monotheism, so taught to Semitic demon-worshippers, as being a truth specially revealed to a small Semitic tribe, and a great idea distinctive of the Semitic genius" (p. 118). He contends that not until the foundation of the Hebrew kingdom have we left the mythopœic age and entered the traditional, although with this, as with many real persons and events, the mythical still largely blends. How much so, the canon "the marvellous is the measure of the mythical" helps us to determine.

The fundamental changes wrought in Jewish theodicy during the captivity in Babylon, notably in the transformation of Satan, a messenger of deity, into an arch-fiend;† the substitution of Abaddon, a hell of torment, for the old Sheol or Hades where good and bad alike go; the more precise formulating of a doctrine of immortality and of a resurrection; the impetus given to the hope of a Deliverer, and to the general eschatology, are admirably explained.

The allegorical features of the literature of the Greek and Herodian periods, Tobit, Bel and the Dragon, &c., are expounded; Daniel's escape from the den of lions is the old Sun's deliverance from the fierce cloud-animals. The general conclusions at which the author arrives are appositely expressed in this sentence:—"It is not a divinely-inspired record which we have examined, but a mythology of Egyptian and Assyrian origin, a ritual based on the most ancient laws and customs of the Aryans, a poetry whose most noble thoughts and images may be matched, if not excelled, by the hymns of the Vedas and of Egypt, or even by those of Babylon and Chaldea." In his chapter on the Essenes, the author's sympathies, ever expanded, as those of each one of us must be the more we know of the great Gautama the Buddha, are manifest in the account of his gradual apotheosis in the lapse of time when to refracted vision it seemed that in the past "the gods came down in the likeness of men." In pointing parallels for our consideration, the author, however, inspires mistrust in virtue of the untenable canon which is laid down in his appendix. He says, "The doctrine of evolution teaches us that where features are found common to two developments, they are generally due to a direct connection of growth between the two." The doctrine of evolution teaches exactly the contrary. As Bastian remarks, "Where no historical transference can be proved, the uniformity must be referred to the organic law of the growth of the mind, which will everywhere put forth similar products, corresponding and alike, but variously modified by surrounding influences."*

In the world-wide discovery of stone implements of similar design, the question of borrowing between one race and another does not arise, it suffices that the same needs excite the same methods of supply among rude peoples, past and present. And the like applies to the satisfaction of man's immaterial needs. We find that among the Incas, when any nun violated her vow of chastity or allowed the sacred fire to go out, she was buried alive. The same punishment was inflicted for the same offences on the Roman vestal. But no one suggests that the Peruvians borrowed this custom from the Romans; still less the Romans from the Peruvians. The virgin had proved herself false to her spouse the Sun; let her, therefore, become the spouse of Darkness, and let the earth swallow her up.

Into the question of the proportion of mythical element which has become mixed with the early Christian records, we cannot here enter, especially as the author again falls back upon his first principles of interpretation, and summons the hosts of heaven as witnesses, as when in the story of the Transfiguration, illustrated by variants from other scriptures, he sees the triad of the rising, and noonday, and the setting sun.

The weakness of the book lies in its fantastic etymologies (one has only to turn to Goldziher to see how varied are the meanings of the proper names), and in the wholesale application of the solar theory to events which, whilst without doubt charged with the mythical and legendary, have a body of fact corresponding to what we know to be the conditions under which wandering tribes pass to a settled state, and under which they advance from animistic to monotheistic belief.

The strength of the book lies in its insistance on the application of the comparative method to the interesting and priceless records of this progress among the Hebrew members of the Semitic family, and in its witness to the absence of all arbitrariness from the successive evolutions of the human mind as from every other department of nature.

Whatever the reason, be it indolence or false economy, much blame attaches to the issue of a book so crowded with topics as this without an index.

SOME BOOKS ON OUR TABLE.

Natural Law in the Spiritual World. By Henry Drummond, F.R.S.E., F.G.S. Eleventh Edition. (London: Hodder & Stoughton. 1884.)—Amid the mass of decla-

* It is distinctly on grammatical grounds that I reject the translation in question, which is not a literal but simply an erroneous one. Neither in the Book of the Dead nor in any other known Egyptian text do the words Nuk-pu-Nuk occur as a sentence. I do not believe that it could under any circumstances be translated "I am that I am."—Letter to the *Academy*, June 26, 1880.

† The author, perhaps by a *lapsus calami*, speaks of the Indian devil, Mâra, as King of Death (p. 153). Yama is the ruler of Death; Mâra is the spirit of evil, who tempts the Buddha.

* Cf. Goldziher, xvi.

mation, abuse, frothy rhetoric, perversion of science, distortion of Scripture, ascription of moral obliquity to opponents, and assumption of infallibility on the part of the disputants, which has recently been rained upon us in the shape of (so-called) "Reconciliations," it is perfectly delightful to turn to the calm, judicial, scholarly, and pre-eminently tolerant work of Professor Drummond, now before us. For surely no more able contribution than this to the polemics of natural theology has been made for a very long time indeed. Starting with the assumption that law reigns as supreme in the spiritual world as it does in the material universe, our author sets himself to show, with impressive ingenuity, how every natural law has its spiritual analogue; and so essays to remove certain stumbling-blocks, and throw light upon more than one obscure problem which religion presents. Mr. Drummond frankly accepts the modern doctrine of evolution in its entirety, quoting freely from Herbert Spencer, Darwin, Huxley, &c., in support of his views. His obviously great personal familiarity with biological science enables him to derive some of his most telling illustrations from the more recondite phenomena of the development of life; and there is something admirable in the ability with which he co-ordinates and shows the absolute parallelism of the laws regulating that development with the fundamental principles of Christianity. His style is charming, his diction essentially that of a scholar and a man of refined taste. Hence his book is an eminently readable one. That it will make numerous converts from the ranks of a mere stupid atheism it would be too much to expect. That, however, it will remove some of the doubts, and strengthen and comfort thousands of religious men, whose faith has been sorely strained by honest philosophical misgivings, it seems impossible to question. Professor Drummond has given us a most remarkable volume.

Lectures on Teaching, by J. G. Fitch, M.A.; *General Aims of the Teacher:* Two lectures by F. W. Farrar, D.D., and R. B. Poole, B.D.; *Three Lectures on the Practice of Education*, by H. W. Eve, M.A., Arthur Sidgwick, M.A., and E. A. Abbott, M.A., D.D. (Cambridge University Press.)—We have classed these three works together as valuable and important contributions to the science, as well as to the mere art, of education. Mr. Fitch's work, in particular, is so exhaustive in its details that no one engaged in practical educational work can afford to neglect its perusal. Even did he speak with less authority than that to which he is justly entitled, the intimate knowledge of his subject which he displays, nay, the mere common sense of his remarks, must commend his lectures to the careful study of all concerned in the welfare and intellectual advancement of the rising generation. Canon Farrar's lecture on "The General Aims of the Teacher" forms really a charming piece of reading for anybody, containing as it does a record of his own personal experiences, conveyed with all that charm of style for which his writings are distinguished; while Mr. Poole's, if not quite equal to it in a literary point of view, is important as conveying the views of one so experienced as its author. The mere names of the authors of the three lectures in the work whose title concludes our heading will suffice to indicate their practical and technical value.

A Sketch of Ancient Philosophy from Thales to Cicero, by J. B. Mayor, M.A. (Cambridge University Press.)—Concise, without being bald, and commendably free from metaphysical jargon, Mr. Mayor's history of philosophy, extending over a period of nearly 600 years, will be welcomed by the student who wishes to gain clear ideas of the progress of human thought from the time of the illustrious Miletian down to that of the mighty Roman orator. That ancient philosophy was not all logomachy, nor the utterances of the sages of the past mere "Sound and fury, signifying nothing," a perusal of Mr. Mayor's work will speedily convince the reader.

The Cambridge Bible for Schools and Colleges. Job, edited by A. B. Davidson, D.D., LL.D.; *St. Luke*, edited by Canon Farrar, D.D. (Cambridge: University Press.)—Judging from the two instalments of the work before us, we have, so far, seen nothing to surpass, even if we have met with anything to equal, this admirable Bible Commentary. Beginning with Dr. Davidson's volume, we may say that while he does not deny the historical existence of Job, he yet regards the book so-called as a sacred drama or poem, composed at the very earliest during the reign of Solomon. The reasons for this are given at length in the admirable introduction. The student who will re-peruse the book of Job in the light of Dr. Davidson's exegesis, cannot fail to derive both instruction and pleasure from it. It seems needless to say more in connection with the volume containing St. Luke's Gospel, than that the sound learning and literary ability for which the Canon of Westminster is renowned are conspicuous in a commentary which must render the most valuable aid to every reader of the New Testament.

The A B C of Modern (Dry Plate) Photography. (London: The London Stereoscopic Company.)—Reading through the most explicit and detailed description of each successive step in the production of a photograph given in the little volume before us, from focussing the camera to drying the finished prints, it would really seem as though nothing short of actual aberration of intellect could prevent any one who will peruse it with common care from becoming a successful photographer. The beginner is told not only what to do, but what *not* to do; the causes of failure are clearly pointed out, and numerous illustrations supplement the text. Verily, this is the A B C of photography.

Tricycling for Ladies. This excellent little book has been written by a *lady* for ladies. Miss Erskine describes the machine and its accessories, the use of the machine, ladies' tricycling dress, the best method of riding, touring, the bye-laws applicable to tricycles, and concludes with some remarks on sketching and photography for lady riders. Under every heading will be found much interesting and useful information which could only be obtained by considerable experience. The book is very neatly written, and beautifully printed, and we can strongly recommend it to any lady about to commence tricycling, or those who are now cycling and wish for hints which will assist them in this most healthful recreation. From the apt quotation on the title-page to the last sentence on photography, every line is to the purpose.

Merry Matches, the popular new round game for children, containing thirty-one original coloured drawings of popular nursery characters (Wyman & Sons, 74–76, Great Queen-street, London, W.C.)—In the packet of cards now before us we have, perhaps, one of the most striking examples of the progress that has arisen from the valuable modern systems of juvenile education. To cultivate the tastes of the young by providing them with an entertaining game in which the whole merry circle can join, and to guide their thoughts into the many happy incidents of their nursery life, to Old Mother Hubbard, Dick Whittington, Cinderella, Father Christmas, &c., by means of beautifully limned and coloured illustrations, is, we think, so praiseworthy an effort and productive of so very much that is to be highly prized in the development of refined tastes in the young, that we feel it our duty, in the interests of all those who are entrusted with the training of children, to bring this most useful contribution to the wants of the household to their notice, and in so doing we can rest assured that they will have ample reason to congratulate themselves on having added to the comforts of a happy home.

THE FACE OF THE SKY.

From September 26th to October 10th.

By F.R.A.S.

The Sun, as heretofore, will be examined whenever the sky is clear for spots and faculæ. The Night Sky will be found delineated on Map X. of "The Stars in their Seasons." Minima of Algol will be observable at 11h. 31m. p.m. on September 27, and at 8h. 20m. p.m. on the 30th. Mercury attains his greatest elongation west of the sun (17° 55′) at 3 a.m. on the 5th, and at this time may be well seen in the east before sunrise. Venus is still brilliant and conspicuous as a morning star, but is becoming a less interesting object in the telescope, as she is assuming a gibbous, or humped, figure, like the Moon when between full and her last quarter. Mars continues invisible, and Jupiter does not rise until between 1 and 2 o'clock in the morning. Saturn, however, is above the horizon about a quarter to nine o'clock at night at the beginning of October, and about 10 minutes past 8 when our notes terminate. Uranus is absolutely invisible, and Neptune, in an utterly blank region in Taurus, may be seen after 8 o'clock in the evening in the east, attaining a considerable height above the horizon by midnight. The Moon enters her first quarter at 10h. 21m. a.m. on September 27, and is full at 10 o'clock at night on October 4. Hence the first half of the period of which we are treating will be the best to observe her in. During the next fortnight there will be four occultations of stars by the Moon. On October 1 θ Aquarii, a star of the 4½th magnitude, will disappear at the Moon's dark limb 40 minutes after midnight, at an angle from her vertex of 77°. Afterwards it will reappear at 1h. 7m. a.m. on the 2nd, at the bright limb, at a vertical angle of 29°. On the 3rd BAC 8,311, a 6½th mag. star, will disappear at the dark limb at 8h. 12m. p.m. at an angle of 69° from the vertex of the Moon, to reappear at the bright limb at 9h. 19m. at a vertical angle of 292°. On October 6 a 5th mag. star, 38 Arietis, will disappear at the Moon's bright limb at 9h. 9m. p.m. at a vertical angle of 39°. It will reappear from her dark limb at 10h. 2m. at an angle of 283° from her vertex. Lastly, on the 9th, 130 Tauri, a 6th mag. star, will disappear at the Moon's bright limb at an angle from her vertex of 73° at 9h. 45m. p.m., its reappearance at her dark limb happening at 10h. 37m. p.m. at a vertical angle of 219°. The Moon is in Ophiuchus at noon to-day, but quits that constellation for Sagittarius at 1 o'clock to-night. Her passage across Sagittarius occupies until 11 a.m. on the 29th, when she enters Capricornus, and, crossing that constellation, crosses its boundary into Aquarius at 3 a.m. on the 30th. She does not quit Aquarius until 2 a.m. on October 3, at which hour she passes into Pisces. It is midnight on the 5th ere she has traversed this great constellation and entered Aries. At 3 o'clock in the afternoon of the 7th she quits Aries for Taurus. Travelling through Taurus, she arrives half an hour after midnight on the 9th on the western edge of the extreme northerly strip of Orion, and, as she crosses this in 12 hours, it is evidently noon on October 10 when she emerges in Gemini. She is passing over Gemini when our notes terminate.

During the past few weeks over a ton of mushrooms has been despatched every day from Dublin to Liverpool.

Sir R. Temple, in his presidential address to the Economic Science Section of the British Association at Montreal, said, regarding electric telegraphs on land, that there are 86,000 miles in the British Empire, or nearly one-fifth of the sum total for the world. It is remarked that the telegraphs in Australia—26,000 miles—are exactly equal to those in the United Kingdom. But in illustration of the difference between an old and a new country there are 31,000,000 of messages yearly in the United Kingdom, and only 5,000,000 in Australia. In other words, the telegraph does six times as much in the old country as in the new. Similarly in the United States, the length of telegraph—121,000 miles—is amazing; but the messages are only 34,000,000—just in excess of those in the United Kingdom. In other words, the work is more than four times as heavy in the United Kingdom as in the United States. Besides the land telegraphs, there are submarine cables in the world with the surprising length of 105,000 miles. Of these the greater part belong to the British Empire.

"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

TEA-DRINKING.

[1411]—I have taken the advice of Mr. Williams, and at once commenced the experiment of weaning myself from the "drug." Should you deem it of sufficient interest to your readers, I will, in a few weeks, give them the result of my experience.

In the meantime, if Mr. Williams would fill up the omission in his article (as a reply to my letter), and state the nature of the mischief to be apprehended and its symptoms, I believe it would serve to arrest the attention of a large proportion of the readers of Knowledge who may still be waverers. A. Gaubert.

A VERY OLD TRICYCLE.

[1412]—Truly there is nothing new under the sun. In Knowledge, No. 150, I read an account of a modified tricycle called the "Coventry Chair." Soon afterwards I found in an old book an account of the oldest sociable. This old book, called "Recreations in Mathematics and Natural Philosophy," was written by James Ozanam in 1694, improved by John Steven Montucla about 1754, and finally translated from the French, and further improved, by Charles Hutton, in 1803. After describing two invalid chairs, in which the invalid grinds himself along by means of handles, the translator goes on to say, "The other carriage, *as Ozanam says*, was moved by a boy seated behind, who trod alternately with his feet on two movable treadles. These treadles, in rising and falling, moved two pieces of wood fitted into toothed wheels fixed to the axis of the large wheels; but this mechanism is so badly explained by Ozanam, both in the description and the figure, that no one can understand it. For this reason we have thought proper" to say nothing more about it. Percy Major.

VACCINATION.

[1413]—Permit me to state a few facts relating to the above important subject. My father had three brothers and three sisters, all of whom were marked more or less. The women were entirely disfigured. My father had six children, all vaccinated. Not one of us had a single mark. The family has spread out widely, for I could count on my fingers fifty or sixty first, second, and third cousins. As far as I can ascertain, not one of them is marked. Let all those who have passed what we consider the limit of human life—let them look back, and I think they will find that mine is not an exceptional case. As to the number of deaths, I am not competent to give an opinion; but, in the very lowest classes, half the children born die under six weeks. Of course, it is *vaccination* that kills them. We have always more mouths than we can fill, but, as a painter, I do not like to see God's image disfigured.

A Very Old Man.

MIND AND BRAIN.

[1414]—In the interest of truth only I should like to reply to Mr. Perrin's remark on Büchner's "force and matter." I certainly take thought to be an "effect" of stimuli passing through the brain-cells, as much as I take "colour" to be an effect caused by light passing through a prism. If, therefore, I have a right to say "colour" is "changed light" by the action of the prism, so I am right in saying stimuli vibrations or simply motion changed by the action of the brain-cells is motion, *i.e.*, changed motion, *i.e.*, thought. In this sense only I understand Büchner to say, "thought is motion."

As to the power which determines the nature of the molecular changes, I take it to be the simple force of circumstances in conjunction with the nature, power, or capacity of our brain-cells. Just as different light, such as star, moon, or sunlight, produces different colours in passing through a prism (?) or through various sorts of glass or in different positions, so will, say, different kinds of stimuli produce different thought in different brains. For instance, a lecture on geology or astronomy would produce different kinds of thought than one on theology, &c. F. W. H.

THOU DUST!

[1415]—We appear to be threatened with a recrudescence of the sunset phenomena of last year. May I venture to suggest to the members of the Krakatoa Committee, through the medium of KNOWLEDGE, that even if they abandon the volcanic theory, they need by no means abandon the hope that the cause is a purely terrestrial one.

During the summer people go from home; in their absence the carpets are beaten, the fine dust rising into the atmosphere produces the observed effects; the colours are intensified by the fragments of dyed wool. *Voilà tout!*

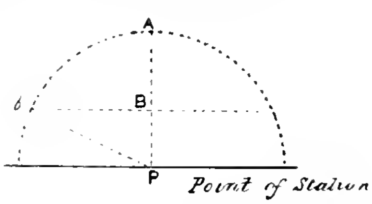
One slight apparent difficulty remains, viz., an explanation of the fact that these effects have only been noticed recently; but a committee whose ability easily coped with the fact that the glow from the dust was seen long before the eruption will doubtless readily dispose of such a trivial and captious bit of criticism. F.G.S.

[It seems to me that there is as much—or as little—to carp at in "F.G.S.'s magnificent theory as there is in that held by the R.S. Committee.—ED.]

FALSE PERSPECTIVE.

[The following letter was inserted in our last issue, but the diagram was inadvertently omitted. We therefore repeat the letter in its complete form.—ED.]

[1399]—If I do not trespass too much on your space and patience, I shall be glad if you will kindly insert the following in answer to your correspondent, "J. H. D." (No. 1386.)



If an object at A appears smaller than a similar one of equal size at B, *because* it is further off, so likewise, and for the same reason, will it appear smaller than B when it is moved to *b*.

The painter must depict things as they *appear to the eye;* it is for the sculptor to represent them as they exist in nature.

R. JONES.

[1416]—I fear my letter (1399) without its accompanying diagram, which has been, I presume, accidentally omitted, will not be very readily understood. I do not purpose troubling you with any further remarks on *False Perspective*, but shall be obliged if you will kindly print this, my final answer to "Eye Witness," "Old Draughtsman," and others who have taken part in the discussion.

"Eye Witness" is right—the horizontal and vertical lines will, doubtless, have vanishing points, which if not quite so far off as the nearest fixed stars, are, nevertheless, sufficiently remote to render their inclination *practically* inappreciable. If "Eye Witness" will refer to my former letters he will perceive that the drift of them has been to establish the fact, that when an observer is so placed that he can see a portion of *two* sides of a rectangular solid, the top and bottom edges of these sides will be seen to trend away in the manner I have described.

"Musafir" objects that my line of posts, if produced both ways, would converge to the right and left. "Old Draughtsman" (in letter 1288) furnished a sketch of a portico whose columns from the centre one right and left diminished in height very rapidly indeed. The effect was certainly peculiar, but *theoretically true to Nature,* although the diagram in question was manifestly intended to afford a sort of *reductio ad absurdum* proof of the fallacy of my own views. If "Old Draughtsman's" grotesque presentment did in any degree answer its inventor's purpose, it was, I fancy, because the details of the drawing were so monstrously inartistic and unscientific in their exaggeration. R. JONES.

Sept. 19, 1884.

[1417]—I have read attentively all the letters on the above subject which have appeared in your columns, and have several times been on the point of writing one myself, but have hitherto refrained. But, after the letter of "An Old Draughtsman" in your last number (150, p. 224), I would like, with your permission, to say something about it. The theory of "A. O. D." that the picture plane can assume other positions than at right angles to the line of vision (or direction in which the spectator looks) is surely utter nonsense. Taking Q Q (see his first figure) as the position of the picture plane, he makes out that the post *f* must be drawn about twice as high in the picture as the post *a*. (A *a* is retained in all his examples as the direction of vision.) Now, let readers produce the line *fa* to the right of *a*, and place a post, say *g*, as far to the right of *a* as *f* is to the left. Join A *g*, produce Q Q to cut A *g* in *n*. The distance of *n* from A *g* will give the distance from the post *a* or *f* in his second figure, at which it has to be drawn to show its apparent size in the picture. Draw it between *z z* and eye of spectator, A. It will be about half as long as *z z*, or one-fourth of *y y*. Call it *n n*. It seems, then, that the posts *f* and *g*, of equal height, placed at equal distances from the spectator, and at equal distances to the left and right of A *a*, the direction of vision, may be represented in a picture by lines in the proportion, say, of 4 to 1. Such a picture would be much after the style of the distorted image which one sees of one's face on looking into a silver spoon or a teapot, at the same time turning the head round a little. Surely "A. O. D." is making fun. It is quite true that Q Q *may* be used as the position of the picture plane, but then the spectator must turn somewhat round, so as to look in a direction at right angles to Q Q, which, of course, alters the whole case. Taking the problem as it stands, the only possible position of the picture plane is parallel to *a f*, that is, at right angles to the direction of vision A *a*. How would "A. O. D." represent the post *f* in his picture if his picture plane Q Q were inclined at a somewhat greater angle than represented, so as to make it pass *through* the line of posts, or behind *f?*

With regard to R. Jones's initial difficulty about the drawing of a cube, of which two sides are seen, one, parallel to the picture plane, being represented by a square, it may be remarked that elementary text-books on perspective show how to place, say a cube, in every part of a picture, and in all positions. But each of these is only a small object in a large picture, and seldom in the centre. In order to get the representation of a cube which R. Jones expected, the cube must be placed directly opposite the spectator, with both visible sides forming angles with the picture plane. It will then occupy the centre of the picture, and both visible sides will vanish. The same will happen with R. Jones's original cube (which is to the left of the direction of vision) if the spectator turns round and looks straight at it. Of course, this changes the direction of vision, at right angles to which a new picture plane must be drawn. We will then have, as before, both sides vanishing.

A curious fact may be mentioned about the perspective representation of a sphere not in the centre of the picture. The rays of light from all parts of a sphere to the observer's eye form a cone. If the sphere is some distance to the right or left, this cone will be cut obliquely by the picture plane, the section being an ellipse. A sphere so placed will therefore be correctly represented in the picture by an ellipse, and not by a circle, as one would at first suppose. STARCH.

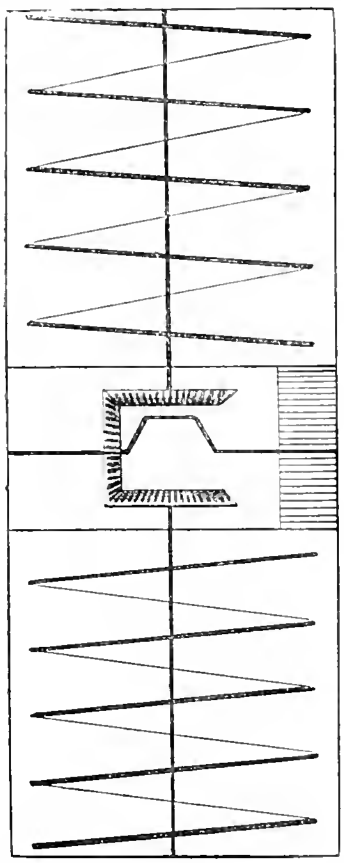
AËRIAL LOCOMOTION.

[1418]—The interest with which I read your recent articles on aërial flight was not unmixed with curiosity, and ultimately, I may confess, with some disappointment at the absence of all reference to one possible solution which has of late years obtruded itself on my speculations on this subject. The method to which I allude is that of *ascent into*, and *continued support in*, the air by the help of a *screw-shaped fan*. I do not know whether it has ever been tried, nor, indeed, can I call to mind any distinct proposal of this kind; yet it appears to have elements of success which might well tempt mechanical invention, and must surely have done so.

If a screw can be made large enough, light enough, and strong enough to *raise* the weight of a man, in addition to the machinery and reservoir of power requisite to turn it at the proper speed, the problem of aërial locomotion will surely be solved; for it will obviously be only necessary to *incline the axis* of the screw in order to obtain lateral motion.

I imagine there can be no doubt as to the *meaning* of what I have above suggested; it only remains for those whose practical acquaintance with such things, and whose theoretical powers of insight are sufficiently recognised to pronounce on the prime question whether an archimedean screw, revolving in air, could be made large enough and strong enough, and could be rotated with a sufficient velocity, to produce the necessary lifting power. It will, I think, be admitted that the *prima facie* likelihood is considerable, although something more than that is needed to stimulate experiment.

There is one point on which I must add a caution. The resistance of the air, due partly to friction and partly to the pitch of the screw, must find some sufficient opposition in the machine itself, otherwise the latter will turn in the contrary direction. This



suggests a second fan, with a contrary pitch—or a subsidiary fan devoted solely to counteraction. The relative advantages of these, and the disposition generally of the fans with respect to the car, are points into which I will not enter, further than to hazard the opinion that the greatest economy would be attained by two equal screws of opposite pitch, revolving in opposite directions, and having their axes in one straight line.

The accompanying diagram, without pretending to be a design for a flying machine, is intended to show how the difficulty glanced at above, can be entirely met. Power is supposed applied either through the crank or by a coiled spring. If two or more screws support a platform, there is no need for other counteraction than their own. J. Herschel.

LETTERS RECEIVED AND SHORT ANSWERS.

[Before these lines meet the reader's eye, I shall have left England for a month's very sorely needed rest. Correspondents must hence bear with me if the replies in this column are during that period practically confined to an acknowledment of the receipt of their communications.]—Dorothy Forster. I know of nothing exactly answering your description; but you might try Miss Yonge's "Aunt Charlotte's Stories from Bible History," any of the volumes of the "Line Upon Line" series, or even "Pinnock's First Steps to Bible and Gospel History." You had better write to Moffatt & Paige, Warwick-lane, London, on the subject of cheap historical wall pictures. They are the likeliest people I know of to publish such things—if, indeed, they are published. In connection with the Kyrle Society, apply to Miss Hill, 14, Nottingham-place, London, W.—W. G. The lines you quote are from a mediæval drinking-song in Leonine Latin, and may be construed, "I mean to die in a tavern; expiring with the wine at my lips (as the English singers say) May the Almighty be propitious to this sot." Truly, not a very edifying sentiment!—L. A. W. Looking through an astronomical telescope is not injurious to the sight, especially if you can teach yourself to do it (as you soon may) with the other eye open. Using the eyes alternately, too, is good. Look in Map VII. of "The Stars in their Seasons" for ζ and η Herculis. Draw an imaginary line from η to ζ, and one-third of the way along it you will find the cluster you refer to. The period of Encke's comet is not 5 but 3·3035 years. It was, I fancy, last seen by Tebbutt, in August, 1878. Halley's comet will not return until 1911. Certainly Vesta, Juno, Ceres, and Pallas can be seen with a 2½-inch object-glass; Vesta sometimes even with the naked eye. They are difficult to distinguish from fixed stars merely by their aspect.—W. G. Wiseman, F.R.G.S., on opening a duck's egg the other day, discovered, in addition to a perfect yolk, another small egg, about the size of a pigeon's, with a hard shell. Will any embryologist explain this not very common phenomenon for his benefit?—Cope Whitehouse offers to furnish gratuitously to any author or publisher clichés of his woodcuts of Staffa printed in his paper read before the geological section of the British Association at Montreal. B. O'Reilly. In the morning. A table-lamp, certainly.—Wave. From the friction of their lower parts against the beach as they approach the land. There is no "easy" way of working out moon-rise, which, in any accurate form, is a very complicated piece of calculation. Of course, it must be computed afresh for each locality. It is given for London in Whitaker's Almanack, but the vol. for 1885 is not yet out.—F. L. Armitage. See Lommel's "Optics and Light" in the International Scientific Series.—T. R. C. sends me a prospectus of "The Society of Science, Letters, and Art of London," which seems to give concerts, conduct examinations, grant hoods, gowns, and decorations or badges (or, I suppose, the right to wear them), furnish lecturers, &c., for literary, musical, and scientific evenings, and require funds to meet expenses. F.R.S.L. means Fellow of the Royal Society of Literature.—A. S. Orr. "Five of Clubs" is, unfortunately, at present on the other side of the Atlantic. A. Roberts. In these latitudes, just prior to the spring equinox, the inclination of the ecliptic to the horizon is very considerable. Moreover, the moon's orbit is inclined some 5° to the ecliptic, so that she may be 5° north of that again, and the line joining her centre and that of the sun seemingly nearly perpendicular to the horizon after sunset. Hence the diameter passing through her cusps lies pretty nearly horizontal when she is very young, and she seems to "lie on her back" in the western evening sky. The idea, however, that this is a cause or sign of rain is as utterly baseless as that her so-called "changes" affect the weather.—H. C. S. wants details and an explanation of the Berkeley-square Ghost. I am unfamiliar with either myself. Can any reader furnish the necessary particulars?—J. B. Findlay. The information contained in every one of the astronomical works advertised by the Messrs. Longmans, on p. viii. of the advertisement sheets in Knowledge, for Sept. 19th, is brought up to the very latest date. See, too, Ball's "Astronomy," by the same publishers, Newcomb's "Popular Astronomy," published by Macmillans, or Sir Edmund Beckett's excellent "Astronomy without Mathematics," issued by the S.P.C.K. The hypothesis that Alcyone is the centre of the visible universe (a mere fancy of Mädler's, of which Sir John Herschel at once pointed out the improbability) has been definitely shown to be groundless by the study of the proper motions of the stars in different regions of the heavens. The latest and most trustworthy theories on the subject of variable stars are those of Professor Pickering. See the "Universe of Stars," for the structure of the heavens. I think that Todhunter's books on Trigonometry are, perhaps, as good as any you can get; but Spherical Trigonometry is not an easy subject to get up without a tutor.—A. J. Harvey. I doubt if there is a single astronomical reader of Knowledge who is ignorant of Schwabe's discovery of the periodicity of sun-spots. His period, however, has since been shown to be erroneous.—T. K. H. Received. No time to deal with your charming little problem now.—Pro Liberis. See reply to "Anonymous" on p. 247.—E. L. Taylor, S., K. H., S. B. Partridge, G. D. Evans, F. S. Thompson, W., and many others who send answers to the Figure Puzzle. Thanks; but the two letters printed contain at once a reply to and an explanation of the theory of the question.—Colonel Herschel. Your interesting letter was, of course, marked for insertion. Replies in this column are mainly confined to correspondents whose letters are *not* intended to appear.—Dr. E. Groth. I failed to lay my hand upon the proof to which I referred, and am very much too busy at this instant to be able to devote an hour or two to hunting it up. Meanwhile may I suggest for your consideration the millions of years which it must, *ex ne-*

sitate, occupy for the fragments of any single body (which must have *solidified* before disruption) to diverge into such wholly different orbits as those described by the planetoids, the very wide scattering of their nodes, and their sorting into separate groups, and invite you to study what Sir William Thomson says as to the limits of the antiquity of our solar system. Forgive me for saying that you seem to resent the assumption that Olbers was wrong, as though you wish to make a personal quarrel of the matter! If you insist on believing that the 250 known (and x undiscovered) bodies travelling between Mars and Jupiter in such very diverse orbits, are fragments of one large one, I am not concerned to undeceive you.—C. E. Doyle. The "Notes on Mapping" will be resumed later on. There is a great press of matter on our columns just now.—Telegraphist. The series of articles on electrical measurement did not cease where you imagine, but was continued into Nos. 75 and 77; and the articles, so far as they went, were complete. The interest and importance attaching to the subject are certainly great, and Mr. Slingo will probably further augment the series at an early date; at least we hope space will permit him to do so.

Our Chess Column.

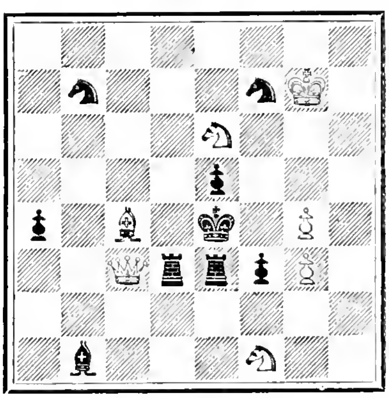
By Mephisto.

SELECTED PROBLEM, No. 130.

By E. N. Frankenstein.

(A masterpiece.)

Black.



White.

White to play and mate in three moves.

CORRECTION.

Problem No. 129, p. 248.

A black Pawn ought to be placed on Black's KKt4.

SOLUTIONS.

Ending p. 228.

1. R × P	P × R or		Q × R
2. B × Kt	Q × B	Q × Q	R × Q
3. Q to K8(ch) mate		B × Kt and wins	
or wins			

If Kt × Q 2. R × R mate.
If R to QBsq 2. R to Q4 and wins.

Problem No. 128.

By Clarence.

1. Q to B7, B × Kt.	2. Q to R7 mate
Kt × P	2. P to B3 „
B to B5	2. Kt to B3 „

Carlton Chess Club, 12, Bell-street, Edgware-road

Sir,—Being desirous of having a Chess club under the above name, we should be glad if you would help us by giving us a few simple rules and hints as to how it should be conducted, and how we should proceed when challenging another club. Can you tell us the names of any minor Chess clubs we could play for a start? We have several very good players. Carlton C. C.

[Elect committee and officers, draw up the usual rules, or copy those of the City of London Chess Club, which you may get on application. Having formed the club, arrange a handicap tournament for the winter season, in which, if the number be not too large, each player (properly handicapped) plays one game with every other man. As to inter-club matches, there has been a meeting of the secretaries of London C. C. this week, at the Ludgate Circus C. C., at Oliphant's Café in St. Bride-street, for the purpose of settling matches for this season, but we have no doubt that a written or personal application to the secretary will give you any particulars you may require. The nearest club in your neighbourhood is the C. C. of the Railway Clearing-house in Seymour-street. Perhaps, though rather strong, they might accept a challenge. Any further information as to conduct of a club you will, no doubt, obtain from the courteous secretary of the City of London C.C., Newgate-street, E.C. If you wish your Club to prosper, give it as much publicity as you can by sending notices of your doings to the press. We understand that a new weekly paper —the *Weekly Echo*—will shortly be started with a Chess Column, a part of which will be especially devoted to the London Clubs.—Mephisto.]

ANSWERS TO CORRESPONDENTS.

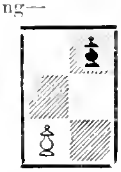
*** *Please address Chess Editor.*

F. J. D.—Thanks for communication. We are pleased to hear from you again. Have you anything original?

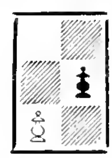
A. E. R.—Problem received, with thanks. Pray excuse the alteration, as otherwise 1. Q to Kt sq (ch) would solve it.

W. Hanrahan.—The author's solution of No. 127 is the most decisive.

J. K. Milne.—You are mistaken about the rule of Pawn takes Pawn in passing. Supposing—



In this position the white Pawn moves two squares. Then the black Pawn has the right to take the white Pawn, as if the latter had only moved one square. But if the position is like this:—



then the white Pawn can advance two squares, and the black Pawn has no right of taking the white Pawn.

Correct Solutions received:—Problem No. 127: S. B. C.; No. 128: J. K. Milne, M. T. Hooton, A. W. Overton. Problem No. 129 solved by Geo. W. Thompson, H. A. N., W.

W.—We are very much afraid you have cooked No. 129. Your solution is as complete as it is correct; pray note correction above.

Geo. W. Thompson, S. B. C.—Solutions incorrect.

H. Smith.—The proposed tournament at the Divan will be open to all comers.

Contents of No. 151.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED - EXACTLY DESCRIBED

LONDON: FRIDAY, OCT. 3, 1884.

Contents of No. 153.

GAMBLING, SHOW-PRAYING, AND LECTURING AT SEA.

By Richard A. Proctor.

MR. THOMAS HUGHES, Q.C., the author of "Tom Brown's School days at Rugby," arrived in New York on August 31, on the *City of Rome, en route* for Rugby, Tenn. He was interviewed by a reporter of the *New York Herald*, who reports that Mr. Hughes was fired with enthusiasm, not so much in relation to the new Rugby and its proposed school, as about a disturbance which had occurred on the steamer coming over.

The following is the report of the interview :—

"There are on the deck of the steamer," Mr. Hughes explained, "two rooms—one a smoking-room, and one a reading-room. The reading-room is supposed to be for the use of the ladies as well as the gentlemen. Monday, the third day out, they turned the room into a card-room and smoking-room, going on with cards, draughts, &c., all day. Well, I went off to the smoking-room, and found that there had been a baccarat bank started there. A man from Australia—a perfectly good, honest fellow he was, but he made his living that way—had started the game with three other men, all middle-aged. The bank was a perfectly square one and the play was entirely honest, so far as I know and believe.

"This was kept up all day, and up to the time of putting out the lights and going to bed, and every day after that, from eleven o'clock in the morning till bedtime, this baccarat bank was kept going; and there was much of the time a row of players five or six deep around the game. Many of these were mere boys, lads of twenty or less, who were allowed to punt their shillings or dollars, or more. The stake was sometimes up to £5, I believe.

"Now, I do not object to the baccarat going on, but what I did object to was its being carried on openly, and boys being allowed to join in the game. And I objected, as many others did, to the reading-room being made inaccessible to the ladies. So one of the passengers, a friend of mine, drew up a memorial, and I led the signatures with my own. It was signed by a large number of the passengers.

"This paper was lying on the saloon table, and the passengers were signing it in great numbers, when I was told that a fellow named Lord was up on deck talking about it and telling all sorts of lies about what we were doing. I went right up and spoke to him. I asked him if he had read the memorial, and he admitted that he had not. Then there was some sharp talk, and a friend of mine, a young American gentleman, struck one of the other side. Of course, we stopped them at once, but there were some sharp discussions afterward and a great deal of bad feeling.

"Since we landed," he continued, "we have presented the memorial to the agents here, and they say they do not propose to do anything about it, so I want the press to take it up. It is going to do a great deal of hurt if our youth are to be exposed to this temptation. A great proportion of the travellers on these steamers are mere boys, and I do not think it right or proper that they should be admitted to any game of this kind. Baccarat is not allowed at our clubs in London, and it seems a pity that it should be played openly on the steamers"

"Capt. R. D. Monroe, the commander of the ship," adds the *New York Herald*, "said that many persons at sea like to pass the time by playing cards for money. The amount of gambling on the *City of Rome's* last trip was not serious. The trouble, he thought, was caused by a young man of twenty losing more money than was convenient, but the circumstances were not such as would justify Capt. Monroe's interference. He thought that his refusal to permit prayer-meetings to be held in the saloon had something to do with the memorial. He did not hear of the paper till the vessel reached quarantine."

I made my own last journey to America in the *City of Rome*, and although I made certain betting transactions which took place on that ship the theme of a short article on the inaneness of the method for passing time to which Capt. Monroe refers, I must say the gambling on board the *City of Rome* was not greater than usual. In the saloon, indeed, there was less gambling than usual—all the whist, for instance, being for "love," whereas usually a good deal of high play takes place in a quiet way. (I remember a case, nine years ago, in which a young New Yorker of moderate means, playing with three merchants who made the points a sovereign a-piece with a five-pound note on the rubber, lost a much larger sum in an evening than he could probably earn in a month.) I heard of much poker being played in the smoking and reading-rooms; but as I was never in the former and only in the latter to get and return books for my family, I can only speak from hearsay. I take it, poker is as busy a gambling game as baccarat; only the latter seems regarded as suitable for clubs, till forbidden by law, while poker seems an appropriate game for cowboys *et id genus omne*.

I must confess I rather pity the captains of ocean steamers, when the rival claims of gambling and show-piety are brought before them. *Only*, if Capt. Monroe did right, as he unquestionably did, in not allowing the use of the saloon for prayer-meetings, he would have done right in forbidding the use of the smoking-room for a baccarat bank, supposing always he was asked to do so. The saloon, smoking-room, and reading-room of an ocean steamer are for the use of the passengers as a body, not for any particular set. If a large majority of the passengers agree to the use of any of these rooms for a special purpose—the captain and purser assenting—it is fitting for the minority to yield. For instance, there is always a certain minority opposed to the use of the saloon for entertainments, dramatic, musical, and otherwise; but they generally put up readily enough with what is to them an annoyance so long as it lasts. As regards prayer-meetings (on week-days), they are never supported by more than a small minority, usually consisting of the steadiest members of the community—excepting only the gambling set. It has always seemed to me as if they started their show-piety just about the time when every fellow-passenger had thoroughly recognised their position as the gloomiest and worst-tempered members of the company. They very seldom find a captain willing to listen to them. The gambling set usually get what they want, by not asking too much. Here and there in the saloon you see a table round which three or four low-browed fellows—some rapacious-looking, others looking more or less idiotic—sit playing for "chips," which represent in reality tolerably large sums of money. In the smoking-room you see more of this crew. There, also, wagering on the ship's run, on the number of the pilot, his complexion, the leg he first puts on board, and other such absurdities, may be watched by those who take interest in noting the lower instincts of humanity. You generally hear towards the close of the journey that a certain number of the more foolish have lost "more money than is convenient," as Capt. Monroe pleasantly puts it. But pity is wasted on these foolish folk. "If wilful will to water wilful must wet,"—that is all that can be said.

When, however, it comes to setting up a baccarat bank, or any other systematic gambling trap, in smoking-room or reading-room, the case assumes a different complexion. The majority of the passengers ought not, however, to trouble the captain or purser in such a case, unless either has given special permission to the swindlers to start their nefarious business. (I reject utterly Mr. Hughes's assertion or admission that the men were honest who started the baccarat bank, or that their system was fair and square; there is no such thing as honest gambling.) They should have claimed their own rights. A sufficient number of ladies and gentlemen should have occupied the reading-room and its neighbourhood; a sufficient number of gentlemen should have broken up the baccarat bank in the smoking-room; and both sets of well-meaning members of the community temporarily brought together should have expressed before the wrong-doers—as occasion arose—their sense not only of their own rights, but of the blackguardism of the attempt to introduce their evil ways into a company of respectable persons. Writing memorials can be of little use in such cases. But a large number of those who will gamble among gamblers are ashamed to go on gambling in the presence of ladies and gentlemen, and in face of their openly expressed contempt for such practices.

A minority even can effectively maintain their rights when these are invaded. I remember hearing of a case on board the *Arawata*, a New Zealand steamship, where an inexperienced lecturer who—strange to say, actually *wanted* to lecture during a sea journey!—was beaten by a small party of passengers who, finding that no one really desired his discourse, continued talking and laughing in his neighbourhood so that none could hear him. A lecture on board ship is a nuisance any way—at any rate to an unfortunate being who is asked to give one. This happened to me in five out of my first six ocean journeys, despite entreaties to be let off. It shows what straits a ship's company may be reduced to for amusement, when nine-tenths of the passengers ask, as a favour, for what certainly only one-tenth of the general community on land would desire. It puts a lecturer in rather an uncomfortable position. If he accedes to the request, a few who object are sure to suppose he has put himself in the way of the work—preposterous though such an idea is in the case of any lecturer having an established position in his profession. If he declines, many consider it must be from churlishness, preposterous though that idea should be, also. On the whole, however, I have had no reason to complain; and I believe the few lectures I have given on board ship have been found unexpectedly free from the dry-as-dust quality supposed to be proper to astronomy. Yet a very small minority would always have sufficed to stop any lecture I had been announced to deliver. If a fourth or a fifth, even, of the company object to the use of any of the ship's public rooms for such a purpose they have a right to maintain their objection. I have never known, however, a case where a minority has acted in such a case otherwise than by keeping away. I have known a case where a majority acted very decisively that way. Indeed, where any one on board ship obtrudes himself either by undertaking to pray for less devout passengers, or by offering gambling facilities, or by proffering a discourse or a lecture, he can expect (and deserves) no other treatment.

But in all such cases, the passengers should act for themselves. Neither purser nor captain should be unnecessarily troubled. Each has enough to attend to without being worried about matters which the right-minded members of the community can settle by their own action. The case illustrates aptly Mr. Thomas Foster's discussion of "The Morality of Happiness." A due regard for the rights of self should be corrected by a just appreciation of the rights of others, and *vice versâ*. The unduly complaisant are almost as mischievous by neglecting to claim just rights, as are the unduly egotistic by claiming what they are not entitled to. The latter try to injure by wronging the rest; but the former may do just as much harm by failing to take their proper part in the work of resisting such wrong-doing.

PLEASANT HOURS WITH THE MICROSCOPE.

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

THERE are many cases in which it is not wise to trust to the old adage that seeing is believing, and the microscopist should make himself acquainted with the sources of fallacy. The difficulties of interpretation are most troublesome where high powers, large angled glasses and condensers of the same nature, are employed. Every student of minute forms is delighted, for example, with diatoms, and not a few microscopists go mad over them, look at nothing else, and deserve the nickname of diatom-maniacs. But while we laugh at them, we should confess that they have rendered an important service in continually demanding more and more approach to perfection in the construction of objectives and means of illumination. For thirty years and more they have studied their pet objects, and again and again some enthusiast has imagined he had quite settled their structure, but the battle still rages, and no one can see when it is likely to end. There are many points to be decided. First, are certain round markings elevations or depressions? Are they really round or hexagonal? How many distinct or distinguishable layers make up the siliceous skeleton of the little plants or animals, or borderland creatures, as the inquirer may prefer to call them? Again, are certain aperture-looking dots real holes or sham ones? The student of natural history in other departments, and of physiology and minute anatomy, may care little for diatoms, or the disputes of the diatom-maniacs, but he meets with the same sort of difficulties that bewilder them, and often cannot, for the life of him, tell when seeing should be believing.

For a low-power experiment introducing one of the difficulties, take a three-inch objective and a lady's silver thimble. There is no doubt concerning the thimble's structure, its depressions and borders, separating one from another, are as plain as the cells of a honeycomb, but if viewed at night, and strongly illuminated from one side, it is very likely to look as if every depression was an elevation. Sometimes if this effect is produced with one-eyed vision, a right view can be obtained by a binocular one, but sometimes not. There are many cases in which depressions look like elevations. Examining the moon through a telescope leads some folks, not infrequently, to see all the crater hollows as projecting mounds, and when the eye has once been deceived, the false view is apt to be excessively troublesome. Nasmyth's admirable moon slides for the lantern frequently puzzle observers, and their difficulty in seeing the hollows lower than their elevated surroundings is increased if slides with shadows to the right succeed others with shadows to the left. Hollow casts of gems in plaster of Paris, or sulphur, can easily be made to look like cameos, either by help of a magnifying glass or a simple hole, a quarter of an inch in diameter, cut through a blackened card. The experimenter with the thimble can usually arrange the light, &c., as to show the true structure, but if the eye has once caught a wrong picture, it may refuse to have it corrected. Besides looking at the thimble itself, impressions in black and red sealing-wax should be examined.

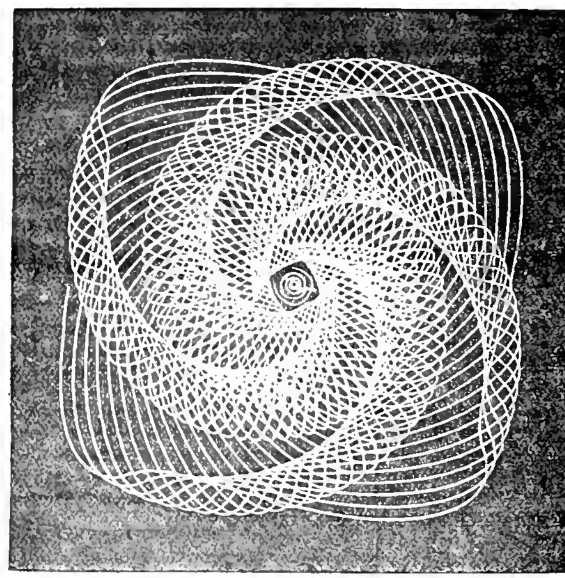
To take another instance: a transparent film, such as one of colloid silica, which cracks in drying on a glass slide, may be employed. Very clear gum or thin white varnish will perhaps do as well. The cracks are easily recognised by holding the slide against the light. One, perhaps, begins with a pretty wide fissure, and thins out to a very narrow one. The narrow part will seem, when magnified one or two hundred times linear, to be elevated like a slender rod superposed upon the slide. This will show how cautious the observer should be when studying many classes of objects.

Similar to the disputes about diatom structure are those about scales of butterflies and moths. The questions are how many membranes go to form a scale. Is there one under and one upper, or more? Are the ribs between the membranes or growths in their structure? Are the minute markings composed of dots of pigments, or of other shapes? In what plane or planes do the several formations lie? &c. When high powers are employed, and it is desired to ascertain in a very thin object what structure is on the surface and what others in successive planes below, the fine adjustment usually fitted to a microscope is not nearly so delicate as it is advisable to have it. Dr. Pigott in such cases adapts a second wheel, moving with a wonderfully fine screw of his own cutting, to the one sent out with his Powell and Lealand microscope. He can show that with a 1-16th or a 1-25th objective and a delicate object, a change of 100-1000ths of an inch in the focus produces a noticeable alteration in its appearance.

Mr. Washington Teasdale devised an excellent test-slide, helping us in these matters. One he kindly ruled for the writer consists of ten groups of parallel lines, at the rate of 2,000 per inch, disposed in a symmetric pattern of eccentric radials. The lines are ruled with a conchoidal fracture, and not a clear cut, so as to give a maximum of brilliance. This slide is to be illuminated by a spot-lens, or dark ground arrangement of condenser. If the light is exactly centred, all the bands are made to glow with equal lustre. Any slant of the light beams brings out those more plainly which lie at right angles to its line of incidence. Instead of spot-lens, or condenser, obtain a dark ground illumination from the sub-stage mirror turned strongly on one side, and then rotate the object and note the changes that ensue.

The observer will soon find that with one illumination certain bands will appear as if on a plane above the others, but by a change in the angle of illumination, can be made to look in one below them.

Most of your readers will have seen compound vibration patterns ruled with two pendulums, or with more complicated apparatus. When done on glass, on a smaller scale for viewing under the microscope, they are instructive as well as beautiful. Having been amply supplied with admirable specimens by Mr. Teasdale, the writer has been able to exhibit the wonderful perspective effects to be obtained by varied modes of illuminating them. Trial slides and damaged ones are very instructive, as any rough edges come out with so much force as to mislead the eye about their relative position.



The figure—one of Mr. Teasdale's—appended hereto, shows a pattern which is very deceptive under the microscope. It is impossible to avoid the impression that the observer is looking at a hollow object. Perspective effects, without shading, are perhaps more striking to persons who are accustomed to watch them out of doors, and also as exhibited in outline etchings. A very slight guidance induces the eye to accept the idea the artist wishes to convey, and when similar guide-lines occur in a piece of mechanical ruling, their intimation is immediately followed. The subject is a very interesting one, partly optical and partly psychological. To the microscopist its study is of great importance if errors of interpretation are to be avoided. When the optical aspect is of doubtful trustworthiness, resort should be had to reasoning from analogy.

For example, the structure to be made out in the coarsest butterfly scales may help to guide to what is probable in others more difficult, and with delicate organs of insects, rotifers, &c., it is prudent to doubt any appearance that seems to contradict the general rule of such organisations. This doubt, however, must not be carried too far, and the happy mean can only be reached as the result of long study and experience.

The largest organ in the world has just been completed by Walck, of Ludswigburgh, and placed in the cathedral Church of Riga. The colossal instrument measures 36 ft. in width, 32 ft from back to front, and 65 ft. high. It contains no less than 6,826 pipes, distributed among 124 sounding stops.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

IX.

MORE graceful is the conception which makes the soul spring up as a flower or cleave the air as a bird. It is, of course, the purified survival of the primitive thought which did not limit its belief in an indwelling spirit to man, but extended it to brutes and plants, and even to lifeless things. For the lower creatures manifested the phenomena from which the belief in the spirits was inferred. They moved and breathed, their life ceased with their breath; they cast shadows and reflections; their cries, which to the savages seemed so like human speech,* awakened echoes; and they appeared in dreams. Among the western tribes of North America, the phantoms of all animals are supposed to go to the happy beasts' grounds, and in Assam the ghosts of those slain become the property of the hunter who kills them; whilst the custom of begging pardon of the animal before or after despatching it, as among the Red Indians, who even put the pipe of peace in the dead creature's mouth, further evidences to barbarian belief in beast-souls. Although such belief has now no place in serious philosophy, the belief in the immortality of brutes has been a favourite doctrine from the Kamchadales, who believe in the after-life of flies and bugs, to the eminent naturalist Agassiz, who advocates the doctrine in his "Essay on Classification;" and in a list of 4,977 books on the nature and future of the soul given in Mr. Alger's elaborate critical history of the subject, nearly 200 deal with the after life of animals. The advocates have often felt the difficulty of granting this after life to man and denying it to creatures to which he stands so closely related in ultimate community of origin; but science, while it finds links of sympathy with the ideas of rude races respecting the common life of all that moves, and presents evidence in support of the common destiny, lends no support to the doctrine of the immortality of oysters. The custom of apologising to doomed brutes is practised in regard to plants. If they exhibit the phenomena of life in a lesser degree, enough are shown to justify the accrediting of them with souls. Besides flinging wavy shadows aud reflections (and it cannot be too often enforced that to the barbaric intelligence motion is a prime sign of life), they are not voiceless. Murmurs are heard in their leaves; sounds echo from their hollow trunks, or tremble, Eolian-like, through their branches; and in their juices are the sources of repose or frenzy.

"The Ojibways believed that trees had souls, and in pagan times they seldom cut down green or living trees, for they thought it put them to pain. They pretended to hear the wailing of the trees when they suffered in this way. On account of these noises, real or imaginary, trees have had spirits assigned them, and worship offered to them. A mountain-ash, in the vicinity of South Ste. Marie, which made a noise, had offerings piled up around it. If a tree should emit from its hollow trunk or branches a sound during a calm state of the atmosphere, or should any one fancy such sounds, the tree would be at once reported, and soon come to be regarded as the residence of some local god."† As expressed in Greek myth, purified in this case from grosser elements, we have the Dryades, who were believed to die together with the trees in which their life had begun to be, and in which they had dwelt. As expressed in folk-lore and its poetic forms, it is in the growth or blossoming of flowers, or the intertwining of branches, that the idea survives. In the ballad of "Fair Margaret and Sweet William"—

> Out of her brest there sprang a *rose*,
> And out of his a *briar*;
> They grew till they grew unto the church-top,
> And there they tyed in a true lover's knot;*

in the story of "Tristram and Ysonde," "From his grave there grew an eglantine which twined about the statue, a marvel for all men to see; and, though three times they cut it down, it grew again, and ever wound its arms about the image of the fair Ysonde;"† while the conception often lends itself to the poet's thoughts, from Laertes' words over Ophelia:—

> Lay her i' the earth,
> And from her fair and unpolluted flesh
> May violets spring,

to Tennyson's

> And from his ashes may be made
> The violet of his native land.

In Grimm's "Teutonic Mythology" a number of illustrations are supplied of the vagaries of popular imagination, which picture the soul as a bird flying out of a dead person's mouth, and, as a cognate example from rude culture, we find a belief among the Powhatans that "a certain small wood bird received the souls of their princes at death, and they religiously refrained from doing it harm; while the Aztecs and various other nations thought that all good people, as a reward of merit, were metamorphosed at the close of life into feathered songsters of the grove, and in this form passed a certain term in the umbrageous bowers of Paradise."‡ But many chapters might be filled with examples of varying conceptions of the soul, the major number of which (for the idea of it as a mouse, snake, &c., must not be forgotten) have as their nucleus its ethereal nature and freedom from the limitations of solid earth, although round that nucleus gather some more concrete ideas for the mind, desiring something more substantial than symbols, to grasp. The belief that inanimate things as well as animals and plants have a dual being is not so obvious at first sight, and yet, given the reasons for the latter, there are as good grounds, because like in kind, for the former. The Algonquins told Father Charlevoix that "since hatchets and kettles have shadows, as well as men and women, it follows that these shadows must pass along with human shadows into the spirit-land." When the tools or weapons are injured or done with, their souls must cross the water to the Great Village, where the sun sets. Besides, spears and pots and pans, as well as men and dogs, appear in dreams; they throw shadows and images in the water, they give forth a sound when struck, and, as the Fijians also argue, "if an animal or plant die, its soul goes to Bolotoo; if a stone or anything else is broken, it has its reward there; nay, has equal good luck with men and hogs and yams. If an axe or a chisel is worn out or broken up, away flies its soul for the service of the gods." Logically, the savage who believes that in the other world

> The hunter still the deer pursues,
> The hunter and the deer a shade,

must put in the hands of the one a shadow spear. So when an Ojibway chief, after a four days' trance, gave an account

* "To the ear of the savage, animals certainly seem even to talk. This fact is universally evident, and ought to be fully realised."—Im Thurn's "Guiana," p. 351.

† Dorman, pp. 287, 8.

* Grimm's "T. M.," p. 827.

† Cox and Jones, "Pop. Romances," p. 139.

‡ Brinton, p. 107.

of his visit to that land of shadows, he told of the hosts whom he had met travelling there laden with pipes, and kettles, and weapons. These primitive ideas explain once and for all matters which have too often been explained by fanciful theories, or cited as evidences of the benighted condition of those places which on missionary maps of the world are painted black. They disclose the reason why food, and utensils, and weapons were broken and buried with the dead; why fires were lighted round the grave; why animals were slain on the death of a chief; why the Greenlanders, when a child dies, bury a dog with him, because the dog, they say, is able to find his way anywhere; why North American Indian mothers in pathetic custom drop their milk on the lips of the dead child; and why, what seemed so inexplicable to the early missionaries to the East, ignorant of the practice of widow-sacrifice among the ancient peoples of the West, as the Gauls, Teutons, and others, wives and slaves were burned on the funeral pyre. Among the Mexicans sometimes a very rich man would go as far as to have his chaplain slaughtered, that he might not be deprived of his support in the other world.

In their initial stage all these gifts are made, all these rites performed, for the supposed need of the dead. Everything had its *manes*, which followed him into the next world, and, lacking which, he would be as poor as if in this world he had lacked it. The spiritual counterpart of the offerings was consumed by his spirit, just as the old deities were thought to enjoy the sweet-smelling savour of the burnt sacrifices; the fires were kindled that the soul might not grope about in darkness. So the obolus was put into the mouth of the dead, that its *manes* might be payment to Charon for the ferry of the Styx, as money is put in the corpse's hand or mouth among the German and Irish peasants to this day; so the warrior's horse was slain at his tomb and the armour laid therein, that he might enter Valhalla riding, and clothed with the tokens of his right to enter the abode reserved for those who had fallen in battle.

Any explanation of customs like the foregoing, persistent as they are in kind, however varying in expression, is defective which does not take into account what large parts the emotions play in all that is connected with death, and how they infuse such practices with vitality. The bereaved refuse to believe that those whom they have lost have no more concern in the interests of life once common and dear to both. As among the Dacotahs, when a mother feels a pain at her breast, they say that her dead child is thinking of her. The place where the body lies becomes the connecting link between it and the soul which is still the solicitude and care, or, it may be, the dread, of the living; succouring and protecting, or, on the other hand, avenging.

The element of dread undoubtedly comes into play early. The awe which we feel in the presence of death, or in passing in the dark through a churchyard, takes in the savage the form of terror. The behaviour of the ghost in dreams, its ability to do what men still in the flesh cannot do, quicken the belief in occult power, and the desire to propitiate it. The articles placed in the grave as gifts for the dead become sacrifices laid on the altar to appease malignant spirits; the mound or tomb becomes a temple, and awe passes by easy degrees into worship. The prevalence in one form or another of ancestor-worship has led Mr. Spencer to the conclusion that it is the rudimentary form of all religions; even sun, moon, volcano, river, &c., being feared and adored because they were believed to be the dwelling-places of ancestral ghosts. The facts are against this theory. It is to the larger, the more impressive phenomena of the natural world, the sun in noontide strength and splendour, the lightning and the thunder, that we must look for the primary causes which awakened the fear, the wonder and the adoration in which lie the germs of the highest religions. Such causes are not only sufficient, but more operative on the undeveloped intelligence than the belief in ancestral spirits of the mountain and the sea, which involves a more complex mental action.* The one is contributory, but subordinate, to the other. It is, as M. Reville remarks, "The phenomena of Nature regarded as animated and conscious, that wake and stimulate the religious sentiments, and become the objects of the adoration of man. . . . . If Nature-worship, with the animism that it engenders, shapes the first law to which nascent religion submits in the human race, anthropomorphism furnishes the second, disengaging itself ever more and more completely from the zoomorphism which generally serves as an intermediary. This is so *everywhere*".†

THE PHILADELPHIA INTERNATIONAL ELECTRICAL EXHIBITION.

THIS Exhibition was opened by Prof. Rowland on the 2nd ult. Referring to it, the *Scientific American* says:—Probably at no other exhibition held in this country was foreign workmanship so readily distinguished from domestic. We are a practical people, and we are not always disinclined to boast of this practicality, but as we look over the European exhibits in this exposition, observe the nicety of the philosophical apparatus and instruments of precision, consider the carefully worked-out theories and laws upon which they are constructed, and then turn to our own exhibits, confined as they are almost exclusively to practical applications for money-getting, it seems after all as though we had been better off were we not quite so practical, and loitered a little more in the paths of pure science.

The arc and incandescence lights of the various systems which ornament the pillars and hang in festoons from the walls have resulted from the application of laws discovered by Faraday and Oersted; and while the inventors of these applications have deservedly won no little fame and are credited with making a deal of money, the men without whose efforts such applications would have been impossible gained little of the former and scarcely enough of the latter to insure them a livelihood.

The principal objects sought by that admirable society, the Franklin Institute, under the auspices of which the present exhibition is given, might, perhaps, be fairly laid down as—1. To give the American electrician the opportunity to compare his work not only with the latest European models, but also with the handiwork of his fellow on this side the water. 2. To exhibit the excellence of American electrical applications.

In regard to the first, it is well known that many practical and ingenious workmen are in the habit of keeping to themselves for fear their ideas should be taken from them. That this is, in great part, a mistake is well illustrated by the small number of really successful applications in electrical science compared with the number of workmen that have struggled tirelessly over what has not given, nor is likely in the future to give, much promise of success. These men, or some of them, are searching for that which is not, or for that which the interposition of a

* Cf. KNOWLEDGE, Sept. 21, 1883.

† "Hibbert Lectures," 1884, pp. 39, 40.

natural law prevents them from finding, at least in the manner they have proposed to themselves.

The opportunity of seeing what has gone before, what has already been done, and for mutual comparison of work, is likely to be of inestimable advantage, and the collection at one point, as at the present Electrical Exposition, of working models of the best construction up to date must, for reasons so obvious as not to require demonstration, be of incalculable assistance to the struggling and ambitious electrician and mechanician. As to what may be regarded as another principal reason for the exposition, viz., the exposure of domestic wares to a foreign audience interested in enterprises for which they are designed, much might also be said. Novelties require more than a casual introduction into a new market. A supply will not always insure an immediate demand. There was no demand for india-rubber goloshes, but the practical demonstration of their usefulness begat a demand. The case of the telephone is a striking illustration of this. Though now known to be a commercial success in the broadest meaning of the term, its usefulness, speaking from a purely commercial standpoint, remained for a long time unrecognised abroad. More than fifty million dollars had been invested in this country in the telephone plant ere it really went into general use abroad.

For these and other reasons the present exposition is likely to further the interests of American electricians, mechanics, and manufacturers, and they have reason to congratulate themselves that it was planned and is now being managed by so estimable a society as the Franklin Institute.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER IV. (*continued from p. 235*).

THE evidence already obtained respecting the earth's figure points so clearly to its being a globe, that the observer would now direct his attention simply to determine the size of other circular sections than those he has already traversed. He first starts eastward or westward from different parts of the north and south line he first surveyed; and then he starts northwards or southwards from different parts of any of his east and west journeyings.

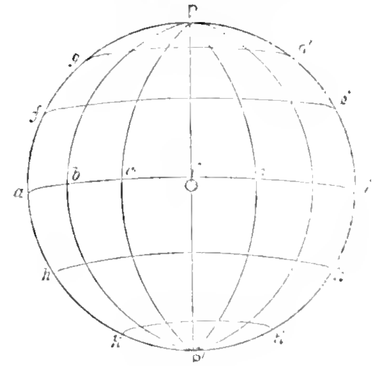


Fig. 1.

By doing this he obtains the most complete and satisfactory evidence of the true figure of the earth; because he finds every north-and-south journey, as P *a* P′, P *b* P′, P *c* P′, &c. (Fig. 1), indicating a circular section having a radius of about 7,900 miles, and every east-and-west journey, as *a a′*, *ff′*, *g g′*, &c., indicating a circular section having a radius proportioned to the distance from the axis P O P′.

Now it must be remembered that, though no person ever carried out such a series of journeys as I have described, yet the various measurements and journeyings made by men over the earth amount even to a more exact and convincing demonstration of the earth's figure. In all parts of the world, in the southern as well as in the northern hemisphere, there have not only been scientific investigations directed to the determination of precisely those points which we have imagined our observer to have inquired about, but the theory of the earth's globular figure has been submitted even to more crucial tests. The sailor voyaging in the southern seas, for instance, estimates his progress strictly according to those results which follow from the globe-figure of the earth. When, for days together—as frequently happens—the sky is so clouded as to give him no opportunity of observing the celestial bodies, he trusts altogether to his estimate of the rate and direction of his voyaging, combined with his knowledge of the shape and size of the earth. If there were any error in the estimates which astronomers have made on this point,* it would be more fatal to the seaman than the most terrible storm-seasons could possibly be.

But, after all, it is to the careful observations carried on by men of science, according to the principles involved in our observer's plan of voyaging, only with a degree of nicety which no single observer could ever hope to obtain, that modern views respecting the true figure of the earth owe their exactness. The measurement of degrees in longitude or in latitude means nothing more than the comparison between the distances travelled either north and south or east and west, with the observed change in the elevation of the pole of the heavens or in the moment of the stars' meridian passages. Our observer effected this comparison roughly—he trusted to a simple contrivance for estimating the elevation of the pole, and to a single chronometer carried from place to place for his estimate of absolute time. But modern astronomy determines these things with an accuracy which is inconceivable by those who have not studied the appliances by which it is secured. The mural circle by which the astronomer measures the elevation at which a star crosses the meridian, has occupied as much attention as the finest piece of machinery ever erected for manufacturing purposes. I can imagine no greater treat for an appreciative mechanical mind than the examination of the multiplied contrivances by which perfectly accurate movements are imparted to the heavy mural circle of a large observatory. The exceeding delicacy of the means by which the instrument's indications are read off is equally surprising and interesting. Then the transit-instrument by which the time of a star's passing the meridian is taken is well worth studying. The easy swing of the instrument in the meridian-plane, the perfection with which it sweeps out that plane, the delicate spider-webs by which the passage of the star across the field of view is measured—all these, and many other matters, serve to show how anxiously the astronomer aims at exactness.

By observatories set up all over the earth, by voyages expressly undertaken to determine the figure of our globe, and by a long and patient scrutiny of all the evidence obtained, the modern theory of the earth's figure has been established. I have hitherto spoken of that figure as globular, and very delicate observations indeed might be

* A paradoxist, who should be the prince of his peculiar people, seeks to prove that the earth is plane, with only one pole—the north pole—and for his purpose it is necessary that the latitude-circles in southern regions should be very large. So he extracts a passage from Ross's "Antarctic Journeys," in which a bottle is said to have floated so many miles in travelling between two places some 120 deg. apart; and thus the length of a degree is calculated on a conveniently large scale. *No mention at all is made of the fact that Ross distinctly speaks of the bottle having been carried the long way round!*

made over the whole surface of the earth without proving anything beyond this. But the observations made by astronomers have attained so great a degree of delicacy as to show how far the earth's shape departs from the figure of a true sphere. Slight differences in the rate of elevation or depression of the pole as the north and south journeys have been carried out, have shown that the curves P *a* P', P *b* P', &c. (Fig. 1), are not true circles; though differing so little from the circular figure, that if their true shape were drawn down on paper, a very sharp eye indeed would be required to detect the difference between their figure and a perfect circle. They are slightly elliptical, P P' being the shorter axis of each. In other words, the earth is somewhat flattened at the poles.

My aim is, however, to give an exact account of the simpler features of the earth's figure, rather than to deal with minor peculiarities, and as the departure of the earth's figure from the true sphere belongs to the latter order, I need not discuss this feature farther.

I conclude this chapter by mentioning certain phenomena which afford tolerably clear evidence of the globe figure of the earth, though I may remark, in passing, that nothing but the complete survey described above can be held to be a satisfactory proof.

Every one who has ever been at the sea side on a fine day, has noticed how clear-cut the horizon-line is, how it forms a well-marked line against the sky. How this circumstance rightly understood gives very forcible evidence that the visible part of the earth's surface is globular. If, on the contrary, it were plane, then, however little the eye were raised above the surface of that plane, yet every part of the plane would be visible: and the appearance of a well-defined horizon-line would imply that we were looking at the actual limits of the plane in that direction, which is obviously absurd. If the plane had no limits within the range of vision, the appearance presented would be that of a gradual fading away up to the horizon level.

When, however, we find further that at the sea side ships pass that apparently well-defined border line, and gradually seem to sink out of view, no doubt can remain that the visible surface is not plane. For we see distinctly the clear-cut water-line across the equally well defined masts and sails of the ship. We know, therefore, that the ship is *beyond* the water-line, and as we know that it has not crossed a limit of any sort, no other explanation is available than that it has sailed over a continuously curved surface.

The conviction thus arrived at hardly admits of being strengthened, but those who have ever used a powerful telescope at the sea side find a certain new interest in observing this well-known phenomenon. It may seem a simple amusement for a student of astronomy, but often when I lived by the sea side, I used to watch with my 4-in. achromatic the gradual disappearance of a ship beyond the sharply cut border-line of the sea with much interest and pleasure. Sometimes the air would be so clear that a tall ship would sink until her upper masts would be out of focus when the sea horizon was brought into focus, and *vice versâ*. A slight motion of the focussing rack-work would bring either the sea-waves or the masts and ropes into focus, as might be wished: a very pretty and simple proof, by the way, of the relative distances of the sea horizon and the ship, and a supplementary evidence of the earth's globular figure, which so far as I am aware has never yet been noticed.*

Another proof of the globular figure of the earth has been derived from the shape of the earth's shadow as seen during a lunar eclipse. This proof is not perhaps very striking, because the curvature of the earth's shadow as seen on the moon is by no means so well marked as many suppose. The shadow has not a well-defined edge, the circle it belongs to is much larger than the moon, and finally the moon's surface is marked with so many variations of brilliancy as to confuse the border of the umbra.

The *real* evidence derived from lunar eclipses is, however, much more striking when it is properly studied. Let it be remembered that the astronomer calculates the minute at which a lunar eclipse begins, and the place at which the earth's shadow at first makes its appearance on the lunar disc, on the hypothesis that, the earth being a globe, the section of the shadow-cone where the moon crosses it is a circle of a certain size, and in no single instance has his trust in this hypothesis been confounded by the eclipse either occurring at the wrong time, or commencing at the wrong part of the moon's disc.

Fig. 2.

A peculiarity noticed by balloonists seems at first sight strikingly opposed to the theory that the earth is globular. When a balloon has risen high above the earth on a clear day, the latter appears to the aëronauts to be shaped like a basin beneath them, the sky assuming also an appearance of concavity (more flattened than usual), facing the earth's apparently hollow surface. Many balloonists have been so struck by this appearance, which is represented in section in Fig. 2, as to think there must be something wrong about the theory of the earth's globular figure. In reality, however, the appearance is precisely what was to have been expected. The balloonist, even after rising four or five miles, has scarcely caused the visible horizon to appear appreciably below his level. It is, in fact, lowered some 3½ degrees, but the unaided eye cannot recognise so small a depression, whereas the vast gap which separates the observer from the earth beneath him is very obviously presented to the eye. Therefore the effect is as though the horizon were on a level with the eye, and the earth's surface under the observer far below that level.

Of course if the peculiarity proved anything, it would show that the earth is basin-shaped, certainly not that it is plane. As yet, however, no one has claimed for the earth the figure of a basin.

(*To be continued.*)

* Perhaps I should not have had my attention called to the fact that the distance of the visible sea-horizon is measurable in this simple way, had it not been for the blatant assertions of a well-known charlatan, that a telescope will bring a ship into sight which has passed beyond the visible horizon. Certainly this man never did a bolder thing than in coming to a sea neighbourhood, and there making an assertion so easily disproved. He told the Plymouth people that he could show them the Eddystone Lighthouse as clearly from the foot as from the summit of the Hoe, and on a certain clear, calm morning in autumn he carried out the experiment. Of course, he failed. But if that were all I should have left the story untold. The best is to come. One might suppose he would have blamed his telescope, though it had shown the Eddystone nicely from the summit of the Hoe. He was too sharp for this, however. It happened that the atmospheric refraction (which is well known to be variable) was unusually weak that morning, and so the lantern of the lighthouse was altogether out of sight, when, according to the Admiralty instructions (calculated for average refractive effects), it should have been partly visible. Here was a means of escape. "I promised to show you the Eddystone," he argued, "though the Admiralty says all but the lantern would be ought of sight. Well, you see the Admiralty is wrong; not even the lantern can be seen. Is it not obvious that the received theory is false?" I am told he even published this argument in a book.

DICKENS'S STORY LEFT HALF TOLD.

A QUASI SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from page 258.*)

TO return to the conversation between Grewgious and Jasper.

Jasper asks, "What is Miss Landless's state?" To this, Grewgious replies at once, "Defiance of all suspicion and unbounded faith in her brother." And, when Jasper pretends to pity her, Grewgious turns, as if in disgust with Jasper, from the subject. "It is not of her that I came to speak," he says. "It is of my ward." And he proceeds to tell Jasper of the dissolution of the engagement between Edwin and Rosa. Now, here I notice a singular thing. Every reader knows why Jasper is overwhelmed by this intelligence. Jasper learns that he has murdered Drood uselessly, and, murderous villain though he is, he is horrified. But no one seems to notice that Grewgious has no special reason, unless he is certain that Jasper believes himself to be the murderer of Drood, for supposing that Jasper will be startled by the news he brings. Yet he does suppose so. He says, "Mind! I warn you that I think it will surprise you," which, from Mr. Grewgious, means a good deal. Again, it is "with a compressed and determined mouth" (which, from Dickens, means a good deal), with provoking slowness and internalness, with fixed look on Jasper, *never changing either his look or action in all that followed*, that Grewgious tells Jasper what, unless Grewgious knew of Jasper's assault on Drood, would seem to him a matter of very little moment at such a time,—savouring of triviality in the presence of the presumed fact that Drood was dead.

That no one should notice the strangeness of this expectation on Mr. Grewgious's part seems to me even more singular than the circumstance, which nevertheless is to me very singular, that few seem to be struck by the strangely brutal behaviour of Mr. Grewgious—or rather by what would be its strange brutality if he were not certain that Jasper was a murderous hypocrite. It is to be observed that Mr. Grewgious's intense dislike to Jasper, shown in this interview and afterwards, has sprung into existence full-grown. There is no trace of it in the earlier and only other meeting between the two. On the contrary, in that meeting, after answering rather sharply a remark of Jasper's which had seemed unnecessary, Mr. Grewgious says, all earnestly and sincerely, "Come, Mr. Jasper, I know your affection for your nephew, and that you are quick to feel on his behalf." "You could not speak more handsomely," Jasper says; on which Mr. Grewgious nods his head contentedly. The rest of that interview is friendly and pleasant; and we note especially that Mr. Grewgious shakes hands with Jasper at its close, as he says of Drood and Rosa, "God bless them both!" But in the interview on Dec. 27, just after Jasper has had so terrible a blow in the loss of the nephew whom Grewgious supposed him to love so much, Mr. Grewgious, so far from sympathising with him, treats him as the "brigand and wild beast" he afterwards calls him. He tells him news which—*somehow*—he knows will horrify him, and as Jasper sinks under the blow he looks on unpitying. He tells him how Edwin and Rosa grew to the idea that they should rather be as brother and sister than as husband and wife; describes how they met for the purpose of interchanging their discoveries; notes how "one of the couple, and that one your nephew," showed such consideration for Jasper as to be enabled to inflict on him the shock of hearing of the parting: and as item after item is slowly brought before him the villain reels and staggers under the successive blows. Then finally he is struck to the earth by hearing that the parting he had witnessed (Grewgious must have learned this after Edwin's disappearance) was final—so far as their ill-advised relation was concerned. As Jasper falls with a terrible shriek in a ghastly heap upon the floor, Grewgious shows no pity —"not changing his action even then, he opens and shuts his hands as he warms them, and looks down at it."

Is it *possible* to explain this except on the assumption that Grewgious *knows* Jasper to be the murderous hypocrite he is? Without hesitation, I say, it is not. Nor can he possibly have known this except from Edwin Drood himself.

Now note that when Jasper comes to he finds Grewgious watching him, as calmly as before. "A man," Grewgious remarks, "cannot have his rest broken, and his mind cruelly tormented, and his body overtaxed by fatigue, without being thoroughly worn out." "I fear I have alarmed you," says Jasper. "Not at all, I thank you." "You are too considerate." "Not at all, I thank you." (Words full of meaning here.) Mrs. Tope gets wine and food ready, and invites Mr. Grewgious to wait till Jasper has taken it. He replies, "with a snort which might mean yes, or no, or anything, or nothing, and which Mrs. Tope would have found highly mystifying, but that her attention was divided by the service of the table," but which the average reader, whose attention is very readily divided, finds not mystifying at all, but simply passes without considering it as worth noticing. Then Jasper asks Grewgious to eat with him. "I couldn't get a morsel down my throat, I thank you," answers Grewgious. He will not eat at the same table with Jasper, whose hand but a few days before he had been willing to take. He sits "with a hard kind of imperturbably polite protest all over him." This again is full of meaning. He is all hardness, and shows no trace even of sorrow, still less of sympathy.

After his meal, and a few minutes' meditation, Jasper begins to see that a part of his plot will fail, unless he can bring new evidence against Neville. He tests the matter by submitting to Grewgious the idea that Edwin may have been moved by his changed position to go away from Cloisterham. Nor does Grewgious reject the idea. He purposely assents to it, waiting to see what the villain aims at. This soon becomes clear. Crisparkle enters, and Jasper suggests the same idea to him, with an air of fairness which thoroughly deludes the simple and kindly-hearted clergyman. Crisparkle immediately opens his heart, and tells Jasper what was doubtless no news to him, but what—once made public—must tell heavily against Neville. He describes the hopeless love entertained by Landless for Rosa. Jasper turns paler as this love is spoken of, but we feel that he had known of it before. He repeats that he will cling to the new hope; and that if no trace of Edwin is found, he will cherish the idea that Edwin "might have absconded of his own wild will."

And now follows a passage which, like many of the most significant passages in the story, has been very little noticed, if noticed at all:—

"It fell out"—whenever Dickens begins thus we know something important is coming (as I could show by a hundred instances)—"it fell out that Mr. Crisparkle, going away from this conference very uneasy in his mind . . . . took a memorable night walk." Observe, a *memorable* walk—though nothing seems to happen, except that strange thoughts come into his mind. "A familiar passage in his reading, about 'airy tongues that syllable men's names,' rose so unbidden to his ear, that he put it from him with his hand, as if it were tangible." He can neither see nor hear aught unusual: yet he has "a strange idea that something unusual hung about the place." He strains his keen ears and his hawk's eyes. Nothing in the least unusual was remotely shadowed forth." But he resolved that he would come back early in the morning.

In the morning he finds the watch, chain, and pin. In a sense, his walk overnight was made memorable by the morning's discovery. But was that all which made the walk memorable? He might have found these things without that night walk. I take it the walk was memorable for other reasons. Jasper was there. Probably Grewgious, too, was there, watching Jasper, when Crisparkle had that strange sense of something unusual. Jasper waited till Crisparkle had gone, and then,—under the very eyes of Grewgious,—placed the watch and chain among the interstices of the timbers, and flung the shirt-pin into the pool. If it could be proved that the watch was kept unwound from Christmas night when it ran down to midnight on the 27th, much would be made thereafter of the events of that memorable night.

(*To be continued.*)

THE INTERNATIONAL HEALTH EXHIBITION.

XVIII.—THE SOFTENING OF WATER—(*continued*).

AMONGST the many processes that have been invented to superinduce the condition through which hard water is fitted for manufacturing purposes there are a certain number still in general use which call for some notice in connection with the subject of these reviews, because they are calculated to retard the progress which it has been the aim of the modern inventor to substantiate. Water ought to be pre-eminently soft to be of the greatest value to the engineer, and when we recorded the results of Mr. Porter's improvements on Dr. Clark's softening process we intended to convey the notion that its utility lies in the fact that it *eliminates the causes* of hardness in accomplishing its results, and does not seek to do so by merely correcting the evil influences of a pernicious supply.

The inefficient methods to which we have just alluded may be classed together as anti-crustation reagents, which act in two ways—viz., either mechanically or chemically. To the former group belong clay, sand, powdered glass, &c., which are introduced directly into the boilers; they are there held in suspension by the ebullition of the water, and are useful, inasmuch as they prevent the consolidation of such salts as are apt to accumulate into a compact incrusting layer. They are to be discarded, because of their tendency to add to the local heating of boiler-plates, to waste of fuel, and to increased wear and tear of the internal parts of the engine. These disadvantages are but slightly modified in the employment of dissolving or emulsifying solutions such as of potato-pealings, starch, dextrine, &c.; or of tannin-bearing compounds, particularly of logwood, cashoo, sumach, tan, and chicory. Other reagents, which enforce a precipitation of dissolved salts and thereby prevent incrustation have also been used; amongst them are salts of baryta, caustic alkalies, and alkaline carbonates, which are introduced at intervals or continuously into the boilers along with the feed water. It is true that they prevent incrustation, and by so doing enable the boilers to be easily cleansed; but insuperable objections arise in the corrosion of taps, and the formation of soap and priming. Innumerable patents have been taken from time to time, with a view to prevent the dangers arising from the use of hard waters, but although some of them are more valuable than others, they are all alike to be condemned on the score of treating an evil, or rather of permitting an evil which could be obviated. One of the most recent and successful appliances used, however, deserves mention on account of its novelty. It is known by the name of Field's Electrical Scale Preventer, and, as its title implies, the formation of adhesive crusts is prevented by the precipitation and immediate removal of the causes of hardness along currents induced by means of electricity.

So serious in its results has the hardness of water been to engineers, that they have even resorted to the modification of their machinery; to the superaddition of separate depositing vessels, and to the employment of feed water-heaters or economisers to relieve them. The only rational system, however, which cannot by any possibility be open to objection, ought to be looked for in a sufficiently inexpensive process for the removal of the undesirable impurities.

Scarcely a year has passed since 1849 without the introduction of some patent for the softening of water, and that alone suffices to prove the importance of the case. The principal aims of such a process are efficiency and cheapness, and that they have at length been attained is attested to by the existence of the Porter-Clark, Atkins, Gaillet and Huet, and Maignen's processes, all of which differ from one another in the working out of details rather than in essentials, and all of which are based on Professor Clark's original researches, an excerpt of which we gave in our last.

An excellent *condensé* of the Atkins, and Gaillet and Huet processes* is given in Mr. Baldwin Latham's paper,† read to the Society of Arts Water-Supply Conference, recently held at the Exhibition; and for the benefit of our readers we shall conclude our remarks for the present by quoting Mr. Latham's observations in their entirety.

"*The Atkins' Process* is also a modification of the Clark process, by which the space formerly required is reduced. The lime is put into a vessel where lime-water is formed, and this water is allowed to mix in its proper proportion with the water to be softened in a specially-arranged mixing-vessel, after which it passes into a reservoir of small dimensions. From this reservoir it is conveyed to filtering vessels which contain a special arrangement of filter, consisting of a series of chambers mounted upon a central hollow shaft, these disc-chambers being covered with prepared canvas, upon which the deposit of chalk, &c., adheres, and through which the softened water filters. These filters are cleaned by means of revolving brushes. The apparatus does not require power to maintain it while at work, the only power used being that necessary to give motion to the brushes when the apparatus is cleansed. The system may be seen at work at the Henley-on-Thames Waterworks and at other places."

"*The Process of Messrs. Gaillet and Huet.*—In this process, which was patented in February, 1883, the patentees make use of certain known agents, the patent itself applying to the apparatus used for the purpose of producing the results after the chemicals have been applied. The agents they propose are lime and caustic soda. Whenever the water contains organic matter, they use salt of alumina or iron in addition. Iron, however, is not recommended in

* A full account of which may be found in a small pamphlet on "The Softening of Water," by Andrew Howatson, C.E., 11, Queen Victoria-street, London, 1884, being an extract from "Étude sur les Eaux Industrielles et leur Épuration," by Gaillet and Huet.

† "Softening of Water," July 25, 1884. Health Exhibition Conference.

any case where the water is required for washing purposes. The apparatus consists, virtually, of a series of tanks in duplicate, in which the chemicals are mixed, and these enter a vertical pipe in proper proportion to the water to be softened, and which communicates with the bottom of an upright chamber divided by a series of sloping shelves through which the water gradually works up in a zig-zag path. These shelves slope in one direction, and are of V shape, so that as the deposit takes place, it accumulates at one point, at which there is an opening ordinarily closed by a tap, and when any tap is open the deposit on the sloping shelf communicating with it is washed out. The apparatus appears to be extremely simple in its design, but its efficiency has yet to be tested, although it is at work at Messrs. Duncan's, Victoria Docks."

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

(*Continued from p. 199.*)

SO far, we have spoken as though vision were confined to a single eye; but, of course, under all ordinary circumstances, we have, and employ, two. Let us then see whether this makes any difference (and if so, what difference) in our perception of external objects. Speaking off-hand, any one who has never had his attention especially directed to the subject would say that vision with two eyes is essentially the same as that with one, for that we only see one image of any given object, whether we regard it with the right eye, the left one, or both together. But a little attention will suffice to convince us that this is by no means the case, and that binocular vision supplies us with a means of estimating solidity, distance, &c., which is wholly wanting in the case of sight with a single eye. Observe especially though that *the two eyes must act together as one instrument.* A dragon-fly has an immense number of eyes (some 24,000), but they are looking different ways and forming images of different objects, so that the advantage and peculiarity of binocular vision proper is wholly lost. In order that it may be enjoyed, the images formed by both eyes must be superposed, and caused to coalesce into one. Now, so entirely accustomed are we to this coalescence of the optical images formed by our two eyes, that it requires a certain amount of thought to perceive and convince ourselves that we really do see everything in reality double. As a preliminary experiment to show this, let the reader hold a common drawing-pencil a foot or eighteen inches in front of his face, and look, not at the pencil itself, but at the further side of the room, or at the horizon, and he will at once see two pencils. By first closing one eye and then the other, he will immediately discover that one of these images is referable to the right eye, and the other to the left one. The fact is, that by adjusting the eyes for distant vision we have thrown the images of the pencil upon different points of the two retinæ, and in order that they should coincide they must be made to fall upon identical points in each eye. A more instructive experiment still, however, in connection with binocular perspective, of which we are immediately about to treat, may be made with a thin book. Holding such a one as near to the eyes as is consistent with distinct vision, exactly half-way between them, and with the back of the book towards us, and first shutting the right eye, we shall see the image L (Fig. 27) with the left one—*i.e.*, the back and left-hand side of the book. Closing the left eye now in turn, and opening the right one, we shall see the image R, or the back of the book and the right side of it. Now here we have made a discovery. It is this: that the images of an object, at a short distance from the observer, are dissimilar, and yet that the eyes unite these two dissimilar images into one, which appears *solid* as well as single. A little attention will show us what it is that gives us this impression of solidity; and this being comprehended, the principle of that pretty toy, the stereoscope, becomes intelligible at once. If, first, as in the case of our pencil, we look at the opposite wall of the room, or at the distant landscape, we see two separate books. Next, if we look at the part of the book furthest from us, the two images will unite, but the book will seemingly have two backs. While, lastly, if we direct our attention fixedly to the back of the book, we shall see only one back; but the part furthest from the eye will now become double. If, however, we take, so to speak, a general view of the book, the eyes will range rapidly over it, and the result of successively combining the images at various distances will be to impress us with the conviction that the book is a single, solid object. In making this experiment carefully, the student will note that the eyes converge, or he has to squint, more to cause the images of the part nearest to his eye to coalesce than he has to cause the combination of the more distant one; such convergence decreasing as the parts recede from the eye; so that at a certain distance no convergence at all is needed to unite the two separate images of any given object. It will also be noticed that the farther an object is from the eyes the less dissimilar the images they respectively form become, until beyond a certain distance they are sensibly identical. And here we are in sight of the principle of the stereoscope. As far as the eyes are concerned, it matters nothing whether they see two slightly dissimilar images of the same object, or whether two images from two separate objects are presented to them, so long as the latter resemble the former in all respects. All that is needed is that by appropriate means these two images should be caused to overlap

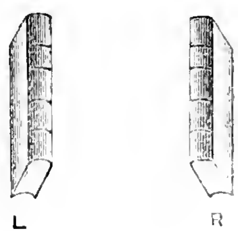


Fig. 27.

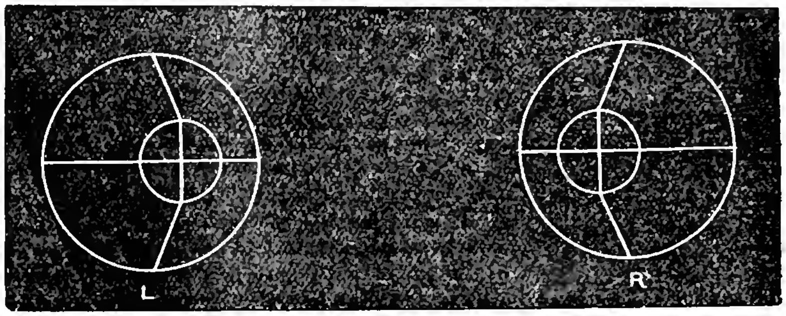


Fig. 28.

and coalesce. This may be effected in the case of drawings or photographs, after a little practice, by squinting. Fig. 28 will illustrate this. It represents a truncated cone, or cone with its sharp end cut off, as seen by the right and left eyes respectively. If now the reader will get a strip of cardboard (preferably of a dead black) about a foot long, and place it on end half way between L and R in our figure, with the other end against his forehead and the root of his nose, so that R is visible only to the right eye and L to the left one; then, on looking, so to speak, at a point far on the other side of this page, the two images will be seen to run suddenly into one, and a startlingly solid little cone will seemingly rise out of the paper. As we have said above, the little circles require greater convergence to make them coalesce than the larger ones, and so are felt to be nearer to the eye, the result being the illusive conviction that we are actually regarding an objective skeleton cone. A careful examination of a photographed stereoscope-slide

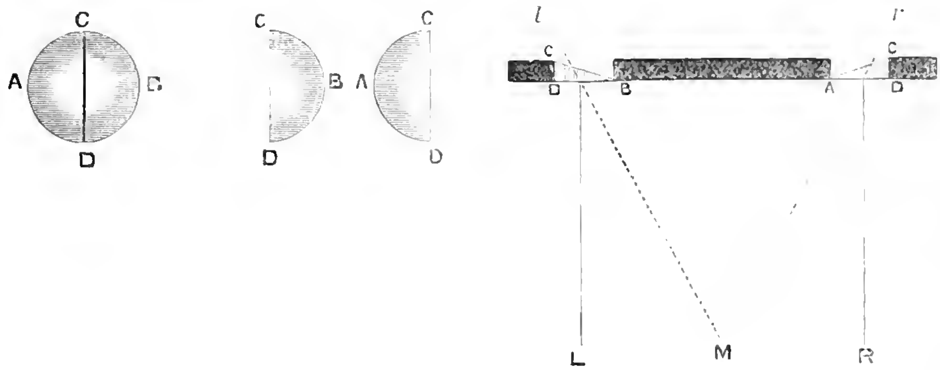


Fig. 29.

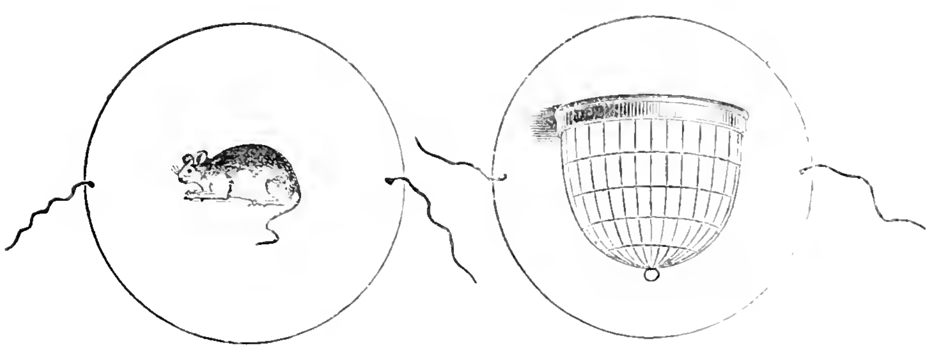


Fig. 30.

will show the dissimilarity of the images of objects in the immediate foreground, and their absolute identity in distant ones. What we have effected by squinting, the lenticular form of stereoscope devised by Sir David Brewster (with which, at all events in its outward form, probably every reader is familiar) does in an even more simple and convenient manner. If the reader will turn back to page 46 and trace the course of a sheaf of rays through a convex lens, he will be prepared to understand the principle of this stereoscope at once. For we simply take a convex lens, like A C in Fig. 19, cut it in half across a diameter B C, and so set the two halves in a frame, the width of the eyes apart, that the sides A and B shall be inward, or next the nose. The left-hand part of Fig. 29 represents the lens as viewed from the front before its halves have been separated. The middle one shows the two halves in plan in the position they occupy as the eye-pieces in a stereoscope. The right-hand diagram exhibits them in section, and shows how they act. Turning to Fig. 18, p. 46, for an illustration of the course of a ray of light through a prism, it will be seen at once in Fig. 29 that a ray coming from the left-hand picture L will be refracted by the prism A C D to *l*, and, of course, be referred by the left eye to M; while the ray from the right-hand picture R will, in like manner, be refracted to *r* by the prism B C D and equally referred to M by the right eye, the illusive impression of solidity from the coalescence of the two slightly dissimilar pictures thus seemingly both emanating from a single object at M being perfect. It is needless to pursue this branch of our subject here, enough having been said to show how it is that we derive the impression of solidity from binocular vision, and how perfectly the sense of sight may be deceived by the presentation to the two eyes of accurate simulacra of the images which they would receive from a material object.

A ridiculous deception incident on our seeing two images was described by Mr. T. Foster on p. 244 of our first volume, to which the student is referred for an experiment as instructive as it is absurd in its effect. Another peculiarity of vision, or properly of the retina and optic nerve, is at the bottom of several familiar optical phenomena and visual deceptions. We refer to the retention on the retina, for something like the tenth of a second, of the impression of an object, after that object has passed away or been otherwise hidden. Observe particularly that it is by no means necessary that any given object should remain before the eye for such an interval for its original *perception*. So far from this being the case, we distinctly see a flash of lightning, whose duration was shown by Wheatstone to be less than a single thousandth of a second. Once seen, however, the image persists for the time first specified. Probably the best known and commonest results of this is that when we wink we do not lose sight of the objects at which we may happen to be looking; their images continuing to impress the retina for the very short interval during which the eyes are closed in the act. It is, of course, this temporary persistence of the images of external objects which is an integral element in the explanation of the illusions we experience with such toys as the magic Wheel (Knowledge, vol. i., pp. 198, 199, and 247), the Strobic Circles (*Id.*, p. 422), and the so-called Zoëtrope (or Wheel of Life), in which such figures as those shown on pp. 199 and 247 of our first volume are placed round the interior of a cylinder, in which slits are cut, and the figures viewed through these slits from the outside as the cylinder rotates, thus dispensing with a looking-glass. The boy's experiment of whirling a lighted stick about, and producing the semblance of a continuously-curved line of light also depends upon this property of the eye, which may be further illustrated by a very simple contrivance (shown in Fig. 30), popular in the days of our fathers, and known as the thaumatrope. It consists of a circular disc of stout white card, upon one side of which we have shown a drawing of a mouse, and on the other one of a cage, which must be drawn upside down, as referred to the first figure. At the sides of the discs are two strings, which are held between the forefinger and thumb of each hand, and twirled rapidly round, the effect being that we see the mouse in the cage. We may, of course, draw in the same way a man on one side and a horse on the other, a tight-rope dancer and his rope, and so on. We may add that if the strings by which the card is twirled be not on a diameter, so that the card does not rotate about its principal axis, the figures will be displaced, so that we may have our mouse either on his cage or under it instead of in it, by a suitable arrangement.

GRASS OF PARNASSUS.

By Grant Allen.

As we have been going in lately for a course of coincidences in Knowledge, I will begin this paper with a sufficiently curious one which happened to me during my summer holiday the other day in Norfolk. I had walked over by the breezy cliff path from Cromer to Beeston Common, and had been diligently investigating for a whole sunny afternoon the exceptionally rich boggy flora of that pretty bit of deep, waterlogged moorland scenery. The ground, for acres together, was covered with pale yellowish-green rosettes of tufted butterwort, and tall lush trefoils of beautiful buckbean, and golden clusters of belated marsh marigolds, blossoming still out of due season. But the prettiest flower in all the wide stretch of swampy vegetation was the white grass of Parnassus, whose exquisite veined blossoms starred the soil on every watery patch in the most astonishing profusion. I stood for a long time watching the flies buzzing idly around them, and then picked a number out of pure wantonness, to take home with me as an appropriate tribute to a great poet who was staying in the neighbourhood. As soon as I got back, I put the drooping flowers in water, and proceeded to open the letters which were waiting for me on the parlour table. The first one at which I looked had been forwarded to me by the Editor of Knowledge, and it ran as follows :—

Sir,—Would Mr Grant Allen or any of your botanical contributors kindly state what useful object (if any) is attained in *Parnassia palustris* by the very curious development of its imperfect stamens, and oblige A Student of Botany?

Clearly this was the finger of fate. *Parnassia palustris*, with its abortive stamens, was staring me in the face from the glass in front of me ; and I had been spending all the afternoon in watching the flies in the very act of being taken in by the deceptive staminal organs in question.

First of all, then, let me begin by briefly describing this grass of Parnassus. It is a marsh-land plant, of the saxifrage family, having some affinities with the sundew, but even more (as has been recently shown) with the true saxifrages and chrysospleniums. From a small tuft of heart-shaped, glossy-green, radical leaves, a rather tall scape rises abruptly, enclosed half-way up by a curiously clasping leaf, and bearing at its summit a single, large, snow-white flower. The blossom has five petals and five perfect stamens ; but the place of the five inner stamens (which occur normally in the saxifrages) is taken by some very strange abortive organs, at the base of the petals, split up into eight or ten short, spreading filaments, and terminated at the end, where the anther ought to be, by a little, yellow, shining, globular gland. So very bright and glassy are these tiny balls that they look for all the world exactly like a drop of liquid ; and the imitation goes so far that even when one has touched them with one's finger it is difficult to believe they are not really glistening drops of limpid honey. These are the organs whose use and function "A Lover of Botany" wishes to learn about.

It was Hermann Muller who first pointed out the true meaning of these odd staminodes. They are really deceptive organs, which attract flies and other insects by the fallacious appearance of a store of honey. "The yellow knobs placed at the ends of the hairs," says Müller, "look so extremely like drops of fluid that it needs close examination to convince one they are thoroughly dry. An observation of my son's proves that even flies are taken in by the appearance of liquidity. He saw from a short distance a specimen of *Eristalis nemorum* trying to lick these bodies for a long time, until at last it flew away on his coming closer." I myself observed exactly the same thing several times over at Beeston Common ; the flies alighted on the disk of the pistil, and tried hard to lick honey, over and over again, from the small, dry glassy bulbs.

We have thus, as Müller remarks, in grass of Parnassus an excellent example of a deceptive flower, which deludes the foolish flies by offering them a number of conspicuous but sham drops of honey. At the same time, the deception is not quite absolute, for the staminodes have a broad base, which secretes two small lots of nectar in two shallow depressions on its inner side. This honey is sufficient to prevent the flies from altogether discovering the imposition, and giving up the hunt in future as useless. After long and vain attempts to find nectar in the deceptive glands, they are at last rewarded for their pains by a much smaller store laid by in the depressions at the base of the staminodes.

The perfect stamens lie at first with their anthers coiled up over the immature pistil, and they ripen slowly, one at a time, each anther as it begins to shed its pollen bending over outward, so as to come into contact with the head and shoulders of the fly who is busily hunting for nectar among the false staminodes. As soon as all the stamens have shed their store, the stigmas of the pistil become fully mature, so that the flies, in visiting the younger flowers, collect pollen on their heads and legs, which they finally rub off upon other blossoms in the second or female stage. This, of course, is a common and familiar device for ensuring the benefits of cross-fertilisation.

It is worth notice that such deceptive flowers occur most especially among the species which lay themselves out to attract the true flies (Diptera). Flies appear to be far more stupid and unintelligent than bees, sand-wasps, moths, and beetles, and therefore more liable to be taken in by simple forms of floral deception. Thus the carrion-flies are imposed upon by many reddish flowers (of which the great oriental *Rafflesia Arnoldi* may be taken as a type)—flowers that imitate putrefying meat in colour and odour, and so induce the flies to lay their eggs upon the surface, and incidentally to cross-fertilise the alluring plants. In the common English arum, again, a very small fly is tempted by the odour to imprison itself behind a *chevaux-de-frise* of hairs ; which also happens somewhat differently to another species in the long tube of the south-European birthwort. Müller notes other instances of pure deception in *Ophrys*, *Paris*, *Stapelia*, and a few more flowers, every one of them designed to take in various species of Diptera. There can be very little doubt that this consensus of condemnatory evidence points to an exceptional degree of stupidity on the part of the two-winged order.

On the other hand, the æsthetic taste of the flies is distinctly high. The colours of the flowers which we owe to the selective action of Diptera are generally pretty; and the grass of Parnassus in particular, which is a creation of the drone-fly group (*Syrphidæ*), is one of the most beautiful and gracefully marked of English flowers. A still more curiously variegated and dappled ally, which also owes its colouration to the selective action of the same family, is the pretty little London Pride of our rockeries and flower gardens. Hardly less delicate is the sky-blue germander speedwell of our hedgerows, yet another production of the lively flies. As in so many other cases, the taste for colour, produced by the search for food among bright blossoms, has re-acted through sexual selection upon the general aspect of the insects themselves; and several of the Syrphidæ are noticeable among all Diptera for the unusual brilliancy and variety of their dainty hues. In fact, wherever in nature we find bright plumage or metallic lustre, we may be almost certain that the creatures which display it feed among crimson and purple flowers, or else among red and yellow tropical fruits.

THE POLYTECHNIC.

By W. Slingo.

Whatever pangs one might have experienced when the closing of the old Polytechnic Institution was announced, they cannot fail to be materially blunted when the scope, aim, and influence of the work now being carried on in the building which is occupied by the Polytechnic Young Men's Christian Institute is considered. The great results which have been secured are due in the main to the munificence, combined with the energy and tact, displayed by Mr. Quintin Hogg. Although it is neither in accordance with our rules nor with our purpose to enlarge upon the religious side of the work, it may perhaps be mentioned that considerable efforts are put forth in this direction, howbeit on broad lines. The result must certainly be satisfactory to the founder of the institution, as he has an average attendance at his Sunday afternoon class of no less than 550 persons. It reflects the greatest honour and credit upon Mr. Hogg and his co-workers that their second, if not their first, idea is to foster and promote every feeling, every exercise, every train of thought which is calculated to help a man in his effort to become a good citizen and an honour to his race. That a very large measure of success attends his labours is beyond doubt. The most cursory inspection must convince the most sceptical on this point.

Apart from religious work, the Institute may be divided into three sections, which attend to relaxation, physical exercise, and mental culture respectively.

Upon the first head we need say but little. Reading-rooms, sitting-rooms, "social" rooms, and so forth, are provided on an extensive scale; they are all well patronised, and as the guiding principle is unobtrusive persuasion, or rather enticement, they are likely to remain so. The rooms are open to members of the Institute upon payment of a nominal subscription, which also admits at reduced fees to the classes and other branches of the institution where non-members are admitted. The number of members is, for obvious reasons, limited, the present limit being 3,000, but for a long time past there have been some 1,200 names on the books waiting their turn for admission.

Physical exercise is regarded as one of the necessities of a healthful, happy, and contented life; and accordingly neither expense nor pains are spared to keep this portion of the Institute's work in a state of efficiency. Athletic clubs are formed, and a large and excellently-equipped gymnasium is provided. The gymnasts, it is mentionable, gave a very clever and well-received display at the Healtherics last week. One of the latest additions is a swimming-bath (the tank measuring 76 ft. by 30 ft.) exceedingly well built and artistically decorated. The cost of the bath was £8,000, which amount has been provided by Mr. Hogg, who has also purchased a cricket-field, twenty-seven acres in extent, or three times the size of Lords', at Merton Hall, Wimbledon.

It is, however, to the educational work that attention is here mainly drawn. Classes are formed in an almost endless variety of subjects useful to the masses of our City in the pursuit of their labours. As it is one of the rules of the Institution that at least eighty per cent. of the members shall be *bonâ-fide* mechanics or artisans, it follows, as a natural sequence, that the general tone of the classes should be more or less technical. Amongst the trade classes are two devoted to tailors' cutting, conducted by Dr. Darwin Humphreys, the able editor of "The Record of Fashion," and other well-known works. These classes are eminently successful, and we learn that a certificate of proficiency from the doctor is regarded by the trade as one of the highest and most valuable recommendations. The plumbing class is also an excellent one, the pupils having gained the first three medals in the City and Guilds Institute competition. A class is to be started in the coming session in watch and clock making, under the tuition of Mr. J. Herrman. Every effort is being put forth to make this the most efficient and successful in the kingdom, and there is little doubt but that these efforts will be crowned with success.

The technical classes are very numerous, amongst them being one in Photography, taught by Mr. E. Howard Farmer, whose last year's pupils gained all the seven medals offered by the City and Guilds Institute. Mr. W. Hibbert, F.C.S., a gentleman by no means unknown in scientific circles, is to start a series of classes in Electrical Engineering (telegraphy, electric lighting, and electrical instrument making). A well-equipped laboratory is provided, and there is little doubt but that great things will here be accomplished. Failure, should it result, will not be due either to the institute or its teacher. Boot and Shoemaking is a new subject, to be studied under Mr. A. Hannibal.

The science classes are also very numerous, and the teachers evidently the best in the market, while the apparatus provided is of the highest order. A school of art has been in existence for some time, and is in an admirable state of efficiency. It is noticeable that although the "General" section is very extensive, it only comprises two languages other than English. These two, however, are the most useful, viz., French and German. It is thought, and, I imagine, wisely, the Latin and Greek are languages very useful and desirable in their way, but altogether beyond the scope of an artisan's requirements. Music has also a large share of attention and patronage. The fees charged are remarkably low, and well within the means of those for whose benefit the classes are intended.

It is worthy of mention that at the City and Guilds Technical Institute examinations, held in May last, the Polytechnic headed the list in the number of successful students, 47 first class and 53 second class certificates being awarded, and, in addition, 14 prize medals, offered in competition to the United Kingdom. In the science examinations, out of 385 candidates who presented themselves for examination, 83 per cent. were successful, being 63 per cent. above the general average. The following prizes, offered in competition to the United Kingdom by the City Company of Coachmakers, were also won by

Polytechnic students, viz.:—First prize, silver medal, and £3, for the best perspective drawing of a Victoria; second prize, the Company's bronze medal and £2; the Company's prize medal for full-sized drawing of a phaeton; and the Company's certificate and £2 for prize essay on "Carriage Draught."

The total number of individual students enrolled during last winter session amounted to 5,519.

In addition to the many attractions above referred to, a weekly journal, called "Home Tidings," containing sixteen pages of very readable matter, is published, which cannot fail to considerably increase the members' interest in the doings of the Institute.

We have of late heard a good deal about the way things are managed on the Continent, but there does not appear to be anywhere an institution comparable with the Polytechnic, concerning which Mr. Woodall, M.P. (Member of the Royal Commission on Technical Education), stated, at a public meeting held last June, that "he had, in connection with the Royal Commission, visited nearly all the technical training schools on the Continent, and he could safely say he had not seen one in which such a thoroughly practical system was followed as at the Polytechnic Institution."

For my own part, all that I can say is in praise of the Institution and its various departments. Like the School of Submarine Telegraphy in Hanover-square, it is unique, in its own sphere it stands alone, without a peer and almost without a rival. It is earnestly to be hoped that many such may spring up throughout the country, to teach our fellow men that labour is honourable, and, honestly pursued, speedily brings its own reward.

THE INFINITELY GREAT AND THE INFINITELY LITTLE.

By Richard A. Proctor.

At first there is a sense of relief in turning from the vast-depths of star-strewn space to contemplate the minute, as revealed by the microscope. One may be said to pass from the infinitely great to the infinitely little. Even the domain of the telescope, though really finite, is for us practically infinite; moreover, the domain of the telescope is obviously but the threshold of a far vaster domain beyond; every increase of telescopic power has shown more and more stars, more and more of that filmy lustre which indicates the presence of stars beyond telescopic range. In like manner the microscope reveals the infinitely minute, or what is practically such for us; while manifestly the range of the microscope towards minuteness is but a step towards that ultimate structure which may be regarded as representing absolutely infinite minuteness. Every increase of microscopic power has shown more and more minute details of structure. No astronomer supposes for a moment, now that he has learned so much of the vastness of space, that he can ever know of more than the merest point in extent compared with the infinity which *is*; no microscopist hopes that he can ever even approach the recognition of the ultimate structure of the objects which come under his scrutiny. We have in fine the same oppression of infinity in studying the minute as in studying the vast.

But this lesson has its parallel when we consider the realms of time, and when we consider the bearing of what we study in our recognition of law throughout the universe. We cannot but perceive that with increase of scale—to consider that point alone, for the moment—comes (on the whole) increase of the duration of the various processes constituting what may be termed life-time. The duration of the animal is far shorter than that of the world, the duration of the world far shorter than that of a system of worlds, the duration of the system of worlds far shorter than that of systems of suns. And as with the duration or totality of life, so is it with the processes belonging to life; the circulation of an animal's blood, the rotation of a planet, the cycles of planetary revolution, the movements constituting what may be termed the circulation of a galaxy of suns—these various processes extend longer and longer in duration the larger the region of space constituting the domain of that which exhibits them. So, in turning to the minute objects revealed, or in part interpreted by the microscope—so far as we can follow these we see that (speaking, of course, with the broadest generality) the minuter objects have the shorter lives and the most rapid life-processes. While on the one hand we have evidence of material life lasting for periods which to us are practically eternal, we see on the other hand creatures whose whole lives pass before us so quickly that mere instants must be assigned to the undiscernible life-processes belonging to such creatures. Beyond the range of our telescopes on the one hand and of our microscopes on the other, we see "Actual Eternity" and the "Real Instant" as certainly, though we can conceive neither, as we see the infinitely vast and the infinitely minute, which are equally beyond our powers of conception.

But, strangely enough, while all who think at all are ready to admit that the study of the vast and the minute bring before us as realities the mysteries of the infinitely great and of the infinitely small, of infinitely long and infinitely short duration of time, many do not seem to admit, or even to consider it right to admit, the extension of law to the infinitely great or small in extent and in duration. No man now rebukes the astronomer for asserting that the universe is infinitely vaster than that which in former ages men supposed to be the universe, nor is any one troubled (at least, I suppose not) when the microscope reveals millions of millions of tiny objects and minute forms of life of which men in former ages knew nothing, and which in no sense entered into their ideas of creation. So—but perhaps not quite in the same degree—with regard to time: I suppose it may be truly said now that no one with competent power of thinking refuses to recognise the evidence of a practical infinity of time past and to come, during which even that which *is* has existed, or, on the other hand, to admit that in the duration of a single breath lives begin and end of whose very existence men in past times had no idea. But to extend the operation of law to the vast and the minute, in space and in time, is regarded by many as absurd, if not wicked. They cannot seemingly understand that there is nothing more remarkable in the operation of law throughout infinity of time and space, and down to the minutest atoms of matter, than there is in the operation of law on a scale more within our scope. If we admit that a tree grows from the seed, or an animal from the germ, we need not be surprised to find evidence that a world or a system of worlds grows in like manner, or that the tiniest creatures have been developed, even as science recognises that the various kinds of animals and plants have been developed, through multitudinous phases of evolution. At a first view it may seem that in some of the wonders of minute life, the eye of a fly, the tongue of a moth, and so forth, we have objects presenting great difficulties in the way of the general doctrine of evolution. How, it may be asked, could a fly's eye, with all its thousanns of separate facets (or rather eyes) have been developed? Yet so soon as we consider how it has actually formed, under the very eyes of science so to speak, we find a mystery quite as overwhelming as the mystery that that very process of formation is itself a development, or the still more impressive mystery that evolution itself, as science deals with it, is a product of a higher process of development.—*Newcastle Weekly Chronicle.*

Editorial Gossip.

If any fresh illustration were needed of the gullibility of the British public, it might well be found in an advertisement which I have met with at once in the columns of the London morning papers, those of the provincial press, and even of, at least, one scientific journal. Here it is, with the address, of course, obliterated :—

Violin for sale, magnificent solo tone, suit lady or gentleman, labelled Antonius Stradvarus Cremona, 1690, lock-up case and bow, 25s. Sent on approval willingly.

It would, though, be more correct to say *one* of the addresses, as the disinterested possessor of this treasure seemingly changes his (or her) residence every week or ten days, and latterly has even modified the name in the instrument. Need I tell any one who ever heard of the old Masters of Cremona that a *real* Stradivarius violin would instantly be gladly snapped up by Mr. Hart, Mr. Withers, or any other dealer, at a hundred times the sum at which this fiddle is offered. Nay, a genuine "Strad" would find scores of delighted purchasers at £250. There must have been a large number of these things sold, or it would not have paid to repeat the advertisement. Meanwhile the incipient violinist may remember that comparatively few instruments altogether were made by the Amatis, Straduarius, or Guarnerius, and that, as I have just intimated, were a genuine one by either of these great artists to come into the market, hundreds of pounds (instead of a score or so of shillings) would scarcely buy it.

A reviewer expressed an opinion on p. 243 that astronomers ought to be able to procure Mr. J. E. Gore's capital Catalogue of Variable Stars by purchase. I am glad to learn, from Mr. Gore himself, that it is obtainable at Williams & Norgate's for a very small sum.

Dean Oakley has been denouncing, none too strongly, what has been well described as that "fool's argument," betting. For the tone and temper of those who indulge in this form of gambling is scarcely caricatured in the anecdote of the man who, after offering to take his oath to a certain alleged fact, refused to wager half-a-crown that it was true! Here, though, my purpose is rather to invite attention to the matter in its sociological aspect, and to point out the gross injustice of the law which permits a lad to cripple his patrimony and permanently straiten the circumstances of a widowed mother or orphan sisters with impunity, so long as his bets are made at Tattersall's, or in "the Ring" on any race-course, while his inferior in social rank, who does identically the same thing "in any street, road, highway, or other open and public place" may be convicted and sent to gaol as "a rogue and a vagabond" under 36 and 37 Vict., c. 83, s. 3. And yet we are often gravely assured that there is *not* "one law for the rich and another for the poor."

Here is another contribution to sociological science, in the shape of an advertisement, which, although at first sight it looks like a mere grim joke, may possibly, and even probably, be genuine :—

A Lady, whose husband has lost his income through mortgages on the estate and agricultural depression, is desired by him to work, as he cannot any longer maintain her; she has endured a very rough and toiling life, and is ready for anything that turns uppermost; excellent health, good sailor and nurse; highest references.—Address, &c.

There are doubtless a few dukes, mine-owners, and manufacturers to whom the *res angusta domi* represents little but a phrase; but the fact remains that the landed classes were never so badly off as they are at this instant, and that the domestic economy of many a stately mansion would very considerably surprise the outside world could they obtain the means of viewing it from within.

Reviews.

SOME BOOKS ON OUR TABLE.

The Mystery of the Universe our Common Faith. By Joseph Wm. Reynolds, M.A. (London: Kegan Paul, Trench, & Co., 1884.)—We think it not impossible that Mr. Reynolds's book may prove convincing—to those who were previously in agreement with its author. That, however, it will carry conviction to the mind, or in any sense alter the opinion of a single reader whose sole end is to examine the question it discusses in an absolutely impartial and judicial spirit, we gravely doubt. It has all the faults of the Duke of Argyll's book, which we reviewed on p. 162 of our last volume, superadded to many others specially pertaining to itself. That its author mistakes assertion for proof is a very euphemistic way of describing the dogmatism which pervades the entire volume. Even had the work been anonymous, it must unhesitatingly have been ascribed to a clergyman, so obviously does it proceed from the pen of a man who is accustomed to make categorical statements in absolute security from interruption or contradiction. *Pulpitum olet.* We disclaim any intention of employing the term in an offensive or discourteous sense, but a more purely *professional* book has seldom come under our notice. The difficulties which beset the earnest student of science in connection with current theology do not arise (as our author over and over again insinuates, even where he does not actually assert) from moral obliquity, or innate wickedness and absolute disinclination to learn the truth; but from a reasonable feeling that evidence, and not assertion, must form the groundwork of our belief. For however strenuously theologians may deny the fact, it remains a fact that belief is *not* voluntary. A man can only really believe a thing as it seems to him. If the salvation of the writer of these lines depended upon his believing that the pen with which they are committed to paper was an oyster, he *must* be damned, no power on earth could save him. We may juggle and quibble with words as we please, but we cannot evade this result of one of the most elementary facts in human psychology. The philosophical doubter of the infallibility of orthodox interpretation requires that his sober arguments shall be met in a similar spirit, and asks for logical demonstration, and not the turgid rhetoric to which he is treated in the work before us. For, sooth to say, it is sermonising throughout. Page after page of bombast, thickly interlarded with poetry (a good deal of it "altered" or "slightly altered") usurps the place of that dialectical treatment for which we are entitled to look in a book like the present one. Its author would seem to have read, and to some extent marked (albeit he has by no means either learned or inwardly digested), several modern works on science, and he parades scientific terminology in his pages in a way which is well calculated to delude the superficial reader into the belief that he is listening to the utterances of a man who has so far made science his special study as to be familiar with the most recent results of research. How far Mr. Reynolds is entitled to make such a claim, we may gather from the calm way in which he pooh-poohs the conclusions of such intellectual giants as Herbert Spencer, Huxley, Owen, Darwin, Wallace, Romanes, Grant Allen, Lubbock, Geikie, Lewes, Lyell, Tyndall, Lankester, Hæckel, Schmidt, Semper, Wilson, &c., &c., and quotes with approbation from the anonymous author of such washy nonsense as "The New Truth and the Old Faith." Moreover, a spirit of disingenuousness materially impairs the value of, what we suppose we must call, his arguments. In a foot-note on page 150, he speaks, for example, of the perturbations of the planets, &c., as affording exceptions to the rule of uniformity in the solar system, suppressing or ignoring the fact that every one of these perturbations is a direct and immediate result of the same law of gravitation which sustains the planets in their orbits; and that hence such uniformity remains absolutely unbroken. Again, on p. 160, he implies that men of science assert that "man descended from the gorilla," when he knows, or might know, that what is really alleged is not that man descended from the gorilla, but that man and the gorilla had a common ancestor. So, further, with his allegations about "the most eminent scientists," on p. 205. How can he possibly exclude from this category such names as those which we have mentioned above; and dare he, for his purpose, include them in it? His very superficial acquaintance with geology, and especially with palæontology (pp. 233 to 260 *passim*); his chronological quibble on p. 34; and his arrogant charge of "ignorance and presumption" against all who presume to contravene his oracular utterances (p. 379), may be taken almost at random as indications of his fitness for his self-imposed task, and the spirit in which he has approached its performance. "Capable thinkers" (p. 123) are those who agree with him; "lower-class minds" (p. 129), those whom his inflated oratory fails to convince. Such grave difficulties as that presented by the indubitable fact that primæval man was a savage, are never touched upon, nor even hinted at. With that portion of the work having special reference to dogmatic theology we are, perforce, silent here.

A System of Logic. By John Stuart Mill. People's edition. (London: Longmans, Green, & Co., 1884.)—It may seem rather late in the day to notice a book of such world-wide reputation as Mills' "Logic," and we only do so here to note its appearance in a form and at a price which places it within the reach of all. No excuse now exists for unfamiliarity with the *magnum opus* of one of England's greatest thinkers. Those familiar with the earlier editions of Mr. Mill's classical work will find important additions in the present one to the chapter on "Causation" as treated in connection with the modern doctrine of the Conservation of Energy. No educated Englishman can afford to remain ignorant of the conclusions of our great departed philosopher.

We have also on our table *The Poetical Works of Longfellow, Illustrated*, London: Cassell & Co., *Society*, *The Medical Press and Circular*, *Our Monthly* (Rangoon), *Naturen*, *Bradstreet's*, *The Tricyclist*, *Ciel et Terre*, *Technical Education for Millers and Bakers*, by W. Jago, F.C.S., *The Dyer*, *The Medico-Legal Journal* (New York), *The Railway Review* (Chicago), *The American Druggist*, and an Arabic scientific journal of which, we regret to say, we are wholly unable to decipher either the title or the contents.

TOTAL ECLIPSE OF THE MOON ON OCTOBER 4.

We may add that there will be a Total Eclipse of the Moon during the evening and night of October 4, the Moon remaining totally immersed in the shadow of the Earth for more than an hour and an half.

We append particulars of the times of the various phases of the eclipse:—

	H.	M.	
First contact with penumbra	7	16·8 p.m.	Greenwich Mean Time.
First contact with shadow ...	8	15·2 ,,	
Beginning of total phase	9	15·8 ,,	
Middle of the eclipse	10	2·0 ,,	
End of total phase	10	48·2 ,,	
Last contact with shadow ..	11	48·8 ,,	
Last contact with penumbra	12	47·2 ,,	

Magnitude of the eclipse (Moon's diameter = 1), 1·525.

The first contact of the shadow occurs at 83° from the northernmost point of the Moon's limb towards the east.

The last contact, 118° towards the west; in each case as viewed with the naked eye.

[The above paragraph was accidentally omitted last week from "The Face of the Sky," on p. 265.]

Miscellanea.

Royal Victoria Hall and Cofeee Tavern, Waterloo Bridge-road, S.E.—Attention is called to the fresh series of Popular Science Lectures, which the kindness of various eminent lecturers has enabled the managers of the above hall to arrange on Tuesday evenings, at prices ranging from a penny. On October 7, P. H. Carpenter, Esq., D.Sc., will give a lecture on "Our Bodies, and how they are kept going," and on October 14, J. M. Thomson, Esq., F.R.S.E., Sec. Chem. Soc., will deliver one on "Air and Ventilation," with experiments. These lectures will all be illustrated with dissolving views, and followed by popular glees, solos, &c., by the Royal Victoria Choir and Band. The concert season at the above hall is now definitely announced to begin on Thursday, October 2nd. The first and second Thursday evenings are to be under the efficient charge of Mr. Lenthal Swifte, and for several succeeding concerts arrangements are being made with such well-known artists as Messrs. F. N. Bridge, George Cox, Mesdames Evans, Warwick, and Annette Frances, Mr. Sinclair Dunn, and many others of like position whose names will shortly be published. Much care is devoted to the arrangement of the programmes so as to secure all possible brightness and variety, and no exertion will be spared to make the season a brilliant and successful one.

The Colours of Tropical Man.—In a recent issue of a contemporary an attempt has been made by Surgeon-Major Alcock to explain the apparently anomalous condition of a dark skin being best adapted for a hot climate. The basis of the argument is that for every permanent characteristic in the animal kingdom there is a special use, therefore blackness of skin must subserve some purpose. The two agents to which the body of an unclothed man is most exposed are clearly heat and light. In a hot climate the action of the former would be obviously intensified by falling on a dark surface; this increased activity must be compensated for by some beneficial effect with regard to light. In support of this the immense influence of the light-waves of the sun upon the great vegetable worlds, past and present, is referred to, and it is asserted that their power upon the animal body has been lost sight of owing to their transcendent results upon the nerve of the eye, which is itself but an exalted nerve of the skin, and which, though it now can see, could once but feel. It is then pointed out that the response of a nerve to a stimulus, consists in increased vibration of the molecular elements of which the nerve is composed; in fact, that when the vibratory waves of heat or light impinge upon nerves attuned to vibrate at the same pitch (as when a piano string takes up a note sung at it), these nerves receive the motion thus communicated, and it is thus that light and radiant heat are absorbed. If, then, in addition to the motion unavoidably set up in the sentient extremities of the nerve-endings by the heat-waves, there should be the further motion which the light-waves are also capable of inducing, the double stimulus would give rise to an amount of molecular disturbance which would be injurious to the species. To prevent this, the light-waves are blocked at the surface by the interposition of pigment. In fact, "the black skin of the negro is but the smoked glass through which alone his wide-spread sentient nerve-endings could be enabled to regard the sun."

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

DR. LARDNER AND TRANSATLANTIC NAVIGATION.

[1419]—May I be permitted to point out that the late Dr. Lardner gave an emphatic denial to the statement (which I have before heard, and which he takes pains to rebut as a popular error), *i.e.*, that he asserted Atlantic steam navigation to be impossible. He says that at the British Association Meeting in 1836, he advocated one of the projects. At p. 118, Vol. X., of the *Museum of Science and Art*, appears an extract from the *Times* of 1837, showing his ideas on the subject, which were simply that too much should not be immediately expected, and that caution should be used. I do not know if he ever held a different opinion, but if not, I consider it only fair to his memory to notice these facts. He adds:—"What I did affirm and maintain in 1836-7 was, that the long sea voyages by steam which were contemplated, could not at that time be maintained with that regularity and certainty which are indispensable to commercial success, by any revenue which could be expected from traffic alone, and that, without a Government subsidy of a considerable amount, such lines of steamers, although they might be started, could not be permanently maintained." He then goes on to notice what was the actual subsequent fate of the earliest Atlantic steamers, which quite corroborates what he had advanced. He likewise mentions that, "long antecedent to the epoch now adverted to, the Atlantic had actually been crossed by the steamers *Savannah* and *Curaçoa*."

Simplex.

ORTHOGRAPHIC MAPS.

[1420]—In an oblique orthographic map of a hemisphere, if you cross the ellipse that represents the equator, by an equal and similar one, turned the contrary way, this ellipse will pass through the foci of all the traces of meridians, and afford a wonderfully ready way of both finding their ends and striking them all with one trammel. I should like to see this demonstrated. E. L. G.

THE WICKED FLEA.

[1421]—"The Wicked Flea" and all other insects hate creosote which I find is more effective than Keating's Powder.

John Alex. Ollard.

AN INVALID ON THE COVENTRY CHAIR.

[1422]—If Mr. Browning could put himself in the place of an invalid, I don't think he would talk of the "Coventy chair" superseding the present Bath chair. He would know that "a crawling pace of about two miles an hour" is more suitable to the nerves of an invalid than the tearing pace of a tricycle. Besides, the "Coventry chair" would be excluded from the parade and the pier—favourite resorts of invalids at seaside places—and would have to keep in the road, where the fear of collision with horse-vehicles is very distressing to an invalid who cannot stir from his place, whatever happens. If he wishes to go only in the roads and streets, he had better go for a drive in an ordinary carriage, which, being of a larger size than a Bath chair or tricycle, can hold its own against other vehicles. I speak feelingly, for, even in this quiet place, I am always in a state of trepidation till my chair reaches the parade. E. C. H.

Worthing.

SOLUTION OF FIGURE PUZZLE (1398).

[1423]—Let x be the number. Writing the figures in order B C D E F A is equivalent to multiplying x by 10, adding A and subtracting 10^6 A.

$$\therefore\quad 10x + A - 10^6 A = 3x.$$

$$\therefore\quad 7x = (10^6 - 1)\,A \qquad \therefore\quad A = \frac{7x}{999999}$$

Similarly,

$$30x + B - 10^6 B = 2x \qquad \therefore\quad B = \frac{28x}{999999}$$

$$C = \frac{14x}{999999} \qquad D = \frac{56x}{999999} \qquad E = \frac{35x}{999999}$$

But $F + 10\,E + 10^2\,D + 10^3\,C + 10^4\,B + 10^5\,A = x$

$$\therefore\quad F + \frac{999950}{999999}x = x$$

$$\therefore\quad F = \frac{49}{999999}x = \frac{7x}{142857}$$

Now F must be an integer less than 10, and 7 is prime to 142857 $\therefore$ x must = 142857.

$\therefore$ 142857 is the number required. Kit.

[1424]—About a fortnight ago a friend sent me the puzzle given by E. Sidders in letter 1398. It appeared, I think, in the *Liverpool Courier*.

I recognised it as a curious property of the number formed by the recurring decimal representing the vulgar fraction $\frac{1}{7}$.

$$\tfrac{1}{7} = \dot{1}\,4\,2\,8\,5\,\dot{7}$$

		A B C D E F	
A B C D E F	=	1 4 2 8 5 7	= the number
B C D E F A	=	4 2 8 5 7 1	= 3 times the number
C D E F A B	=	2 8 5 7 1 4	= twice ,,
D E F A B C	=	8 5 7 1 4 2	= 6 times ,,
E F A B C D	=	5 7 1 4 2 8	= 4 times ,,
F A B C D E	=	7 1 4 2 8 5	= 5 times ,,

R. B.

[Correct solutions, mainly, it would seem, by the system of trial and error, have also been received from E. C. H., H. K., C. J. B., F. B. Whitmore, F. G. S., P. P. G. Goolden, E. O. H., G. H. Howe, J. McD., T. K. H., and others.—Ed.]

COINCIDENCES.

[1425]—Seeing in your issue of July 25th last a letter headed "A Coincidence," it has struck me that an experience of mine in the same direction may amuse some of your readers.

One night several years ago I went to a dance in town. I dressed at a well-known hotel, only going there just before the dance, gave no name, left my luggage, on which there was no name, and returned to sleep about 3 o'clock. Next morning, on coming down, a porter addressed me *by name*, and handed me a card. It bore the printed name of a man whom I only knew by name. Over the name was written in pencil my name, initials all correct, and on the back, also in pencil, a direction to an address curiously like mine (the number identical, and one being Old Square and the other Old Jewry), and in a very similar handwriting to that of, and signed with the initials of, a man whose whereabouts I did not know, and whom I was anxious to see. I asked the porter how he knew it was for me; he said it had been left while I was out for a gentleman who was expected that night, and I was the only one who had come.

Now, I never was in that hotel before or since. I only made up my mind to go ten minutes before I went. The card was meant for some one else, who bore (as I found out by a directory) my exact name in initials and only with a small variation in full. That person was expected there that night and did not come. The card belonged to a man of whose existence I knew. The writing on the back resembled that of, and the initials were the same as those of a man whom I wanted to see, but who was then in India (as I found out later), and the address given was curiously like mine. And yet my connection with the whole thing was a pure accident. A document so going astray in a play or novel would be set down as an improbability: but this was what did happen in the case of this card. I may add that none of the names were common ones, and one is a particularly uncommon one. It seems to me to be a nest of "coincidences." Exsul.

[1426]—A few years since, I was waiting for a train to arrive at the station of a large town, that I might go on by it. I saw an elderly gentleman, whose face struck me and who looked hard at me. We soon recognised each other, though we had not met for forty-two years. After talking for some time of old days, the train came in, and we were then standing at the door of a compartment which I intended to enter, and in which were two or three ladies, one seated close to the door. I then said, "What became of that beauty, Miss ——, who married —— ——?" naming a very pretty but fast young lady. Instead of answering me, he walked quietly away, and, on my joining him, said, "That was her in the carriage close to you, and she must have heard you."

I had heard of her marriage soon after I left England, more than forty-one years before, and, about four years after, I heard of her husband's death. From that time I had not heard of her, neither did I know if she was living.

Does not this strange coincidence prove that "truth is stranger than fiction?" S.

Morai, Aug. 22.

[1427]—Apropos to the numerous coincidences reported in your columns, I send you a true story, which, however, hardly comes under the term coincidence. At Darjeeling, early in 1861, a few of us banded together and formed a club, the main object of which, barring social intercourse, was to play upon an ancient and chronically-frozen wooden billiard-table. As the Derby drew on it was proposed that we should have a lottery, and settle matters finally on a future day. As I cared not an atom for racing, I had no intention of joining; but, strange to say, that night, and the one following, I had the same dream or revelation most vividly impressed upon me—"Join the lottery, and you will draw Cambuscan." I thought this so strange that I mentioned it to my friends in the club, stated my determination to join the lottery, and my fixed expectation of drawing Cambuscan. Of course, my vaticination was greeted with credulity or derision, and more so when the drawing-day came, and I declared my determination to draw last, in full confidence that my ticket would bear Cambuscan. So it was; each drew, and one paper remained in the hat, which I took, and it bore the name "Cambuscan." "I'll give you R300 for your ticket," cried a member. "No, thank you, I expect the whole lottery," I greedily answered. But Cambuscan did not win the Derby, but ran second. R. F. H.

GIVING UP THE GHOST.

[1428]—Mr. Lodge in his ghost story [1379], recorded in a recent issue of your useful publication, states that in America General Winyard beheld at the *same* hour as his brother died in England, a "figure" that "bore the strongest resemblance" to him.

Allowing for the difference of time, if Mr. Lodge's story be "A Fact," as stated, the ghost must have appeared in America at least more than four hours before the General's brother died in England.

Did the General's brother know *beforehand* the *precise hour* he should die? Could his ghost (supposing he had one) have crossed the Atlantic several hours before his death?

Can ghosts at *one stride* cross over thousands of miles? Can they from *afar* discern the one they seek and *instantaneously* appear to him? If so, who would not be "a ghost?" C. R.

THE BEAN-FLOWER.

[1429]—I shall be glad if Mr. Grant Allen can inform me what insect it is which pierces a hole through the calyx of the bean-flower on its upper side and close to the junction with the receptacle. I thought at first it might be bees; so watched, and saw several bees visit flowers, but in *all* cases they rejected those which were unpierced, and sucked the honey through this hole. What insect frequents the bean-flower, and so fertilises it? I have always been *told* that bees are very fond of this flower, but, for my own part, I have never found them visit the bean except as above stated. E. W.

PHONETIC SPELLING.

[1430]—I am much obliged to you for going so far in the direction of qualifying your previous opposition to the improvement of spelling. May I say that it would have been most unreasonable on my part had I urged the adoption, or even the partial introduction, of improved spelling in your journal. Its discussion, however, is another matter. The study of phonetics is unquestionably a branch of the great domain of science, and as such would, I suppose, come within the scope of your publication. Even the practical questions of the early invention of alphabetical writing on phonetic principles by a gradual evolution from a hieroglyphical system, the improvements naturally necessitated by its transference to fresh languages, and the degradation and restoration of the forms and values of the letters, would also appear to merit consideration. Whether the double invention (1) of a sufficiently complete alphabet for the representation of our speech by separate signs for each well-marked sound, and (2) the devising of a graduated series of successive intermediate modes of spelling so as to carry us over the inevitable transition state—whether these are beneath notice I must leave you to determine.

I would not claim that the Reform must grumble if crowded out, nor yet if opposed by fair debate; but to be treated with contempt, based merely upon misapprehension, by one so impartial as yourself, demands an effort to remove the misunderstanding, which you will, doubtless, approve. J. GREEVZ FISHER.

PHOSPHORESCENCE OF THE SEA.

[1431]—On Sunday, Sept. 2, during a passage from Hull to Antwerp, I witnessed a brilliant display of the above phenomenon. On the day mentioned we were in the midst of a severe cyclonic storm, and as night closed in, the waves, which were of considerable proportions, became luminous to a remarkable degree. So bright were these lights that our pilot, knowing that we were near the coast, but being unable to detect the Dutch lights from amongst so many, and afraid of venturing nearer, anchored until daybreak. Are such brilliant displays of rare occurrence in the North Sea? Am I correct in thinking that the luminosity in question was caused by myriads of Noctiluca miliaris? A. PEARSON.

TRANSPORT OF PUMICE-STONE BY OCEAN CURRENTS.

[1432]—Here, at a missionary station, whither news does not arrive with much speed or regularity, I have just read in your issue of April 18, an article on "The Spread of the Krakatoa Dust-Cloud," which gives the astonishing rate of 1,700 miles a day for the conveyance of light dust in the air from east to west. I am able to supply an analogous fact with regard to the rate of the associated pumice-stone, probably from the same eruption, through the water. Late in June, I was at Zanzibar, when the western coast was suddenly observed to be lined at high-water mark with great quantities of this substance, of all sizes up to that of a child's head, extending for at least four miles south of Zanzibar, and I think I heard of it twenty miles north. Hearing Java suggested as the source of the phenomenon, I made a rough calculation of the intervening time and distance by ocean current, which appeared to give a rate of about twenty miles a day, or less than a mile an hour—a rate almost as surprising for its slowness as that of the aërial dust for its rapidity, but I suppose by no means inconsistent with it. I crossed the channel to the mainland a few days ago, and expected to find a similar lining along this coast at Payani, which is about 1° N. of Zanzibar (*i.e.*, 5° S. of Equator); but I only found a single small specimen.

In February last, I noticed green halos round the moon, which was itself similarly tinted. Yours faithfully

A. H. HAMILTON.

Mkuzi, East Africa, July 24, 1884.

IS COLOUR OBJECTIVE?

[1433]—The contention in my letters was not for a change of common parlance, but of scientific language; nor do I see how you can consistently object to that, as you have by your own admission found it necessary to impress the non-externality of colour on the readers of KNOWLEDGE. My contention was, that the erroneous conception of the externality of colour has led to endless mistakes in attempts to expound the theory of the harmony of colour, and notably on that special point of the so-called *primaries* and *secondaries*.

The belief in the externality of colour has led artists and writers to imagine that the student has to study some outer objective harmony, some relations of the prismatic spectrum, instead of the laws of his own sentient nature. It has also led to the phenomena of the accidental colours of the ocular spectra being treated even in professedly scientific works as external realities when they have no externality whatever, and to many other mistakes too numerous to mention. It is from the æsthetic point of view that the nomenclature of the text-books on colour are so misleading. Men who are accustomed to abstract reasoning do not require the fact, on which I have laid so much stress, to be repeatedly pressed home to them, but with the artist it is a different matter. Even quite recently I met with a painter lecturing on colour, who was as confident of its externality as of that of the canvas and frame of his picture.

But to resume my argument in respect to *primaries* and *secondaries*, it must be clear that we cannot treat the sensations themselves—those which we name red, green, and violet—as *primaries*. It must be something in the nature of the wave-lengths, which cause those sensations, that would give them the right to this distinction. But Brewster affirms that no single wave of the prismatic spectrum can be decomposed; every wave in this series is therefore of an equally indecomposable rank; but he also states that in some instances similar sensations of colour can be produced, by compounding two waves, to those produced by single waves in other positions of that spectrum, but that, in these cases, the two original waves may be resolved by the prism, showing thereby that there is no such thing as a secondary vibration in the natural series of wave-differentiations. W. Cave Thomas.

SLAUGHTERING ANIMALS.

[1434]—If you will allow me to add to your remarks anent the use of the poleaxe as an effective means towards "Euthanasia for the Lower Creation," I would say that the method of poleaxing admits of modification so as to be easily applied in the case of the smaller animals, as sheep, pigs, &c., when being slaughtered. If a piece of steel rod or wire—not larger than a ¼ inch diameter—be fixed at right angles to a short handle of wood, we have an instrument which, if placed over the proper point of the animal's cranium, and struck with a short heavy stick, will deprive the animal of sensibility as quickly and as surely as the poleaxe does in the case of oxen. Norfolk Farmer.

MIND AND BRAIN.

[1435]—If the Rev. S. F. B. Perrin will read the first volume of "The Mechanism of Man," by the late Mr. Serjeant Cox (Longmans, 2 vols.), he will find, I believe, an answer more or less satisfactory to the question he raises in his letter, No. 1404.

To embody in a letter the contents of nearly five hundred pages is impossible, but it may suffice to say that the dominant idea of the writer is that three forces direct the mechanism of man—namely, *Life*, mortal, beginning and ending with earthly existence. *Mind*, the aggregate action of all the intellectual and emotional powers of the brain. *Soul*, the self, the *ego*, the conscious I, the man, unlike the body, unchangeable, imperishable; the brain and the nerves being the material medium through which the soul receives by the senses communications from external nature, and by the will transmits its mandates to the body, and manifests itself to the outward world.

M. Louis Fignier, in his "Day after Death," considers that man consists of three elements. The body, the life, and the soul, but he deals with the future of the last, rather than with the question under consideration. Eye-Witness.

LIFE AFTER DEATH.

[1436]—Seated one afternoon a few weeks ago in a room overlooking an arm of the sea, I witnessed a scene the incidents of which re-aroused in my mind certain thoughts concerning the hereafter, which for years had slumbered.

Half a mile or so out when it first caught my eye, was a punt with one occupant. He was pulling easily shorewards, and shortly drew up close to the steps leading on to the pier. There was a strong tide running, and the water was very deep. The oarsman, evidently a novice, clumsily endeavoured to bring his punt into a position to enable him to leap ashore, and when, as he thought, sufficiently near, he jumped, but fell backwards into the water. There were a number of people about, who endeavoured to assist the drowning man; but as the boat had drifted away with the tide, their efforts were unavailing, and he sank for the last time. Just after, a man arrived from a short distance with a boat-hook, and, quite at random, not knowing where the body had sunk, groped about in the water. By an almost miraculous chance, he succeeded in catching a portion of the submerged man's clothing, and so hauled him to land, and after a time, by the application of suitable means, life was restored.

I interviewed the victim some days after, and elicited the fact that practically he had been dead. He had suffered all that he could suffer from the drowning process, and had become totally oblivious of any sensation whatever. His body was so much drowned as to have stopped thought and destroyed consciousness. He knew and felt *nothing whatever*, and lay at the bottom of the water, to all intents and purposes stone dead.

Now, sir, if there is, as some teach, a life after death, why was no sign of it manifested here? Those who teach the doctrine of a hereafter, aver that death does not destroy the mind. If this be true, why was this man unconscious of everything? He recked not of this world or the next. It is, of course, impossible to ask those who die and do *not* return to life, whether, during the passage from this life to the life supposed to be hereafter, a state of absolute oblivion intervened, and how long it continued. But in the case I have just related, the man was practically killed, his body was bereft of breath and motion, and this physical state produced a total suspension of his mental and physical faculties, a state of things which, *so long as he continued dead, manifested no symptom of change whatever;* no throb of another life animated his mind or his soul, and the probability is, that if he had continued unhelped, and remained under water till his body had been decomposed utterly or eaten by fish, no change or reawakening in his mental or spiritual faculties would have occurred, but that he would have remained as he was, dead—body, soul, and spirit—for ever.

I do not, sir, with all deference, think I am, by introducing this subject, trenching on the limits you have wisely indicated with regard to theological questions. Theology I have long since and utterly discarded and put aside, as far as I am personally concerned. I only present the subject as an effort to obtain knowledge, and I do hope to hear from some of your extremely able correspondents on the matter. I take a deep interest in the question of a future life. I do not believe there is such a thing, but, on the other hand, I do not *know*. I often feel as if, like the two disciples of an ancient philosopher who heard of immortality for the first time, and immediately and violently "shuffled off this mortal coil," I would like to put an end to a somewhat troublesome existence from mere curiosity, and so solve, for myself at least, the great riddle. But there is no need for this. I think the question may be settled otherwise.—I am, Selwyn Thorne.

[The very curious and momentous question raised in Mr. Thorne's letter must be discussed in these columns from a purely scientific point of view alone. We have had more than enough of the *odium theologicum* lately. A few (fortunately a very few) readers never see anything here conflicting with *their* particular form of orthodoxy without writing letters—which, of course, I never print—not obscurely hinting that I am an infidel and an atheist for permitting anything to appear that runs counter to the views of that most straitest sect to which they may happen to belong. Whatever such writers may think, it is both hurtful and offensive to me to be branded in such untruthful fashion. Hence my determination that while science shall not interfere in Knowledge with dogmatic theology, neither shall dogmatic theology interfere with science.—Ed.]

LETTERS RECEIVED AND SHORT ANSWERS.

[Owing to some muddle among various post-offices, one packet of redirected letters has gone entirely astray. Perhaps correspondents whose communications are neither noticed here, nor appear in our correspondence columns within three weeks, will kindly write again.]

A. H. R.E., T., Ed. Walker, Alfred Buss, Thos. Ward, Robert Moore, H. Huber, A. G. H. S., M. Smith, H. Minchin, Jessie H. Howat, Chas. J. Wetherill, Pi, G. J. Pilcher, E. W. Gundry, B. Gleam, and a large number of other correspondents, send solutions, some mathematical and some empirical, of Mr. Sidder's figure puzzle.—Daniel Dewar. Received.—Nigel Doble. In making observations it is customary to attach a number to each, expressive of its accuracy or trustworthiness; 10 representing a *perfect* observation and 1 a worthless, or practically worthless, one. Such a number is technically known as the "weight" of the observation to which it is appended.—Ignoramus. See "Mars in a Three-inch Telescope," vol. V., p. 140.—W. J. Harding. The notice (which you will find elsewhere this week) was omitted from "The Face of the Sky" last week by an error. No directions for finding the new comet can be given until its elements are computed, and an ephemeris calculated from them. It is, I fancy, in Cygnus.—John W. Staniforth points out that Encke's Comet was seen on Aug. 20, 1881, by Dr. Hartwig and Prof. Winnecke at Strasburg; on the 24th by O. Struve at Pulkowa; and on the 28th by Lohse at Dunecht. In September it was observed on the 20th at Nashville, Tennessee, and five days later by our own correspondent, "F.R.A.S." Many thanks for the information.—T. Hartley. Delayed for several days, owing to your addressing your letter to "the Editor." It is the *Publishers* who supply copies of Knowledge.—W. Franklin. I regret that I can afford no space in these columns for the discussion or exposure of that exploded imposture spiritualism.—B. Gleam. "Five of Clubs" is on the other side of the Atlantic. Can any whist-playing reader give the name of the publishers of the "Westminster Papers," and say if the back numbers are now procurable?—H. L. I have never even heard of the system you speak of. Pitman's leaves nothing to be desired.—A. Steele. Doubtless the act of the cat was prompted by the conviction that it had done wrong. Its progenitors had been punished for acts of theft, and it seems more than probable that what we call "instinct" is merely inherited memory. In this sense each successive generation of domesticated animals may improve in morality.—Ignoramus. No wonder the M.R.C.S. laughed at such an assertion. That editor and you might pair off as you suggest.—A Geologist. The facts, certainly not the *inferences*. The "publicity" of which you speak was doubtless a mistake.

Our Chess Column.

By Mephisto.

THE GAMBIT DECLINED.

(Continued from p. 228.)

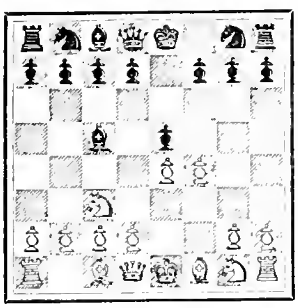
(Continued from p. 228.)

THE easiest way of declining the Gambit is by playing 1. P to K4, P to K4. 2. P to KB4, B to B4. Of course White cannot play 3. P × P, on account of Q to R5 (ch). A similar bad result would follow 3. B to B4, for then Black would play B × Kt. 4. R × B, Q to R5 (ch). 5. K to B sq., Q × P (ch), &c. Positions, however, often occur in this Opening and the Vienna Game when the check on R5 is disadvantageous for Black. Thus, for instance, if White plays 3. QKt to B3, it would not be good to play as before, *i.e.*, 1. P to K4, P to K4. 2. P to KB4, B to B4. 3. QKt to B3, B × Kt. 4. R × B, Q to R5 (ch). 5. P to Kt3, Q × RP. 6. R to Kt2. Now the Q dare not play to R sq., as she would there be sadly out of play, if Q to R6, White can play 7. P × P with a strong centre and an open game, or he may first play 7. Kt to Q5, followed by P × P and Kt to B4.

The Q is often lost in this variation. It follows that discrimination is required before (ch) on R5 is given in this Opening. It is mostly good if Black has the chance of doing so after the White KB has moved.

In reply to 3. Kt to QB3, Black plays :—

Black.



White.

3.	P to Q3.
4. Kt to B3	Kt to KB3
5. B to B4 (*a*)	P to B3
6. P to Q3	Q to K2
(threatening P to Q4)	
7. Q to K2	B to Kt5
8. B to K3	Kt to Q2
9. Castles QR	Castles QR

and the position is fairly even.

(*a*) White would jeopardise his position if 5. P × P, P × P. 6. Kt × P, Q to Q5. 7. Kt to Q3, B to Kt3. Although a P ahead, White has a very bad position 8. Q to B3, B to KKt5, followed by Castles with a strong attack.

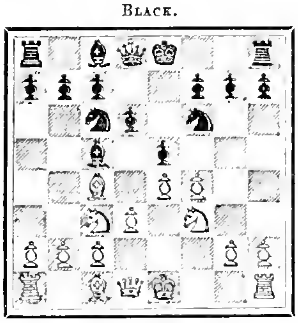
Instead of P to B3 Black may on his 5th move play Kt to B3 in the main variation, when the following might result, 5. Kt to B3. 6. P to Q3. We have now a main position which occurs in another variation of the Gambit Declined, when White plays 3. Kt to KB3, and which is also brought about by a transposition of moves in the Vienna game, *i.e.* :—

1. P to K4	P to K4, or	1. P to K4	P to K4
2. P to KB4	B to B4	2. Kt to QB3	B to B4
3. *Kt to KB3*	P to Q3	3. P to B4	P to Q3
4. B to B4	Kt to KB3	4. Kt to B3	Kt to QB3
5. P to Q3	Kt to QB3	5. B to B4	Kt to B3
6. Kt to QB3		6. P to Q3	

It is therefore of more importance to know the main features of an Opening, than merely to commit certain lines of play to memory. A player who understands the principle of each opening (which we endeavour to show) will, if he plays with judgment, mostly find the right way of steering clear of danger, though the attacking moves be varied.

Now we are certain that in this position many a game has been lost by Black playing Kt to Kt5, or that White (if he be a careful player) in order to avoid the position, crippled his game unnecessarily, for in reality Kt to Kt5 by proper defence will result in improving White's game, *i.e.* :—

Black.



White.

6.	Kt to KKt5
7. Q to K2	B to B7 (ch)
8. K to B sq.	B to Kt3
9. P to KR3	Kt to B3
10. P to B5	Kt to KR4
11. Q to K sq.	

to be followed by P to KKt4, and White's game will be well-developed. Instead of 6. Kt to Kt5 Black may Castle without much danger or play B to KKt5. White may adopt another line of play, *i.e.*, 1. P to K. P to K4. 2. P to KB4, B to B4. 3. Kt to KB3, P to Q3. 4. *P to B3*. To this, Black would reply with B to KKt5. 5. B to B4, Kt to QB3. 6. P to Kt4, B to Kt3. 7. P to QR4, P to QR3, with a fair defence.

With a slight transposition of the moves, we give the variation of the game recently published in our columns between Zukertort and Judd. 1. P to K4, P to K4. 2. P to KB4, B to B4. 3. Kt to QB3, P to Q3. 4. Kt to B3, Kt to KB3. 5. B to B4, Castles. 6. P to Q3, P to B3. 7. Q to K2, P to QKt4. 8. B to Kt3. Here we should play QKt to Q2, or Q to K2, with the intention of then proceeding with P to QR4, B to R3, and R to K sq., &c.

PROBLEM No. 129.

Having last week amended the position by placing a Black P on KKt4, we defer the solution till next week.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W. W. Smith.—Pray excuse us if we did not succeed in making ourselves intelligible—apparently an exceedingly difficult task. In the position of the consultation game, *second diagram, p. 188, after White's 32nd move*, the Black Q cannot play to Kt6. The whole point of the position consists in the fact that the Black Q must protect the KBP, as otherwise mate in four follows, *i.e.*, 32. Q to Kt6. 33. B to R7 (ch), K to R sq. 34. B to Kt6 (ch), K to Kt sq. 35. Q to R7 (ch). K to B sq. 36. Q × P mate; *vide* also analysis, p. 208.

E. W. Y.—You are quite right. In the game Zukertort *v.* Judd. p. 248, White would have done better to play 14. B × Kt, and if then K × B, 15. Q to B3 (ch), followed by 16. Kt to K2.

R. F. (Dundee.)—Received with thanks. It is a well-known press rule that persons not wishing their name to appear, must affix some other signature to their contributions.

W. Furnival.—Problem welcome, and will be examined. Solution of 129 correct.

F. J. D.—Thanks for your kind promise.

S. B. C.—In Problem No. 129, if 1. Kt to K4 (ch), K to Kt3. 2. B to Kt4, Kt to Kt2, and you cannot mate in two moves, for if 3. Q to QB8, R to Kt sq. In Problem 130 you have likewise not struck oil, for if 1. Q to Kt2, R to Q7. 2. Q × B (ch), other R interposes, and there is no mate.

Wm. De Morgan.—See above reply.

Correct Solutions received.—Problem No. 126. Chas. Wilbraham. No. 127, W. Parker. No. 129, M. T. Hooton. No. 130, W., William Godden, F. J. D.

Contents of No. 152.

NOTICES.

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CONTENTS OF NO. 154.

THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

XLIV.—THE COOKERY OF WINE (*continued*).

THE paternal tenderness with which wine is regarded, both by its producers and consumers, is amusing. They speak of it as being "sick," describe its "diseases" and their remedies as though it were a sentient being; and its diseases, like our own, are now attributed to bacilli, bacteria, or other microbia.

Pasteur, who has worked out this question of the origin of diseases in wine as he is so well known to have done in animals, recommends (in papers read before the French Academy in May and August, 1865), that these microbia be "killed" by filling the bottles close up to the cork, which is thrust in just with sufficient firmness to allow the wine on expanding to force it out a little, but not entirely, thus preventing any air from entering the bottle. The bottles are then placed in a chamber heated to temperatures ranging from 45° to 100° C. (113° to 212° Fahr.), where they remain for an hour or two. They are then set aside, allowed to cool, and the cork driven in. It is said that this treatment kills the microbia, gives to the wine an increased bouquet and improved colour—in fact, ages it considerably. Both old and new wines may be thus treated.

I simply state this on the authority of Pasteur, having made no direct experiments or observations on these diseases, which he describes as resulting in acetification, ropiness, bitterness, and decay or decomposition.

There is, however, another kind of sickness which I have studied, both experimentally and theoretically. I refer to the temporary sickness which sometimes occurs to rich wines when they are moved from one cellar to another, and to wines when newly exported from their native climate to our own. The wines that are the most subject to such sickness are those that are the most genuine—the natural, unsophisticated wines, those that have not been subjected to "fortification," to "vinage," to "plastering," "sulphuring," &c.—processes of cookery to be presently described.

This sickness shows itself by the wine becoming turbid, or opalescent, then throwing down either a crust or a loose, troublesome sediment.

Those of my readers who are sufficiently interested in this subject to care to study it practically should make the following experiment:—

Dissolve in distilled water, or, better, in water slightly acidulated with hydrochloric acid, as much cream of tartar as will saturate it. This is best done by heating the water, agitating an excess of cream of tartar in it, then allowing the water to cool, the excess of salt to subside, and pouring off the clear solution. Now add to this solution, while quite clear and bright, a little clear brandy, whisky, or other spirit, and mix them by shaking. The solution will become "sick," like the wine. Why is this?

It depends upon the fact that the bitartrate of potass, or cream of tartar, is soluble to some extent in water, but almost insoluble in alcohol. In a mixture of alcohol and water its solubility is intermediate—the more alcohol the smaller the quantity that can be held in solution (hydrochloric and most other acids, excepting tartaric, increase its solubility in water). Thus, if we have a saturated solution of this salt either in pure water or acidulated water or wine, the addition of alcohol throws some of it down in solid form, and this makes the solution sick or turbid. When pure water or acidulated water is used, as in the above-described experiment, crystals of the salt are freely formed, and fall down readily; but with a complex liquid like wine, containing saccharine and mucilaginous matter, the precipitation takes place very slowly; the particles are excessively minute, and become entangled with the mucilage, &c., and thus remain suspended for a long time, maintaining the turbidity accordingly.

Now, this bitartrate of potash is the characteristic natural salt of the grape, and its unfermented juice is saturated with it. As fermentation proceeds, and the sugar of the grape-juice is converted into alcohol, the capacity of the juice for holding the salt in solution diminishes, and it is gradually thrown down. But it does not fall alone. It carries with it some of the colouring and extractive matter of the grape-juice. This precipitate, in its crude state called *argol*, or *roher weinstein*, is the source from which we obtain the tartaric acid of commerce, the cream of tartar, and other salts of tartaric acid.

Now let us suppose that we have a natural, unsophisticated wine. It is evident that it is saturated with the tartrate, since only so much argol was thrown down during fermentation as it was unable to retain. It is further evident that if such a wine has not been exhaustively fermented, *i.e.*, still contains some of the original grape-sugar, and, if any further fermentation of this sugar takes place, the capacity of the mixture for holding the tartrate in solution becomes diminished, and a further precipitation must occur. This precipitation will come down very slowly, will consist not merely of pure crystals of cream of tartar, but of minute particles carrying with it some colouring matter, extractives, &c., and thus spoiling the brilliancy of the wine, making it more or less turbid.

But this is not all. Boiling water dissolves $\frac{1}{6}$ of its weight of cream of tartar, cold water only $\frac{1}{180}$, and, at intermediate temperatures, intermediate quantities. Therefore, if we lower the temperature of a saturated solution, precipitation occurs. Hence, the sickening of wine due to change of cellars or change of climate, even when no further fermentation occurs. The lighter the wine, *i.e.*, the less alcohol it contains naturally, the more tartrate it contains, and the greater the liability to this source of sickness.

This, then, is the temporary sickness to which I have referred. I have proved the truth of this theory by filtering such sickened wine through laboratory filtering paper, thereby rendering it transparent, and obtaining on the paper all the guilty disturbing matter. I found it to be a kind of argol, but containing a much larger proportion of extractive and colouring matter, and a smaller proportion of tartrate than the argol of commerce. I operated upon rich new Catalan wine.

This brings me at once to the source or origin of a sort of wine-cookery by no means so legitimate as the Pasteuring already described, as it frequently amounts to serious adulteration.

The wine-merchants are here the victims of their customers, who demand an amount of transparency that is simply impossible as a permanent condition of unsophisticated grape-wine. To anybody who has any knowledge of the chemistry of wine, nothing can be more ludicrous than the antics of the pretending connoisseur of wine who holds his glass up to the light, shuts one eye (even at the stage before double vision commences), and admires the brilliancy of the liquid, this very brilliancy being, in nineteen samples out of twenty, the evidence of adulteration, cookery, or sophistication of some kind. Genuine wine made from pure grape-juice without chemical manipulation is a liquid that is never reliably clear, for the reasons above stated. Partial precipitation, sufficient to produce opalescence, is continually taking place, and therefore the brilliancy demanded is obtained by substituting the natural and wholesome tartrate by salts of mineral acids, and even by the free mineral acid itself. At one time I deemed this latter adulteration impossible, but have been convinced by direct examination of samples of *high-priced* (mark this, not *cheap*) dry sherries that they contained free sulphuric and sulphurous acid.

The action of this free mineral acid on the wine will be understood by what I have already explained concerning the solubility of the bitartrate of potash. This solubility is greatly increased by a little of such acid, and therefore the transparency of the wine is by such addition rendered stable, unaffected by changes of temperature.

But what is the effect of such mineral acid on the drinker of the wine? If he is in any degree predisposed to gout, rheumatism, stone, or any of the lithic acid diseases, his life is sacrificed, with preceding tortures of the most horrible kind. It has been stated, and probably with truth, that the late Emperor Napoleon III. drank dry sherry, and was a martyr of this kind. I repeat emphatically that high-priced dry sherries are far worse than cheap Marsala, both as regards the quantity they contain of sulphates and free acid.

Anybody who doubts this may convince himself by simply purchasing a little chloride of barium, dissolving it in distilled water, and adding to the sample of wine to be tested a few drops of this solution.

Pure wine, containing its full supply of natural tartrate, will become cloudy to a small extent, and gradually. A small precipitate will be formed by the tartrate. The wine that contains either free sulphuric acid or any of its compounds will yield *immediately* a copious white precipitate like chalk, but much more dense. This is sulphate of baryta. The experiment may be made in a common wine-glass, but better in a cylindrical test-tube, as, by using in this a fixed quantity in each experiment, a rough notion of the relative quantity of sulphate may be formed by the depth of the white layer after all has come down. To determine this *accurately*, the wine, after applying the test, should be filtered through proper filtering paper, and the precipitate and paper burnt in a platinum or porcelain crucible and then weighed; but this demands apparatus not always available, and some technical skill. The simple demonstration of the copious precipitation is instructive, and those of my readers who are practical chemists, but have not yet applied this test to such wines, will be astonished, as I was, at the amount of precipitation.

I may add that my first experience was upon a sample of dry sherry, brought to me by a friend who bought his wine of a most respectable wine-merchant, and paid a high price for it, but found that it disagreed with him; since that I have tested scores of samples, some of the finest in the market, sent to me by a thoroughly conscientious importer as the best he could obtain, and these contained sulphate of potash instead of bitartrate.

My friend, the sherry-merchant, could not account for it, though he was most anxious to do so. This was about three years ago. By dint of inquiry and cross-examination of experts in the wine trade, I have, I believe, discovered the origin of the sulphate of potash that is contained in the samples that the British wine-merchant sells as he buys, and conscientiously believes to be pure. I will state particulars in my next.

FLIGHT OF A MISSILE.

By Richard A. Proctor.

(*Continued from p. 253.*)

I PROCEED to follow the simpler course employed in dealing with the flight of a vertical missile.

If v is the velocity, ε the elevation, $v \sin \varepsilon$ the vertical velocity, then the time t_1 of ascent or of descent $= \dfrac{v \sin \varepsilon}{g}$; the height attained $h = \dfrac{v^2 \sin^2 \varepsilon}{2g} =$ A M, Fig. 2.

The missile starts, then, from O in the real direction Op, with velocity V; and the resolved part of this velocity in direction O l (in both figs.) is V. cos p O l, or

$$\sqrt{v^2 \cos^2 \varepsilon + u^2 + 2\,u\,v \cos \varepsilon \cos \alpha}.$$

Suppose now a point to travel uniformly along O l, Fig. 2, with this velocity V cos p O l, while the body pursues its course along the path O A a starting with velocity V, and under the influence of terrestrial gravity (which, so far as this motion is concerned, may be supposed to result from the whole mass of the earth concentrated at S). Then

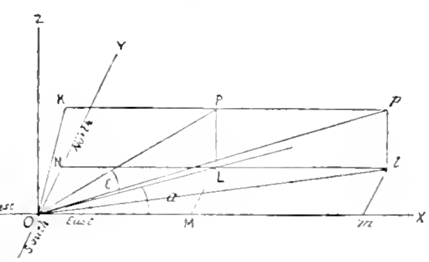

Fig. 1.

throughout these movements the missile travelling along O A a and the point travelling along O l b sweep out equal areas, and each the same area per unit of time, around S. Hence if the moving point reaches b when the missile arrives at the ground again at a, we have

$$\text{Area S O A } a = \text{sector O S } b$$

$$\therefore\ \text{area O A } a \text{ M} = \text{sector S } a\ b$$

Or, appreciably, $\frac{2}{3}$ O a . A M* $= \frac{1}{2}$ S a . a b

$$\text{or } a\,b = \tfrac{4}{3}\,\text{O}\,a\,.\,\frac{h}{r} = \tfrac{4}{3}\,\text{O}\,b\,.\,\frac{h}{r}$$

* It is clear that, for such an area as O A a must necessarily be, the relations between a parabolic area such as O A a (A M the axis) and the enclosing rectangle, must be approximately fulfilled, the curve O A a not differing appreciably from a parabola when so small an area as O A a is taken.

approximately, because, as compared with O M a, $a\,b$ may be neglected.

Now O $b = 2t_1$. V cos p O l

$$= 2t_1 \sqrt{v^2 \cos^2 \varepsilon + u^2 + 2\, u\, v \cos \varepsilon \,.\, \cos \alpha}$$

Hence we have

$$a\,b = \frac{4\,O\,b\,.\,h}{3\,r}$$

$$= \frac{4\,t_1}{3\,r\,g} \cdot v^2 \sin^2 \varepsilon \sqrt{v^2 \cos^2 \varepsilon + u^2 + 2\, u\, v \cos \varepsilon \cos \alpha}$$

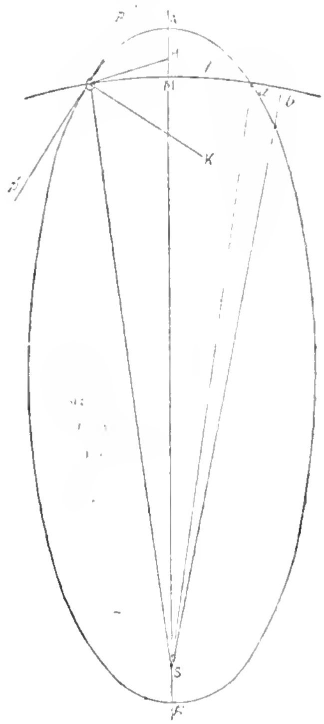

Fig. 2.

Now, in Fig. 3, let O $l\,a\,b$ represent the path O $l\,a\,b$ of Fig. 2, and let O m X represent the latitude-parallel O m X of Fig. 1. Put O k to represent the distance traversed by O along this latitude parallel, in time $2\,t_1$, owing to the earth's rotation, so that the point O is carried to k by the time the missile has descended to a. Then $k\,a$ is the real range of the body; and obviously $k\,b$ is the range calculated in the usual way, for in determining O b we supposed the

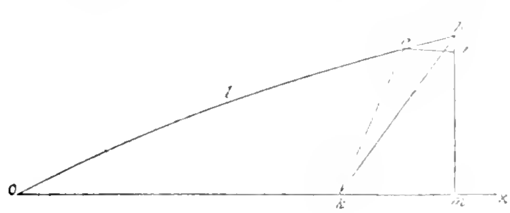

Fig. 3.

horizontal velocity constant during the time of flight. Thus, drawing $a\,n$ perpendicular to $b\,m$, we see that the point a actually reached by the missile lies south of b, the point calculated in the usual way, by the distance $b\,n$, and west of b by the distance $a\,n$.

Thus we have

Southerly displacement of the missile $= a\,b \sin l\,O\,m$ ⎫ See
Westerly displacement $= a\,b \cos l\,O\,m$ ⎭ Fig. 1

We have already obtained the value of $a\,b$: and we have

$$\sin l\,O\,m = \frac{l\,m}{O\,l} = \frac{v \cos \varepsilon \sin \alpha}{\sqrt{v^2 \cos^2 \varepsilon + u^2 + 2\, u\, v \cos \varepsilon \cos \alpha}}$$

$$\cos l\,O\,m = \frac{O\,m}{O\,l} = \frac{v \cos \varepsilon \cos \alpha + u}{\sqrt{v^2 \cos^2 \varepsilon + u^2 + 2\, u\, v \cos \varepsilon \cos \alpha}}$$

Hence we have, finally—

$$\text{S. Dispt} = b\,n = \frac{4\,t_1}{3\,r\,g}\, v^3 \sin^2 \varepsilon \cos \varepsilon \sin \alpha$$

$$= \frac{8}{3\,r}\, t_1\, h\, v \cos \varepsilon \sin \alpha$$

$$\text{W Dispt.} = a\,n = \frac{4\,t_1}{3\,r\,g}\, (v^3 \sin^2 \varepsilon \cos \varepsilon \cos \alpha + u\,v^2 \sin^2 \varepsilon)$$

$$= \frac{8}{3\,r}\, t_1\, h\, (v \cos \varepsilon \cos \alpha + u).$$

A portion of the westerly displacement is independent of the angle of inclination of the plane of flight to the latitude-parallel through the point of projection, and depends only on the time of flight, the elevation, and the latitude. The last-named, we remember, is connected with u by the relation

$$u = 2\,\pi\, r \cos \lambda \div \text{no. of secs. in sidereal day.}$$

Substituting this value for u, and putting P for the number of seconds in a sidereal day, we have

$$\text{Westerly displacement} = \frac{t_1 h}{3} \left(\frac{8\,v \cos \varepsilon \cos \alpha}{r} + \frac{16 \pi \cos \lambda}{P} \right)$$

When $\varepsilon = 90^\circ$, or the missile is projected vertically, we have

$$\text{Westerly displacement} = \frac{16\,t_1 h\, \pi \cos \lambda}{P},$$

the value obtained in the first number of vol. IV.

It will be observed that both in the expression for the southerly and westerly displacements, cos ε is always positive; for ε is the angle of inclination with the horizontal line, and is always less than 90°. But α being the angle of inclination with the latitude-parallel on the eastern side of the point of projection, is measured (as angles are always measured) in the direction contrary to that in which the hands of a watch move: this angle may have any value from 0° to 360°. If α is greater than 180°, or the projectile has a southerly direction, the expression for the southerly displacement becomes negative, or the displacement is northerly. In the southern hemisphere these relations are not reversed, a projectile directed northwards from a point in the southern hemisphere having southerly displacement, while a projectile directed southwards has northerly displacement. A projectile directed vertically has no displacement in latitude.

If α is between 0° and 90°, or between 270° and 360°, in other words, if the projectile is directed towards the east (in either hemisphere), both terms of the westerly displacement are positive. But if α is between 90° and 270°, or the projectile is directed towards the west, the first term is negative. The second term is always positive. In this case the easterly displacement corresponding with the negative first term may be equal to or greater than the westerly displacement corresponding with the positive second term. The relation which should hold for these displacements to balance each other, is manifestly obtained by equating the above expression for the westerly displacement to zero, giving

$$v \cos \varepsilon \cos \alpha = u = \frac{2 \pi r}{P} \cos \lambda$$

If $\alpha = 0$, or the missile is projected at an angle ε with the horizon due west, we have

$$v \cos \varepsilon = u$$

or the horizontal resolved part of the missile's velocity westwards is equal to the velocity of the point of projection eastwards on account of the earth's rotation. In this case, and in this case only, the range of the missile is the same (apart from atmospheric resistance) as that given by the usual formula.

In order that a missile should fall exactly at the point of projection, we must have, manifestly, the northerly range (estimated by the usual formula) equal to the southerly displacement, and the easterly range equal to the westerly displacement, giving the equations

$$2t_1 v \cos\varepsilon \sin\alpha = \frac{8}{3r} t_1 h v \cos\varepsilon \sin\alpha \qquad \text{(i.)}$$

$$\text{and } 2t_1 v \cos\varepsilon \cos\alpha = \frac{8}{3r} t_1 h (v \cos\varepsilon \cos\alpha + u) \qquad \text{(ii.)}$$

(i.) is satisfied if $\varepsilon = 90°$, or if $\alpha = 0°$; or if $h = \frac{3}{4} r$

(ii.) cannot be satisfied if $\varepsilon = 90°$ or if $h = \frac{3r}{4}$. If $\alpha = 0$, (ii.) is satisfied if

$$3r \,.\, v \cos\varepsilon = 4h(v \cos\varepsilon + u)\,; \qquad \text{(iii.)}$$

which may be written in either of the forms

$$v \cos\varepsilon = \frac{4hu}{3r - 4h} \qquad \text{(iv.)}$$

$$\text{and} \qquad h = \frac{3rv \cos\varepsilon}{4(v \cos\varepsilon + u)} \qquad \text{(v.)}$$

(iv.) Shows what the horizontal velocity (east) should be if the missile is projected to a given height, h; and (v.) shows what the height should be if the missile has a given horizontal velocity (east); in order that a projectile should fall back to the place of projection.

In all cases of actual missiles or projectiles, h is very small compared with r, the earth's radius, and $v \cos\varepsilon$ is very small, compared with u; so that—

$$\text{(iv.) may be written } \quad v \cos\varepsilon = \frac{4hu}{3r} = \frac{8\pi}{3P} h \cos\lambda \qquad \text{(vi.)}$$

$$\text{and (v.) may be written} \quad h = \frac{3rv \cos\varepsilon}{4u} = \frac{3P}{8\pi} \,.\, \frac{v \cos\varepsilon}{\cos\lambda}$$

which is the same as equation (vi.).

To illustrate the application of (vi.); suppose $h = 1{,}000$ ft., and $\lambda = 0$, or the point of projection is on the equator. Then $v \cos\varepsilon$, or the resolved part of the velocity of projection parallel to the horizon $= \frac{8000 \times 3{\cdot}1416}{3 \times 24 \times 60 \times 60}$ (using an ordinary instead of a sidereal day),

$$= \frac{251{\cdot}328}{108 \times 24} = \frac{251{\cdot}328}{2592}$$

or the horizontally resolved part of the velocity of projection is less than the 10th of a foot per second. The velocity of projection may be regarded as identical with the vertical velocity, giving

$$v^2 = 2gh = 32200$$

$$\text{or} \qquad v = 180 \text{ ft. per second very nearly.}$$

Hence the angle of projection is so nearly vertical that the vertical part of the velocity exceeds the horizontal more than 1856 times. The inclination to the vertical would be almost exactly 1′ 50″, or $\varepsilon = 89° \, 58' \, 10''$.

The *St. Petersburg Herald* reports that Captain Kosztowitz is building at Okhta a large cigar-shaped balloon, 200 ft. in length and 80 ft. in height, including the car, which he has furnished with a screw and also with wings. He considers that he will be able to take a crew of sixteen men and 250 lb. of ballast, at the rate of forty German miles an hour, and the experimental trip is expected to take place early next month.

EMIGRANTS' PROSPECTS IN CANADA.

FROM AN ENGINEER'S POINT OF VIEW.

By W. R. Browne, M.A.

(*Continued from page* 237.)

If Canada offers no field for English engineering, it does not follow that it offers no field for English engineers. The rapid development of the country, agricultural and otherwise, cannot but create a demand for manufacturing and repairing shops, and therefore produce favourable openings for capital in those directions. But capital is scarce in Canada, and what there is goes, most naturally, into the two great staples—land or timber. There are hundreds of young men now in England with a good engineering training, industrious habits, and a small capital to fall back upon, who yet find it almost impossible to get any suitable opening in Great Britain. Such a man might do worse than betake himself to Canada, and content himself for a year or two with earning journeyman's wages—say, 8s. a day—in some good country shop, keeping in view the hope of becoming a partner, in that or some similar concern, as opportunity offered. A sketch of one such country machine works, to which I paid a brief visit, will show the nature of the prospect thus offered. The works in question are situated at Sherbrooke, one of the most thriving and prosperous towns in what are called the "eastern townships" of the province of Quebec. In great measure it owes its prosperity to the fact that the River Magog, after passing through a succession of lakes, acting as natural reservoirs, here falls into the St. Francis in a succession of picturesque cataracts, having a total height of about 200 ft. It is only a small section of the fall with which we are concerned at the moment; yet this is sufficient to give, day and night, summer and winter, a continuous supply of not less than 700-horse power, which is utilised by an arrangement of high-speed turbines for the needs of a large three-storied building. One part of this building is occupied by the machine works now to be described; another by a mill for rasping up soft wood and converting it, by the addition of water, into a sort of fine gruel, which is afterwards pressed between rollers and turned into paper pulp. Yet a third part is occupied by a number of light tools for turning out bobbins of all shapes and sizes: and a fourth by the shops of a general joiner and undertaker. To return to the engineering works. They were founded about thirty years ago by an artisan from the United States, the present proprietor, whom I found working steadily at his vice among his hands, like an English millwright of the olden time. His son, who acts as outdoor manager and general foreman, took us round, and was ready to answer any questions. The fitting shop was occupied with a variety of machines, entirely of American or Canadian construction, but not wanting in solidity or excellence of finish. This was specially noticeable in a shaping-machine by Mackenzie and Bertram, of Dundee. Modern improvements were not wanting. For instance, a lathe, by the Putman Manufacturing Company, had an emery wheel mounted alongside the bed, which was traversing along it and rapidly polishing a roll for a paper-mill. A good deal of work is done in repairs for paper-mills, which form a considerable industry in this neighbourhood, and also in the repairs and erection of saw-mills and other woodworking plant. In addition, the firm contract—at day rates—to do all the repairs for two lines of railroad in the district. These are among the many new roads brought into existence by the recent improvement in the fortunes of Canada, and are not yet sufficiently developed to have set up repairing-shops of their own. The work to be done for these includes the casting, boring, and pressing on of car wheels, the machining of locomotive castings, the boring out of cylinders, &c. If to this we add repairs to brewing plant, &c., and the erection of boilers and engines for various other tracks, it will be seen that there is enough to keep a shop of forty to fifty hands in full activity; and so, in fact, we found it. The castings turned out—from Scotch pig—were very good in quality, and the foundry was sufficient to run four or five tons per day. The boilers are, of course, chiefly adapted for burning wood, and are made with the large grates extending almost the whole way under the boiler; the gases return through tubes to the front, and thence pass by brick flues along the sides to the chimney. On the whole, the impression given by the general appearance of the works was that of a prosperous, increasing, and, above all, of a tolerably steady trade. The journeyman's wages, when in the shop, are 2 dols.—8s. 4d.—for a day of ten hours, and overtime is reckoned throughout at time and a half. Apprentices are taken, though without formal indentures, generally for a period of three years.

It must not be supposed that the building here mentioned contains all, or nearly all, the manufacturing enterprise of Sherbrooke. Lower down on the river is another and larger machine-shop—which, however, we had not time to visit—besides a file manufactory and other works. Higher up is the Paton Woollen Mill, on a scale which would not look small even in Bradford, running a large number both of looms and mules—the former mainly of American make, the latter bearing the familiar name-plate of Platt Brothers—and making excellent homespun cloth from Canadian wools, as well as finer qualities from South American, &c. With such mills, and with the aid of steam tailoring establishments, which are already in operation, there seems no reason why Canadian settlers should much longer have to pay more for their clothing than those they leave behind in the old country.

Hard by the woollen mills we inspected the fire-station of the town, whose complete appointments and spacious premises would have gladdened the heart of Captain Shaw himself. It was tenanted by some half-dozen magnificent Canadian horses, whose numbers are supplemented when required, in virtue of an arrangement made with the authorities having the care of the streets. It contained—besides hand machines—two steam fire-engines, one of the familiar Merryweather type, the other resplendent with nickel sheeting, &c., and bearing an American name-plate. We also inspected a "lumbering" establishment, placed at the very head of the fall, where there is a convenient site for a timber pond. The trees floating in this pond are brought up to the front of the works, where they are attached to an endless chain, and at once dragged up an inclined plane to the level of the sawmill. Here they are rolled on to a saw-bench, and presented to a large saw, which deals with them in a number of minutes which, if stated to an English audience, would hardly be credited. To reduce a good-sized log to rough 1½ in. planks seemed to require scarcely longer time than is needed to describe the operation. I was not able to learn the exact speed of travel, but am certain that it was at least 50 per cent. greater than that which is usual in English mills. Other saws were at hand—some large, some small, some hung on vertical, some on horizontal arms—for the purpose of reducing the rough planks to the various dimensions required. Planing machines, &c., were also forthcoming, together with special machinery for making "shingles" and "clap-boards"—the former going to cover the roofs, and the latter the sides, of the timber houses which form the general type of Canadian homesteads. As others' education, like my own, may be in default on the subject of clap-boards, I may explain that a clap-board is a light strip of wood, about 4 ft. long, 6 in. wide, and triangular in section, varying in thickness from ½ in. at the back to nothing at the front. When laid in strakes, even lapping each other by 3 in., with the thick edge downward, and well painted, they form an admirable and economical casing to a "frame house," as the luxurious dwelling of the modern Canadian farmer is termed, in opposition to the log hut of the early settler.

It will be seen even from this slight description that an English engineer coming to Canada will undoubtedly have something to learn—probably something also to unlearn; but it may be safely affirmed that, if only steady and energetic, he will never want employment, and that he will have opportunities of advancement open to him, such as it has long been hard to find in what, for good and for evil, is emphatically the "old country."

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE BOTTOM (*continued*).

We have now to consider the life-history of caddis-worms. The parent insect, a moth-like creature living amongst the vegetation at the edge of the pond, deposits her eggs in the water, sometimes actually descending below the surface, and attaching them to the leaves of water-plants. But it is very seldom that they have been detected doing this. Mr. McLachlan speaks of having seen females of *Phryganea grandis*, one of our largest species, "on a calm summer evening *on* the surface of the water, with wings expanded and trembling, causing a commotion on the surface like that occasioned by a drowning insect; and as they took up the position voluntarily, and were evidently in no danger of drowning," he naturally came to the conclusion that they were depositing their eggs. But, again, on the other hand, females are sometimes found with their wings soiled, as though they had had a muddy bath, and had been contaminated thereby; so that in all probability there are different methods of conveying the eggs to suitable situations. The eggs, when first extruded, are enveloped in a gelatinous mass, and before being deposited in their final resting-place are often, for some time after actual extrusion, carried by the mother attached to the end of her abdomen. When in the water the gelatinous substance swells by absorption of the liquid, and attains twice its former diameter. The eggs soon hatch, but the young larvæ remain two or three days enveloped in the jelly; then leaving their cradle, which by this time is almost in ruins, they begin life on their own account, each constructing a tube for itself, proportionate to its infantile dimensions, and each species, even at this early age, manifesting the power of selecting appropriate materials for its domicile.

Fig. 1.

The larva (Fig. 1) has a pale, soft body, which is, no doubt, a tempting morsel to fish; and hence the necessity for the protective case. The head and front segments, however, are hard and horny, as they are the only parts exposed when the creature is crawling. The head carries a pair of stout jaws, often notched at the tips. To the three segments immediately succeeding are articulated three stout pairs of legs, which have a wonderfully tenacious grip. To different parts of the body are attached in some species isolated threads, and in others bundles of the same, which are respiratory in function, *i.e.*, they contain branches of the tracheæ, and the interchange of gases is effected in the same way as previously described in the case of the dragon-fly larvæ. At the end of the abdomen of those that construct movable dwellings, there are two short, recurved hooks, by means of which the case is kept in position and dragged along. The larval stage is the great feeding-time; the insect takes no nourishment during pupahood, and probably very little in its adult stage, its only business then being the reproduction of its kind. But the larvæ seem to be able to endure prolonged fasting, and it would appear that they must pass the winter almost without food. After some months spent in the larval condition, the time for pupation arrives. The two ends of the case must now be closed sufficiently to guard the helpless being within from foes, but, at the same time, not so closely as to prevent the access of water for breathing purposes. Some species construct at each end a sort of grating of silken threads, others fix a quantity of vegetable *débris* in the same position. Some take a further precaution still. There is one called *Micropterna sequax*, which inhabits clear running water. This insect, before pupating, elongates its case by adding stones to one end, and then sinks it vertically in the mud, until it is almost entirely imbedded. To do this the larva turns round in its case, a gymnastic feat no doubt difficult of performance, but still rendered possible by the flexibility of its body and the dimensions of the case—and, thrusting its head and legs out at the wrong end, digs a hole and so lets itself down; this done, it resumes its ordinary position and patiently awaits its coming change. In three or four days the pupal stage is entered, and the creature is thereby much altered in appearance. It is no longer a caterpillar-like being; but all the organs of the adult insect appear—wings, legs, and antennæ being neatly folded down by the side of the body, each wrapped in a separate portion of the pellicle which enshrouds the whole creature. The peculiar arrangement of its limbs gives it a most amusingly sanctimonious expression. It is generally free in its case, though its only movements consist of oscillations of the body. When the time arrives, some two or three weeks after, for making its final transformation, it ruptures the grating at the larger end of its case, darts out of its prison cell with great speed, swims rapidly through the water by aid of its still encased legs, and on its back, like a water boatman, and thus makes its way to some dry place, where its thin pupal skin splits and allows the soft imago to creep out; some, however, do not take the trouble to leave the water, but, like gnats, merely float on the surface, and effect their transformation there, using the old pupa case as a raft on which to dry their wings.

Caddis worms are particularly careful not to expose more than the well-armed part of their body while walking, and even then, if an intruder appears, they will instantly and sharply retreat into their cases, when the only part exposed to attack is the hard head, and even this is not to be reached without entering the case. But, notwithstanding all their precautions, they do not succeed in escaping the attacks of those inveterate foes of insect life, ichneumon flies, and from one species also has been bred a two-winged fly belonging to a group well known for their habits of parasitism.

Though caddises are, as a group, aquatic in the larval state, there is one species the larva of which lives in moss at the roots of trees far removed from water. Nor are the insects absolutely confined to *fresh* water. One marine species has been reported from North America, and another from New Zealand, the latter of which formed a straight tubular case of fragments of coralline seaweed.

We may here notice some allied insects, the larvæ of the *Ephemeridæ* or Mayflies. These crawling things, which may easily be recognised by the three bristle-like appendages at the tail, and a number of leafy projections at the sides, do not make cases, but burrow in the muddy banks of ponds and streams, and constitute what is known to anglers as "bank-bait." The burrows are tubular, and, after running straight for a little distance, bend back upon themselves in the form of a U, and open into the water at both ends, so that the insect has no need to turn in its burrow, but can enter at one end and make its exit at the other. Small though they are, they are said to live two or three years in the larval condition, a remarkable contrast to the extreme brevity of their adult life, which is measured by hours, or at most by days. The pupa is similar to the larva, except that it exhibits traces of wings. When about to change into the winged form, it quits the water and "shuffles off its mortal coil," after the manner of several other insects already referred to; having so done, it looks like a perfect insect, and might fairly be expected to be such, but, marvellous to relate, it has yet another change to undergo—another skin to cast—before it reaches maturity. This is remarkable as being the only instance in the whole class of insects in which a change of skin is effected after the assumption of the winged form. So perfect is this last rejected vestment, when left sticking to the stalk or leaf which formed the disrobing place, that, like the cast armature of a crayfish or lobster, it might easily be mistaken for the complete animal itself.

(To be continued.)

THE INTERNATIONAL HEALTH EXHIBITION.

XIX.—THE SOFTENING OF WATER—(*concluded*).

It now remains for us, in conclusion of our notes on the softening of water, to give an outline of the process devised by Mr. P. A. Maignen, which has been adopted by the Executive Council, and may be seen in operation at the aquarium tanks of the Exhibition.

The apparatus employed may be adapted to the wants of the household, or to the treatment of vast quantities. Fig. 33 is an explanatory drawing of the instrument now in use at the Exhibition. The upper left-hand corner of the engraving shows an automatic reagent precipitator. Fig. 34 is a diagrammatic drawing to represent the mode of action of this ingenious contrivance. It may there be seen that the water from the main works a paddle-wheel, which, in its turn, causes a revolution of the feed arrangement. Provision is thus secured for a supply of the reagent to the water to be treated, in proportions exactly suited to the requirements of each individual instance. The modified water is somewhat turbid through the precipitation of the lime salts which cause the hardness; it is, therefore, conveyed to an asbestos filter shown at the right-hand side of Fig. 33, and this filter is constructed upon the principle of the "Filtre Rapide." Thereafter the water, deprived of its hardness, and cleansed of all its other impurities, passes on to the supply pipes.

The reagent used has been patented under the specific name of "Maignen's Anti-Calcaire." It consists of an admixture of lime, soda, and alum in proportions suitable to the requirements of each case. The inventor claims, with perfect justice, that when this powder is made to act upon hard water, it not only precipitates the carbonates, thereby correcting the temporary hardness, but also eliminates the sulphates, and thus gets rid of the permanent hardness. In passing through the indestructible asbestos filter, on to which the precipitated materials settle in such

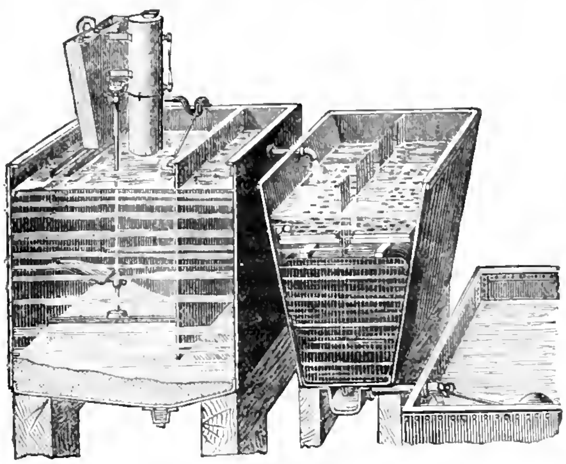

Fig. 33.

a way as to form a more perfect strainer, the water is admirably fitted for the use of manufacturers and engineers. A small portion of the *carbo calcis* added to the filter frame will deprive the filtrate of every other impurity, and render the supply a good potable water. We find that the "Anti-Calcaire," supplemented by the Filtre Rapide, is quite adequate to the production of a supply of the highest value to both the householder and manufacturer.

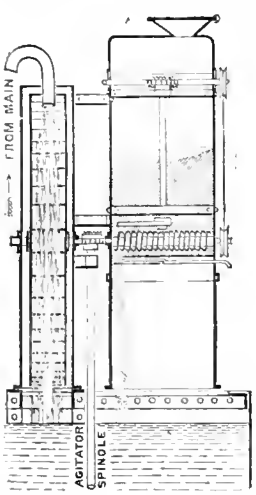

Fig. 34.

Fig. 35.

The next matter of importance is one of commercial significance—viz, its price. It is stated* that one pound of "Anti-Calcaire" powder suffices to soften from 300 to 500 gallons of water, that pound being retailed for the sum of 6d. It may also be interesting to know how it can be turned to account in the economy of an ordinary home; we therefore quote the following extracts for the benefit of our readers :—

"M. Alexis Soyer says that the quantity of tea which gives three cups with hard water will make five cups with soft water; so that a family which consumes 1 lb. of tea per week, say at 3s. per lb., would spend £7. 16s. per annum with hard water, whilst with soft water they would only require 32 lb., at 3s. per lb.—cost, £1. 16s. Thus the chalk present in the London water costs a family of five persons a loss of £3 a year in tea alone. To remove this chalk by our new system of softening water would only cost 3d."

"To soften 100 gallons London water with washing-powders and soap, the cost would be, say, washing-powders 5d., and soap (2½ lb. at 4d.) 10d.—total, 1s. 3d. To soften the same quantity by our precess would cost about 2d."

"The boilers, which would last ten years with soft water, are often worn out in two years with hard water; so that in the former case it is sufficient to deduct 10 per cent. for depreciation every year. In the latter, upwards of 50 per cent. must be deducted, to say nothing of the stopping of engines and loss of time. Hard water takes 8½ minutes to boil, whilst soft water boils in 6 minutes." *

Fig. 35 shows a convenient form of water-softening pan which is suited to the wants of a household. Into this small reservoir the "Anti-Calcaire" may be introduced, either automatically or by being merely thrown in. If the latter operation is resorted to, it will, during the course of a night, have acted sufficiently to convert the hardest into quite a soft water. Another household convenience which we would strongly recommend to the notice of our readers is the softening ewer, respecting which we are told to put "as much 'Anti-Calcaire' powder as will go on a shilling, fill with water, and allow it to rest all night." The water in the morning will come out of the tap soft and clear.

In our next communication we propose to treat of the purification of water in its relation to the pollution of rivers, and trust to be able to show how the great questions of sewage contamination and the utilisation of waste products from the habitations of man and his industries ought to be dealt with, by an examination and brief review of the so-called sanitary sections of the Exhibition.

* "Water, Preventable Disease and Filtration." By P. A. Maignen, 22 and 23, Great Tower-street, London, E.C., 1884. p. 30.

NOTES ON COAL.

By Richard A. Proctor.

(*Continued from p. 255.*)

It is, in the first place, a remarkable circumstance that although vegetation was certainly not limited to the carboniferous period, yet it was in that period that all the chief coal-fields were formed. There are exceptions, no doubt, to this rule. In the times which preceded the carboniferous period, some coal-seams were formed, and some well-known coal-fields belong to later geological periods. There are beds of true coal belonging to the tertiary period (the latest of the main geological periods); and, passing from the oldest tertiary period to our own time, we find instances of the deposition of enormous quantities of *lignite* and *brown coal*, as well as of the formation of *peat*, which must be regarded as only needing submersion and consequent pressure to become, in the lapse of time, either true coal or very near akin to it.† Yet, it remains true that

* *Loc. cit.*, p. 30.

† "Near the surface," says Professor Austed, "this substance (peat) is light-coloured and spongy, and the vegetable matter is little altered; deeper, it is brown, dense, and decomposed; at the bottom, it is black, and nearly as dense as coal." As a fuel, however, peat contains much ash. The same is true of lignite and brown coal. Moreover, brown coal is injured by exposure to the weather, which is not the case with true coal. Lignite splits in the air; brown coal falls to powder.

the carboniferous group is the coal-group *par excellence;* and when to this consideration is added the enormous thickness of the series of strata included in this group, we seem justified in concluding that this long period was characterised by some remarkable and distinctive peculiarity.

Now, whether we consider the lower portion of the carboniferous series remarkable for the masses of limestone derived chiefly from animal substances, or the upper, where the coal-seams or vegetable layers abound, we find evidences of the presence of enormous quantities of carbon. In the upper part, the mere existence of a most abundant vegetation implies the presence of vast quantities of carbonic acid gas in the air. It seems not unlikely that this gas escaped from subterranean regions through the outlets formed by volcanoes; and the idea is suggested that the carboniferous period was one of great volcanic energy. In the older periods, there was probably a greater degree of subterranean activity, and from the carboniferous period onwards, even until our own, movements of the earth's crust have been probably more irregular and violent. But it would seem likely that, in the carboniferous period, an intermediate state of things prevailed when, owing to the greater heat of the earth's crust, and consequently the greater relative thickness of the plastic subterranean portions of the crust, the movements were more steady, and affected wider regions than at present, while the relief given by volcanic craters, instead of being intermittent as at present, was afforded uniformly and on a grander scale.

If this were, indeed, the case, then, towards the close of the carboniferous period, great disturbances of the earth's crust might be expected to have taken place, since that would be the time when the chief volcanic vents ceased to relieve the pent up subterranean forces. This accords well with the condition of the geological record. "The termination of the carboniferous formation," says the author of the "Vestiges of Creation," "is marked by symptoms of volcanic violence" (by which he evidently means simply subterranean violence), "which some geologists have considered to denote the close of one system of things and the beginning of another. Coal-beds generally lie in basins, as if following the curve of the bottom of the seas; but there is no such basin which is not broken up into pieces, some of which have been tossed up on edge, others allowed to sink, causing the ends of strata to be, in some instances, many yards, and, in a few, several hundred feet, removed from the corresponding ends of neighbouring fragments. These are held to be results of volcanic movements below, the operation of which is further seen in numerous upbursts and intrusions of fire-born rock (trap). That these disturbances took place about the close of the formation, and not later, is shown by the fact of the next higher group of strata being comparatively undisturbed. Other symptoms of this time of violence are seen in the beds of conglomerate which occur among the first strata above the coal. These, as usual, consist of fragments of the elder rocks, more or less worn from being tumbled about in agitated water, and laid down in a mud paste, afterwards hardened.* It is to be admitted for strict truth" (rather a desirable object, by the way, in all such inquiries) "that, in some parts of Europe, the carboniferous formation is followed by superior deposits, without the appearance of such disturbances between their respective periods; but apparently this case is exceptional. That disturbance was general is supported by the further and important fact of the destruction of many forms of organic being previously flourishing, particularly of the vegetable kingdom."

It may be remarked in passing that the coal-seams are strikingly deficient in the fossil remains of animals. It is natural to ask, says Sir Charles Lyell, whether there were not air-breathing inhabitants of those forest regions where the accumulations of vegetable matter produced the coal-beds; but, if abundance of carbonic acid gas in the air were a main condition of the great vegetable wealth of the carboniferous period, the probability would seem to be that air-breathing creatures would be few, and those few of the lower orders of animal life. Certain it is that the poverty of the coal-seams in remains of animals has long been commented upon by geologists. We find footprints of a monstrous newt, or rather of an animal resembling the tadpole of the newt.* These creatures were truly amphibious, however, sharing the dominion of the water with the ganoid fishes—an association which "reminds us," says Lyell, "that the living" creatures of the same order "in America frequent the same rivers as the ganoids, the bony pikes." They were undoubtedly powerful swimmers, Professor Huxley considers; and, indeed, the main evidence we have of their having been air-breathers is the circumstance that they left footprints on the sand. If they had been walking under water, their weights would have been so much reduced that they would have left no impressions, or only faint ones, whereas these are deep and distinct. They are not unlike the impressions which would be left by a small and rather plump hand. It is by no means clear that this creature ever made its way into the ancient forests, or could be in any proper sense regarded as their inhabitant.†

I have mentioned impressions left in sand belonging to the carboniferous period, and the ingenious way in which geologists have explained the features of these impressions. There is, however, a record on the sandstone of this period, which is, perhaps, even more significant. Impressions of rain-drops have been detected in carboniferous sandstone by Dr. Dawson, Sir Charles Lyell, and, more recently, by Mr. Brown, in Australia; and these rain-marks are, on the average, about as large as those which are produced by the rain of our own period. As Lyell well remarks, "the great humidity of the climate of the coal period had been

* "Volcanic disturbances," adds our author in a note, "break up the rocks; the pieces are worn in seams, and a deposit of conglomerate is the consequence. Of porphyry there are some such pieces in the conglomerate of Devonshire, three or four tons in weight." It is evident from this note, following, as it does, on the above passage as to the older rocks, that the writer is speaking of subterranean disturbances, not volcanic action, properly so-called; for volcanic action does not break up the older rocks; that is the work of earthquakes.

* The reader will be reminded of the suggestive remarks, by the author of the "Vestiges of Creation," on similar tracks left by the *labyrinthodont* of Owen: "That massive batrachian which leaves its handlike footsteps in the new red sandstone, and then is seen no more. Not for nothing is it that we start at the picture of that strange impression—ghost of anticipated humanity—for apparently it really is so." It need hardly be said, however, that this is not the view at present entertained by naturalists.

† Owing to the circumstance that in our books on geology this creature is called a batrachian, many popular writers have been led to assert that a monstrous frog inhabited the ancient forests whence the vegetation of the coal-seams was derived. But the order of batrachians includes other animals than the frog and toad. According to the views at present adopted of the batrachian of the carboniferous period (as well as of a kindred but later species called by Professor Owen the *labyrinthodont*), this creature was further removed even than the newt from the common frog. It probably resembled in structure creatures still existing (but on a much smaller scale), which have four limbs like the newt, but have gills as well as lungs.

previously inferred from the number of its ferns, and the continuity of its forests for hundreds of miles; but it is satisfactory to have at length obtained such positive proofs of showers of rain, the drops of which resembled in their average size those which now fall from the clouds. From such data, we may presume that the atmosphere of the carboniferous period corresponded in density with that now investing the globe, and that different currents of air varied then, as now, in temperature, so as to give rise, by their mixture, to the condensation of aqueous vapour."

(To be continued.)

DICKENS'S STORY LEFT HALF TOLD.

A QUASI-SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(Continued from page 277.)

SIX months pass and we find Crisparkle waiting at the office of the Haven of Philanthropy for Mr. Honeythunder. We notice in this interview enough to show that Grewgious has not yet confided to Crisparkle his knowledge of Drood's safety. If we could feel any doubt on this point it would be removed by the interview between Crisparkle and young Landless. The interview between Crisparkle and Grewgious is much more significant however. We find that Grewgious is keeping a watch upon Neville Landless, obviously in the young man's interests. Can one doubt —seeing this—that Grewgious knows that about the disappearance of Drood which no one but Drood himself could have told him? In passing note that Mr. Grewgious could not possibly maintain this watch alone, and that undoubtedly Bazzard would be the man he would employ to share the work with him,—which would fully account for what he afterwards tells Rosa about Bazzard being "off duty in the office." Grewgious sits at the window watching, and even while Crisparkle is with him, detects the slinking figure of Jasper, who has followed Crisparkle to town. The two agree that Jasper's object is to keep a watch on Neville, haunting and torturing his life, and exposing him to perpetually reviving suspicion. Grewgious begs Crisparkle to leave him,—for "I entertain," he says, "a fancy for having our local friend under my eye tonight"—as well as Neville, and *not* in Jasper's interests. Mr. Grewgious's watch is maintained till late. Even when he retires to his bedroom, he looks out on Neville's chambers. Grewgious is thoughtful and anxious about Neville, and looks at the stars as if he would have read from them something that was hidden from him. He feels naturally anxious after what Crisparkle has told him about Neville's state, and after what they have both seen of Jasper's pursuit of him. Is it purely accidental that the next words— the opening words of a new chapter, bring Datchery—the most terrible of all Jasper's foes—upon the scene? I cannot think so.

"At about this time," we read, as if partly in pursuance of Mr. Grewgious's plans for relieving Neville, a "stranger appeared in Cloisterham; a white-haired personage with black eyebrows,"—who describes himself as "a single buffer living on his means," and to the jackass Sapsea as "a diplomatic bird." In passing, I remark that recognising Datchery as Drood, all that relates to him is full of fun (save for here and there a touch of pathos), but regarding him as any one else is stupid and unmeaning. If Bazzard were Datchery, the "Datchery assumption" is worse than unmeaning, it is bad literary workmanship. If Datchery is a mere professional detective (a view which Dickens himself enables us to reject), the Datchery matter is dull and heavy. Datchery can be no one else, unless he is Drood. But regarding him as Drood, every line about him is in Dickens's best manner,—and the character of Drood is very cleverly maintained, with just such modification as the terrible experience through which he has passed would render necessary. The "Mystery of Edwin Drood" would be worth reading if for nothing else but this clever bit of writing.

Datchery cleverly leads the waiter at the Crozier to suggest Mr. Tope as a likely party to tell him what he wants, or even to let the very lodgings he wishes to occupy for his watch on Jasper. On his way he becomes bewildered, boggling around the Tower, as if he felt "hot" in his search when he saw it, and "'cold' when he didn't see it." This, of course, is to prevent the ordinary reader from recognising Drood in Datchery; for Drood might be expected to know his way to Topes's. Yet any one who has wandered through the back streets of Cloisterham (Rochester) knows that even a resident might easily be bewildered there, and Drood was not a resident. The Crozier, we are expressly told, was a hotel of a most retiring disposition. But the description may easily be regarded as applying only to what Mr. Datchery seemed to do. It would have had a most suspicious appearance if, as a stranger in Cloisterham, Mr. Datchery had found his way too readily. Asking the way from the Deputy would serve a double purpose, nay a triple one;—1, testing his disguise; 2, starting an acquaintance with that useful little imp; and, 3, confirming the idea that he was a stranger in Cloisterham (for the Deputy was likely enough to talk at the Travellers' Rest).

The scene which follows is worth careful studying. Edwin Drood tries his Datchery assumption on four persons any one of whom might be expected to have recognised him unless his disguise were very perfect,—on Mrs. Tope, on Mr. Sapsea, on Durdles, and on Jasper (though Jasper assuredly had good reason for knowing, as he supposed, that, whoever Mr. Datchery might be, he could not possibly be Edwin Drood—Jasper in fact would be likely to be as blind to the truth, here, as the average reader whose ways Dickens so well understood). No wonder we find Datchery saying at the close of his afternoon's work, that "for a single buffer, living idly on his means, he has had a rather busy afternoon." Were he other than Drood the afternoon's work would have been easy enough.

Datchery's confused knowledge "of the Drood mystery, and the necessity under which he places Mrs. Tope to correct him in every detail," would be a little overdone were not Mrs. Tope so foolish a woman. His talk with "The worshipful the Mayor" is irresistibly funny when we think of him as Drood, but would be silly enough for any other detective. "Might I ask his Honor," he says, "whether that gentleman we have just left is the gentleman of whom I have heard in the neighbourhood as being much afflicted by the loss of a nephew, and concentrating his life on avenging the loss?" (Only a few minutes before Mr. Datchery had told Mrs. Tope he knew scarcely anything about the matter in which he now expresses so much interest). "That is the gentleman, John Jasper, sir." "Would his Honor allow me to inquire whether there are strong suspicions of anyone?" "More than suspicions, sir," returns the Jackass Mayor: "all but certainties." "*Only think now!*" cries Mr. Datchery. There is a world of meaning in this Droodlike and Dickenslike reply.

Later we have a touch of Dickens's observant manner, in the way in which Datchery puts his hand to his head, "as if with some vague expectation of finding another hat upon it." Dickens himself, when taking part in private theatricals, must often have clapped his hand to his bewigged head that way.*

In the talk with Durdles, and again with Deputy, we catch a part of Edwin Drood's plan for punishing the man who has dealt so murderously with him. Truly he had had "a rather busy afternoon" of it.

(*To be continued.*)

* In Wilkie Collins's little story, "Love's Random Shot," a kindred use is made of theatrical knowledge.

ELECTRIC LIGHT DANGERS.

By W. Slingo.

The very sad accident which occurred last Saturday week at the Health Exhibition, is one which will not be lost sight of for some time to come, and there is no doubt but that the champions of the gas interest will do their best to draw from it a moral which, it is to be feared, will be only too readily received by the great number of people ignorant of the circumstances. It will be remembered that the main features so far known to pertain to the accident were as follows:—Henry Pink, aged 21, an attendant employed in the dynamo shed, had one hand on one of the brushes of a 25-arc light Hockhausen machine (generating a current having an electro-motive force of several hundred volts). By some means he got his other hand either on the other brush or on another part of the machine, with the result that a part of the current passed through his body, and so caused his death; not instantaneously, however, but after a lapse of some minutes. It transpired at the inquest, which was held on the 1st inst., that strict instructions had been given to each employé not to allow both his hands on the dynamo at the same time. Such injunctions, however, are not always of very great utility, and we may easily suppose that in a moment of absent-mindedness, or when, perhaps, the existence of a small amount of vanity may infuse into the mind of a young man a desire to make an impression upon a wondering and wide-mouthed throng of sightseers, the injunction may be forgotten. It is to my mind a matter of wonder that accidents of this nature have not happened before. We know, too, the old saying that "familiarity breeds contempt," is as true in the treatment of dangerous commodities as between one person and another. One unused to the sight or to the work cannot but be impressed with the apparent recklessness with which many occupations are carried on—such, for example, as the manufacture and storage of explosives. In these occupations, however, the employers do their utmost to prevent accident, arising either from miscarriage in the process employed or negligence on the part of the workmen. But have we any evidence that such precautions have been systematically, or even occasionally, adopted for the protection of the men employed in electric light installations? I think we might search the whole country in vain; and yet what is easier, what more efficacious, than to provide an indiarubber glove for the one hand, leaving the other free to do that work which rarely, if ever, calls for both hands at the same time? Or, again, should there be any difficulty in placing a guard between the brushes of the machine which would permit the hand to be placed on or near one brush, but would not allow it to work round too close to the other? Guards might also be very easily devised which would, by imparting, say a slight prick, indicate that one is approaching dangerous ground.

It is most imperative that every possible precaution should be taken to guard against the recurrence of such an accident as this which has so rudely awakened us to the dangers to which many, perforce, young labourers are daily subjected.

But the question arises, What are these dangers? It is well known that the ordinary incandescent machines may be handled with impunity in their most powerful parts. To the untutored mind this is inexplicable. Nor is the reason so very clearly defined in the minds of more learned men. It is, nevertheless, a notorious fact that a current of as much as 200 volts can do little harm, while a current thrice as intense is more than dangerous. There are two, or even three, theories now current to explain the fact. One man supposes that only currents of very high electromotive force are capable of producing death, and in proof of this, deaths from lightning and from currents received from arc-lamp machines are quoted. Another man maintains that it is the strength or volume of the current which wreaks the damage; and, in proof of this, it may be pointed out that while the electricity produced by such a machine as the Holtz may have an electro-motive force of several thousand volts, the very high resistance in the circuit prevents it attaining the necessary strength, and so nothing more serious than a twitch or a jerk ensues. There is yet a third theory, which is well put by M. Gariel, in our Parisian contemporary, *L'Electricien*, in referring to the fatal accident which occurred two years since at the Tuileries. It appears that a well-insulated circuit was established, but that at a particular place one of the wires was enveloped in insulating material, while the other was bare, but supported on porcelain insulators. Two men, named Kenarec and Martin, respectively, came in contact with the bare wire, and they were both killed. According to M. Gariel—"The condition of double contact seems to have been produced in both cases. It appears from the autopsy that *both* the hands of Kenarec bore distinct traces of burning, and that in the case of Martin the cheek, the neck, and the ear, on the one hand, were distinctly burnt by contact with the wire, whilst on the other, the left hand presented a mark which may likewise be attributed to a burn.

"We are, therefore, led to the opinion that death resulted from a derivation of a part of the current through the body. The intensity of the derived current thus produced could be only a small fraction of the total current, for the resistance offered to the passage of the electricity by the organised parts traversed is enormous in comparison with the resistance of a copper wire six millimètres in diameter, and of a length of a few decimètres, which represents the distance between the points where the derivation was established. But it is far from being proved that, in the action of electricity upon organised beings, it is the intensity of the current—that is to say, the quantity of electricity—which determines the results produced. Perhaps even the fall of potential has to be taken into account. Perhaps, also (and we should be personally inclined to admit that it is so), it is the energy which determines the magnitude of the action, *i.e.*, the product of the quantity of electricity by the fall of the potential."

From the foregoing it is quite evident that we are still a long way from a knowledge of the quality of the electricity which kills a man. Nor are we much nearer a perception of what the effect is upon the system. There is little doubt but that death often results from such a shock to the nervous system as to bring about a stoppage of the heart, but where actual death results, when there is

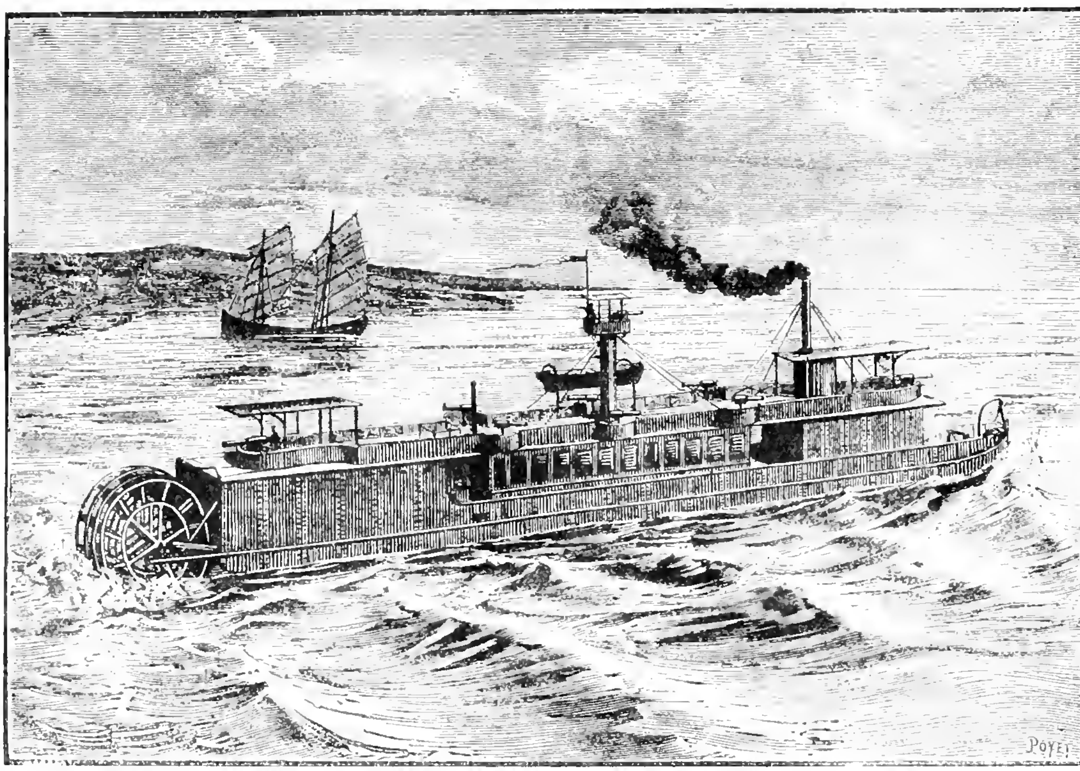

Fig. 1.—New French Stern-Wheel Gunboat.

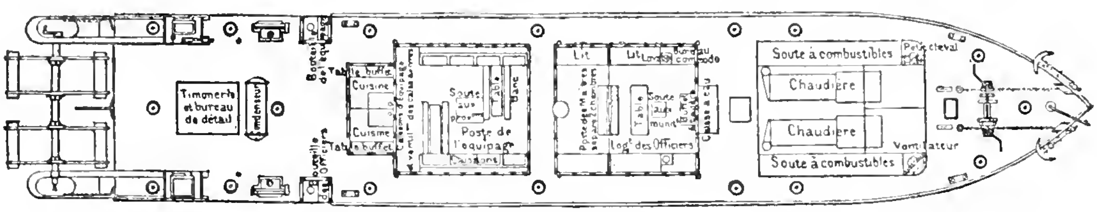

Fig. 2.—Plan of the Vessel.

not the slightest evidence of a shock having been imparted, we, or rather doctors, are still totally at sea in explaining the disaster.

There is, however, sufficient evidence to enable us to determine what does and what does not constitute a danger. Where there is a low electro-motive force, say, of 100 volts (as in machines for supplying incandescent lamps), however low the resistance of the dynamo, even if it be "decimal nought, nought, nothing," no harm can accrue because of the high resistance offered by the human body. Consequently it matters little, so far as personal safety is concerned, what the connections are or where they are made. With machines of high electro-motive force, however, the case is different. Bare wires should rarely if ever be permitted. The Paris accident above quoted clearly establishes this. Further, a complete metallic circuit should be insisted on, that is to say, the circuit should never be completed through the earth, otherwise danger attends every operation.

With proper care in planing and fitting, supplemented by average intelligence on the part of attendants or users, there is not more—nay, rather there is even less—danger to be apprehended from the adoption of the electric light than from gas. Nothing is here said about the many other advantages pertaining to illumination by electricity, my object being rather to point out what dangers really exist, and how easily they may be counteracted.

NEW STERN-WHEEL GUNBOATS.

Our engraving gives a general view of one of the new stern-wheel gunboats that the Minister of the Navy and Colonies has lately built for service on the rivers Tonkin and Gaboon. These vessels, five in number, were constructed by the Société des Anciens Etablissements Claparede. They bear the names of Henry Riviera, Carreau, Garnier, Berthe de Villers, and Pionnier. As they are designed to run upon Chinese and African rivers, whose waters are often very low, their maximum draught is 0·70 m., and their minimum speed is nine knots. They are provided with a 250 h.p. motor.

Each vessel consists of a flat-bottomed float of Bessemer or Siemens-Martin steel, of the first quality, thoroughly zinced. It is provided with three false keels, and the deck is surrounded with a rail. Upon the deck, and under a roofing are established cabins for the commander and crew. Above the roofing there is a platform arranged in such a way as to receive all the vessel's armament. The latter consists of two 90 mm. guns, one fore and one aft, and four Hotchkiss revolving guns. There are six places provided on the platform for three of these revolving guns, the fourth being stationed at the top of a hollow steel mast located amidship. The interior of the float is divided into twenty-eight compartments that contain the various store-rooms and magazines, as shown in the plan in Fig. 2.

The length of each vessel between perpendiculars at the load water-line is 37·2 mètres; the width amidships is 7·4 mètres; and the depth is 1·3 mètres.

The engine, which is of the compound type, is a surface condensing one, without expansion apparatus. It has two horizontal cylinders and direct connecting-rods, and develops, at a minimum, a 250 indicated horse-power, at a velocity of fifty-five revolutions per minute. Four of these gun-boats are designed for the Tonkin, and one for the Gaboon.—*La Nature.*

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p. 257.*)

THE THIRD EVENING.—PARTICULARS OF THE WORLD IN THE MOON, AND PROOFS OF THE OTHER PLANETS BEING HABITABLE.

The Marchioness was so intent upon her notions, that she would fain have engag'd me next day, to go on where I left off; but I told her, since the moon and stars were become the subject of our discourse, we should trust our chimæra's with no body else. At night we went again into the park, which was now wholly dedicated to our learned conversation.

"Well, Madam," said I, "I have great news for you; that which I told you last night of the moon's being inhabited, may be otherwise now. There is a new fancy got into my head, which puts those people in great danger."

"I cannot suffer this," said she; "yesterday you were preparing me to receive a visit from the Lunarians, and now you would insinuate there are no such people in nature. You must not trifle with me thus; once you would have me believe the moon was inhabited. I surmounted the difficulty I had, and did believe it."

"You are a little too nimble," I reply'd; "did I not advise you never to be entirely convinc'd in things of this nature, but to reserve half of your understanding free and disengag'd, that you might admit of the contrary opinion, if there be any occasion?"

"I care not for your suppositions," said she, "let us come to matter of fact. Are we not to consider the moon as St. Dennis?"

"No," said I, "the moon doth not so much resemble the earth as St. Dennis does Paris: the sun draws from the earth and water, exhalations and vapours, which mounting to a certain height in the air, do there assemble and form the clouds; these uncertain clouds are driven irregularly round the globe, sometimes shadowing one country, and sometimes another: he then who beholds the earth from afar off, will see frequent alterations upon its surface, because a great country, overcast with clouds, will appear dark or light, as the clouds stay, or pass over it; he will see the spots on the earth often change their place, and appear or disappear as the clouds remove: but we see none of these changes wrought upon the moon, which would certainly be the same, were there but clouds about her; but on the contrary, all her spots are fix'd and certain, and her light parts continue where they were at first, which truly is a great misfortune; for by this reason, the sun draws no exhalations or vapours above the moon; so that it appears she is a body infinitely more hard and solid than the earth, whose subtile parts are easily separated from the rest, and mount upwards as soon as heat puts them in motion; but it must be a heap of rock and marble, where there is no evaporation: besides, exhalations are so natural and necessary, where there is water, that there can be no water at all, where there is no exhalation; and what sort of inhabitants must those be, whose country affords no water, is all rock, and produces nothing?"

"Very fine," said she; "you have forgot how short a time since you assur'd me, we might from hence distinguish seas in the moon. Pray, what is become of your Caspian Sea, and your Black Lake?"

"All conjecture, madam," replied I: "tho' for your ladyship's sake, I am very sorry for it; for those dark places we took to be seas, may perhaps be nothing but large cavities; 'tis hard to guess right at so great a distance."

"But will this suffice, then," said she, "to extirpate the people in the moon?"

"Not altogether," I replied; "we will neither determine for, nor against them."

"I must own my weakness (if it be one)," said she; "I cannot be so perfectly undetermin'd as you would have me to be, but must believe one way, or the other; therefore pray fix me quickly in my opinion, as to the inhabitants of the moon: preserve or annihilate them, as you shall think fit; and yet methinks I have a strange inclination for 'em, and would not have 'em destroy'd, if it were possible to save 'em."

"You know, madam," said I, "I can deny you nothing; the moon shall be no longer a desert, but to do you service, we will repeople her. Since to all appearance the spots in the moon do not change, I cannot conceive there are any clouds about her, that sometimes obscure one part, and sometimes another; yet this does not hinder, but that the moon sends forth exhalations, and vapours. The clouds which we see in the air are nothing but exhalations and vapours, which at their coming out of the earth, were separated into such minute particles, that they could not be discern'd; but as they ascend higher, they are condens'd by the cold, and by the re-union of their parts, are render'd visible; after which they become great clouds, which fluctuate in the air, their improper region, 'till they return back again in rain to us: however, these exhalations and vapours do sometimes keep themselves so dispers'd, that they are imperceptible; or if they do assemble, it is in forming such subtile dews that they cannot be discerned to fall from any cloud. For as it seems incredible that the moon should be such a mass, that all its parts are of an equal solidity, all at rest with one another, and all incapable of any alteration from the efficacy of the sun; I am sure we are yet unacquainted with such a body. Marble itself is of another nature: and even that which is most solid is subject to change and alteration; either from the secret and invisible motion it has within itself, or from that which it receives from without. It may so happen, then, that the vapours which issue from the moon may not assemble round her in clouds, and may not fall back again in rain, but only in dews. It is sufficient for this that the air with which the moon is environed (for it is certain she is so,* as well as the earth) should be a little different from our air, and the vapours of the moon be a little different from those of the earth, which is very probable. Hereupon the matter being otherwise disposed in the moon than on the earth, the effects must be different; though it is of no great consequence whether they are or no; for, from the

* Some of the confidence of half-knowledge is here shown by our worthy author.—R. P.

moment we have found an inward motion in the parts of the moon, or one produced by foreign causes, here is enough for the new birth of its inhabitants, and a sufficient and necessary fund for their subsistence. This will furnish us with corn, fruit, water, and what else we please, I mean according to the custom or manner of the moon, which I do not pretend to know, and all proportioned to the wants and uses of the inhabitants, with whom I pretend to be as little acquainted."

"That is to say," replied the Marchioness, "you know all is very well, without knowing how it is so, which is a great deal of ignorance founded upon a very little knowledge. However, I comfort myself that you have given the moon her inhabitants again, and have wrapped her in an air of her own, without which a planet would seem but very naked."

"'Tis these two different airs, madam, that hinder the communication of the two planets: if it was only flying, as I told you yesterday, who knows but we might improve it to perfection, though I confess there is but little hopes of it? The great distance between the moon and the earth is a difficulty not easy to be surmounted; yet were the distance but inconsiderable, and the two planets almost contiguous, it would be still impossible to pass from the air of the one into the air of the other. The water is the air of fishes; they never pass into the air of the birds, nor the birds into the air of the fish; and yet 'tis not the distance that hinders them, but both are imprisoned by the air they breathe in. We find our air consists of thicker and grosser vapours than the air of the moon; so that one of her inhabitants arriving at the confines of our world, as soon as he enters our air will inevitably drown himself, and we shall see him fall dead on the earth.

(*To be continued.*)

TRICYCLES IN 1884.

By John Browning,

Chairman of the London Tricycle Club.

A NEW TWO-SPEED GEARING.

HIRST, of West Croydon, the well-known maker of specially-light tricycles, has just perfected yet another Two-speed Gearing. This arrangement, proposed in the first place, I believe, by Mr. Rich, seems to be as simple in plan and efficient in action as such a contrivance can well be made. It is like several other arrangements intended for a similar purpose,—to a certain extent, a modification of the well-known sun-and-planet action.

When the machine is geared to travel at speed, a small-toothed wheel is *locked* in the centre of the lower chain-wheel, and the whole of the parts work together without extra friction. When it is desired to drive with more power, but, of course, at a lower speed, a slight turn of a spade-handle unlocks the toothed wheel, and a movement forward shifts the chain-wheel, so that a hollow toothed ring inside the chain-wheel engages into the teeth of the small central cog-wheel previously referred to. In this condition the chain-wheel is driven through the intermediation of the cogs, and I may say at once that it performs well.

Before saying this I have had opportunities of testing the contrivance severely, as I have had it applied to my small Sociable made by Hirst, which is one of the most perfect machines I would ever wish to ride. I have tried a machine belonging to the maker, and Mr. Grace has kindly placed the first machine of the kind, which was made specially for him, at my disposal. My own machine was geared exceptionally low, and the maker's rather unusually high. Mr. Grace's machine was geared to 39 in. for power and 52 in. for speed, a combination exactly suited to my requirements. This machine is a front-steerer with 40-in. driving wheels, having $\frac{7}{8}$-in. rubber tires, and a 20-in. steering-wheel with 1-in. rubber tires. The machine weighs 82 lb., but it was weighted with touring requisites so as to weigh about 90 lb.

I started with this machine, and rode thirteen miles, of which about ten or eleven miles were up-hill; then I rode it with the high-speed gearing up a long and tolerably steep hill, and immediately, without resting, changed to the power gear, and rode it up another hill still longer and steeper.

Under all circumstances, both the machine and the gearing arrangement acted admirably. I could not suggest any alteration in them which would be likely to improve them.

My own small Sociable, the first Cobweb made, I have ridden 150 miles, accompanied by my wife, with the new gearing on it, and this has behaved just as well.

One ride we took from Reigate to Worthing, and on to Littlehampton, in one day, and the next went on to Arundel and Chichester. The last stage of this ride, about eleven miles, includes, I should think, eight miles of short, rather steep hills. Just before we reached Arundel it had been raining hard for several hours, so that the roads were very heavy, and we had a strong wind against us; yet we rode the eleven miles in one hour and three quarters with only one dismount, and walked less than a quarter of a mile. Had the machine not been provided with this excellent hill-gearing, we must have dismounted nearer a dozen times and walked through the mud for several miles.

There is, I regret to see, a strong disposition on the part of many writers to undervalue the usefulness of two-speed gearings. It is, I think, unfortunate, as it acts against the spread of tricycling that nearly all the articles written on the subject are written by athletes who have for years ridden bicycles and tricycles, and who can, by the aid of strong muscles and incessant practice, drive nearly any machine along at the rate of from ten to twelve miles an hour. From such a rider I received a letter a few days since, in which he says:—"How differently we are constituted; most of us, when we have a two-speed gearing, never think of using it; we prefer using a little more muscle, and making progress to show with it."

Of course, this is a hint that all other riders should do the same. The advice is very like the Dutchman's direction, "You must go along the road as far as you can, and then you must go a little further."

For the pace to be satisfactory, a high-gearing must be used, say from 54 to 57. Let the rider of a machine so geared come on to very rough or muddy roads, or against a high wind, and he must either walk or submit to slavery. But if the machine has two-speeds, with a lower-gearing to fall back upon, then the high gearing has not this drawback to contend against.

About a fortnight ago I rode 63½ miles on my two-speed Rucker in 6 h. 57 m., over a right-away road, and left off fresher than I began. I did not dismount for any hill in the whole distance. I was accompanied by my friend Mr. Arthur Salmon, who took the time and checked the distance with maps, road-books, and a cyclometer. I feel certain this ride would have been impossible for me without a two-speed gearing. Seven miles an hour is as much as I care to ride for a distance of fifty or sixty miles on an ordinary machine; the pace of over nine miles an hour was only achieved entirely by the use of the double gearing.

When racing on a prepared path, two-speed gearings are, of course, unnecessary, but I think it cannot be too clearly understood that road-riding and path-racing have nothing in common with each other; one is a sport, the other is a healthful recreation. They are as little connected with each other as horse-riding and horse-racing.

In describing the Emperor tricycle in my last paper, I unwittingly did the machine some injustice by stating that it required an arrangement for tightening the chain, in the event of its becoming slack, owing to strain or wear and tear. I find that it is provided with a very simple and efficient contrivance for tightening the chain, so ingeniously contrived and well made, that it easily escapes notice; the upper part of the lower chain-wheel bracket turns on a hinge, and counter-nuts, on a cantilever rod, secure it in any position.

Since the above was written, 100 miles have been ridden by Mr. George Smith over right-away roads on a Kangaroo safety bicycle in 7 h. 10 m.—that is at the rate of fourteen miles an hour. The bicycle driving-wheel was only 36 in. in diameter, and it weighed 40 lb., yet it was driven faster than any machine with a 60-in. wheel has ever been ridden 100 miles before. Can anything more be wanted to show the absurdity of fitting up tricycles with 48-in. driving-wheels?

Mr. Webb, of the London Tricycle Club, has ridden the same 100 miles in 7 h. 35 m., and he would have ridden in less time but for an accident.

Mr. Webb rode a Humber tricycle with 42 in. driving-wheels, which weighed about 48 lb.; if Mr. Webb's Humber had had 36-in. wheels, the weight of his machine might have been reduced several pounds, and it is quite possible that he might have beaten the bicycle, instead of being beaten, as a very few pounds difference in weight would have made from 20 m. to 25 m. difference in a 100 miles' ride.

Editorial Gossip.

I have discovered (experimentally) a very real source of danger in mountain climbing—I mean that arising from a sudden gust of wind striking you when you are on a narrow and precipitous ridge. You may possess the best imaginable "head"—be able to look down a sheer precipice without feeling giddy, and be, normally, as firm on your feet as need be; but to be twisted laterally by a sudden squall may not impossibly result in your losing your balance, and making a *facilis decensus* which you will never repeat on this earth.

The opinion which I pronounced here, colloquially, on "the Healtheries," some time ago, has since been uttered more authoritatively by Herr Hartmann, of Berlin, in his report of that show to the meeting of the Society for Health Technics at Frankfort. In it, speaking of the Health Exhibition, he says: "Indeed, from a scientific point of view, it was simply pitiable." If the Commissioners of the Exhibition of 1851, and the other Highnesses and Mightinesses at South Kensington ever read such an essentially common poet as Burns, they will recollect his prayer for the gift "to see oorsel's as ithers see us."

I see by the English papers that the curate of a parish in one of the home counties, a week or two ago, attributed (from the pulpit) the shortness of the hop-crop to the fact that the farmers in the locality, which he must at once adorn and illuminate, did not come to church! A fact which he emphasised by pointing out that only three of them were present to listen to the very edifying address in which this astonishing dogma was propounded. It is stated that the church-going farmers felt this to be "the unkindest cut of all," inasmuch as their crops of hops were no whit better than those of their Nonconformist neighbours.

As every one knows, at present, the initial meridian from which longitudes are reckoned varies with the nationality of the ephemeris-computer or map-maker, although, from the wide diffusion of the "Nautical Almanac," Greenwich is a very generally accepted one. The Geodetical Congress last year was practically unanimous in the recommendation that it should be universally adopted; and I had hoped that the existing confusion might have been abolished by the universal acceptance of that recommendation. The only dissidence at all to be expected was from that neighbouring nation whose entire metrical system is founded on an erroneous measurement of a local arc of the meridian, and whose action towards other countries generally in matters scientific, literary, social, and political, is modelled on that of the militiaman, who, on being reminded by his left-hand man that he was out of step with the whole battalion, replied, "Change your'n, then!" France now declines to support the proposition, but favours a so-called neutral meridian throughout the Azores or Behring's Strait, as a means of defeating the choice of Greenwich.

I do not fancy that astronomy can be much cultivated in the Isle of Man, as I learn from a correspondent of unquestionable veracity that recently it was determined to hold a bazaar for Church purposes, at a village on the western side of the island; and that an old inhabitant reputed to be learned in the stars was consulted as to the probability of fine weather. After pondering the matter for a night and a day, he returned this oracular response: "Oh! yes, have the bazaar, the day will be fine; the planets are favourable. *Juniper* and *Vesuvius* are in conjunction." What an acquisition this prophet of Mona's Isle would be to the Solar Physics Committee, to be sure!

I shall look out curiously for accounts of Observations of the Lunar Eclipse of last Saturday night. At the place whence I write the effect at the time of totality differed from any which I have ever previously witnessed. Ordinarily, at the time of greatest obscuration, the moon has assumed the appearance of a huge glowing coppery-red ball hung up in the sky. On Saturday she was barely visible as an ill-defined ring of a sickly green hue. If, as is practically certain, the usual ruddy tinge of the moon when totally eclipsed has its origin in the refraction of the sun's rays through our own atmosphere into the shadow-cone, that atmosphere must have been laden with *something* which acted as a dense screen to them on the night of the 4th. Are we here once more brought face to face with the cause of the persistent haze in the sun's neighbourhood, and of the wonderful fore and afterglow?

M. C. Flammarion has received anonymously a sum of 5,000 f. to be awarded as a prize to the author of the best project for the reform of the Calendar. Doubtless, a competition is the best method of finding out the difficulties of such a reform; as also the direction it should take without upsetting established customs. The editor of *L'Astronomie* has therefore opened a competition, in the hope that those *savants* who will undertake the task will be able to produce some simple, definite method appreciable to all nations. Papers must be sent in by Oct. 1, 1885, to M. Flammarion, 36, Avenue de l'Observatoire. A committee will read the papers, award the prize, and propose the reform to an international congress.

Reviews.

SOME BOOKS ON OUR TABLE.

International Health Exhibition Handbooks:—"Athletics," "Infectious Disease and its Prevention," "Diet in Relation to Health and Work," "Healthy Nurseries and Bedrooms," "Health in the Workshop," "Alcoholic Drinks," "Healthy Furniture and Decoration," "Ventilation, Warming, and Lighting for Domestic Use," "Accidental Injuries," "Dress, and its Relation to Health and Climate," "Healthy and Unhealthy Houses in Town and Country." (London: Wm. Clowes & Sons. 1884.)—These handbooks form a continuation of that series of remarkable shilling's-worths which we noticed on p. 13. One and all excellently done, we may perhaps single out such of them as Messrs. Eassie & Field's "Healthy and Unhealthy Houses," Mr. Cantlie's "Accidental Injuries," and Mr. E. W. Godwin's "Dress," as possessing an interest which will survive when the Health Exhibition itself has sunk into oblivion. We do not, however, desire to make invidious distinctions where all have performed their work so well; and the reader who takes an interest in any of the subjects indicated in the list of titles above may invest his shilling with the certainty that he will get his money's worth for his money.

Technological Examinations of the City and Guilds of London Institute. (London: Gresham College. 1884.)—From the report whose title heads this notice we observe that out of 3,635 candidates who presented themselves in May last for examination in various branches of technology, only 1,829—or, as nearly as may be, one-half—succeeded in passing. Moreover, we note that the percentage of failures has risen from 37·5 in 1883 to 49·7 in 1884. The reasons for this are set down fairly and candidly in the reports by the various examiners. Want of skill in drawing seems to be a very fruitful source of "plucking" among the competitors. *Malgré* this, the institute seems to have done good useful work, and had it only stuck to the *locale* in which so much of that work has been accomplished and devoted, the money so shamefully wasted (in the interests of a jobbing clique) on the costly and inconvenient building at Brompton, and to the endowment of technical education at King's and University Colleges, its sphere of usefulness might have been indefinitely extended.

W. & A. K. Johnston's Natural History Plates. (W. & A. K. Johnston: Edinburgh and London.)—We have seen nothing so far to excel, if, indeed, we have seen anything to equal, these beautiful engravings, which are produced of a large size for wall prints. The three before us, of the elephant, camel, and domestic cat, respectively, are excellent reproductions of the animals they pourtray; the print of the elephant, in particular, being really admirable. No better way could be devised of teaching the rudiments of zoology to children remote from menageries than that afforded by such plates as these.

W. & A. K. Johnston's History Chart. (W. & A. K. Johnston: Edinburgh and London.) — Here is another remarkable essay in the way of boiling down history! In a table, or set of tables, extending over four sheets, the student may see, almost at a glance, the leading facts in the histories both of England and Scotland. Nay, he may even familiarise himself with the personal aspects and manners of the various sovereigns who reigned over these countries from the time of the Norman Conquest; both as separate Kingdoms, and, subsequently, as an united one!

THE FACE OF THE SKY.

From October 10th to October 24th.

By F.R.A.S.

Signs of activity in the shape of spots and faculæ continue to appear on the Sun, which should hence be examined by the student daily. The night sky is portrayed on Map X. of "The Stars in their Seasons." There will be minima of Algol ("The Stars in their Seasons," Map I.) at 1h. 12m. in the early morning of the 18th, at 10 p.m. on the 20th, and at 6h. 49m. p.m. on October 23. A minimum of Mira Ceti, too (Map XII. of same work), may be looked for on the 24th. Mercury is a morning star during the succeeding fortnight, and but indifferently placed for the observer. Venus is a morning star, too, shining brilliantly over the eastern horizon before 2 a.m., and being still a very conspicuous object. Mars is invisible, and Jupiter, as a morning star, does not rise until an hour at which the ordinary amateur would scarcely care to look for him. Saturn, though, rises between four and five minutes past 10 o'clock to-night, and about 9h. 12m. p.m. at the end of the fourteen days. Hence he may be fairly seen by midnight, and a beautiful spectacle he presents. He is a little above ζ Tauri ("The Stars in their Seasons," Map I.). In the eastern confines of Taurus, too, Neptune may be picked up now, but needs an equatoreal for that purpose. Uranus is invisible. The Moon enters her last quarter at 2h. 29·2m. p.m. on the 11th, and is new at 31·4 minutes after midnight on the 18th; so that very little will be seen of her practically until the end of the fortnight we are considering. Only one occultation, at anything like a convenient hour, will happen during that period: it is that of the 6th mag. star, A^2 Cancri, which will disappear at the moon's bright limb at half-past twelve o'clock on the night of the 12th, at an angle from her vertex of 345°, and reappear at her dark limb 28 min. afterwards, at an angle of 281° from her vertex. The moon, situated at noon to-day in the confines of Orion and Gemini, passes into the latter constellation very shortly afterwards. She quits Gemini for Cancer at 3 a.m. on the 12th, continuing in the last constellation until 5 p.m. on the 13th. Then she travels into Leo, descending at 6 p.m., on the 14th, into Sextans, but re-emerging in Leo at 10 o'clock the next morning. She finally quits Leo for Virgo at 11 a.m. on the 16th; and it is not until 7 p.m., on the 19th, that she has completed her journey across this great constellation and entered Libra. At 8 p.m., on the 21st, she leaves Libra for the narrow northern strip of Scorpio, passing out of this into Ophiuchus at 7 o'clock the next morning. At 5 a.m., on the 24th, she crosses into Sagittarius, and there we leave her.

WOLF'S COMET.

The following Ephemeris (if employed in conjunction with either the "New Star Atlas" or the "Larger Star Atlas" of the conductor of this journal) will enable the observer to follow the Comet in its passage through the sky during the next twelve days. It is slowly increasing in brightness:—

At Berlin midnight: *i.e.*, 11h. 6m. 25·1s. p.m. Greenwich Mean Time.

October	Right Ascension. H.	M.	S.	Declination North. °	′
10	21	32	15	12	36·8
11	21	33	33	12	5·4
12	21	34	53	11	34·0
13	21	36	16	11	2·6
14	21	37	41	10	31·3
15	21	39	8	10	0·0
16	21	40	38	9	28·8
17	21	42	10	8	57·7
18	21	43	45	8	26·7
19	21	45	22	7	55·8
20	21	47	2	7	25·1
21	21	48	45	6	54·6
22	21	50	31	6	24·2

We are indebted to Dunecht Circular No. 91 for the above.

A remarkable discovery of topazes has been made in New South Wales. A portion of a large bluish-green crystal, weighing several pounds, found at Mudgee, is now in the colonial museum. Some crystals, from two to three inches in length, have been found in Uralia. One found at Gundagai weighs 11 oz. 5 dwts., and one from Gulgong weighs 18 oz. avoirdupois.

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

SHOOTING STARS AND METEORS.

[1437]—Permit me to remark, in reply to "Eye Witness," that in the first place, it is certain that all shooting stars, and probably a good many meteors, which are not heated to luminosity approach so near the earth that its attraction must, for the time at least, be much more powerful than that of the sun. This attraction must materially alter their orbits, and, with regard to those which enter our atmosphere, a further alteration is caused by its resistance. In the next place, considering the great velocity of the earth in its orbit and the very considerable depth of its atmosphere (the resistance of which increases the further the shooting star advances in it), the motion of the meteor in rushing through the atmosphere may be so retarded that the solid body of the earth has cleared its track before it reaches the point where a collision would have occurred if the original velocities were unaltered. This, I think, would probably occur if the meteor was vaporised. Vaporisation by itself would have no tendency to arrest the motion of the meteor, but the moving vapour would be much more retarded by the resistance of the atmosphere than the moving solid. Thirdly, it is no explanation of what becomes of the vaporised meteors to describe them as disintegrated. The question is, what happens afterwards? We can hardly suppose them to remain in their gaseous condition in the atmosphere, after the great heat which converted them into vapour has passed away. If not, they must again solidify, and either fall to the earth (probably in fine dust) or else get clear of the atmosphere and pursue a course in space, which can hardly coincide with their former orbits. But where did the meteors which formed the great star-showers of 1866 and 1872 fall? And if they did not fall, where are they now?

The ring-system of Saturn may have originated in the manner which "Eye-witness" suggests, but whether other planets would be similarly affected is by no means clear. The formation of such a ring would probably depend on several causes—the mass and volume of the planet, the extent and resisting power of its atmosphere, its distance from the sun (which by lessening the sun's attraction would render it more easy for the planet to attach the meteor system to itself), the relative velocity of the planet, and the meteors, and the angle at which their orbits intersected; but, above all, on the number and mass of the meteors, whose orbits intersected that of the planet. Our greatest star-showers arise from the meteors attached to comparatively insignificant comets. If the orbit of a great comet intersected that of Saturn, under favourable circumstances, a ring might naturally result. Such a ring, however, could hardly be formed within the limits of the atmosphere of any planet, owing to the resistance of the latter to its motions.

W. H. S. Monck.

THE AFTERGLOW AND ITS CAUSE.

[1438]—I differ entirely from "F. G.S." as to the cause of the afterglow. I beg to state that, according to the incontestible assertion of an influential member of the Krakatoa Defence Committee, I kicked up my dust into space far above the limits of the earth's atmosphere; it consequently remains suspended in space. The earth has again reached that portion of space: hence I, and no one else, am clearly the sole cause of the beautiful phenomenon which delights the eyes of thousands all over the world.

Krakatoa.

[What *can* be more convincing?—Ed.]

[1439]—The sunsets and afterglow are now being repeated with an intensity equal to those of last year. The first, more remarkable than usual, was on the 18th of this month succeeded by others on the three following days, that on Saturday, the 20th, being equal to anything seen here last year. Till last evening, the sky has been overcast at sunset. The afterglow then and this evening lasted till 6.40 and 7 respectively, the colour being red and orange, shading off to pinky purple at the outer edge of the glow. Last evening, the whole eastern horizon was, during the afterglow, spanned by a pink arch, shading off to pinky purple, the glow on the higher mountains being at the same time very remarkable.

The halo or haze round the sun has been more conspicuous this month, and of a deeper copper hue. On the evenings of the 1st, 2nd, and 3rd, the moon had a similar halo. I may add that I have never once this year seen the sky of the intense blue usual here, and that I have been unable—on some days apparently clear—to detect Sirius and other stars at transit, usually distinctly visible by day in my instrument. On these days the solar haze seemed to be of a deeper copper.

Notes of last year's sunsets and afterglows observed by myself and others were sent by me privately to another scientific journal, but having been made the subject of insulting editorial comment—the editor's apparent wish being to prove Krakatoa responsible for the afterglow—I prefer on this occasion to send them to Knowledge, in the hope that they may be acceptable as helps towards a solution of the afterglow difficulty.

M. F. Ward.

P.S.—I omitted in my letter yesterday to state that whether seen from the plain or from a height of 2,000 ft. or 3,000 ft. above it, the colouring of the afterglow is the same, the evening haze or mist which exists in the plane not affecting it in the least.

Partenkirchen, Bavaria, Sept. 27, 1884.

[I have received another letter from Captain Noble on the same subject, which is too long for insertion here. In it he quotes from a second communication recently received by him from Mr. Neison, the Government Astronomer at Natal, in which that eminent man of science reiterates the expression of his great surprise that any of his confrères in Europe should attribute to the Krakatoa dust a phenomenon occurring repeatedly under circumstances which rendered it impossible that the Javan Volcano could have had anything to do with it; in point of fact, long before the eruption ever took place at all.—Ed.]

VISUAL PHENOMENA.

[1440]—Referring to letter 1,296, by Mr. P. J. Beveridge, on "Squinting," I should like to make a few remarks which may not be altogether irrelevant.

As regards the eye becoming tinted with the complementary of the colour at which it looks fixedly, I have observed that this effect becomes so marked if the stare be continued, that if a person gaze steadily at anything, keeping his eyes fixed *on one point* all the while, he will soon see nothing. This remark would seem to answer the question put in the second paragraph of above-mentioned article, and I think that the fact of our becoming deaf to a continued sound, and blind to a continued scene, may be all referred to the principle, that we can only be cognisant of any fact, idea, or impression by its difference from that which preceded it (we only judge by comparison). Thus, we see that monotony causes oblivion of ideas, as seen in the case of persons who have been lost in some mammoth cave, being found in a temporary state of insanity, attributable to the oppressive silence reigning in these places.

Respecting the question asked by Mr. Beveridge, whether any one had effected a super-imposition by *divergence* of the eyes to a more distant point, I may mention that this is my regular practice with stereoscopic views, and could, therefore, not understand the object of the wicked destruction recommended, until reading the last paragraph. I think any one could succeed in doing this with a little practice.

Ali.

LIFE AFTER DEATH.

[1441]—"Eye-Witness" represents soul as an entity, distinct and independent of the body. Now, may I ask where is or was this immortal entity before the body came into existence? what did it do? where are all the souls "yet to come into bodies" not yet born? Or can "an immortal" thing be born? The idea of immortality appears to me to be born of the wish for it.

Again, I see with my eyes, smell with my nose, hear with my ears, feel with my nerves, think with my brain. What can the soul do without the body and the senses? All these organs are, as science teaches us, entirely destroyed in death, and used up—every atom of them—to build up other and similar lives and living bodies. The soul, therefore, having no senses, again I ask what can it do? It can't see, hear, smell, feel, or think. What does it do? How does it occupy its existence?

Mr. S. Thorne's letter completely expresses my thoughts and experience on this important matter. When we are asleep, in sound, dreamless sleep, consciousness of soul is gone. Where? As it often happens when men are severely injured, they are unconscious, soulless for periods of weeks and months; that whole time is a perfect, entire blank to them when consciousness returns, although all other life functions went on as usual. All this appears to point to the same conclusion, that mind and soul are functions of the brain and nerves, which cease with death.

F. W. H.

[1442]—Will you allow me to put to Mr. Thorne the common-sense question which must have risen to the lips of hundreds as they read his extraordinary letter in your last issue? Was the man *dead*, or was he not? Mr. Thorne hardly ventures to say he was, but talks about his being "practically" so. The idea that a man really dead could by ordinary methods be brought to life again is so utterly unscientific that I am driven to suppose that Mr. Thorne would, if pressed, admit the second alternative. Life was, therefore, merely suspended. If this be so, the case was exactly the same as we find in ordinary unconsciousness, or even in sleep when without dreams. As far as the mind is concerned, there is no conceivable difference. And does any reasonable man think of the future state as one which may be visited during a mere temporary suspension of consciousness? The only future state I ever heard of is one which is entered by the soul when it has finally and irrevocably quitted the body.

A classical student, debarred reference to a higher authority, is tempted to point to Socrates, whose strong faith in the hereafter is better evidence than a hundred arguments like Mr. Thorne's. But if your correspondent wishes for true science, let him turn to a book to whose high character you, sir, have lately testified most emphatically—I mean Mr. Drummond's "Natural Law in the Spiritual World." He will find there the question dealt with from a strictly scientific standpoint, and if it does not convince him, I think you will have judged him more severely than I should venture to do here.

I most cordially agree with you, sir, as to the necessity of excluding theology from your pages. But perhaps you will permit me to remind your readers of the advantage it gives to the "heterodox" side—I object to the term, but use it for shortness' sake. The attack can be made with purely scientific weapons. The full force of the defence can only be felt when arguments are admitted from a wider sphere. If this be remembered, I object to nothing that science has to say. For myself I like to think of theology and science as separated by a very vague dividing line. I have not "discarded" either of them, and never shall. On the contrary, I feel more and more the power of a scientific theology and a theological science. And it was this cause that I was so grateful to you for advancing in your review of the book I have referred to.

J. H. Moulton.

King's College Cambridge, Oct. 3, 1884.

[1443]—Surely a complete answer to your correspondent, Mr. Selwyn Thorne, is to be found in the fact that his "victim" of drowning was not dead. Had he been so he could not have been interviewed as a living man by Mr. Thorne some days after, unless by a miracle. Death is the separation of the soul from the body, and here it is clear no such separation had taken place. The "victim" could not have been really bereft of breath, although he may have been of motion, and his mental and physical faculties (save that of breathing) totally suspended. But how does this state differ from that of a person in a trance, or even in sleep? and yet we do not expect these on awaking to bring us news of the next world.

F. C. N.

["Reductio ad Absurdum," "W.," "P. J. L.," "Edwd. B. Morton," "T. W.," "Chas. E. Strong," "Naturalist," and many others, substantially reiterate "F. C. N.'s" argument, in language more or less varied. "Naturalist" suggests the fluidity of the blood as a test of vitality, and alleges that if the drowned man's hand had been held so that sunlight or candlelight shone through it, a ruddy glow would have been seen, showing that the blood remained fluid in the vessels.—Ed.]

BRAIN POWER.

[1444]—I send you a suggestion, which you may not think altogether unworthy of your consideration. May not great mental power arise from the harmony that exists between the several parts of, rather than from the size and weight of, the brain? Phrenologists assign different functions to different parts of the brain. Let 7 represent the maximum development of any of the parts of the brain. Would not a man, all the parts of whose brain marked 5, produce greater effect, be a greater genius, in fact, than the man whose brain had 3 parts each equal to 7, but all the rest varying from 1 to 1? If there is any truth in my suggestion, then a woman's brain, though lighter than that of a man, might, under proper cultivation, owing to the greater harmony of its parts, produce as high intellectual effects as those now produced by men. Up to this time men have shown their superiority in every department of mental effort. The best poem, the best statue, the best picture, the best history, the best musical composition, the best of every mental production, has come from the brain of a man. But woman has not had the same care bestowed upon the development of her brain as man has had. What public school or college in olden time was ever endowed for her benefit? There may be in woman's brain such potential powers that, hereafter, she may produce, alternately with man—when, through several generations, she has received the instruction that man has received—the best of every mental work. May it not be the harmony of the parts and not the size of the brain that produces intellectual greatness?

W. H. Jones.

THE INFLUENCE OF MOONLIGHT.

[1445] A friend of mine, who has resided many years in China, told me the other day, as an article of his belief, that sleeping in the moonlight in the tropics is most dangerous, as it leads to blindness or to the face being "drawn" permanently into strange shapes. He also added that mackerel, among other food, becomes perfectly putrid in one night if exposed to the moonlight. He believed this entirely! and added that a friend of his had his face permanently distigured by so sleeping on the deck of a ship. To me the statement was as novel as it was amusing; but I did not care to combat it, as I was without information on the subject. Moreover, I saw plainly that any attempt to shake his faith would be useless. But I since find that the idea is generally known, and often believed in; and therefore ask you whether you could devote a short article to exposing the origin of the myth, for apparently there must be some accidents or incidents that have given rise and a colourable support to the theory. If you do not think it of sufficient importance or interest for an article, perhaps you would kindly say where I shall find any reference to the matter.

Littleton Hay.

Balhousie, Southbrook-road, Lee, Kent, Sept. 14, 1884.

[The idea that moonlight causes putrefaction is as old as Pliny and Plutarch; and is, as our correspondent asserts, very common in tropical climates. My own impression is that the evil effects attributed to moonlight have their origin in exposure to the *clear sky*, under which radiation takes place rapidly, and dew is copiously deposited. Moisture in conjunction with heat is a most fertile agent in decomposition, and I suspect that the mackerel would go bad just as rapidly on a clear starlight night as they would when the moon is above the horizon. There may, however, be some other explanation of the effects produced on the human system, and I insert Mr. Hay's letter in the hope of eliciting it. —Ed.]

FERTILIZATION OF BEANS.

[1446]—"Bean" is a very indefinite word. Will "E. W." kindly inform me on what particular sort—French bean, scarlet runner, broad bean, &c.—his observations have been made, and I will do my best to investigate the matter. But it will want another season now, in all probability.

Grant Allen.

HARE-LIP.

[1447]—To what is a hare-lip a reversion? and in what degree is it hereditary?

E. W. A.

TEA AND COFFEE.

[1448]—Mr. Carus-Wilson's letter with this heading in your number for September 19 is doubtless valuable as giving his own experience, and detecting a source of evil not yet acknowledged by public opinion.

Let me say, in support of this view, that twice in my life it has happened that neither tea nor coffee passed my lips during a space of several months, and upon my resumption of tea, though I had made it weak, and drank it early in the afternoon, I was kept awake for several hours at night.

But before we can accept Mr. Carus-Wilson's theorem as proved, he ought to tell us how his tea was made. I mean, what length of time usually elapsed between the boiling water meeting the tea-leaves and the pouring out from the teapot into his cup? I have good reason for this question, founded likewise upon my own experience. This I will state, with your permission, when we have received his reply. D. A. Beaufort.

FUNGOID GROWTH FROM DEAD FLY.

[1449] I should like an explanation of the following. I found a fly on its back, dead. In a circle around it were a multitude of spores (?). It seemed as if this appearance of dust had been shot out of its body. I enclose drawing same size. I have before seen flies with fungus growing over them, but this is different. The fly appears free from the dust that is all around it. It recalled to my mind a description of a small-pox patient "shooting out deadly spores in all directions." St. John.

[The drawing simply represents a fly surrounded by a circle of dust of approximately five times the fly's length in radius. The dust is thicker laterally, and it is in the direction of the axis of the insect's body.]

VACCINATION.

[1450]—I am one of a family of twelve, of whom ten were born before 1802, and inoculated as was then the prevailing custom. I was born in 1801, and my father was induced to have me vaccinated. But in consequence of my suffering severely from glandular swellings in the neck, when the twelfth child, a son, was born, he was inoculated. Now, of all these children, I alone had the small-pox, when I was about twenty-five years old; and this I caught from a neighbouring clergyman, who, *N.B.*, had been carefully vaccinated by an eminent London surgeon, Sir A. Cooper, his uncle.

N.B.—Within the next four years two other clergymen in Hemel Hempsted had the small-pox. Both had been duly vaccinated, and both suffered notably. F. S.

LETTERS RECEIVED AND SHORT ANSWERS.

Thos. Radmore. As the eclipse was simply caused by the passage of the moon through the earth's shadow, you will, I think, see that neither the "fore" nor "afterglow" can be referred to it in any way. Thanks for P.S.—E. C. Chapman. Certainly *not*. Facts right enough, the rest rubbish. John Hampden. My dear sir! Do not excite yourself so needlessly; and use such strong—not to say libellous—language.—W. F. Curtis sends a long account of a child five or six years old, whose skull was so frightfully fractured by the kick of a horse that the brain actually oozed over his face and neck. Given up by the doctor as fatally injured, the clergyman of the parish baptised the boy (that rite never having been previously administered), supposing him to be *in articulo mortis*. The sprinkling of the water, however, so far revived him as to cause the facial muscles to twitch; whereon he was taken to the Coventry Hospital, and eventually recovered. My correspondent forwards this apropos of the question of "Two Brains" (p. 229), but the connection appears to me somewhat remote.—W. Waring. A matter with which the Editor has nothing to do. You should advertise them.—Dr. Davey. It may or may not be that the functions of the brain are susceptible of localisation, but certainly all modern research goes to negative the mapping out of the cerebrum into areas of the size of a shilling or a florin, as in the system of Gall and Spurzheim. In the case of the cerebellum they were demonstrably wrong, and "mesmeric" experiments count for nothing, on the hypothesis that the mesmeriser influences the mind of the mesmerisee; since, if the former possesses the power claimed for him over the mind of the latter, and *believes* that he is touching (say) the organ of "acquisitiveness," his patient ought to feel himself "acquisitive" straightway. I do not know the address of the gentleman whose name you put on your pamphlet.—H. D. Hinde. I cannot remember whether Kant's "General History of Nature and Theory of the Heavens" has been translated into English, and am very far from books of reference where I write. Look at a list of "Bohn's Libraries" if you can.—F. W. Halfpenny. I fancy that the plant which cures the bite of the rattlesnake has its origin in novelists' licence. Perhaps some toxicologist, though, can say if there is any truth in the notion.—Dr. Wilson. I do not think that the barely conceivable possibility is denied (granting, of course, a sufficient number of millions of years). It is the reasonable probability that has to be shown. If your paper does that, and is not too long, I will do as you suggest.—G. I cannot say, off-hand, how far tidal influence is felt above London Bridge. Locks, &c., must complicate the matter.—W. Cave Thomas. Any letter within reasonable limits, explaining your views, will be inserted. You must not, however, expect to escape criticism. I fail to understand what you mean by colour not being "attributed to the ether waves." I always fancied myself that the sensation of colour had its origin in the variation in the length and frequency of the waves impinging on the retina.—E. S. Phillips. Yet another solution of Mr. Sedden's problem.—Piccolo asks if Mr. Mattieu Williams classes cocoa among stimulants?—F. Heeley sends me some remarkably economical outline maps for filling in by students of geography. As they are seemingly executed by one of the "graph" processes, they are, of course, very much cheaper than any engraved ones.—Frank H. Grierson thinks that *spectral* analysis, as applied to the *heavenly bodies*, must be a work of spirit! G. R. Griffith. Will be noticed in due course.—Miss Stuart. The price of Knowledge was raised to threepence per copy on March 7, 1884. See concluding paragraph (in capital letters) at the head of correspondence column.—J. H. D. Is not your contention just open to the charge of logomachy?—Robert McMillan. I acknowledged the receipt of your letter when it reached me; but, up to this present writing, "Professor" Manville's paper has never turned up at all.—An Original Subscriber. The effect to which you refer would probably co-operate with that described in producing the effect of concavity.—Excelsior. You will see that "F.R.A.S." does furnish an Ephemeris of Wolf's comet this week on p. 303. Of what earthly use would it be for him to occupy space by the mention of comets visible only in very large telescopes as small, dim nebulæ, of which a 3-inch telescope would show no trace whatever?—A. E. Conte. Forwarded to publishers, who deal with such matters, with which the editor has nothing to do.—John Towers. I was really interested by your letter and its enclosure. The young astronomer has no reason to be ashamed of his work. Floreat semper.—Amy Newland.—If you intend to devote yourself to the observation and measurement, &c., of double stars, obtain the largest refractor you can afford. If, on the other hand, you propose to study solar, lunar, and planetary detail, star clusters, nebulæ, &c., by all means purchase a reflector. Aperture for aperture, reflecting telescopes are *very* much cheaper than achromatics, and, for studying the heavens generally, you get so much more for your money.—J. Elois. Far away from a single book of reference, I can answer you but vaguely. (1) The method of measurement is too uncertain for us to predicate definitely which star is approaching us the most rapidly. Besides (as in the case of Sirius) recession may be converted into approach—and *vice versâ*. (2) The glorious cluster to which you refer, is 33 (Herschel) Persei; it is commonly known as "The sword-handle of Perseus." (3) No large meteoric stones have recently fallen in England. (4) On November 13 (after midnight), and again on the 27th.—Alpha. Your telescope is not sufficiently powerful to show Saturn. At best it could only exhibit him as a misshapen star. He is a little to the left and above ζ Tauri, and is so much brighter and more conspicuous than that star as to be unmistakable. Midnight is none too late to observe Saturn now: in fact, he does not south until between four and five o'clock in the morning. Ball's "Astronomy," published by Longmans, is excellent. For books on special departments of astronomy by the conductor of this journal, see Messrs. Longmans' announcement in our advertising columns.—Roland Ellis. The axis of the earth's shadow lies in the plane of the ecliptic to which the moon's path (from right to left across the face of the sky) is inclined. She was travelling, as it were, *downwards*—as well as from west to east—on Saturday night: hence the seeming direction taken by the shadow across his surface. It is the refraction of the sun's rays through our atmosphere which bends them into the shadow cone and dimly lights the moon's surface. Were that atmosphere removed, she would wholly disappear in a total eclipse.—Maximilian Strong. The date of the birth of Our Lord is not known with absolute certainty. I am unaware of any calculations of Sir Isaac Newton's having reference to this point. I will look up the question of Tiberius Cæsar on my return to England. You will see that the figure puzzle has been solved by a very large number of subscribers.—W. Had your solution of the figure puzzle arrived earlier it would have been inserted. I have had reams almost of answers, which I have had perforce to suppress. "Coincidences" possess a certain amount of value in a mathematical point of view, and, undoubtedly, they seem to interest a multitude of readers.

Forestry having changed hands, Mr. Francis George Heath has retired from the editorship.

A new small motor actuated by explosion of small charges of gun cotton has been made by Mr. E. Sturge, and is said to be applicable wherever small powers are required.

The Russian Customs Department has issued an order, dated Sept. 3, 1884, that goods bearing trade marks with effigies of the Holy Virgin, Saint George, or other saints, will not be admitted into the Russian Empire.

Our Whist Column.

SIR,—The illustration given by "Five of Clubs" in KNOWLEDGE of Sept. 12 appears to me unsound, for *Y must* make two tricks if he does *not* discard his winning Spade, but plays what is manifestly the proper card, *i.e.*, the Club three, keeping the Heart five, so as not to have to lead up to the tenace in Clubs. Thus :—

Trick 1.—*A* leads Diamonds Queen; *Y* plays Club three. Won by *A*.

Trick 2.—*A* leads Spade. Won by *Y*, with Queen. *B* plays Club two.

Trick 3.—*Y* leads Heart five. Won by *B*, with Queen.

Trick 4.—*B* must lead a Club, and *Y* must make his Knave.

If, at trick 2, *A* leads his Heart, *Y* must still make his Club Knave and Spade Queen. I am, sir, &c., KONGE.

UNSCIENTIFIC AMERICAN WHIST.

WHEN I wrote in *Longman's Magazine* an article on the science of the game of Poker—which may be called a thoroughly American game—many journalists in America expressed their doubts whether I should not be altogether beaten at the game itself by men who know nothing of the scientific principles which are really involved in the game. I think this not unlikely, considering that I have never taken a hand at the game—to which I may add that I am never likely to do so, the game being a purely gambling one, and gambling, in my opinion, is a degrading practice for any above the condition of the savage. But, during my recent stay in America, I have had occasion to play pretty frequently at the more scientific game—Whist, and I have been led to notice certain peculiarities in the way in which Americans play this game (growing gradually in favour among them) which shows that they have still much to learn. Of course nothing of what I am about to say is intended to apply to those Americans who know and appreciate what may be called the European method of playing Whist; only to those, ninety-nine I think out of a hundred, who regard themselves as good Whist players, but are not acquainted with—or despise—the conventional language of the game.

I note, first, that Americans very sensibly object to the part which honours play in Whist at home. The utmost they will allow honours to count is one-half our estimate. That is to say, if two partners hold three honours out of the four, they count "one" only instead of "two"; if they hold all four they count "two" instead of "four." But most Americans prefer to count nothing for honours. In one sense this is good, for it makes more depend on skill, and Whist is a game of skill; in another sense, however, it rather injures the game, because it eliminates those pretty positions which frequently arise where the saving of a game or of a point depends on making a certain number of tricks, counting before honours, already declared against you. Looking keenly out for the honours, or indications of their position, a good player sees that such and such tricks must be made to save the game, and plays entirely to make them, entirely changing his tactics perhaps for the purpose.

Again, Americans prefer long Whist to short, and here again the game loses certain points of great interest, arising when the play depends on details of the score.

But the chief point which is noticeable in American Whist play is that which Deschapelles (far and away the greatest Whist player ever known) called the most detestable fault a Whist-player can have: Americans at Whist are inveterate "players of their own hand." They will not admit, or cannot see, the advantage (in nine cases out of ten) of that system by which each player regards his own hand and his partner's as one—a system by which the game is made really scientific. For this system the general rule holds that it is better to inform your partner than to deceive the enemy. The American who considers himself strong at Whist adopts, instead, the principle that it is best to play a dark game. He reasons that by playing dark he hides his own hand from the adversaries, while, if they play the open game, he knows something about their hands—a manifest advantage, if his unfortunate partner had no part to play. But as the partner is equally deceived, and so far from helping is like to obstruct, the mischief much outbalances the advantage of the dark game. This I had known theoretically long since. But never till I played Whist in America did I have such clear proof of the fact as I have recently had. I have played repeatedly with a partner who knows the Whist language, against two partners, each of whom plays his own hand with considerable skill. Repeatedly I have been perplexed by the play of one or other of the adversaries, and occasionally I have seen that they have been able to make use to their advantage of those indications by which I and my partner indicate the cards we hold in particular suits. But I have satisfied myself that at least one trick in ten is gained in the long run (by which I mean that ten tricks are made for nine) by playing the open game, the two partners working together against two adversaries working separately.

Among the methods of play arising from this one-hand (or my-own-hand) system, is the practice of leading from a short-suit or a singleton, if no suit has much strength. This Americans do quite irrespectively of the question whether they hold few or many trumps. It is bad enough to lead thus, even when you hold only two or three trumps; but to lead from a singleton or a two-card suit, when you hold four trumps, is surely a Whist atrocity of the first magnitude. You get your anxiously-desired ruff, and presently find that your partner has a fine suit which only needed that fourth trump of yours to be brought in: instead, however, the enemy lead trumps, get the command in them owing to your cleverness, bring in their good suits, and make a great game. To which must be added that while, by leading from a very short suit, you fail to tell your partner which is your long suit, you quickly disclose to the whole table which is your weak suit: you omit to give your partner the only kind of information which, as a rule, can really be of use to him, and give the enemy just that kind of information which is most useful to them. For, as double dummy shows, there is no information at Whist more useful than that which tells where the weak suits of the enemy lie.

It will be understood that Americans like to play a ruffing game, and are in their glory when they get a cross-ruff. (In fact the only excuse for leading from a singleton is the chance of establishing a cross-ruff.) I roused intense wrath in an American partner when, after he had established a cross-ruff, I broke it by leading trumps. I had five, and a strong suit which had been established; he had led me a suit which I had been obliged to trump, and I could have led him twice from a suit he could ruff. We should thus have made by the cross-ruff five tricks, but no more, and two of these would have been sure ones anyhow. But of course I played no such game. I led trumps to stop the cross-ruff; got out all the trumps (making three tricks in that suit besides the two ruffs), brought in my strong suit, making three tricks in that—or eight instead of five. Yet he never ceased to rebuke me for stopping a cross-ruff which would have ruined us.—*Newcastle Weekly Chronicle.*

ONE of the most attractive objects at the Nice Exhibition is said to be a Chinese clock, which is stated only to date back to 800 B.C.

A DESPATCH from Washington recently stated that an Australian syndicate proposes to lay a cable from Brisbane, Australia, to San Francisco, and that the Government of the Hawaiian Islands will probably grant a subsidy towards the enterprise, amounting to £4,000 per annum for fifteen years.

INCANDESCENT electric lamps are being used to show how things are getting on in a temperature of 600° Fah., in Messrs. Perkins & Sons' bakers' oven at the Healtheries. The oven door contains a sheet of plate glass, through which the whole of the oven is distinctly visible.

A RED SOLAR HALO.—M. Forel, a French *savant*, has observed a remarkable reddish halo round the sun from a position in the Bernese Alps on August 26. At an altitude of 1,000 mètres the phenomenon was visible, at 1,500 mètres it was quite distinct, and at 3,000 mètres it appeared of striking splendour. The effect was repeatedly seen by M. Forel about this time and at different places in Switzerland, such as Grimsel, Innert-kirchet, and the Glacier du Rhône. The phenomenon was also observed in July by M. Forel at Saas-Fée at an altitude of 1,800 mètres; and he does not hesitate to affirm that during the months of July and August last a red halo or corona surrounded the sun, which, though difficult to see at low altitudes, became quite brilliant at 2,000 mètres above the sea. It would be well if aëronauts would keep a look-out for this phenomenon.—*Engineering.*

PURCHASED TITLES.—M. Jules Claretie, in the *Temps*, exposes the operations of an Italian agency that offers to supply titles of every degree of nobility for a fixed sum. The circulars of this novel bureau are usually addressed to bankers and flourishing financial agents in every part of Europe. The informant has become possessed of one of the missives, which is couched as follows:—"Sir,—Knowing the high position you justly hold in the financial world, and wishing you to profit by the same, either in the interests of your business or those of your family, through resources of nobility, I have the honour to inform you that I can, against an amount officially fixed, obtain for you either certain decorations or a title, which would doubtless facilitate the transactions which you have undertaken. Title of prince, 75,000 francs; duke, 50,000 francs; count, 25,000 francs; baron, 20,000 francs. All warranted, and in good form. Trusting to the favour of an early answer,—I am, sir, &c."

Our Chess Column.

By Mephisto.

PROBLEM No. 131.

(Selected.)

Black.

White.

White to play and mate in two moves.

A FEW CRITICISMS ON PROBLEM No. 130.

A most distracting problem.—P. J. D.

A very pretty problem, and very difficult.—G. W. Thompson.

Truly, as you say, a masterpiece.—H. A. N.

Certainly a masterpiece. I had some difficulty in not believing that 1. Q to Kt2 was the actual move.—W. Furnival.

SOLUTIONS.

Problem 129, by J. G., p. 218.

Position.

White (7 pieces).—K, QKt8. Q, KR8. B, KB8. Kts, Q6 and QB2. Ps, K3 and QR4.

Black (12 pieces).—K, QB4. Q, KKt7. R, KKt3. Kt, Q sq. P's, QR3, QB3, 5, 6, K3, 4, KB3, and KKt4.

Solution.

1. Q to R sq., threatening, if Q × Kt, 2. Kt to B8 mate; or, if Q, R, or Kt moves, 2. Kt to K4 (ch.) (K to Q4, Kt × QBP mate) K to Kt3. 3. Q to Kt sq. (ch), K to R4, Q to Kt4 mate.

1.	Q × Q, or (a)
2. P to K4	

(Threatening Kt to B8 mate)

If Q to Kt8 (ch), 3. Kt to Kt7 (double ch), K to Kt3. 4. B to B5 mate.

	Q × P
3. Kt to B8 (ch)	K to Q4
4. Kt to Kt6 (ch) mate.	

(a) If 1. K to Kt3, 2. Kt × P mate; or if 1. K to Q4. 2. Kt to Kt4 (ch), K to B4. 3. Kt to B8 mate; or if

1.	P to K5, or (b)
2. Kt to B7 (ch)	K to Q4

If 2. K to Kt3. 3. Q to Kt sq. (ch), K to R4. 4. Q to Kt4 mate.

3. Kt to Kt4	Mate

(b) If 1. P to R4. 2. Kt to K4 (ch). K to Kt3. 3. Q to Kt sq. (ch). K to R3. 4. Kt to B5 mate, &c.

Problem No. 130, by E. N. Frankenstein, p. 268.

1. Kt to B4	R × Q, or	1.	P × Kt (a)
2. Kt to Q2 (ch)	K to Q5	2. Q to B6	P × P
3. Kt to K6 (ch)	mate	3. Kt × P	Mate
(a)			
1.	P to B7, or	1.	B to R2
2. B to Q5 (ch)	R × B	2. B × R (ch)	R × B
3. Q × R	Mate	3. Q × R	Mate

SPECIMEN OF OLD PROBLEM COMPOSITION.

Sir,—The enclosed problem was the invention of M. Calvi, of Paris. It was first introduced to the Chess Club of that capital as a problem of more than ordinary difficulty, and was not solved during the meeting. M. Alexandre, author of the "Encyclopædia of Chess," was the first to discover the solution, but this was not until the morning after the meeting of the club. It was first published in this country more than forty years ago. I send it to you in the hope it may prove sufficiently interesting to your "Chessists" for you to give it a diagram.

Black.

White.

1. Q × KP (ch)	1. K × Q
2. Kt to Q6 (ch)	1. K × Kt
3. P to B4 (ch)	3. K × Kt
4. P to K8	
Becoming Kt mate.	

William Godden.

ANSWERS TO CORRESPONDENTS.

**** Please address Chess Editor.*

Eugene Hamburger.—The Problem 130 is right enough, but we must apologise for mistake in answering "S. B. C." last week. If 1. Q to Kt2, then R to Q5 (a very fine defence), followed by R(K6) to Q6.

Scribbler (Chelsea).—If in No. 130, 1. Q to K4, Kt to Q3. 2. K to Kt5(ch), K to K4, and there is no mate. See above reply. Do you really expect any honest Christian to make out your signature?

Q. T. V.—See first reply.

A. E. R.—Received with thanks.

Correct solutions of Problem 130 received from M. T. Hooton, W. Furnival, H. A. N., Geo. W. Thompson.

Contents of No. 153.

NOTICES.

Part XXXV. (Sept., 1884), now ready, price 1s., post-free, 1s. 3d.

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CONTENTS OF No. 155.

OUR TWO BRAINS.

By Richard A. Proctor.

(*Continued from p.* 230.)

THE next point on which Dr. Wigan insisted, was the fact that among insane persons we often recognise two different minds, either one sane and the other insane, or both insane but in different degrees. No one who has studied the literature of insanity can fail to recall instances; but I shall venture to quote in illustration a passage from an American narrative, "The Hoosier Schoolmaster," based, I am assured, on an actual case which came under the notice of the author of that pleasant story.

"Ralph stood looking into a cell, where there was a man with a gay red plume in his hat and a strip of red flannel about his waist. He strutted up and down like a drill-sergeant. 'I am General Jackson,' he began; 'people don't believe it, but I am. I had my head shot off at Bueny Visty, and the new one that growed on isn't nigh so good as the old one; it's tater on one side. That's why they took advantage of me to shut me up. But I know some things. My head is tater on one side, but it's all right on t'other. And when I know a thing in the left side of my head I know it.'" (This illustrates a point on which Dr. Wigan specially insisted. An insane patient knows he is insane. He will put forward insane ideas, and immediately after having put them forward he will say, "I know they are insane." "The lunatic is at one and the same time perfectly rational," says Brown-Séquard, "and perfectly insane." Dr. Wigan concluded, like the poor lunatic of the Indiana workhouse, that in such cases one-half of the brain is normal and the other half diseased; one-half employs the faculties in a normal way, the other half employs them in a wrong way.) The crazy pauper is called on to give evidence, or rather he introduces himself to the judges, with the remark that one side of his head being "sound as a nut," he "kin give information." He refuses to be sworn, because "he knows himself." "You see when a feller's got one side of his head tater, he's mighty onsartin like. You don't swear me, for I can't tell what minute the tater side'll begin to talk. I'm talkin' out of the lef' side now and I'm all right. But you don't swar me. But if you'll send some of your constables out to the barn at the poor-house and look under the hay mow in the north-east corner, you'll find some things maybe as has been missin' for some time. And that a'n't out of the tater side neither." The exactness of the information, with the careful references to locality and time, as also the suggestion of the proper course of action—not merely "go and look," but send some of your constables, &c.—all this illustrates well the perfect contrast often existing between the two states in which a so-called lunatic exists.

There are cases, however, which are even more interesting, in which two different mental conditions are presented, neither of which presents any indication of mental disease, except such as might be inferred from the completeness of the gap which separates one from the other. Dr. Brown-Séquard gives the following account of a case of this kind. "I saw a boy," he says, "at Notting-hill, in London, who had two mental lives. In the course of the day, generally at the same time, but not constantly, his head was seen to fall suddenly. He remained erect, however, if he was standing, or if sitting he remained in that position; if talking, he stopped talking for a while; if making a movement he stopped moving for a while; and after one or two minutes of that state of falling forward or drooping of the head (and he appeared as if falling asleep suddenly, his eyes closing), immediately after that his head rose, he started up, opening his eyes, which were now perfectly bright, and looking quite awake. Then, if there was anybody in the room whom he had not previously seen, he would ask who the person was, and why he was not introduced to him. He had seen me a great many times, and knew me very well. Being with him once when one of these attacks occurred, he lifted his head, and asked his mother, "Who is this gentleman? Why don't you introduce him to me?" His mother introduced me to him. He did not know me at all. He shook hands with me, and then I had a conversation with him as a physician may have with a patient. On the next instance, when I was present during an attack of this kind, I found that he recognised me fully, and talked of what he had spoken of in our first interview. I ascertained from what I witnessed in these two instances, and also (and chiefly, I may add) from his mother, a very intelligent woman, that he had two lives in reality—two mental lives—one in his ordinary state, and another occurring after that attack of a kind of sleep for about a minute or two, when he knew nothing of what existed in his other life. In his abnormal life, the events of his normal life were forgotten—his ordinary life became a blank.* He knew

* I have been compelled slightly to modify the report of Dr. Brown-Séquard's statement. Though manifestly a report taken by shorthand writers, and intended to be *verbatim*, there are places where it is clear that either a part of a sentence has been omitted or some words are wrongly reported. I speak from experience in saying that even in America, where lectures are much more carefully reported than in England, mistakes are not uncommon. The enterprise of the *New York Tribune*, in taking full reports of lectures considered noteworthy, is a well-known and most creditable feature of American journalism. But it is a mistake to suppose that reports, even if actually *verbatim*, can exactly represent a lecturer's meaning. A speaker, by varieties of inflection, emphasis, and so on, to say nothing of expression, action, and illustration, can indicate his exact meaning whilst using language which written in the ordinary manner, may appear indistinct and confused. Thus a most exact and carefully-prepared lecture may appear loose and slipshod in the report. This applies to the case where a lecturer speaks at so moderate a rate that the shorthand writers can secure every word, and is true even when in writing out their report they make no mistake, though it seldom happens, as any one will readily understand who is acquainted with the stenographic art. But the case is much worse if a lecturer is a rapid speaker. A reporter is compelled to omit words and sentences occasionally, and such omissions are absolutely fatal to

nothing during the second state about what had occurred in previous periods of that same condition; but he knew full well all that had occurred then, and his recollection of everything was as perfect then as it was during his ordinary life concerning the ordinary acts of that life. He had, therefore, two actually distinct lives, in each of which he knew everything which belonged to the wakeful period of that life, and in neither of which did he know anything of what had occurred in the other. He remained in the abnormal—or rather the less usual state, for a time which was extremely variable—between one and three hours, and after that he fell asleep, and got out of that state of mind pretty much in the same way that he had got into it. I have seen three other cases of that kind, and as so many have fallen under the eyes of a single medical practitioner, such cases cannot be extremely rare."

The circumstances just described will probably remind the reader of cases of somnambulism, during the recurrence of which the person affected recalls the circumstances which had taken place during the previous attack, of which in the intervening wakeful state he had been altogether oblivious. Dr. Carpenter, in his fine work on "Mental Physiology," records several instances.* Forbes Winslow cites cases in which intoxication has produced similar effects; as, for instance, when a drunken messenger left a parcel in a place which he was quite unable to recall when sober; but, becoming drunk again, remembered where it was, and so saved his character for honesty through the loss of his sobriety.

It may fairly be reasoned, however, that the actual duality of the brain is not demonstrated or even suggested by cases such as these last. In fact, it is not difficult to cite evidence which, if interpreted in the same way, would show that we have three brains, or four or more. Thus Dr. Rush, of Philadelphia, records that "an Italian gentleman, who died of yellow fever in New York, in the beginning of his illness spoke English, in the middle of it French, but on the day of his death only Italian." It is manifest that the interpretation of this case, and therefore of others of the same kind, must be very different from that which Brown-Séquard assigns, perhaps correctly, to the case of two-fold mental life above related. Knowing as we do how greatly brain action depends on the circulation of the blood in the vessels of the brain, we can be at no loss to understand the cases of the former kind, without requiring a distinct brain for the different memories excited.* In the same way, possibly we might explain the well-known case of an insane person who became sane during an attack of typhus fever at the stage when sane persons commonly become delirious, his insanity returning as the fever declined. But we seem led rather to Dr. Brown-Séquard's interpretation, by a case which recently came under discussion in our law courts, where a gentleman whose mind had become diseased was restored to sanity by a fall which was so serious in its bodily consequences as to be the subject of an action for damages.

(*To be continued.*)

the effect of a lecture, regarded either as a demonstration or as a work of art. Still more unfortunate will it be for a lecturer if he should be carried away by his subject, and pour forth rapidly the thoughts which have come uncalled into existence. Take the most eloquent passage from the pages of Sir J. Herschel, Tyndall, or Huxley, strike out as many words, not quite necessary to the sense, as shall destroy completely the flow and rhythm of the passage, omit every third sentence, and leave the rest to be slowly read by a perplexed student, and the effect will correspond to the report of passages which, as delivered, formed the most effective part of a lecture. The result may be a useful mental exercise, but will surely not be suggestive of fervid eloquence. The student of such reports will do well to read, as it were, between the lines, taking what appears as rather the symbol of what was said than its actual substance. So read such reports are of great value.

* One of these, however, is scarcely worthy of a place in Dr. Carpenter's book. I refer to the narrative at p. 596, of a servant-maid, rather given to sleep-walking, who missed one of her combs, and charged a fellow-servant who slept in the same room with stealing it, but one morning awoke with the comb in her hand. "There is no doubt," says Dr. Carpenter, "that she had put it away on a previous night without preserving any waking remembrance of the occurrence; and that she had recovered it when the remembrance of its hiding-place was brought to her by the recurrence of the state in which it had been secreted." This is not altogether certain. The other servant might have been able to give a different account of the matter.

* "No simple term," says Sir Henry Holland, "can express the various effects of accident, disease, or decay, upon this faculty, so strangely partial in their aspect, and so abrupt in the changes they undergo, that the attempt to classify them is almost as vain as the research into their cause." The term "dislocation of memory" was proposed by him for the phenomena of complete but temporary forgetfulness.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

X.

THE existence of the ghost-soul or other-self being unquestioned, the inquiry follows, where does it dwell? Like the Trolls of Norse myth who burst at sunrise, the flitting spirit vanishes in the light and comes with the darkness; but what places does it haunt when the quiet of the night is unbroken by its intrusion, and where are they?

The answers to these are as varied as the vagaries of rude imagination permit. We must not expect to find any theories of the soul's prolonged after-existence among races who have but a dim remembrance of yesterday and but a hazy conception of a to-morrow. Neither, among such, any theories of the soul abiding in a place of reward or punishment, as the result of things done in the body. Speaking of the heaven of the red man, Dr. Brinton remarks that "No contrast is discoverable between a place of torment and a realm of joy; at the worst but a negative castigation awaited the liar, the coward, or the niggard." Ideas of a devil and a hell are altogether absent from the barbaric mind, since it is obvious that any theory of retribution can arise only when man's moral nature had so developed as to awaken questions about the government of the universe, and to call another world into existence to redress the wrongs and balance the injustices of this. His earliest queries were concerned with the whereabouts of the soul more than with its destiny, and it was, and still is among the lower races, thought of as haunting its old abode or the burial-place of its body, and as acting very much as it had acted when in the flesh. The custom of placing articles whose *manes* would serve its supposed needs is an evidence of this. The shade of the Algonquin hunter chases the spirits of the beaver and the elk with the spirits of his bow and arrow, and stalks on the spirits of his snow-shoes over the spirit of the snow. Among the Costa Ricans the spirits of the dead are supposed to remain near their bodies for a year, and the explorer Swan relates that when he was with the North-Western Indians he was not allowed to attend a funeral, lest he offended the spirits hovering round; whilst the Indians of North America often destroy or abandon the dwellings of the dead, the object being to prevent the ghost from returning, or to leave it free so to do. But it is needless to multiply illustrations of a belief which has been persistent in the human mind from the dawn of speculation about the future of the soul to the present day. The barbarians, who think that the spirits of the dead move and have their being near the living, join them on their journeys, and sit down, unseen visitants, at their feasts (to be driven off, as among the Eskimos, by blowing the breath), are one with the multitudes of folks in Europe and America who, sorrowing over their dead, think of them as ministering with unfelt hands and as keenly interested in their concerns.

> We meet them at the doorway, on the stair.
> Along the passages they come and go,
> Impalpable impressions on the air,
> A sense of something moving to and fro.

The Ojibway, who detects their tiny voices in the insect's hum, and thinks of them as sheltering themselves from the rain by thousands in a flower, as sporting by myriads on a sunbeam, is one with the Schoolmen who speculated on the number of angels that could dance on a needle's point, and with Milton in his poetic rendering of the belief of his time, that

> Millions of spiritual creatures walk the earth
> Unseen, both when we wake and when we sleep.

The Hottentot who avoids a dead man's hut lest the ghost be within, is one with the believers in haunted houses, in banshees, wraiths, and spectres. Such as he should not be excluded as "corresponding members" of the Society for Psychical Research in the invitations which its committee issues to folks who have seen apparitions, and slept, or tried to sleep, in the dreaded chamber of some moated hall of mystery.

If we look in vain for any consistency of idea or logical relation in barbaric notions, our wonder ceases at the absence of these when we note the conflicting conceptions entertained among intelligent people. But the underlying thought is identical. The examples given in a foregoing paper on the belief in the passage of the soul into other human bodies, into animals and stones, strengthened as this is by the likeness in mind and body between children and dead relatives, by the human expression noted on many a brute, by the human shape of many a stone, show how the theory of the soul as nigh at hand finds many-sided support. In this belief, too, lie the germs of theories of successive transmigrations elaborated in the faiths of advanced races, when the defects of body and character were explained as the effects of sin committed in a former existence.

Next in order of conception appears to be that of the soul as living an independent existence, an improved edition of the present, in an under or upper world, into which the dead pass without distinction of caste or worth.

The things dreamed about respecting the land of spirits and their occupations are woven of the materials of daily life. Whether to the sleeping barbarian in his wigwam, or to the seer banished in Patmos; whether to the Indian travelling in his dreams to the happy hunting-ground, or to the apostle caught up in trance into paradise; earth, and earth alone, supplies the materials out of which man everywhere has shaped his heaven. Her dinted and furrowed surface; valleys and mountain-tops; islands sleeping in summer seas, or fretted by winter storms; cities walled and battlemented; glories of sunrise and sunset; gave variety enough for play of the cherished hopes and imaginings of men. If we collect any group of barbaric fancies, we find, speaking broadly, that a large proportion have pictured the home of souls as in the west, towards the land of the setting sun. Seen from many a standpoint to sink beneath river, lake, or ocean, which for untutored man enclosed his world, it led to the myth of waters of death dividing earth from heaven, which the soul, often at perilous risk, must cross. Such was the Ginnunga-gap of the Vikings, the great water of the Red Indians, the Vaitaraṇi of the Brahmans, the Stygian stream of the Greeks, and the Jordan of the Christians, that flows between us and the Celestial City "where the surges cease to roll." The sinking of the sun below the horizon obviously led to belief in an underworld, whither the ghosts went. Barbaric notions are full of this, and the lower culture out of which their beliefs arose is evidenced in the Orcus of the Romans, the Hades of the Greeks, the Helheim of the Norsemen, the Sheol of the Hebrews, and the Amenti of the Egyptians, the solar features of which last are clearly traceable in their doctrine. Among the Hebrews, Sheol (translated, curiously enough, thirty-one times as "grave," and thirty-one times as "hell" in our Authorised Version) was a vast cavernous space in which the shades of good and bad alike wandered —"the small and great are there, and the servant is free from his master." It is akin in character to the Greek Hades, where they "wander mid shadows and shade, and wail by impassable streams." As ideas of a Divine Rule of the world grew, its manifestations in justice were looked for, and the mystery of iniquity, the wicked "flourishing like a green bay tree," led to the conception of a future state, in which Lazarus and Abraham would change places. Sheol thus became, on the one hand, a land of delight and repose for the faithful, and, on the other hand, one of punishment for the wicked.

Persian, and still older, influences had largely leavened Hebrew conceptions, and local conditions in Judea added pungent elements. The Valley of Hinnom, or Gehenna, "the place where lie the corpses of those who have sinned against Jehovah, where their worm shall not die, neither their fire be quenched;" the dreary volcanic region around the Dead Sea, with its legend of doomed cities, supplied their imagery of hell with its lake of fire and brimstone. And, as the belief travelled westward, it fell into congenial soil. The sulphurous stench around Lacus Avernus, the smoke of Vesuvius, Stromboli, and Etna, wreathed themselves round the hell of Christianity, and the under-world of barbaric myth, and from Talmudic writer to classic poet, to Dante and to Milton, the imagination exhausted the material of the horrible to describe the several tortures of the damned. The hell of our northern forefathers remained below the flat earth, but the cold, misty Niflheim melted away before the fiery perdition of Christian dogma. And, in the region bordering thereon, the *limbus patrum*, the *limbus infantum*, &c., we have the survival of belief in separate hells characteristic of the Oriental religions, and of the sub-division of the lower world in more rudimentary religions.

Beyond the narrow horizon which bounded the world of the ancients, lay the imaginary land of the immortals, the Blessed, the Happy, the Fortunate Isles. But as that horizon enlarged, the Elysian Fields and Banquet Halls were transferred to an upper sphere. In the wonder aroused by the firmament above, with its solid-looking vault across which sun, stars, and clouds traversed: in the place it plays in dreams of barbarian and patriarch, when the sleeper is carried thither: in its brightness of noonday glory as contrasted with the dark sun-set under-world, we may find some of the materials of which the theory of an upper world, a heaven ("the heaved") is made up. There the barbarian places his paradise to which the rainbow and the Milky Way are roads; there he meets his kindred, and lives where cold, disease, and age are not, but everlasting summer and summer fruits. There, too, for the conceptions of advanced races are drawn from the same sources, the civilised peoples of Europe and America have placed their heaven. And, save in refinement of detail incident to intellectual growth, there is nothing to choose between the earlier and the later; the same gross delights, the same earthborn ideas are there, whether we enter the Norseman's Valhalla, the Moslem's Paradise, or the Christian's New Jerusalem.

PLEASANT HOURS WITH THE MICROSCOPE.

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

THERE is no class of animals which exhibit a more curious variety of mouth organs than the insects, and some of the most remarkable belong to the dipterous, or two-winged group, roughly known as flies. They all feed upon fluid matter, but their habits are so different, as to require, or to speak more philosophically, to result from, peculiar modifications of the mandibles, maxillæ, lips, tongues, &c. The dipters are extremely numerous in species and individuals; many of them being the most annoying and mischievous plagues. Of the whole lot it may be said that their two wings cannot be folded, and are accompanied at the base by a pair of little expansions called alulets, and that they have two poisers, filaments terminating in knobs, which represent the lower or absent pair of wings, or at least are generally thought to have that character.

The divisions of insects into orders founded upon peculiarities of their wings bring together species whose mouth organs are strikingly different, and this is very conspicuous amongst the dipters. A gnat, for example, is a pumper or sucker, its mouth apparatus includes instruments for making holes in its victims, and tubes to suck up their blood. Common house-flies, bluebottles, and many others are lickers or lappers; and the most wonderfully provided with a lapping tongue is, so far as the writer has seen, the daddy-longlegs (*Tipula oleracea*), grouped with the gnats by entomologists. The bee is a lapping insect, but it does its feeding work with a sweep of its mopping tongue, as was explained in a former paper. The blow-flies, or bluebottles, and flies more or less like it, lap in a different way. Fig. 1 shows in outline the horse's head sort of shape presented by its proboscis when its two lobes are pressed together. Fig. 2 shows them when they are opened to lap up a fluid, as may be easily seen by putting one in the tubular live-box

Fig. 1.

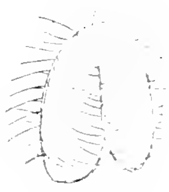


Fig. 2.

described in a former paper, and supplying the creature with a drop of honey, or syrup, or blood. The blow-fly does not possess by any means the simplest form of this sort of proboscis, but it is a good one to study, because the insect is very common, and very ready to exhibit its mode of using the instrument.

A student will do well to mount one of these organs in Canada balsam, after carefully washing it, but avoiding opening and spreading out its two lobes. It should be well examined in this position, which shows it to be supplied with a number of tubes, at first sight like the breathing tracheæ, but the rings are not complete. There are gaps in them which allow a fluid to enter.

It is well worth while to buy one of Topping's beautiful preparations of the blow-fly proboscis, with the lobes open and extended. It is a work of great skill to produce anything so perfect in its way, and the object is singularly beautiful with dark-ground illumination. It is also desirable for the student to prepare slides with the lobes expanded, and he will then see parts which Topping cuts away to make others plainer. Each lobe has thirty pseudotracheæ, broad at their commencement, as they spring from larger tubes, and getting gradually slender towards their tips. No published drawings of the proboscis, in accessible books, can be regarded as satisfactory. It would take a clever artist a good while to make a good likeness, and the engraving would be difficult to execute in a satisfactory way. Fig. 3 shows portions of the pseudotracheæ magnified about 500 times linear, and represented in plan. In a perspective view the tubular character would appear. Each pseudotrachea may be likened to a gutter, but the two edges can be brought closer together when the two lobes are in contact.

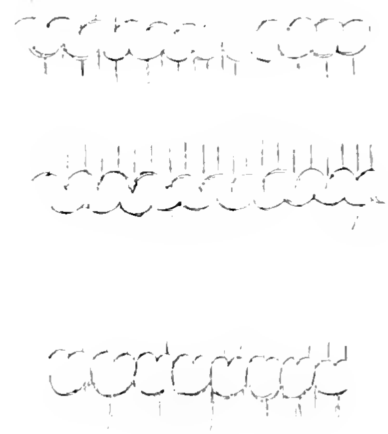


Fig. 3.

Common flies and bluebottles are omnivorous feeders upon things that are either fluid or easily dissolved. If they attack a bit of sugar, they can scrape it with teeth.

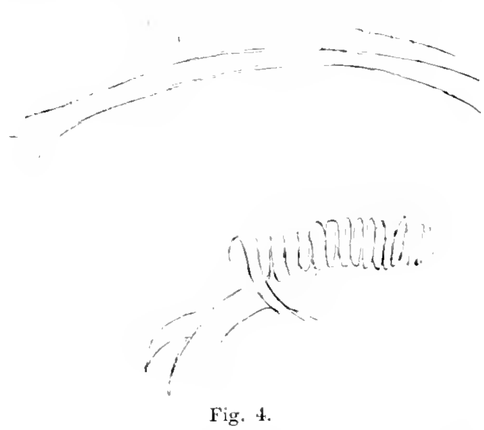


Fig. 4.

When the proboscis is spread out with the lobes open, these instruments are seen in the median line. Mr. Lowne, in his book on "The Anatomy of the Blow-fly," says there are from fifty to sixty of these bidentate tools, and Mr.

Suffolk, whose paper will be found in the *Monthly Microscopical Journal* for April, 1869, saw marks of their work upon sugar comfits with which he fed them. Their scraping action is accompanied with an outflow of saliva by which the sugar particles are dissolved. The smaller pseudo tracheæ are connected with larger ones, and the fluid that is sucked up runs into the mouth.

Fig. 5.

At this time of the year, large flies, looking so much like drones that they are commonly taken for them, are frequently found on the windows of country houses. They are drone-flies, with a larger and differently shaped proboscis to that of the blow-fly. A rough outline of its appearance is shown in Fig. 5. The pseudo-tracheæ are much finer and more numerous. They are also nearer complete tubes than in the blow-fly, and I think act as such when the two lobes are in contact. This insect is not omnivorous. It would not touch a droplet of meat soup as a blow-fly would have done, but worked vigorously at one of honey. The blow-fly thrusts its proboscis forward in front of its head in feeding. The drone-fly likes to work it at right angles to the line of its body. Putting the insect in a wide test-tube, is a good way of seeing the proboscis in action. When the lobes are open and pressed against the glass to lap up the honey, a ripple is distinctly seen round its margin. When a certain quantity is taken up, the instrument is drawn back, and the lobes brought together. This must cause a pressure on the tubes, and drives the fluid into the mouth.

The drone-fly is furnished with piercing and pumping tools to get at nectar which the proboscis could not reach. I do not know what flowers it operates upon in this way. It is fond of the Michaelmas daisy, and reaches its nectar by thrusting the proboscis down the tube of the flower. When engaged at its meals it is not readily frightened, and a quiet observer can stand by and watch the process with a long-focussed lens.

If formed by a gradual process of development, a long time must have elapsed before so complicated an organ as the proboscis of the common flies, blow-flies, and drone-flies came into being. If we look to what advantage this form of mouth-apparatus bestows upon the creatures, we find the pseudo-tracheæ act as filters as well as conduits. Unlike the biting insects, the beetles, no solid particles suit these creatures, and the varying delicacy of the pseudo-tracheæ adapts them to different fluids. Perhaps the blow-fly and his relations may take up thicker fluids than the drone-fly, and the daddy-longlegs, to which reference will be made in the next article, only dines upon those which are very limpid.

DICKENS'S STORY LEFT HALF TOLD.

A QUASI-SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from page 298.*)

THE next chapter brings us to Rosa again, at Miss Twinkleton's. We may remark here, that no note in the opening music suggests the tragic tone which we should expect were Rosa sorrowing for Edwin's death. We presently find her full of horror at Jasper's pursuit, but even then there is no suggestion of any feeling that Drood is dead. On the other hand, there are passages strongly suggestive of the contrary. She speaks of fearing to open Edwin's "generous eyes," of keeping the truth from him "for his own trusting, good, good sake," as though he were still alive. Of course the words would serve well enough were he dead; yet is there a subtle distinction between them and those she would more naturally have used if she had deemed him dead. Just as, later, when she says to Grewgious, "His uncle has made love to me," we feel that she would not have said this, but "Mr. Jasper has made love to me," were Jasper's nephew really dead; so in this interview we feel that Rosa knows Drood to be alive though she does not know how Jasper had dealt towards the man whom he pretended to love so warmly.

The next chapter—"Rosa's Flight"—is still more significant. After showing the state of Rosa's mind in regard to Jasper, it tells us that she determined to go to her guardian, and to go immediately. She knows that he has the power not only to protect her against Jasper, but to check the vile scheme which Jasper has threatened to carry out against Neville Landless. Noting in passing that she finds Mr. Grewgious at the open window, his shaded lamp placed far from him on a table in a corner—manifestly maintaining his watch over Neville—we see her appealing at once to Mr. Grewgious for protection. Let us look a little carefully into this part of the story. He asks her how she came, and on her telling him, he asks why she had not written to him to come and fetch her. Clearly it had been arranged that if any new development required it she was to write to him. Her answer is remarkable: "I had no time. I took a sudden resolution. *Poor, poor Eddy!*" And Mr. Grewgious's reply is as strange. "Ah, poor fellow, poor fellow!" He has asked her why she came, and she says, "Poor, poor Eddy." Yet he finds the reply full of meaning, and instead of asking her how it bears on his question, simply echoes her thought! What can this mean? "I had no time. I took a sudden resolution. *Poor, poor Eddy!*" Clearly there is reference here to something which had been arranged beforehand between Rosa and Mr. Grewgious. Doubtless when he told her Edwin was alive, but that she must keep the knowledge of this to herself, he told her also of the love for her which had sprung into existence in Eddy's heart with the recognition of her real nature. *She*, not Eddy, had decided that she and Edwin could never be man and wife. If Mr. Grewgious had told her, as he doubtless did, that Edwin loved her, she must have answered that she loved him only as a brother. But, if Mr. Grewgious had suggested that perhaps with time a warmer feeling might find growth in her heart, and that did this chance he would wish her to tell *him* that one day Edwin might be more to her than a brother, she would not have rejected the thought, though her own heart might say nay to it. Doubtless there was a reference to some such thought when Mr. Grewgious asked why she had not written to him. "Poor, poor Eddy!" from her meant that her sudden resolution had no relation to Edwin's love; and, "Ah, poor fellow, poor fellow!" from Mr. Grewgious was the natural answer to what her sorrowful words implied, for he, too, had loved one so like Rosa that he had just mistaken Rosa for her ("I thought you were your mother"), and loved without hope, like Edwin.

And then she goes on, without further question from Mr. Grewgious, to say why she has suddenly come to him. "His uncle" (the uncle of the living Edwin you are sad for) "has made love to me. I cannot bear it. I shudder with horror of him, and I have come to you to protect me and all of us from him, if you will?" Not, "if you *can*." She knows he can, for she knows he can at any moment announce Edwin Drood to be alive. But, "if you *will*." And Mr. Grewgious makes no pretence of want of power to save Rosa and all of them. "I will," he says. "Damn him!

"Confound his politics,
Frustrate his knavish tricks,
On Thee his hopes to fix—
Damn him again."

(The whole of this scene between Rosa and Grewgious is worthy of Dickens's very best days, for quiet humour and pathos, fun and feeling.)

He is not even in a hurry to learn further particulars about Jasper's threats, so sure is he that he holds him safely. After the extraordinary outburst, in which he shows at once his detestation of Jasper and his contempt for the villain's plots, we have the laughable talk about Bazzard. Most certainly Dickens does not wish us to suppose that change of employment from clerkly duties to detective work (though no doubt Bazzard is employed in detective work) has suddenly changed the character of Bazzard. Throughout the talk with Rosa ("Let's talk," says Grewgious, quaintly) Bazzard is presented as the selfish, conceited dolt he had shown himself during the conversation with Edwin.

Then, after three pages of talk, Grewgious says, "And now, my dear, if you are not too tired to tell me more of what passed to day—but only if you feel quite able—able" [observe how Dickens emphasizes Grewgious's coolness about Rosa's news] "I should be glad to hear it. I may digest it the better if I sleep on it to-night." As she gives the account, it is to be noticed that Mr. Grewgious pays special attention to the part relating to Helena and Neville, which parts he "begged to be told a second time." He thanks her, takes her to the open window, showing her where Neville and Helena live" (and showing the attentive reader that, at the beginning of the scene, when Rosa entered, he had been keeping watch on them), and in response to her very natural request that on the morrow she might go to Helena, answers, doubtfully, "I should like to sleep on that question to-night." This last point is noteworthy, for it shows how largely the thought of the Landlesses enters into the plans of Mr. Grewgious—which are those of Edwin Drood—for bringing Jasper to a very bitter reckoning.

(*To be continued.*)

The International Prime Meridian Conference re-assembled on Monday, and adopted a resolution in favour of Greenwich as the standard meridian. The representatives of France and Brazil did not vote, and the San Domingo Delegate voted against the resolution.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER V.—THE EARTH'S ROTATION.

I HAVE often been asked what is the most striking and convincing proof of the earth's rotation. My answer has always been—the earth's revolution. The fact that the earth revolves round the sun is founded on much stronger evidence than any we have respecting the earth's rotation, considered separately. If there is one fact in the whole range of science which has been more completely demonstrated than any other, it is that of the earth's revolution. Now, accepting that fact, we are forced to accept with it the earth's rotation, because it is obviously absurd to suppose that while the earth revolves in an enormous orbit around the sun once in every year, the whole solar system, including the sun himself, revolves round the earth once in every day.

But the various facts of astronomy are so interwoven, that one is compelled, whatever order one may select for exhibiting them, to present some first, which in reality owe their establishment to others that must be dealt with later. I could not conveniently deal with the earth's revolution before considering her rotation, because before I consider those motions of the sun and planets which establish the fact of the earth's revolution, I must set apart, so to speak, the motions due to the earth's rotation.

Fortunately, however, there are many direct evidences of the earth's rotation, which, while not so striking as that founded on her revolution, are yet sufficiently convincing when rightly apprehended. These proofs are:—First, the diurnal motion of the heavens; secondly, the varying effects of gravity; thirdly, observed peculiarities in the descent of bodies from great heights; fourthly, observed peculiarities in the motion of a free pendulum; fifthly, experiments with the gyroscope; sixthly, precession and nutation; and lastly, the rotation of the planets. I shall take these proofs in their order, dealing with them at greater or less length, according as their importance may seem to warrant.

First, then, as respects the diurnal motion of the heavens:—We have seen what the nature of this motion is. It is perfectly regular for the fixed stars, slightly variable for the planets, the sun, and the moon; but undoubtedly, so far as the question of the earth's rotation is concerned, these slight irregularities may be neglected. We have only to consider that regular and persistent rotation which the stellar motions present to us, and to inquire whether it is more probable that the earth rotates from west to east, within the sphere of the fixed stars, or that the sphere of the fixed stars rotates from east to west around the earth.

Now, in the first place, we have proved that our earth really is a sphere, whereas, though we speak of the sphere of the fixed stars, we have no knowledge at all what the actual figure of the sidereal system may be. So, in so far as sphericity is suggestive of rotation, we have far better reason for believing that the earth rotates than that the stars do. But, secondly, we have proved that the earth is very small indeed compared with the distances which separate her from the fixed stars. So that as far as that explanation is more probable which accounts for observed appearances by the smallest expenditure of motion, we again have much better reason for believing that the earth moves within the star system, and not the star system around the earth. And, thirdly, we know that the earth is hanging suspended in space, not attached at any part of its surface to any other object, and therefore *free* to rotate. We may note also in passing that the minutest force applied tangentially to such a globe supposed initially at rest would cause it to rotate uniformly —however slowly—and if no new force were applied this rotation would continue until time should be no more. At least, then, we have a simple account to give of the earth's rotation; but when we consider the rotation of the sidereal scheme we find no simple explanation available. Are the stars rigidly bound together in some way? Then indeed they can rotate with the uniformity observed in their diurnal motion. But then we become immediately perplexed by the sun, moon, and planets, which, while partaking of the uniform diurnal rotation, have, superadded to this, motions peculiar to themselves. We must have for each of those bodies a separate sphere rotating about the same axis as the stellar sphere, each body being within its own proper sphere. If the stars are *not* thus bound together, then each travels uniformly in its proper circle, and at its proper rate round the polar axis; and instead of a single rotation accounting for the whole system of stellar motions, we require that each star of the thousands we see should travel independently on its proper diurnal path, and that path millions of miles in circuit, even by what we have already learned.

This is sufficiently difficult to believe; but when we add to this the evidence afforded by the telescope, the idea that the stars revolve diurnally round the polar axis becomes altogether incredible. In the first place, for every star visible to the naked eye, the telescope reveals thousands, each following the same law of motion which is observed among the lucid stars. Secondly, the careful telescopic examination of the heavens has revealed the fact that the so-called fixed stars have certain minute motions—a circumstance which suffices to show that they are not rigidly attached together in any way; so that we are compelled to dismiss the only possible conception by which the uniformity of their rotation seemed explicable. Lastly, the telescope reveals the existence of pairs of stars revolving around each other—a circumstance which yet more clearly proves that the stars, like the earth, are suspended in space, free to circle around each other or to sweep onward in solitary state, upon their several orbits.

The second proof of the earth's rotation is founded on the varying attraction of gravity in different parts of the earth's surface. We have seen that the earth's figure is that of a somewhat flattened sphere. Now without assuming the theory of gravitation as Newton propounded it, we yet know quite certainly that the earth's mass exerts an attraction upon all terrestrial bodies. A thousand experiments convince us that this attraction is appreciably uniform in any given place. The swing of a pendulum, the flight of a projectile, and many other obvious circumstances serve to prove this. Therefore, quite independently of Newton's theory, we can look on terrestrial gravity as not only an established fact, but one from which we can glean useful information.

Now, if a pendulum be set swinging at a considerable height above the earth, and its oscillation be compared with that of a pendulum at the earth's surface, gravity is found to decrease according to a certain law.

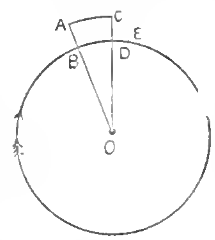
Suppose, then, we carry a pendulum from the polar regions to the equator, so that (according to what we have already learned respecting the earth's figure), the distance of the pendulum from the centre of the earth continually increases. Then it is not difficult for the mathematician to determine according to what law gravity ought to diminish in consequence of this increased distance. I do not enter into a consideration of the mode of calculation, because it depends on principles rather too abstruse for these pages. Suffice it to say, that these principles are thoroughly well established and certain, and that they lead to the conclusion that gravity at the equator should be about 1-289th less than gravity at the poles, if we merely took into account the earth's shape.

But instead of this, gravity at the equator is found to be less than gravity at the poles (or rather than gravity as calculated for the pole from the observed gravity in high latitudes), by fully 1-195th part. Whence then can the difference arise? This difference is equal to 1-195 − 1-289, or 1-599, and is not much less than half the estimated decrease, so that it is a quantity far too important to be neglected.

Now, it is really calculable that the diminution of weight due to the centrifugal force at the equator, if the earth really rotates once in a sidereal day, is exactly 1-599th part. In other words, if the earth were a perfect sphere, a body at the poles would weigh more than a body at the equator in the proportion of 599 to 598, supposing the earth really to be rotating. We see that this relation actually holds:—A body at the equator weighs less by 1-599th than it should weigh on the supposition that the earth does not rotate. Thus we have direct evidence of great weight, in favour of the view that the earth does rotate.

The evidence derived from the descent of bodies from a considerable height is one of the most interesting of all the proofs of the earth's rotation. It is also, I believe, one of the least known.

The general principles on which this proof depends are very easily explained. Let B be a point on the earth's equator, O the centre of the earth. A a point vertically above B. Then, clearly, the point A moves faster (if the earth is rotating) than the point B. We see, for instance, that in the time occupied by A in passing to C, B only passes to D, and A C is obviously greater than B D. Hence, if a body be let fall from A, it will not fall directly towards B, but will be carried by the excess of its motion, somewhat towards D. In fact, if we suppose that while the body is falling from A to the ground near B, the point A is carried to C, then the point B will have been carried to D, and our falling body will have reached a point E, such that B E = A C. The small displacement D E will be all that will be noticed by the observer; and when we remember how very small the distance A B must be in all real cases, when compared with B O, it will be seen at once that D E must always be very small indeed. Still, it has been found possible, by very delicate appliances, to render sensible the displacement of a falling body towards the east (the direction of the earth's rotation). Before describing the experiments made on falling bodies, it may be well to consider the minuteness of the results to be looked for. Suppose we consider the case of a body at the equator, let fall from a height of 1,000 feet; then, according to the usual formula, the time of falling is



$\sqrt{\frac{2000}{32}}$ (taking gravity at 32 for convenience); that is, the time is rather less than 8 sec. Now, in 8 sec. a point on the equator travels about $\frac{25{,}000 \times 8}{24 \times 60 \times 60}$ miles $= \frac{250}{108}$ miles $= 2{\cdot}3$ miles or thereabouts. And in order to see how much farther a point 1,000 feet above the level of the earth would travel, we have only to take the same portion of 2·3 miles, that 1,000 feet is of the earth's radius. Thus we get (in miles) $2{\cdot}3 \div \frac{4{,}000 \times 1760 \times 3}{1{,}000}$ roughly; that is, $\frac{2{\cdot}3}{4}$ ft.: or not quite 7 inches. Now, the slightest breath of air when the falling body was so far from the ground would suffice to cause such a displacement as this. And since it has never been found possible to secure so great a height with perfect freedom from disturbing causes, the displacement which has commonly had to be looked for is one measurable not by inches but by lines. Even the resistance of the air tends largely to diminish it.

Newton suggested this method of proving the earth's rotation, and Dr. Hooke, then Secretary of the Royal Society, carried out the first experiment. He dropped a number of balls from a height of 27 ft., and found that they fell towards the south-east. This result, however, though accordant with theory, cannot be depended upon, since the theoretical deviation for this height is only about a fiftieth part of an inch.

Guglielmini, 113 years later, next tried the experiment in the tower Degli Asinelli at Bologna. The fall was about 300 ft.; but he found that his experiments were interfered with during the daytime by the vibrations of the tower. He therefore worked at night, and only when the air was perfectly calm. The suspended balls were examined with a microscope until it was found that all oscillation had ceased; then they were liberated by burning the thread which held them. They fell on a cake of wax. So truly were the experiments conducted that the greatest deviation between the holes made by the balls did not exceed half a line. Guglielmini then had to determine where the true vertical would fall, and for this purpose he dropped a plumb-line in August, 1791. Some idea of the difficulty of the problem and of the delicacy of the operations necessary to secure success, will be suggested by the fact that he had to wait half a year before his plumb-line came to perfect rest. He found, then, that the deviation of the balls he had dropped (16 in all) was 7·4 lines towards the east, and 5·27 towards the south.

The mathematicians set to work to inquire whether this result accorded with theory. They found the deviation should have been but about five lines towards the east, and none towards the south. On inquiry it was found that the difference might fairly enough be ascribed to two circumstances—first, the fact that the walls of the tower were perforated in different places, and the air consequently disturbed by currents; secondly, the fact that whereas the balls were dropped in the summer, the plumb-line was let fall in the winter, and the tower would doubtless be affected by the difference of temperature.

But while these considerations explained the observed discrepancy, they rendered the experiments valueless. If scientific men were like the paradoxists they would have stuck to it through thick and thin that the experiments proved their position; but, fortunately for the interests of truth, scientific men are more modest, more truthful, and more patient. They quietly abandoned the experiments as practically a failure, and forthwith instituted new trials with new precautions and new contrivances to render the results more trustworthy.

The successful experiments finally conducted on Newton's method are full of interest and instruction.

(To be continued.)

On Saturday last, Mr. J. H. Adams, riding a 46-in. "Facile" bicycle, accomplished the astonishing distance of 266¼ miles within the twenty-four hours, thus beating all previous records. The route was from Devizes, *viâ* Marlborough, Hungerford, Slough, Rickmansworth, and St. Albans, to Biggleswade, and returning by same route as far as Hungerford, thence to Swindon and back, and completing the time on the London road. This performance has caused considerable excitement in cycling circles. On the same day Mr. E. Oxborrow, also riding a "Facile," accomplished 234 miles over the same route.

BRITISH SEASIDE RESORTS.

FROM AN UNCONVENTIONAL POINT OF VIEW.

By Percy Russell.

(Continued from p. 216.)

Great as is the interest attaching to Peel and Douglas, Castletown, known in Manx as *Balley Cashtal*, or the town of the Castle, far exceeds them both in its historic and antiquarian associations. It stands on the margin of a bay of the same name, and clusters about Castle Rushen, originally a Danish fortress of extraordinary strength. Some of the almost Cyclopean walls of this famous fastness of the Danish times are six yards thick. They are constructed of very hard limestone, and such is the almost imperishable character of the masonry that the marks of the mason's chisels still remain in many cases distinctly visible, although the work is not much less than a thousand years old. The castle was originally founded by Guthred II., and has been added to during succeeding epochs, so that it is in some measure a visible and most instructive record of British castle architecture. Robert Bruce once besieged the castle for six months, in or about 1313. On the shore, not far from this fortress, is a mound surmounted by the remains of what was once the place of execution in this ancient seat of Manx Government, and here William Christian, who makes so striking a figure in Walter Scott's "Peveril of the Peak," was put to death by order of Lord Derby for surrendering Castle Rushen to the Parliament. The history of the Isle of Man carries us far back in its early authentic phases to a line of wild Welsh Kings, who reigned from the sixth century for several generations. A line of Norse Kings succeeded, until the Manxmen, weary of their rulers, appealed for protection to Edward I., and, by a formal document, submitted the island to the British Crown, retaining, however, all their local laws and customs. The government of the island was eventually granted in perpetuity to the House of Stanley, and the Earls of Derby were long Lords of Man. Eventually, by marriage, the island descended to the Athol family, and in 1806 the sovereignty was bought of the Duke of Athol by the British Government, and some privileges he still retained were subsequently sold for a large sum. Once on a time, the Isle of Man was undoubtedly a great Druid station, and this is attested by numerous archæological remains. The Isle of Man now forms a separate Bishopric, believed to be as old as the year 447 A.D. The island, as is popularly known, has its own constitution, laws, and courts; and the House of Keys, self-elective until 1866, is one of the most curious legislative bodies in Europe.

Few parts of the British Isles thus far north possess so fine and equable a climate. This is the result, no doubt, of the position occupied, sheltered at once by Irish, Scotch, English, and Welsh mountains; but the wild, rocky shores are scourged by terrible tempests at times.

Myrtles, Portugal laurel, the arbutus, and other plants usually associated with a very much warmer latitude thrive well, and in an orchard at Castletown a single apple-tree yielded in one season 16,000 excellent apples. In the winter, however, there are heavy snowstorms, and the pastoral interest suffers severely at times. Some beautiful larch-trees have been planted in places, but the sea gales are very unfavourable to their growth. The oak thrives well, and one lovely glen conducting from Douglas to the interior should be visited by every tourist who has a soul for sylvan beauty. This place is known as Glen Darrah.

In the northern districts wheat is raised, and oats and barley are freely grown. Flax is raised, too, and wrought up by many of the cottagers, both for home use and for export. A race of very hardy ponies is peculiar to the island, and partridges and hares abound, as do also woodcocks and snipe. In olden days falconry was much practised, and, indeed, the falcons of Man were much celebrated. It has been frequently remarked that no poisonous creature is found, but this, I fancy, is rather apocryphal. Red deer once roamed over the mountains, and the skeleton of the elk has been found in quarries. The land-tenure system is worth studying, especially in these days, when the English landlords are on their trial. "We do not hold farms," a Manxman will remark, "as is done in England; there they pay for them and return them to the proprietor; ours are our own, and we bequeath the whole." There are, however, numerous exceptions; and, indeed, for so small a community, there is ample variety in the existing modes of land-tenure. The selling of the island to England by the Duke of Athol was a most unpopular proceeding, and a current rhyme among the people declares that:—

> The babes unborn will rue the day
> That the Isle of Man was sold away.

Formerly the British Navy was largely recruited from among the islanders, and Manxmen were and are held in high esteem by British naval officers. One man, pressed out of Douglas, rose to be first lieutenant to Nelson in the *Victory* at Trafalgar. There are a good many native domestic manufactures and industries worthy of notice, but the fisheries employ a large number of the inhabitants, and the departure of the great herring fleet is a sight that once seen is not easily forgotten. The people are healthy and, as a rule, long-lived, and as a body are superstitious to a degree. They are a religious people, as may be inferred, and it is to their credit that the Manx language does not include any words at all equivalent to those oaths which, unfortunately, abound in our Anglo-Saxon. I don't know how this may be just now, but not many years ago, when an ill-advised emissary of some Infidel propaganda landed in the island to distribute tracts, a sensation was produced among the people as though a man-eating tiger had made its appearance, and yet I must confess that with all this the Manxmen are rather addicted to drunkenness. They are, like most Celts, fond of music, and pay great respect to their various ancient remains, their circles and crosses, and other legendary monuments One trait strikes a stranger much, and that is the singular fondness of the people for law. Formerly, love of litigation was so great that persons are said to have gone for redress in the courts of law for sums amounting to only one shilling, which, by the way, used to be the ordinary day's earnings of an industrious Manxman. As is the case with their Celtic cousins in Ireland, indolence is a characteristic of these simple and generally amiable islanders, and most of the workmen observe the custom of taking not one but two hours as an interval of rest in the middle of the day. Like the Irish, the Manxmen are hospitable, but to English notions this hospitality goes rather far, since even the passing beggar, on presenting himself at the door of a house and asking for board and bed, could not be denied his "simple boon," and at one time the plague of sturdy beggars was a serious evil.

The Manxmen have really no literature, except some very melancholy songs in the style of Ossian, and, like most Erse poetry, indicating consciousness of vanished national power. The first book ever printed in Manx was issued by Bishop Wilson as late, comparatively speaking, as 1699. Subsequently, village libraries were formed, and real progress made in removing the reproach of illiteracy from this corner of the British Islands.

One of the best views in all the island is from Ramsay Bay, in the north. The coast at this point forms a fine semi-circular sweep, flanked by the huge precipices of Maughold Head and by a range of red cliffs. Right in front is the fine and lofty Mull of Galloway, with its grey cliffs and storm-worn aspect. The innumerable sea-fowl, too, which breed among the cliffs of the island, give a very striking character to the coast, and assimilate them greatly to some of the western islands of Scotland. Taken all in all, for persons seeking entire freshness of scenery, combined with great natural beauty, and desirous of combining studies of primitive rural British life with seaside recreation, the Isle of Man forms an excellent resort, and its historic and archæological reminiscences and remains abound in permanent national interest. It now remains to deal in detail with the very extensive coast line of Scotland, which, as I shall show in my next, possesses some very extraordinary and deeply interesting features.

THE INTERNATIONAL HEALTH EXHIBITION.

XX.—ANTISEPTICS AND DISINFECTANTS.

As preliminary to an inquiry into the present aspect of the sewage question, the pollution of rivers, and the utilisation of house refuse, we propose to give a brief review of the principal methods which have been introduced for the purpose of securing those conditions which are so important to the maintenance of healthy homes, where the accumulation of waste products, and their outcome of filth, cannot conveniently be avoided. To check the spread of disease arising from dirt, and the consequent growth and multiplication of evil germs, is the work of the purely antiseptic re-agent. But there are many drawbacks to the exhibition of such preparations as carbolic acid, tar, turpentine, &c., the chief of which lie in their deleterious effects upon the vitality of living things, and their own offensive odours. Their mode of application, too, in the form of powders or soaps for *general* use is, to say the least, far from desirable; for, in the former instance, the accumulation of dust is aggravated, and, in the latter case, they cannot be employed with any degree of convenience and comfort. Powders and soaps, however, are both of great value in *special* instances, and we are delighted to find that the new Carbolic Sanitary Company, of Hackney Downs railway-station, have produced a carbolic powder under the name of "The Government Disinfectant," which is a combination of various agents, carbolic acid predominating, and which acts as a deodoriser in addition to its other antiseptic and disinfecting properties.

To fulfil the requirements of a good disinfector, the material employed ought to be odourless, free from staining propensities, non-poisonous to man and the higher animals, non-corrosive, and capable of being both generally and specially applied with the greatest degree of convenience and a minimum of expense. There are many such preparations now in the market, amongst which the more notable may be viewed and tested in the Eastern Annexe of the Exhibition.

"Condy's Fluid" claims our prior attention as having been the pioneer of this class of disinfectants. It is prepared from the permanganate of potash, and acts as a powerful oxidiser of organic matter. The varied uses to which it can be applied may be gathered from a little pamphlet issued by the Company,* in which a large amount of useful information is incorporated. There are two qualities of the Fluid—one crimson and the other green; both have the same properties, but differ in degree of strength, the crimson being the more potent of the two, and better adapted for general domestic purposes than the green.

A preparation called "Hartin's Crimson Salt" deserves special mention here because it fulfils, in their integrity, all the requirements of a good disinfector, which we have noted above. As its name implies, it is prepared in form of a readily soluble salt, a shilling bottle of which will make 300 gallons of crimson fluid of a strength sufficient to supply the wants of any ordinary case where disinfection may be necessary. It thus comes within the easy reach of even the poorest householder, and we therefore strongly recommend it to the notice of those who are desirous of promoting really valuable sanitary measures.

"McDougall's patent Carbolic and Sulphurous Disinfectants, in Powder, Fluid, and Soap; or, in other words, the most potent Antiseptic with the best Disinfectant," is the title of a descriptive and illustrated price-list issued by Messrs. McDougall Bros., of 10, Mark-lane, in which a large variety of excellent preparations, each adapted to some special want, is given. Amongst other things, we may draw attention to the "Fluid Carbolate,"—a combination of carbolic and sulphurous acids in the strength of 1 per cent. each, which is an antiseptic of value for healing purposes, being applicable both externally and internally. It is a neutral solution of carbolate of lime and sulphite of magnesia, and combines all the valuable qualities of both carbolic and sulphurous acids without any of their objectionable properties. We shall have occasion to notice these exhibits once more in connection with improved appliances for disinfection, fumigation, &c.

The old-fashioned plan of burning sulphur and charcoal in the fumigation of infected dwellings has not been abandoned. It is, indeed, a most effective method of operation; its only drawback lies in the fact that it is inconvenient. We are glad to find, however, that this really useful process bids fair to be revived in the compact sulphur disinfectant cakes brought into use by Mr. Charles Gander. Sanitary Inspector of Alcester, and now being exhibited by Mr. Overbury. One of the cakes can be carried by the sanitary inspector in his pocket, and lighted in the house after the patient has recovered sufficiently. It is estimated that the fumigation of one house would by this means cost about 6d., so that we consider it to be, from every point of view, a decided advantage over all former methods.

Under the fanciful name of "Affinitan," an excellent disinfectant, manufactured by Mr. A. J. Shilton, F.C.S., of 40, Paradise-street, Birmingham, is now being exhibited. The inventor claims that it "is entirely free from smell, and does not stain. All foul odours are instantly destroyed by it, and as a means of preventing the spread of disease it is unrivalled." Its cost brings it within the reach of all.

Anti-Microbe † is another valuable disinfectant. It is said to act as much on ammoniacal and sulphuretted hydrogen gases, as on organic matters which are subject to decomposition, and this it does without any disagreeable odour. These combined with its non-poisonous properties, place it in the foremost rank of modern disinfectants.

A novel device is the Austin Porous Disinfector,‡ of which the following quotation will give a sufficiently explicit outline:—

"They require no fixing, as they can either be suspended or placed at the bottom of the cistern. There are no mechanical parts whatever in them, as the disinfector consists merely of a box of a porous material, through which the disinfectant passes after the crystals are dissolved by the action of the water. They will deodorise the water in the w.c.'s drains for fourteen months, and prevent zymotic diseases. The crystal disinfectant contained therein is inodorous, non-poisonous, and non-corrosive." We consider that every household ought to be provided with one of these useful disinfectors.

* "The Book of Directions for the Use of Condy's Fluid." Condy & Mitchell (Limited), 67 and 68, Turnmill-street, E.C.

† To be obtained from J. R. Meihe, 15, Abchurch-lane, London, E.C.

‡ Called after its inventor, Mr. Austin, 61, Wool Exchange, Coleman-street, London, E.C.

VACCINATION FOR YELLOW FEVER.

Dr. Freire, of Rio Janeiro, in a recent letter to the *Sanitary News*, writes as follows:—

In compliance with your request, I will give you an account of the chief points of interest connected with my studies on yellow fever. I can, of course, give you only a very brief summary, and for further information may refer you to my two memoirs—"The Cause, Nature, and Treatment of Yellow Fever" and "The Contagion of Yellow Fever." An extended report on all the theoretical and practical bearings of my researches is now in press, and a copy will be sent to you as soon as issued.

The method of culture which I have followed is Pasteur's. I withdraw blood, or any other organic liquid, from persons sick with yellow fever, or from the bodies of the dead, using the most scrupulous precautious, and introduce these liquids into Pasteur's flasks, previously sterilised, and containing a solution of gelatine or beef "bouillon." In these conditions the microbe develops abundantly, and becomes of itself attenuated by the action of the air, which filters through the tampion or amianthus with which the flask is corked. The purity of these cultures is demonstrated by microscopic examinations, of which you will find a good illustration in my memoir, "Experimental Studies on the Contagion of Yellow Fever."

The microbe appears in the form of little black points, like grains of sand (780 diameters); in the mature form it presents the appearance of round cells with an ash-grey or black rim, containing in their interior yellow and black pigment and some granulations which will be the future spores. These cells burst at a given moment, and pour out their contents, *i.e.*, the spores, the pigments, and a nitrogenous substance composed of ptomaines, which I have isolated not only from vomited matter, but also from the blood itself, and from the urine. The yellow pigment, being very soluble, produces the icteric infiltration of all the tissues by a sort of tinctorial imbibition which may go on even after death; the black pigment, as well as the detritus, resulting from the rupture of the cells, being insoluble, is carried into the general circulation, and produces obstructions in the sanguine capillaries, whence the apoplectic symptoms so common in yellow fever and in the urinary tubules, whence the suppression of the urine, a very frequent and terrible symptom in this disease.

I have described this microscopic organism under the name of *Cryptococcus xanthogenicus*; its development resembling that of this genus of algæ.

After having demonstrated the contagious nature of yellow fever by experiments upon barndoor fowls (see my memoir), I made experiments in preventive inoculations, first upon animals and afterward upon men: I did not fear to do this, because a multitude of experiments upon animals had previously convinced me of the perfect safety of inoculation with attenuated cultures.

Up to this date I have vaccinated 450 persons, for the most part foreigners recently arrived. Freedom from yellow fever has been pronounced among those thus vaccinated, for they have passed through a quite severe epidemic, and only six deaths have occurred among the 450 vaccinated persons—that is to say, less than two in a hundred—while more than a thousand deaths have occurred among the non-vaccinated, the mortality of the non-vaccinated sick being about thirty to forty per hundred. Thus, if we take one hundred vaccinated persons, under the most favourable conditions as regards receptivity, we have only two deaths during the entire epidemic; if we take one hundred non-vaccinated sick, we have thirty to forty decedents, which gives a mortality fifteen times greater among the non-vaccinated. Even if the mortality were only ten times or five times less great among the vaccinated, the preventive measure would be worthy of adoption. The protective inoculation for charbon gives an immunity to one-tenth, and that of vaccination for small-pox guarantees an immunity to one-fifth, according to the calculations of Bousquet.

Dr. Domingos Freire,

Professor in the Faculty of Medicine of Rio Janeiro,
President of the Central Junta of Public Hygiene.

"ENGLISH AS SHE IS SPOKE" IN AMERICA.

By Richard A. Proctor.

Many Americans believe that English is only spoken in its purity under the Stars and Stripes. Possessed by the notion that every English-born person systematically drops his h's where they are wanted, and inserts them where they ought not to be, the American is apt to regard the peculiarity as typical of the differance between English English and American English. If this view were sound, it would be interesting for Englishmen to inquire how the language which, after all, is theirs, is spoken beyond the Atlantic. There is work for a new grammarian in this direction. For, if Americans, as a whole, are more careful than Englishmen about their aspirates, they assuredly have some very original notions about other matters not less important. Thus in the new grammar, if based on the language of the immense majority of Americans, especially out West, we should find the following new form of the imperfect tense of "To be":—

I was, he was, we was, you was, they was.

We should, furthermore, have rules justifying the expression, "There aynt no." The past tense of "do" and "come" would be found to be "done" and "come" in this new grammar—*as*, "I know he done it," "we knew you'd do it when you come along." The new language would have no verb "to lie," except as signifying "to tell a lie"; so that "let it lay there" would replace our bad English "let it lie there"; with many other changes of an equally original nature.

Whether, with the further progress of time, still stranger changes would not have to be made may be reasonably asked. For much of the atrocious grammar used in America has arisen from the habit of imitating negro talk. And already you hear white folk say, not "he did it," as we benighted Englishmen do, nor "he done it," as the more grammatical Americans still try to say, but "he gone done it," and so forth.

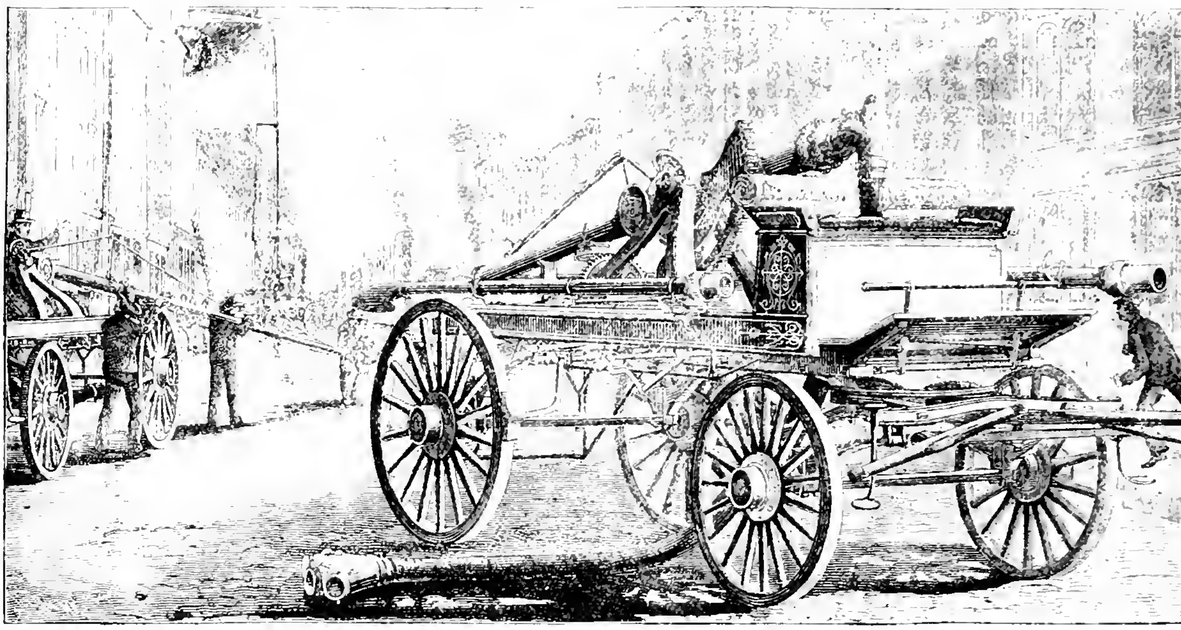
To what grammatical lengths our kinsmen in America may go, if they encourage their present taste for novelty, is painfully suggested by a little story in the *Century* for September. Consider the following speech (made by a well-to-do farmer):—"Young people, 'special females, owes it to theirselves to be monst'ous, streemous keerful and particklar who they take up with in that kind o' style" (he is talking about marriage), and "special in the pints o' prop'ty. For it's a heap easier, and it's a heap convenanter, and it's a heap comfortabler to *start* with some prop'ty than it is to work an' projeck, and deny a body's self the lugiieries, an' the comforts, an' sometimes the very needcessities of life, which, in course, a person'd like to have 'em, but which, when they start po'" (nigger English or American for poor) "they has to wait for 'em, an' which, ef they'd wait an' look around keerful, the chances is some of 'em might do better than what they been a expectin'."

On the whole, I prefer English English to nigger English, but this may be a weakness on my part.—*Newcastle Weekly Chronicle.*

THE NEW YORK FIRE DEPARTMENT.

Although the single swing of a pendulum only measures a second of time, yet each one of these periods may be so intimately and directly connected with events of such vital interest as to become of the greatest importance. It is doubtful if there be any moment, in any calling, in which so many movements bearing immediately upon the result are crowded as in the fire department when an alarm is received. The ease with which an incipient fire can be extinguished, and the fearful rapidity with which it spreads and gets beyond control, compelled the adoption of every device and method that would in any way lessen the time intervening between the alarm and the arrival at the fire. Consequently, each fraction of a second is carefully guarded lest it escape before having seen the performance of some step tending toward the accomplishment of the main object. The seeming confusion, the apparent mixing up of men, horses, and machinery, is the outcome of persistent study aided by a thorough acquaintance with the wants, and with even the minutest detail that could be made subvervient.

All the fire-alarm boxes in this city are connected by wires with the headquarters of the fire department, and are all numbered. When the hook in a box is turned down, the alarm is made only at the headquarters, where the operator, by the aid of a switch-board, instantly sends the number of that particular box to every fire company in the city. In each company's house, near the door, are placed the gongs, recording apparatus, telephone, &c. (The position of the various instruments, the location of the engine and stalls, and of the poles by which the men descend from the upper floors, and the method of hanging the harness so that it may be placed upon the horses in less than a second, are all plainly shown in in our view of the interior of the quarters of Engine Company 33, on Great Jones-street.) The first alarm is sounded upon a small gong, familiarly known as the joker, and the first stroke sets in motion a train of mechanical movements which, though in operation but an instant, produce most strange results, and change a scene of quiet into one of startling activity and of absorbing interest to the stranger who chances to be present. The first impulse of electricity passing over the wires attracts the armature of a magnet, which releases a small weight sliding on a rod placed beside the gong. This weight strikes the arm of a lever that permits the fall of a heavy weight



The Water Tower.

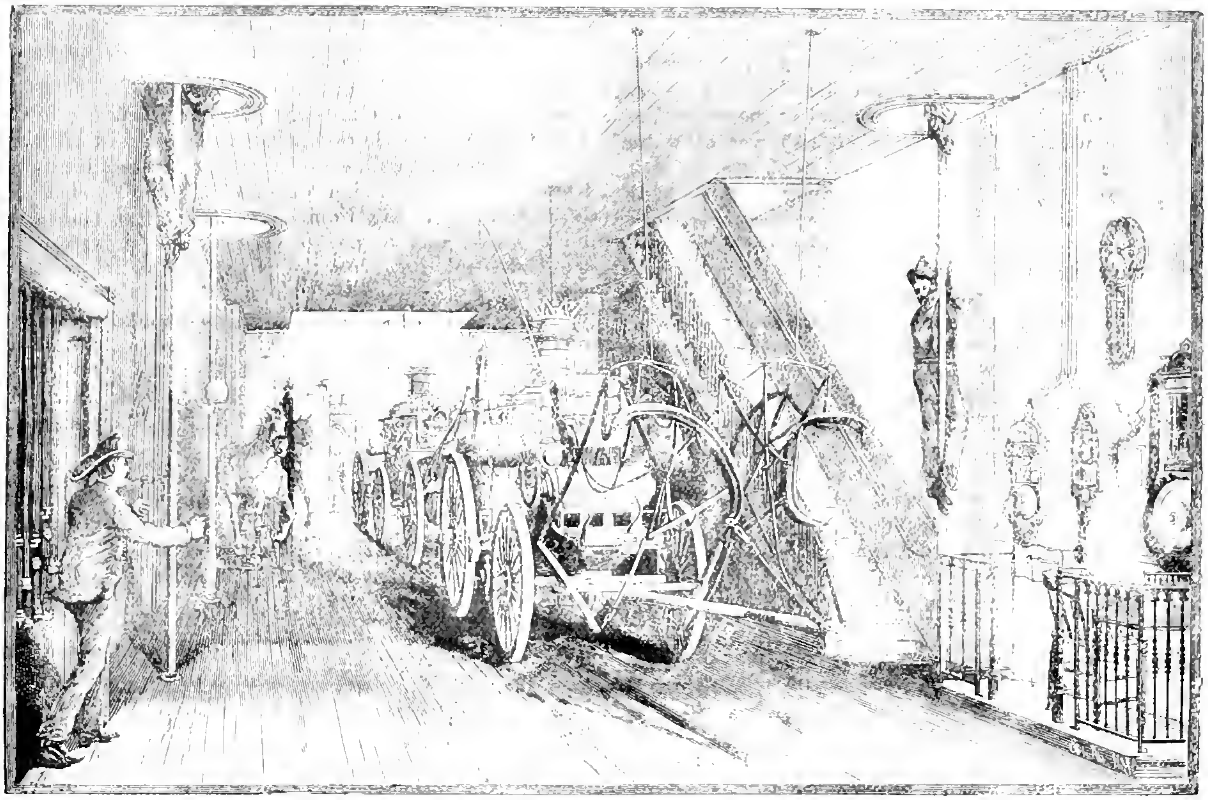
located below the floor, and which is so connected as to withdraw the bolts holding the halters of the horses, who dash forward to their places under the harness. The same impulse of electricity has sounded the alarm upon gongs in the sleeping apartment on the second-floor and in the reading-rooms on the third-floor, and the men come sliding down the brass rods. The time of receiving the alarm is recorded by a small clock that is stopped at the first stroke. Before the gong has ceased ringing the harness has been dropped and clasped, the driver is belted to his seat, and the men are waiting for the doors to be rolled back.

So far each company in the department has gone through these operations, since all are compelled to hook up at every alarm. The boiler of the engine is directly connected with a coil of pipe in an ordinary egg-shaped stove placed in the basement. Low down upon the rear of the engine are two pipes which are attached by telescope joints to two pipes leading up from the coil. When the engine is to go out, two valves which prevent the escape of water from the boiler are closed by moving a lever, and a rod pressed down through a hole in the floor. This rod operates four valves; two which close the pipes leading through the floor, and two which open pipes leading to a small tank in the ceiling, in order that the coil may be supplied with water during the absence of the engine. The rod also raises the lid of the stove to deaden the fire.

The strokes upon the joker might be compared to a series of dots and dashes sounded quickly—thus, two strokes and a pause, three strokes and a pause, and five strokes would indicate that the alarm came from box numbered 235. These strokes are repeated two or three times by the joker, and are then told off, but much more deliberately, upon the large gong. This arrangement is to save time, and while the men are hitching up they are counting the strokes. and if there is any doubt about the number they wait until the signal is given by the big gong. But it generally happens that the engine is on its way to the fire before the second gong has begun its work. After the exact number has been ascertained, all those companies which are expected to respond to that number start for the scene of the fire, while the other companies, after waiting a short time, unhook the horses and place the apparatus in the condition it was before the alarm was struck. We thus see that one stroke places the entire force of the department on the alert, and fifty-four engine companies (nine of which are double companies, and are provided with an extra engine and a large number of men), seventeen hook and ladder companies, and the two water towers are ready to turn out at every alarm. Many of the companies are frequently out of their houses in three, four, or five seconds, and at the last horse show in Madison Square Garden, this city, Engine Company 33 hitched up once in $1\frac{3}{4}$ sec., once in $1\frac{5}{8}$ sec., and once in $1\frac{3}{4}$ sec.—or three consecutive times in less than two seconds.

The most important item in the time question is getting the horses in harness. The horses are placed in stalls as near the pole as practicable, and are kept bridled. The harness is attached to the engine, and is raised to such a height that the horse has no difficulty in passing to his place beneath it. It is suspended from a Y-shaped frame of tubing, at each end of which is pivoted a downwardly-curved hook, upon which the harness rests. The reins pass through a catch in the centre of the frame, so that by pulling them the hooks are released and the harness allowed to fall upon the backs of the horses. The collars are hinged at the middle, and one free end is provided with a bolt which enters a socket in the other end, in which it is held by a spring catch. The hinge is made wide so as to prevent lateral movement and insure the entrance of the bolt when the ends are brought together.

The forward fire-engine shown in the illustration is from the Clapp & Jones works, and is what is known as second class. The plunger is $4\frac{7}{8}$ in. in diameter, and the engines (double) are 8 by 7 in. The boiler is 64 in. high, 35 in. in diameter, has 120 drop water pipe tubes, and 40 smoke flues. It is capable of throwing three streams, two side ones $2\frac{1}{2}$ in., and a centre one $3\frac{1}{4}$ in. in diameter. It is not necessary to notify the engineer of the amount of water required, since the quantity can be controlled by the man in charge of the nozzle. In the nozzle is a conical shaped plug that can be moved longitudinally by turning a screw collar, and by this means a stream can be obtained



Interior View of a Model Fire-Engine House.

varying from the size of a pin to the full capacity of the pipe. In case the nozzle is reduced or is completely shut off, the engine is relieved of all liability to serious strain by the action of an automatic relief valve designed by Mr. Pallet, of Engine 24. This valve is placed beside the pump, to which it is connected at two points, one above and the other below the plunger. The connecting passage is interrupted by a valve held upon its seat by a spring in such a way that the pressure necessary to raise the valve can be regulated at will. When the full power of the engine is required, the valve is screwed down; but, for ordinary work, it is set at about 80 lb. As soon as the water pressure in the pipes is increased beyond this point, by partially closing the nozzle, the valve is lifted, and communication made between the top and bottom of the pump-chamber; when the nozzle is completely closed, the valve is raised clear of the passage, and the pump churns the water round and round. The engineer is relieved of all care, and the control of the water is placed in charge of the one who best knows the quantity required. The spray nozzle consists of a cylinder, one portion of which is thickly studded with small holes, and upon which slides a collar wide enough to cover the perforated section when a spray is not desired.

The sleeping quarters of the officers and men are on the second floor. Through the floor, in locations so as to be most quickly used, are three openings, in the centre of each of which is a smooth brass rod leading to the floor below. Upon the third floor are the billiard-room, lockers, drying-room, which has a zinc floor, and, together with the bath-room, is heated by a furnace in the basement, and feed-room. Hay and grain are raised from the rear. The grain bins are connected with the lower floor by tubes, and the hay is passed down through chutes, so all the dust is confined to one small room.

When fighting a fire, it sometimes becomes essential to throw a powerful stream into the upper stories of a building, and to give the most satisfactory results the nozzle should be elevated and brought in close proximity to the window. This is accomplished by the water tower (shown in several positions in the first view), which consists of a large pipe so mounted upon trunnions that it can be quickly raised to a vertical position. The lower end of this pipe is connected by a flexible pipe that extends under and to the rear of the truck, where it terminates in four 3-in. inlets, each of which may be coupled to a hose leading from an engine. Each inlet is furnished with a swinging valve, operated by the pressure of water in the pipe. Various lengths of pipe can be screwed upon the upper end of the trunnion pipe, giving the following lengths: single, 29 ft.; long single, 36 ft.; two short lengths, 43 ft.; two long, 50 ft. Between the end of the pipe and the end of the nozzle is inserted a short piece of flexible pipe that moves between two side flanges. Projecting from each side of the nozzle is a stud that enters a groove in the flange. The nozzle is connected by a light wire rope with a small drum placed on the body of the truck, from which location all the movements of the tower are guided. By winding up this rope the nozzle will be depressed, and will deliver water in a downward direction. The short connecting-pipe bends upon a curved frame that prevents wrinkling. The elasticity of the pipe and the force of the water are sufficient to raise the pipe when the rope is unwound. To stay a long length of pipe there is a stout wire rope extending from the top to a drum at the base. This rope is extended by braces hinged to the lengths. The vertical pipe may be moved upon its own axis. The stream may be delivered at any height below a certain limit, and directed up or down or to either side.

A distributor to be attached to the end of a hose consists of two curved hollow arms, one at each side of the closed end of the pipe. Upon the hub of each of these is a pinion engaging with a gear on the pipe. When water under great pressure is sent through these arms, they are rapidly revolved upon their own axes and at the same time about a common axis, so that they send a shower of water in all directions.

Water tower No. 2 is located in the same house with Hook and Ladder Company 3, on Thirteenth-street. Few people have any conception of the number of implements forming the equipment of a hook and ladder company, and fewer people still have any understanding of the uses of these tools. The truck here referred to carries the following tools, the use of which we briefly mention:—Two Bangor extension ladders, one 65, the other 45 ft. long, so constructed that they may be made any length up to the extreme; two ladders 35 ft. long, one 33 ft. long, one 25, one 20, one 15, one 12, one hook 20 ft. long, one 15, one 12, two 10, and six 6 ft. long. Two Babcock fire extinguishers, used upon small fires when required. One battering ram weighing $64\frac{1}{2}$ lb., and formed with a thick wooden section terminating in an iron shoe at one end, and having a short rod at the other; this is manned by six men; its use is apparent. Six tubular hand-lamps, four rubber buckets, seven forcible entrance tools. The iron shutters and doors upon the buildings of New York, being secured upon the inside, are most serious obstacles placed in the way of firemen, who, in order to effect a quick entrance, are supplied with crowbars and jimmies made of the best steel and after the most approved pattern. One 10-pound steel maul. Four cotton hooks, four hay forks, and two shovels for the removal of loose material. Four axes for cutting through floors, roofs, and partitions, and two picks for entering walls. One crow-bar, ten wrenches and belts, including a gas-pipe wrench for shutting off the gas when necessary; one roof rope 125 ft. long; two horse blankets; one whip. One respirator, by which the wearer is enabled to enter dense smoke and to encounter noxious vapours. One distributor, described above. One four-way connection. One length $3\frac{1}{4}$-in. combination hose. One copper pipe $3\frac{1}{4}$ in. Three nozzles. One iron pipe holder. One calcium light, with oxygen and hydrogen tanks and fittings. This is found most useful in lighting up the scene of operations. Two danger flags, to signal trains upon the elevated railroads, one patent horse-shoe, one butting-stick, one brass gong, two cushions. One cellar pipe, $1\frac{3}{8}$-in. nozzle, which is used to direct a stream to any part of a cellar, up or down, when thrust through a lower window, and which is of the utmost advantage in situations where the ordinary nozzle could only be made to deliver a downward stream One cross bar and chain. Three scaling-ladders of the following lengths and weights: 16 ft., 35 lb.; 18 ft., 39 lb.; and 14 ft., 27 lb. These are wooden poles backed with a strip of iron, and having steps at about every fourteen inches. To the upper end is secured a right-angled arm, which is notched upon the under side, and which ends in an angle piece. The hooks so formed are long enough to extend to the inner side of the widest window-sills. The ladder is raised and the hook thrust through the window when the fireman ascends. Another ladder may be handed to him and by him hooked in the second window, and another in the third window, until a string of ladders reaches the roof, or he may support himself upon the sill, raise the ladder he came up by to the second window, and so on to the roof. One life-line, 150 ft. long, and three coils of life-saving rope. The total weight of the tools is 2,718 lb., and these, together with the twelve men who go with the truck, and the truck itself, weigh 9,756 lb.—*Scientific American.*

Reviews.

Analysis of Milk, Condensed Milk, and Infants' Milk Foods. By Dr. N. Gerber. (London: Trübner & Co.)—This laboratory guide to exhaustive analysis of all kinds of milk derives, if possible, additional interest and importance from a recent decision of one of the London Police Magistrates, refusing to fine the vendor of tinned Swiss milk which was found to be deficient in cream. Dr. Gerber's book furnishes the most explicit instructions for the testing and analysis, chemically, microscopically, and physically, of every kind of milk—human, animal, condensed, preserved, and in the form of so-called milk-foods; treats of milk as the cause of disease; of Government control over its supply, &c., &c. This is a book which should be in the hands of every analyst and sanitary inspector in the kingdom.

The Safe Use of Steam. By An Engineer. Fifth Edition. (London: Crosby, Lockwood, & Co. 1884.)—The ignorance exhibited by a far too great proportion of those in charge of steam-boilers is something awful; and that what the author of this most excellent and practical little work before us rightly speaks of as "the appalling results" of steam-boiler explosions are not even more frequent than they unhappily are, may well excite the wonder of all who have ever seen how those belonging to thrashing-machines and traction-engines in agricultural districts are attended to. With the very plain and explicit directions contained in this small pamphlet, once mastered, a boiler accident ought to be, humanly speaking, impossible.

Comic Readings, English and American. (London: W. Kent & Co.)—Performers at "Penny Readings" (a form of entertainment still surviving in some agricultural districts) will find suitable subjects for their elocutionary efforts in this little volume.

Architecture and Public Buildings. Their relation to School, Academy, and State in Paris and London. By William H. White. (London: P. S. King & Son.)—Among the things which "they manage better in France" the author of the work before us would give a very prominent place to the supervision of the erection of public buildings. He attributes the artistic superiority of Paris to the existence of the Academy and of the School of the Fine Arts there, and to the fact that a State hierarchy of direction and control, consisting mainly of architects of position, has the virtual superintendence of every public building and monument in the French metropolis. He is very severe upon our own Royal Academy for its dereliction of duty in the matter of architecture, and essays to prove how dismally our Department of Public Works and Buildings breaks down in the absence of competent, disinterested, professional architectural advice. He endeavours to show that were the Government only to appoint a species of consultative council, to be drawn (although Mr. White rather implies than asserts this) from the Royal Institute of British Architects, public buildings would be erected better, more economically, and, above all, much more beautifully and artistically than they are under the present system. He tries to discuss his theme more or less judicially, and to keep his personal proclivities in the background, but here and there they peep out, as in his ill-disguised expression of contempt for the Gothic revival. On the whole, though, his book is worth reading by all who are concerned for the beauty and utility of our Government buildings, and his *exposé* of the utterly irresponsible character of the supervision supposed to be exercised over their erection may well be laid to heart by the British taxpayer.

PRACTICAL DIETETICS.

[COMMUNICATED.]

SOME time ago I promised some tables, the result of practical experiment, as opposed to the theory of foods. The following tables are taken from the XXVI volume of the Journal of the Statistical Society, article "Dr. Guy on Dietaries."

"A series of eight experiments were made, consisting of six (the first three and last three) on groups of ten prisoners variously constituted of men and women at different ages, and of boys and girls about 13 or 14 years of age; and of two larger groups of 21 and 20 respectively, of which the greater number were adult males. The particulars of the eight dietaries, with the average weights of the prisoners at the end of the month (each dietary being continued for that period) are given in the table annexed:—

at Millbank. The facts are given on the authority of the Governor of the Devizes House of Correction. The dietary consisted of—

Bread	196 ounces per week.	
Potatoes	112 ,,	,,
Total solid food	308, and gruel 7 pints.	

On two days in the week, a vegetable soup was substituted for the potatoes; but there was no meat whatever in this dietary, and no milk, or other animal matter. Nevertheless, the governor was able to report that this dietary agreed well with the prisoners, that no loss of strength was noticed, and that no prison could be more healthy. And he added, 'There is not now, nor has there been, any "case of scurvy."' It should also be observed that this exclusively vegetable diet, having been adopted in an English prison must have been strange to most of the inmates, who, before they

EXPERIMENTS AT GLASGOW BRIDEWELL 1840.

	Per week.							
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.
Oatmeal	91	91	91	91	91	56	91	—
Potatoes, boiled	336	336	—	224	112	112		672
,, baked	—	—	336			112	56	—
Bread	—				—		—	—
Meat	—			28	56			—
Total solid food	427	427	427	343	259	280	147	672
	Pints.	Pints.	Pints.	Pints.	Pints.	Pints.	Pints.	Pints.
Buttermilk	$10\frac{1}{2}$		$10\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{1}{2}$	7	$10\frac{1}{2}$	—
Skimmed Milk	—	$2\frac{1}{4}$		—			—	—
Broth*		—			—	—	11	
Total liquid food	$10\frac{1}{2}$	$2\frac{1}{4}$	$10\frac{1}{2}$	$10\frac{1}{2}$	$10\frac{1}{2}$	7	$21\frac{1}{2}$	—
Average weight gained	4 lb.	4 lb.	—			$2\frac{1}{4}$ lb.	—	$3\frac{1}{2}$ lb.
,, ,, lost	—	—	$1\frac{1}{2}$ lb.	$1\frac{1}{4}$ lb.	very slight loss		less than $\frac{1}{2}$ lb.	—
Prisoners submitted to experiment	5 men 5 boys	5 men 5 girls	3 young men 5 ,, women 2 boys	16 males 5 females	15 males 5 females	5 young men 5 ,, women	5 young men 5 ,, women	10 young men and boys.

* Containing to the quart 4 oz. of barley and 1 oz. of bone, with vegetables.

"Now, though the groups of prisoners are small and variously constituted, and the experiments consequently wanting in scientific exactness, some of the results are worth noting, as throwing light upon the value of these weighings as used as tests of a sufficient dietary. Between the first and third experiments, for instance, there is this difference only, that the potatoes are boiled in the one and baked in the other; but while the ten prisoners in the one experiment gain on an average 4 lb., the same number in the other experiment lose, on an average, $1\frac{1}{2}$ lb.* Again, though the substitution in the second experiment of $1\frac{1}{3}$ pints of skimmed milk of $10\frac{1}{2}$ pints of buttermilk in the first leaves the average gain of 4 lb. unaltered, the restoration of the $10\frac{1}{2}$ pints of buttermilk in the third experiment is followed by an average loss of $1\frac{1}{2}$ lb., in lieu of an average gain of 4 lb. It is also worthy of remark that, while the four dietaries which are followed by a considerable average gain are all vegetable diets, and one of them consists of 6 lb. of potatoes daily, two out of four dietaries which show a loss of weight contain a liberal element of meat. Lastly, it may be observed that, while the eighth dietary, consisting wholly of potatoes, shows an average gain of $3\frac{1}{2}$ lb., the seventh dietary, the only one from which the potato is wholly omitted, shows an average loss of less than half a pound." * * * * * * *

"Hitherto I have been dealing with mixed dietaries, several of which contain meat in some form or other, and the experiments at Pentonville were with dietaries of which meat formed a part; but I must now ask the attention of the society to dietaries from which meat has been wholly excluded, and to three dietaries especially which contain no animal food whatever. The first of these exclusively vegetable dietaries is very interesting, inasmuch as it is a prison diet on which prisoners were fed for long periods, and weighed at the beginning and end of their sentences. The history of this dietary and of its effects on the health of the prisoners and on their weight will be found in the Report of 1823 on the epidemic

* W. Mattieu Williams please make a note of.

became prisoners, had doubtless been able to procure more or less of animal food and of meat. The prisoners had been kept on this diet from various periods up to eighteen months—many of them for six months and more: 292 prisoners, in various groups, were weighed on entering and on leaving prison. Of thirty-eight prisoners thus weighed, after periods varying from two weeks to six months, twenty-seven were found to have gained, two to have lost, and nine to have neither gained nor lost. The average gain in weight was 3 lb. Two other prisoners, after eighteen months, had gained, on an average, 6 lb.; and twenty prisoners, confined for twelve months, had gained, at the end of that period, 5 lb., on the average. Four other groups of prisoners, confined during six months, three months, two months, and one month, respectively, gained, on an average, 3 lb., 3 lb., 2 lb., and 2 lb.

Here, then, we have in favour of a bread, potato, and gruel diet the most conclusive evidence. There was no loss of strength, an excellent state of health, no scurvy, and a most satisfactory addition to the weight of the prisoners. It should also be observed that there were among the prisoners several whose terms of imprisonment were sufficiently long to severely test any dietary.

Dr. Baly, in his paper in the *London Medical Gazette*, to which I have already had occasion to refer, gives an example of the same kind. It is that of the Stafford County Gaol, in which the weekly allowance of food consisted of:—

Bread	196 oz.
Potatoes	112 oz.
Total	308 oz.

with twenty-one pints of gruel, but no meat and no soup, and yet scurvy did not occur, its absence being verified by his own inspection of seventy prisoners confined in that gaol for periods of from three to six months.

In this case also a diet consisting wholly of vegetable food must have been new to the prisoners.

The third example of an exclusive vegetable diet is afforded by the eighth series of Glasgow experiments. The ten prisoners were fed for one month on 6 lb. of potatoes per diem, and at the end of that period had increased in weight, one with another, no less than 3½ lb., or only ½ lb. less than the average gain in the first and second experiments of that series.

These are the only examples that I have happened to come across of a purely vegetable diet—a diet from which not merely meat, but every animal product, even milk, was excluded. But I have already, in this paper, given several examples of dietaries from which meat was wholly excluded, the only animal element being milk made into porridge with oatmeal, and into pudding with Indian meal. I ask your attention again to the exceptional dietaries, of which I am able to give you two notable examples. In the report on military prisons (1861) the diet for military prisoners in solitary confinement for periods less than 56 days is shown to consist of

Bread	56 oz. per week.
Oatmeal	56 ,,
Indian meal	42 ,,
Total solid food	154 oz. with 10½ pints of milk.

And the penal class diet of Millbank Prison comprises:—

Bread	84 oz. per week.
Oatmeal	70 ,,
Indian meal	70 ,,
Potatoes	56 ,,
Total solid food	280 oz. with 10½ pints of milk.

The diet of military prisoners given above does not encounter objection on the part of the governors or medical officers whose views are stated in the report, and it may, therefore, be assumed to be sufficient for the support of robust men in confinement for periods less than fifty-six days; and this view receives strong confirmation from a passage in Dr. Tufnell's report from Dublin. He says:—"To the increase in the dietary, and especially its alteration, I have ever been, upon principle, opposed, because I found that I could, upon the old scale of dietary, maintain the men in the most perfect condition." Of the sufficiency of the more liberal penal class diet of Millbank, not merely for prisoners undergoing short terms of imprisonment, but for those who are in close confinement and under punishment for many months together, I am able to furnish the most convincing proofs. This dietary was favourably reported upon by my predecessor, Dr. Baly, in 1858, and in my own report for 1859. It has stood the test both of experimental weighings and more general observation of the state of health of the prisoners; and I have recently had occasion to report cases of men whose health has been maintained on this diet for seven, nine, eleven, fourteen, seventeen, and eighteen months. The women who are on this diet are weighed every month, and the results are quite satisfactory.

I have no hesitation, then, in expressing an opinion in favour of the sufficiency of a dietary from which the meat element is wholly excluded. I have no doubt that health may be preserved, and with it capacity for labour, on a diet consisting of milk and vegetable food; and I should have no hesitation in prescribing for all criminals under short terms of imprisonment a diet consisting wholly of bread and potatoes. I think that the experience acquired at the Devizes House of Correction, at Stafford, and at Glasgow would be complete justification for such a dietary."

These are a few examples of a non-flesh dietary, and later on I may be able to adduce more of recent date, showing that health, strength, &c., can be kept up without flesh. I also hope that our prisons and workhouses may be supplied with such diet, for the thousands of vegetarians in this country show that flesh is not a necessity.—By T. R. Allinson, L.R.C.P.

THE RECENT ECLIPSE OF THE MOON.

WRITING from Broughty Ferry, "Senex" tells us that all the earlier phases of the eclipse were only seen there through thick cloud and mist. The sky, however, cleared somewhat by 9h. 45m., after which my correspondent goes on to say:—"And we saw the Moon as a whitish blotch with the naked eye, but as a complete disc of dirty white in the telescope; no red colour, and the 'mares' quite black. About 10.20 p.m., the north-east limb began to show brightness, and then the copper colour crept over the Moon, and remained visible until the close of totality, and was then replaced by a beautiful blue arc, delicately shaded, which continued for ten or fifteen minutes, and then vanished. After this the shadow gradually receded; but, owing apparently to the haze, the edge of it was quite ragged."

"Hallyards," dating from Fornie (France), says:—"The sky here was extremely clear during the whole time; the Moon did not disappear entirely (as sometimes) nor did her whole disk remain visible, as usual, during the whole of totality, but a very trifling part, that nearest the limb of reappearance, and even this did not uniformly extend up to the limb; so that an ill-defined, varying, nebulous patch seemed hung up aloft; a new comet or nebula. At the beginning of totality, the light flickered about the disk like a dying candle for some time. Once only, for a moment or two, I saw the whole circle of the disk (naked eye all the time). After enough of the disk had reappeared to cast a shadow, I still saw the copper-coloured segment, which had remained visible all the time. This I mention as a test of eyesight. As seen from the Moon, the Earth is surrounded by a brilliant ring of light—refracted sunshine in our atmosphere. (Will not the solar corona also afford a notable contribution?) This is the cause of the moon not disappearing always totally: but this cause (or two causes) must give a *constant* amount of light. What, then, is the reason of the *flickering* of the light on the lunar disk? May it be due to an auroral self-luminosity of our atmosphere? Why is the Moon sometimes entirely invisible? Supposing her even in the centre of the shadow, and at perigee while we are in aphelion, would it not still be probable that our ring of sun-lit air would be bright enough to show her in some degree?—considering that the light of the crescent earth does so sometimes and a continuous ring of refracted sunlight should be surely stronger than a half-earth of reflected light."

A correspondent, who signs himself "E. C. H.," writes as under:

"Sir,—I watched the eclipse of last Saturday from Worthing Pier, and was much struck with its difference from other lunar eclipses that I have noticed, though the difference did not seem to be perceived by the friends who were with me at the time, or by those whom I have spoken to about it since. It was certainly the darkest eclipse I ever saw, and the moon, when entirely covered by the shadow, instead of assuming the 'appearance of a huge, glowing, coppery-red ball hung up in the sky' (to use, Sir, your words in Knowledge for Oct. 10), was visible only as a patch of dull, ashen-gray; I should hardly describe it as 'sickly green,' it was too neutral-tinted for that. This was the appearance as seen with the unaided eye; when I looked through a binocular glass that I had taken with me, I could make out the moon's circular shape, as I also could a little before totality, but not long before."

[The interesting point in the above communications lies in the fact of the faint, sickly-green hue of the visible limb of the Moon at the time of totality, and the change of the tint of the Earth's shadow to copper-colour at a later stage of the eclipse. (The latter change "Senex" says (writing subsequently) was not seen at all in Arbroath, Forfar, Dundee, &c., when the sky was clear. Hence he is disposed to refer to it in some way to the haze prevailing at Broughty Ferry.) This suggests the idea that during the first half of the eclipse a densely cloud-laden atmospheric ring must have surrounded the Earth in a direction at right angles to the Sun's rays; but that the Earth's rotation must, later on, have brought a more transparent annulus into the same position. Obviously, were our atmosphere *filled* with dense clouds, no refraction of the solar light into the umbra could take place, and the Moon would seemingly disappear entirely.—Ed.]

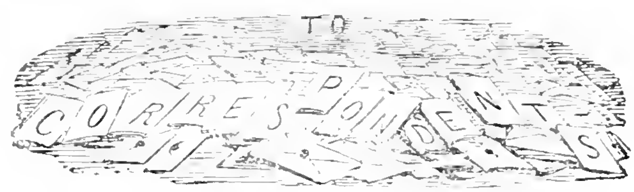
Government Inspectors.—A return has been issued by the Home Office of the number of inspectors in the employ of the several departments of the Government, and the amount of the fixed salaries paid to them. It is as follows:—England.—Privy Council Office—Agricultural Department, 27, £5,420; Education Department, 259, £105,075; Education (Scotch) Department, 48, £20,070; Science and Art Department, 4, £1,865. Home Office.—Inspectors of Factories, 56, £21,988; Inspectors of Mines, 26, £15,642; Inspectors of Fisheries, 2, £953; Inspector of Burial Grounds, 1, £500; Inspectors of Reformatories and Industrial Schools, 3, £1,386; Inspectors of Constabulary, 4, £3,300; Inspectors of Explosives, 3, £2,400; Inspector under the Cruelty to Animals Act, 1, £210; Inspectors of Anatomy, 3, £1,060; Inspector under the Habitual Drunkards Act, 1; Inspector of Rivers Pollution (Scotland), 1, £50. Board of Trade. Railway Department, 4, £4,400; Marine Department, 121, £41,980; Commercial Department, 3, £365; Inland Revenue, 53, £28,310; Local Government Board, 56, £30,080; General Register Office, 2, £1,180; Charity Commission, 3, £2,400; total, 684, £297,634. Scotland.—Fishery Board, 3, £1,165; General Board of Commissioners in Lunacy, 4, £3,200; Board of Supervision, 3, £1,400; total, 10, £5,765. Grand total, 694 inspectors, and £303,399 salaries.

Miscellanea.

Mr. W. Crookes, F.R.S., and Drs. W. Odling and C. Meymott Tidy, reporting to Colonel Sir Francis Bolton, official water examiner for the metropolis, on the composition and quality of daily samples of water supplies to London last month, state that of the 168 samples derived from the mains of the seven metropolitan water companies taking their supply from the Thames and the Lea, "the whole were, without exception, clear, bright, and well filtered. The excellence of the water supplied to the metropolis during August was indicated by its state of aeration, and by its freedom from colour and from any excess of organic matter. Further, its perfect filtration was evident by the absence of even a trace of suspended matter in any one of the numerous samples submitted to examination."

The experiments on the relative efficiency of different illuminants for lighthouse purposes which are being carried out by the Trinity Brethren, aided by the observations of the captains of the mail packets, the Peninsular and Oriental liners, pilot vessels of different nationalities using the channel, trading vessels plying between England and foreign ports, and by several French cruisers have in some respects been completed. They support the conclusions previously arrived at. So far as has been ascertained at present, there seems to be very little difference for all practical purposes between gas and paraffin oil. The gas-light, if anything, is slightly superior in fine weather, and the electric light is overwhelmingly superior to both the other lights. The crucial test of the electric light, however, will be in hazy weather, and it is stated that in some experiments which have already taken place when the weather was rather thick the light did not hold its own against the other luminants. Important tests will take place during the autumn, into which the experiments will be extended, when hazy weather and a greater variety in the conditions of the atmosphere may be expected.

Extent and Resources of Great Britain.—Those who are looking for statistics may find some rather startling figures in the address recently delivered by Sir Richard Temple on "Economic Science and Statistics" before the British Association at Montreal. On this authority it appears that the area of the British Empire is eight and a half million square miles. Including countries politically under its control, such as Egypt, Zululand, and Afghanistan, the total amounts to ten million square miles, or one-fifth of the habitable globe. One-quarter of this area has been topographically surveyed. The total coast-line is 28,500 miles, with 48 large harbours. Only one-fifth of the area is cultivated or occupied. There is room enough in Canada and Australia to support a population of 200,000,000. The total population of the empire amounts to 315,000,000, of which 30,000,000 are Anglo-Saxons and 188,000,000 are Hindoos. The annual revenue amounts to £203,000,000 of which sum £89,000,000 come from the United Kingdom, £74,000,000 from India, and £40,000,000 from the colonies and dependencies. Only one-forth of the total revenue is derived from land taxation. Including local taxation the revenue is £264,000,000, and amounts to £1. 5s. 4d. per head per annum. The number of men trained to arms amounts to 850,000, about 700,000 of these being of the fair and dominant race. The defensive armaments by sea and land cost £41,000,000 annually, which is less than that shown by any great State in the world except in the United States. There are 560,000 policemen in the empire, 1 to every 571 inhabitants and to every 16 square miles. There are 246 war-vessels, and 30,000 merchant ships manned by 270,000 sailors. The factory steam power in the world is represented by 7,500,000 horse power; of that total 2,250,000, or about 30 per cent., is British. If the main elements of national industry be taken together—namely, commerce, manufactures, mining, agriculture, carrying trade, and bankin—the total £2,000,000,000 and upward annually is about the same for the United Kingdom and the United States. But the United States are advancing the fastest, and are already passing ahead. There are 675,000 persons convicted annually of crime in the empire, of which number more than nineteen-twentieths pertain to India. The number of paupers in the United Kingdom under relief amounts to 1,000,000, or rather less than one-thirtieth of the population, and the cost of their maintenance is £10,000,000 sterling annually. In regard to the Post-Office, the letters posted annually in the world are 5,200,000,000; of this total 1,500,000,000, or 31 per cent., are in the British empire. Respecting education, there are 5,250,000 pupils at schools in the United Kingdom, 860,000 in Canada, 611,000 in Australia, and 2,200,000 in India, making a total of 8,921,000 pupils in the British Empire.



"Let Knowledge grow from more to more."—Alfred Tennyson.

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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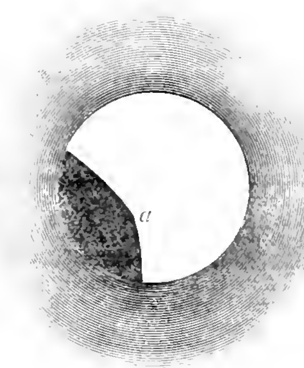
No communications are answered by post, even though stamped and directed envelope be enclosed.

THE LUNAR ECLIPSE OF OCTOBER 4.

[1451]—That well-known Belgian astronomer, my friend M. Ad. de Boë, of Antwerp, sends me an account of so remarkable and interesting an observation of his own of the eclipse of Saturday week that I am induced to hope that you will find space for a *précis* as short as I can make of it.



Briefly, then, at the stage of the eclipse represented in the annexed slightly exaggerated diagram the arc of the earth's shadow was quite decidedly peaked at *a* instead of being rigidly circular. "Il n'y a (says M. de Boë) dans cette observation aucune illusion. Deux personnes présentes la constatèrent immédiatement." Now, at the time of the phase indicated, the moon *was on the horizon of the Cordilleras,* while when she was half eclipsed she was similarly placed as regards part of the Pacific Ocean. At this time, however, all traces of the peaked appearance had absolutely vanished, and the periphery of the shadow was sensibly circular. Can the curious deformation figured have been the shadow of the Cordilleras, or had it its origin in the form of the lunar surface?

From all my friends abroad and at home I hear of the curious phosphorescent green tint of the earth's shadow during totality, a phenomenon which struck me forcibly in observing the eclipse myself. William Noble.

Forest Lodge, Oct. 13, 1884.

INFLUENCE OF MOONLIGHT.

[1452]—The following, partly for its bearing on Mr. Hays' letter (1445), partly to elicit information on the subject mentioned. A fellow tourist last summer, noticing that I had slept with my bedroom windows open, greeted me with "You will some day catch an ophthalmia." In further conversation on the subject I was told that an inquiry had been made by French surgeons as to the cause of ophthalmia, which had been noticed to be prevalent among French soldiers in Algeria while camping out. It was found that the sufferers were in general men who, not liking their small close tents, would sleep out in the open. Since the inquiry the men are allowed to sleep outside their tents, provided they wear a warm protective bandage over the eyes. My informant was a stranger to me, but I have no doubt the above is in the main correct.

That a sleeper in the moonlight runs the risk of waking blind, or with his face distorted is a very prevalent belief among sailors. Probably the fact that the face of the sleeper is cold—perhaps very cold—for some hours together is a sufficient reason for the effects occasionally observed.

As regards the mackerel, however, although, as the Editor remarks, moisture in conjunction with heat is a most fertile agent in decomposition, it is difficult to see how *cold*, whether produced by radiation or otherwise, can be damaging; perhaps germs settling down in the still air with the dew may be the culprits, if any; or, perhaps, Pliny and Plutarch notwithstanding, King Charles's fish question is pertinent. A. Le Sueur.

"LIFE AFTER DEATH."

[1453]—Before we can even reasonably speculate as to what happens at death, it would seem advisable to find out, if possible, what really happened in cases such as the one referred to by Mr. Thorne and in analogous cases. And it would be well if the experiences were kept clearly distinct under the heads of subjective and observed.

In the hope that some good will come of this suggestion, I give my experiences under the heads of drowning, anæsthetics, sleep, fainting from weakness, effects of a violent blow. I may say these are entirely subjective experiences; what I have observed I reserve as being in my opinion not so important.

I make no inferences, as I hold that at present we know too little of the subject to enable us to do so with any approach to accuracy. The sensations or feelings are given in the *order* of occurrence; but I have no consciousness of the relative length of time elapsing for each particular sensation.

A.—Immersion in water until "loss of physical power, thought, and consciousness ensued:—1. Violent physical struggle to obtain air; 2. Mental consciousness of danger, and vivid action of memory in recalling the actions of life; 3. Sense of weight, darkness, and cold; 4. Loss of physical power to move and feeling; 5. Loss of power of continuous thought; 6. Loss of consciousness.

B.—Under anæsthetics:—Change begins with No. 3, and follows the same order, but in several trials I do not remember ever to have lost consciousness of being, although having no power to reason or even form a concept of what was taking place. This particular phenomenon is more apparent in my case under the action of nitrous oxide than with chloroform.

C.—Sleep: I cannot at present separate the order of feelings. They seem from Nos. 3 to 6 instantaneous.

D.—Fainting: Change begins with No. 3, very marked, but there seems no interval between this and 6.

E.—There is no interval between consciousness and loss of consciousness where the blow is unexpected.

It is worthy of notice that in all these states there are two things common. The action of the heart has never entirely and totally ceased, and the limit of phenomena, except in B, is the same—viz., "loss of consciousness," and therefore I fail to see why A is death any more than C, D, or E.

If this is correct, why draw conclusions from A that cannot be drawn from the other states? Until we know more of the nature of life and mind, it seems hopeless to expect to unravel the problem of the effect of the cessation of life on mind. Supposing mind to have a separate existence from physical life, it seems hardly likely that the cessation of this life will affect it. If mind and physical life are one, then death must destroy both. It seems to me, therefore, the solution of Mr. Thorne's problem depends on the solution of the questions relating to the nature and relationships of life and mind. J. C. H.

[1454]—Your correspondent "Selwyn Thorne" appears to imagine that he has made an important case against those who believe in a life after death. But he has done so by being singularly illogical. Negations are usually regarded as somewhat difficult of proof; but he has undertaken to prove a negation by a mere assumption. He assumes that which every sane man will doubt, *that the man was dead*, and says, "he lay at the bottom of the water, to all intents and purposes stone dead." I believe that there is not one single instance recorded in medical experience (of course, I am not speaking now of Biblical cases) where total death has taken place and the patient has been resuscitated. Medical men tell us that the heart beats and there is some sort of circulation long after apparent death; but here there was no length of time, or resuscitation would not have taken place. To argue that because this man saw or pretended to know nothing, that, therefore, *something* does not exist is very rich indeed. Besides, his experience is certainly different from the bulk of those who are recovered from apparent death (for it is in such cases *only* apparent) from drowning. I have known and conversed with several who have been drawn from the water in a similar state, and their testimony is unanimous in describing not a total suspension of the mental faculties, but an extraordinary state of intromission, in which, while dead to all around, they lived over again, in a moment of time, the events of years of their lives. The logic of the fourth paragraph is certainly beyond my comprehension, especially in its conclusion. We shall require something more than Mr. Thorne's "probability" to induce us to accept his position. E. M.

[I have myself conversed with a professional rowing man who was "drowned," and who described this "intromission," or crowding of the events of his life into a seemingly few seconds, as preceding total insensibility.—Ed.]

[1455]—The instance cited by Mr. Thorne is one of restored "sensation" (vitality), not of restored "animation" (soul endowment); in common parlance, the one expression conveys the same meaning as the other, although there is a wide distinction. Chloroforming, under certain conditions, may occasion sensations similar to death by suffocation. It results (first stage) in suspension of sensation. Keep the patient too long under chloroform and death (second stage) ensues in addition to insensibility.

The "drowned" man had reached the first stage—the half-way house—but not the second stage—"the undiscover'd country from whose bourne no traveller returns."

Apply M. Figuier's definition (quoted immediately above Mr. Thorne's letter), "Man consists of three elements—body, life, and soul." The life had gone out of the "drowned" man, but not the soul. He had no "post-mortem" experiences to record; had he remained as many hours under water as he did minutes, and then been able to narrate his experiences, they would have been original and interesting. C. J. T.

[1456]—The question which Mr. Thorne has raised in your issue of Oct. 3, concerning an "after-life" may, I think, be satisfactorily answered in the affirmative from a purely scientific point of view, if you will allow me a few lines to explain a theory which, although it *may* be wrong, appears to me somewhat conclusive.

Mr. Thorne tells us that the person whose restoration from an apparently drowned state he witnessed could remember nothing from the time of his dying last effort until the moment of returning consciousness, that is to say, he had no idea as to the duration of time, and (to his senses) the moment his faculties failed, the selfsame moment came the dawn of returning life. This is important.

Now, let us suppose (as the opponents of after-life ideas would have us suppose) that man is a chance production of "force" and "matter," the "mind" or "life" bearing the same relation to the physical forces as the body does to the substantial elements—namely, an elaborate and intricate compound, death being the severance of these, or the want of unison between them, the same natural forces existing after death, just as the chemical elements of the body remain intact after death, although assuming different forms and compounds.

It must be evident, then, that, by the natural laws of "chance," at some future time (a long time, I will admit, but science can place no limit to time), these elements (physical and chemical) must inevitably be brought together in exactly the same compounds and positions as formerly, the only requisite being sufficient time, just as (on a colossal scale) a number of coloured balls, placed in a bag, when drawn out at random, are capable of producing ten thousand different orders of succession, any given order must recur and recur again indefinitely if the balls be drawn out a sufficient number of times.

If, then, a person is unconscious of time after the moment of death, as we must admit, this resuscitation must come upon him almost instantaneously, despite the enormous extent of time which may have elapsed. We have all heard, at one time or another, of persons who, during illness, have remained unconscious for many days together, and, upon returning to their former self, have not a faint idea of the lapse of time.

If there is any error in this reasoning, I hope to be enlightened, as I fail to see any. Trusting this letter may prove interesting to some of your readers, Alex. Mackie.

[1457]—I think no satisfactory answer can be given to the main question in Mr. Selwyn Thorne's letter, No. 1436, concerning the future life. Whether we believe in such a state or not, no one can *know*.

Analogous to heat and light, the materialists regard the phenomena of thought as a form of motion of the molecules of the brain. Possibly such motions may play a part in the creation of thought and emotion, but I incline to the idea that behind the brain there must be an intelligence, a soul, to take cognisance of and to control these motions.

The body during life is always dying, the lost materials being as constantly renewed. At death the elements of which it is composed, may according to its disposal, from a few moments to a lengthened period, form parts of the bodies of numberless plants and animals, including man himself. Never permanent, but undergoing diffusion from birth to death and after, the belief in the resurrection of the body cannot be entertained.

If there be a mortal soul, or no immortal soul, death ends all.

If, on the other hand, there be an immortal soul, the belief generally accepted, the offspring partly of early training, and one supported too by the inborn craving man has for knowledge, a powerful argument in favour of the belief, pointing as it does to some benefit or use which is to be made of such acquirements hereafter; the question arises, what becomes of this soul?

For my part, I think it has a future untramelled by a material body, with enlarged powers of intellect, locomotion, and senses. But at best this is only speculation—an opinion; we have nothing to guide us.

Referring to the incident that gave rise to Mr. Thorne's letter, I do not see how the experience of an apparently drowned man can throw any light upon the question of a future state. This man, after suffering from the drowning process, in from one and a half to three or four minutes becomes oblivious. He is asphyxiated. Thought and consciousness are at an end, he knows and feels nothing whatever. He appears to be stone dead, but he is really alive; asphyxia being only an abnormal phase of life.

For six or eight hours out of the twenty-four, when in health, we are all, during sound sleep, putting aside the suffering attending drowning, and the cessation of the heart's action, in the same state—that is, absolutely without thought and consciousness, knowing and feeling nothing whatever.

How can a person in such a condition obtain any insight into any subject, much less in one so abstruse as the unknown attributes of a future life?

What we want is what we shall never get—the experience of some one who has passed the portal we call death, not that of one who has only approached it, practically as unconscious as a sound sleeper.

Whether science will ever directly satisfy the natural curiosity all feel regarding the after-life, who can tell? There appears little hope of any direct evidence on the subject ever manifesting itself. It seems rather destined to remain enveloped in mystery.

Eye-Witness.

[1458]—Of course, the obvious reply to Mr. Selwyn Thorne's letter (1436) is, that the man was never really dead. But, admitting the supposition that, had he died, he would have been unconscious of any further sensation, it would hardly have proved there is no life after death. The instance given rather proves that sensation can be totally suspended for a time, and reproduced with all its former effects. The majority of religious systems which deal with the question of a life after death, provide a material body of some kind in which the spirit may dwell, and on which it may exercise its influence.

Most thinking men of the present day, irrespective of creed, are divided into two classes—materialists and spiritualists—those who believe that matter itself contains the power which alters its form, and those who believe that matter itself is dead, and the power which gives it motion and life is outside. The materialist merely sees in the human body a combination of particles which produces what is called life, and as soon as that particular combination is broken up, life is destroyed. The spiritualist, on the other hand, sees a force acting on a certain combination of particles, and so long as that combination continues, so long does the force act on it. When the combination is broken up, the force ceases to act. But some spiritualists further believe that the same force, after remaining dormant in the meanwhile, may, at some future time, act on a similar combination of particles, and resuscitate in the new combination sensations which were felt in the former combination.

Nothing can be proved for or against either supposition. For my own part I find it easier to believe in spirit acting on matter, than in matter endued with life; and, with the imperfect knowledge I have of science, there appears to me an impassable gulf between so-called dead and living matter; for physicists tell me that the composition of a man's body, just killed by a bullet in his heart, is the same as it was a moment before, when he was full of life and strength. I can understand a watch stopping when the mainspring is broken, because the power in the mainspring is an external power, transmitted to it when the watch was wound up. But, unless some external power winds up a man in the same way, I cannot understand why stopping the action of the heart should destroy life in the rest of the body. Life is not sensation, life is not consciousness, and life is not intelligence. All these and each can be destroyed and life continue; but once destroy life and it cannot be restored. Sensation may come back, consciousness may be renewed, and intelligence may return after many years' absence, but on this earth, except by a miracle, life once lost can never be found again.

Jos. W. Alexander.

[1459]—Admitting the hypothesis that the man was *really* dead, and that his spirit existed for awhile apart from his body, is it in accordance I will not say with psychological, a science but little understood—but with physiological teaching, to suppose that a brain dead to all thoughts and nerves, dead to all sensations, could reproduce the thoughts or emotions experienced in a spiritual state of existence?

A. E. S.

DEATH BY LIGHTNING.

[1460]—On reading the paper in Knowledge, p. 258, which purports to be derived from one by Dr. J. Rouyer in *La Nature*, it appears to me that some of the statements are much at variance with all that we know of the effects of lightning.

I do not at all dispute the correctness of the assertion that in many of these cases death is so sudden that the attitude of the moment when death occurs is retained for a time after. But I think No. 4 is very doubtful, and No. 8 is so entirely improbable (viz., the sudden resolution into a heap of ashes) that it would have been well to add a note to the effect that the statement must be taken *cum grano salis*, and then that it would be difficult to swallow.

Geo. D. Brown, F.L.S.

THE "WESTMINSTER PAPERS."

[1461]—At p. 287 of Knowledge a question is asked as to whether the "Westminster Papers" are now procurable, &c. The last issue was dated April 1, 1879, the publishers being the Civil Service Printing and Publishing Company, Limited, 8, Salisbury-court, Fleet-street, and Kent & Co., Paternoster-row. I cannot say whether all or any parts of these papers are now procurable. I possess the whole series of eleven volumes, and value them too much to be induced to part with them, except at a price that would probably be prohibitive.

I should think it will be difficult to purchase a complete set.

Geo. D. Brown.

ANIMAL (?) AND MINERAL MAGNETISM.

[1462]—As is well known, Reichenbach describes an experiment in which the needle of a compass was moved by the finger of a so-called "sensitive," merely pointed at it, and he argues from this a connection between mineral and animal magnetism. The possibility of such a thing has been strenuously denied by the scientific world in general, and I am far from maintaining it; but there is a somewhat similar experiment which I have frequently performed, and which may have tempted Reichenbach to a rash conclusion. It is this: By passing my finger (sometimes only once) over the glass cover of the compass, and in contact with it, one end of the needle may be made to adhere to the glass. If now my finger is brought near it when in this position, the needle will certainly be moved, that is to say, it will be repelled from my finger.

I should imagine that this phenomenon admits of a very simple scientific explanation. I presume that the needle adheres to the glass because the latter has been electrified by the previous friction, and that then the change of temperature produced by the proximity of the finger repels the needle. Is this a correct and sufficient explanation? Certainly the finger does not act as a magnet, for it repels equally either end of the needle.

It seems to me that the experiment is interesting, if only as tending to explain how the idea of "animal magnetism" may have originated.

A. Eubule-Evans.

BREEDING IN AND IN.

[1463]—Some weeks ago an article appeared in your paper which broached the theory that the poor unfortunates to whom sight with its boundless joys, and speech in which to give them utterance, are denied, owe their ills to the thoughtlessness or sin of their parents marrying within the proscribed degrees. I have come across some facts, probably known long since, bearing if not upon this issue, still upon one having an analogy to it.

At farmyards cats are absolutely necessary. One well-known to me in boyhood became the home of a splendid tortoiseshell cat. She found no rivals. In the country dogs and lads often form stabler offensive leagues against the feline race than ever Christian emperors can against their neighbours. However, the new cat undoubtely found lovers. In due course she founded a clan seemingly destined to rival the British race in number. But fate, or rather nature, ruled otherwise. Continued inter-breeding did its work.

At one time the family numbered some forty. Here the decline began. Snifters, as the disease is locally and onomatopoeiacally called, appeared—a complaint in which, I believe, breathing becomes difficult, and, as a consequence, the poor animals grow thin and mangy. Eating entails torture. Awhile they linger, and deaths comes, a welcome relief.

Maimed specimens were common. Many wanted ears and tails, wholly or in part (can the Isle of Man cats owe their hideous deformity in any way to this?). One had no nostrils.

On the same farm a mare, which had been unwittingly placed in a field along with a half-brother on the male side, gave birth to a foal deformed in various parts. Besides wanting ears and nostrils, one of the legs was only half the proper length, no hoof, but clean off as if amputated and then healed.

I mentioned Manx cats. Did it ever strike you that etymologists, being word-twisters, have overlooked the obvious significance of the name "Isle of Man?" Why go back to the names of ancient kings for the derivation? Take the plain Anglo-Saxon Man, the human race. May it not be a remnant of the truth? May not the island have been the scene of the slow transition of present man from a more ancient type? The cats are tailless. May man not have at least lost his prehensile tail in Mona's bright glens, or on her bleak mountains? Tails would be useless, for Mona sorrows in her scarcity of trees. Please don't call this a paradox. Accept my wishes for the increased usefulness of KNOWLEDGE, and for continued health to yourself. To me the greatest charm in KNOWLEDGE is the close connection between yourself, your contributors, and your readers. All form as it were a vast literary co-operative society, knit together by friendship.

JAS. HORNELL.

A FLIGHT OF HAY.

[1464]—June 17, 1884, very fine weather, wind N.E., just strong enough to turn the sails of a mill, a good deal of hay passed over my house. Some fell, other lots sailed on: two large armfuls I watched as far as the sea—half a mile. They took about five minutes to do it, so the wind may be put at six miles an hour. They did not seem any lower in the air.

I suppose that the air, heated in the hollow stalks, and also in the mass of hay, had become so much lighter than the surrounding air, that, a gust or eddy having started them from some field to windward of me, they could not sink. But I never saw a similar occurrence in my life before.

HALLYARDS.

MIND AND BRAIN.

[1465]—May I be allowed to supplement previous letters on the above subjects with a few remarks? *Soul* is the Anglo-Saxon word *self*, and is equivalent to the whole person; it is also a term used to represent *animal life*. *Spirit* is that which we breathe, and contains *power* to develope thought out of brain-substance in a suitable organisation. When a man ceases to breathe he ceases to think; this proves the dependence on each other of breath and thought. The thoughts that spring from a living person are common to all mankind, and are as *natural* as the spirit (or breath) that generates them or enables them to be generated. Hence, neither soul, nor life, nor spirit is necessarily immortal, for they are part and parcel of the nature common to all created things. These remarks do not apply to the "power that maketh for righteousness," which, being eternal, must necessarily be the "same yesterday, to-day, and for ever."

J. C. H.

[But if it be true that "when a man ceases to breathe he ceases to think," a diver must be unconscious until he comes to the top of the water again.—ED.]

BRAIN POWER.

[1466]—Mr. W. H. Jones, in his letter (No. 1444), which appeared in your issue of Oct. 10, is opening up a wide question—to wit, the true nature of "genius." Is "genius" to be defined, with Johnson, as implying "large general powers accidentally determined in some particular direction?"

Is it possible to say that, with a different training, a Shakespeare might have become a Napoleon, or a Titian might have developed into a Bismarck? Or shall we be nearer the mark if we say that genius is always one-sided; that a man's brain is of such a nature that its possessor can achieve the foremost rank in one department of knowledge, and one only?

Surely this latter theory has more inherent probability than the former; and if so, "the man whose brain had three parts each equal to seven, but all the rest varying from one to four," would in all probability "produce greater effect, be a greater genius," than the "man all the parts of whose brain marked five."

A. F. OSBORNE.

LETTERS RECEIVED AND SHORT ANSWERS.

E. SWINN. From the bending of the sun's rays within the shadow cone by refraction in the earth's atmosphere.—AN UNDERGRADUATE. Yours is one of the seventy or eighty letters which have reached me contending that no one can be said to be dead who is susceptible of resuscitation. Mathematics take their turn with other subjects, as KNOWLEDGE addresses a very large *clientèle* of the most diverse possible tastes. Thanks for friendly wishes.—PROTEA. It is very probable indeed, though not absolutely certain, that Dr. Huggins has succeeded in photographing the corona of the uneclipsed sun. The strongest piece of corroborative evidence is, I think, to be found in the occurrence of a rift in one of Dr. H.'s photographed coronæ, which was seen during an eclipse which was elsewhere total at the time the photograph was taken. It is impossible in the existing state of our knowledge to say what is the mass of the 250 planetoids already discovered, and, *à fortiori*, of those which still remain to be found. The total mass, however, must be relatively very small.—THOMAS THOMAS and J. KENNEDY ESDAILE. Forwarded to publishers. For the twentieth time, the *Editor* does not supply copies of this journal.

J. W. KEARTON. Your otherwise excellent and thoughtful letter does not help much towards the solution of the difficulty.—F. S. L., Q. T. V., W. J. W., and others continue to send solutions of Mr. Sidder's figure-puzzle. W. A. The calculation of each eclipse requires a considerable amount of mathematical knowledge, and is very operose indeed, involving the taking out of whole columns of logarithms. If a sufficient number of readers cared, however, for an explanation of a *graphical* method of approximately predicting the details of a Lunar Eclipse, I might perhaps give it in these columns.—JAS. N. KIRBY. "Tricycling for Ladies" is published by Iliffe & Son, 98, Fleet-street, London.—MAY KENDALL. Many thanks for your really charming translation of the Prologue to "Faust," but the mere press of scientific matter on these columns would prevent the insertion of poetry at present, even were such insertion customary.—W. J. W. Your hint about barometric indications shall be considered.—A. C. M. T. Write to E. W. Maunder, Esq., Royal Observatory, Greenwich.—THE GHOST OF A LITTLE DOG. Your jeu d'esprit leaves the formidable objection of "C. R." quite untouched.—T. E. WELLER. Narrating the experience of a brother who was drowned and resuscitated, says that, lying at the bottom of the water, the drowning man seemed to be surrounded by coruscations of light prior to becoming insensible. This is one of the most familiar sensations attendant on congestion of the brain, and is said to occur in a certain stage of intoxication, and in hanging. I have experienced it myself while inhaling chloroform for experimental purposes, and we all know how a blow on the head causes its recipient to "see stars."—W. JEROME HARRISON, F.G.S. Received with thanks. The pressure on our space just now, though, is so tremendous (we have a hundred columns of matter up in type waiting for insertion) that it must, perforce, be some time before it can possibly appear.—HALLYARDS. Two letters of yours of scientific interest are marked for insertion: to reproduce the rest of your curiously miscellaneous matter would almost necessitate a supplement. I am more in accordance with you on the question of Royalty than you think. Your American friend who stated that the conductor of this journal is not a Cambridge graduate told you a deliberate —— (Well, let us say it may be expressed by a Saxon word of three letters). Thanks for your vindication. The paragraph to which you take exception dealt with much more than a mere misprint. Read it again. I hope that you haven't been overburdened with poetry in KNOWLEDGE lately. I have received very different criticisms to yours on the Fontenelle papers. As to reproducing the Almagest! the laborious work of Copernicus, or Kepler's wild dreams and fantasies here—where is the space to come from? "Venus in Sole Visa" has already been well translated, and appeared in a compendious form in English. I have noticed a few of your points, but am rapidly emptying *my* ink-bottle too.—S. W. Goodeve's volume in Longmans' "Text-books of Science" ought to suit you. You will also find a quantity of useful information on the subject of mechanics generally in "The Student's Mechanics," by the late lamented Walter R. Browne. I have not seen Prof. Cotterell's book.—T. W. CAVE. *Quot homines, tot sententiæ.* If you can elucidate the subject from a scientific point of view, you need not fear that your letter will remain unread.—ERASMUS BEYNON suggests, with reference to the case of a man insensible from drowning, illness, &c., that, as the brain is, *pro tempore*, non-recipient, so it can give nothing out; can have no new sensation to reveal on recovering to its normal state, and "consequently the soul cannot put itself in evidence."—Miss L. W. Tomlinson and others send accounts of the afterglows, which appear to be once more increasing in intensity.—W. H. Harrison. Many thanks, but our columns are crowded to an extent in excess of any previous experience. The puzzle is really what to do with matter already in type. B. M., F.R.C.S., M. C. N., E. W. J., Rev. F. S. Lea, C. E. D., W. C. P., F., A. E. S., A. Bennett, W. H., H. B. L., W. H. S. Monck, W., and others writing on the subject of "Life after Death," one and all reiterate, in various forms, the argument from the analogy of the condition of the drowned man to that of a person unconscious from sleep, the effect of narcotics or anæsthetics, or from disease.—John Bell. Your letter on the same subject is excluded by its length. This remark applies, too, to the very clever and well-reasoned letters of Lancashire Mon, Chas. Rose, W. T. E., and J. T. Routledge. The present pressure on our limited space is tremendous.—T. Common. You run dangerously near the boundary line—even if you do not actually cross it.—H'sftt tells a story of a wealthy Jew who won a bet of £10, and £80 besides, at poker of a Californian gambler while crossing the Atlantic.—Alfred Kitson. You ignore the fact that I most carefully investigated the subject for myself. I will not waste too precious space by admitting its discussion here. Your attempt to do so indirectly is shrewd enough, but "I think *not*," said the lamb.—Dr. Cory. I inserted the letter of "F. S." solely on the principle *Audi alteram partem*, albeit I am absolutely in accord with you that vaccination is "one of the most benificent medical appliances that has ever been used." I wish that you could see your way to a material condensation of your argument, as the great length of your communication entirely precludes its insertion. With—as I have said elsewhere—100 columns of matter actually standing in type; with "Editorial Gossip," Reviews, &c., hopelessly crowded out, it will be impossible, for some time to come, to insert any letters but those very briefly worded.—Chas. J. Ryan. Undoubtedly. A small spectroscope fitted to a 5½ in. reflector would show you the lines in the solar prominences. A rainband one would do so perfectly. You might even see the prominences themselves if you chose to risk blinding yourself. Alcyone is *not* "the central sun round which the solar system revolves."—A. E. Conte. Your postal order and stamps forwarded to the *Publishers*. The Editor has nothing to do with such matters.—Nigel Doble. No, the data are insufficient. You cannot even find the hour angle of a star from the meridian without knowing the latitude and its declination, as well as its altitude. Given the declination of a star, its hour angle, and the latitude of the place, though, its altitude and azimuth may be determined.—Theodore Bell. No, the motion of the sea or air might be converted into heat, but the converse is impracticable. Difference of temperature is a *sine quâ non* in the development of mechanical energy. If every part of a steam-engine, for example, were equally heated, it would cease to act.—W. I had many scores of solutions of the Figure Puzzle, which I wish, with all my heart, now *had* been sent to "The Family Tea-tray." Any succinct explanation of its theory would have been inserted, but none such reached us. With reference to "Coincidences" it may—or may not—be that the two multitudes were identical. This in no way affects the fact that they were, or are, multitudes.—Knowledge addresses readers of the most diverse possible tastes. One man wants it to consist mainly of mathematical papers; another thinks it should be filled with tricycling; a third (with, I fear, much more reason) that geology is neglected, and so on. Do you remember the fable of the old man and his ass?

[The "Life after Death" controversy must now terminate, as it is seriously encroaching on our space, to the exclusion of other subjects of interest. A few more letters (already marked for insertion, on account of their containing more or less novel contributions to the discussion) will appear, but none subsequently received will do so.]

The International Electrical Exhibition at Philadelphia, which was highly successful, the receipts largely exceeding the expenses, was closed on Saturday night.

Errata.—Page 302, first paragraph of Editorial Gossip, for "decensus" read "descensus." Page 303, Review of "Technological Examinations, &c.," delete comma after "devoted," and read "devoted the money"; delete also the word "and" after "Brompton." Page 306, column two, "Ephermeris" should be "Ephemeris"; and, in reply to Roland Ellis, "his surface" is printed for "her surface." In footnote to Letter 1449 (p. 306), delete the comma after "laterally," and for "and it is in" read "than it is in."

The Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

AN IMPROVED SASH-FASTENER.

Irrespective of the want of security in ordinary window-catches, they do not even exclude draught or prevent the sashes from rattling. Wedges are clumsy and inconvenient contrivances, and the proper remedy is undoubtedly an invention like one patented by Mr. John Bennett, of 149a, Great Hampton-row, Birmingham. The device in question is simple enough. The knob of the ordinary fastener is converted into a screw-nut, which cannot become detached, and by merely turning, draws the sashes together so closely that a sheet of tissue-paper cannot be interposed. This arrangement is absolutely thief-proof and draught-proof. It is, moreover, very cheap, and should come into universal household use.

IMPROVED GLAZING.

Skylights of all kinds are notoriously troublesome, on account of leakage, notwithstanding the many patented systems of improved glazing. Mr. George Deacon, of 103, Lower Thrift-street, Northampton, has, however, invented a method of glazing suited for all kinds of roofs and horticultural buildings, which is claimed to be a perfect remedy for all the evils incidental to ordinary skylights. In this invention the rafters to carry the glass are made with a circular groove down the centre of the top edge, to carry off any water that may force a passage between the squares of glass which are laid down edge to edge on the centre of the rafter. The glass is secured by means of a galvanised iron, or, it may be, a brass, nut, provided with an indiarubber washer underneath, to prevent the breaking of the glass under pressure. The panes are made to pass the screw for the nut by cutting off the top corners under the lap. The vertical glazing is secured by a small round-headed screw. The glass butts each way. Under this system any leakage is said to be impossible.

AN IMPROVED SPANNER.

A new spanner is now being introduced by Messrs. Turner, Naylor, & Marples, of Leeds, and is claimed to be superior to the ordinary screw-wrench in several respects. Fitted, as it is, with the Clyburn-spanner motion, it can be adjusted to the work in hand with ease and correctness, and, when so adjusted, it cannot be shifted by being laid aside or thrown down. In the ordinary wrench the screw on the leg and the cutting in the body to admit the ring, weakened the tool where strength is most required. In this wrench these weaknesses are avoided, and the whole strength of the tool is made available. Another defect of the ordinary appliance is avoided, we are told, in the improved wrench by making the handle fast to the body, thus giving the user a firm grip of the tool and a thorough command of his work. The jaws are not cut, and the wrench can, consequently, be applied to bright-work without injury.

PATENT TROUGHS FOR HOLDING AND KEEPING CUT GRAPES.

Mr. George Ward, the well-known grape-grower of Bishop Stortford, has patented an invention which entirely abolishes the objections of the "bottle" method, and relieves the grower of grapes of every kind of difficulty in properly keeping grapes after they are cut. This invention is characterised by extreme simplicity. The troughs employed are oblong in shape, and about 17 in. long, and are made single and double, of glazed earthenware, which possesses the advantage of being non-porous, cleanly, and cheap; but they could be made in many other materials. Each trough has a flange or ledge, against one of its sides in the single trough, and in the middle of the double trough. The manner of using them is as follows:—The trough is filled with water nearly up to the brim. The shoot bearing the bunch of grapes is cut from the vine sufficiently long to admit of the bunch hanging free of the trough in its natural position, while the end of the shoot is inserted under the ledge or flange. The shoot acts as a lever working on the edge of the trough as a fulcrum; the weight of the grapes thus presses the end of the shoot firmly up against the ledge or flange, and the bunch then holds itself in position without any tying or fastening whatever. All grape-growers will appreciate this invention.

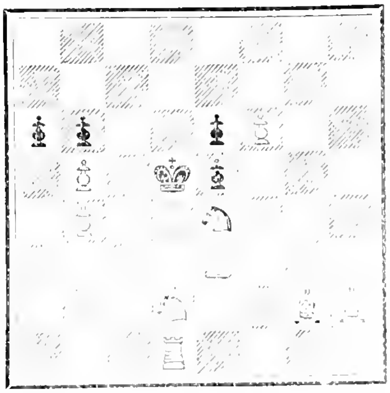
Our Chess Column.

By Mephisto.

PROBLEM No. 132.

By W. Furnival.

Black.



White.

White to play and mate in three moves.

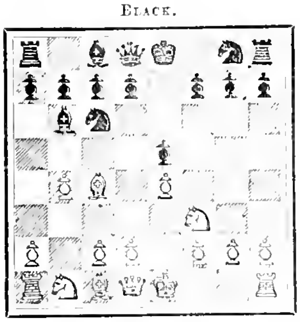
THE EVANS GAMBIT.

1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. B to B4. B to B4. 4. P to QKt4. The sacrifice of this Pawn enables White. to develop his game very freely, and to obtain almost endless varieties of attack. True, the theorists maintain that with the best defence, Black ought to be able to keep an advantage, and Zukertort has given this view practical expression by betting a player large odds in off-hand games on condition that he has to take the move and play the Evans Gambit. Nevertheless, we consider this opening formidable, and dangerous to meet. We may mention that both at the Vienna and the London Tournaments Steinitz lost against the Evans attack played by Tchigorin, the talented Russian player. Moreover, our opinion is further confirmed by the fact that Zukertort—than whom there is no greater authority on this opening—contrary to his expressed opinion, *did not accept the Gambit against Tchigorin*, but declined it, and won.

We therefore follow in the footsteps of a great master in giving wise preference to discretion before valour. We will examine the result of declining the Gambit, before dealing with the Opening itself.

4. B to Kt3

Black.



White.

The only safe way of playing, and which ought to yield Black a fair defence. White has now two moves at his disposal, viz.:

5. P to QR4, or	P to Kt5.
If 5. P to QR4	P to QR3
6. Castles	P to Q3
7. P to R5	B to R2
8. P to Kt5	P × P
9. B × KtP	Kt to K2
10. P to Q4	P × P
11. Kt × P	B to Q2

with a fair game.

White can vary his play on the sixth move in this variation by playing 6. P to B3, Kt to B3. 7. Q to Kt3, Castles, &c., but with careful play Black ought to obtain a safe game. It is, however, different if White adopts the more attacking move of 5. P to Kt5; although this gives rise to complicated positions, yet with best play Black ought to obtain an advantage.

5. P to Kt5 Kt to R4

6. Kt × P

Now Black would not do well to play B to Q5, as the following variation will show: 6. B to Q5. 7. Kt × BP, Q to B3. 8. Q to K2, Kt × B. 9. Kt × R, B × R. 10. Q × Kt, Kt to K2. 11. P to QB3, and White will remain with a P more.

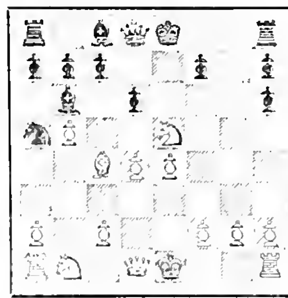
6. Kt to R3

White would not do well to play now the likely-looking move of 7. B to Kt2, for then Black plays P to Q3. 8. Kt to Q3 (best) (for if 8. Kt to KB3, Kt to Kt5) 8. Kt × B. 9. B × P, R to Kt sq. 10. B × Kt, Q to R5, with the better game. Therefore

7. P to Q4	P to Q3
8. B × Kt	P × B

Now White can play either Kt × P or B × P (ch), or Q to B3 or R5

Black.



White.

(*a*) 9.	Kt × P	Q to B3
10.	Kt × R	Kt × B
11.	P to QB3	B to K3

with the better game, as the Kt cannot escape.

(*b*) 9.	B × P (ch)	K to K2
10.	Q to R5	P × Kt
11.	B to Q5	Q to Q3
12.	P × P	Q to Kt3

and although White has three Pawns for the piece, Black's game is good.

(*c*) If 9. Q to B3, R to B sq. 10. B × P (ch), K to K2. 11. Kt to QB3, B to K3, and Black has the best game.

Finally, if 9. Q to R5, Q to B3. 10. Kt × P, Kt × B. 11. Kt × R (ch), K to K2. 12. Kt to B3, B to K3. 13. Kt to Q5 (ch), B × Kt. 14. Q × B, Kt to R6, and Black must win.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

J. J. Cridlin.—We may write on odds some day. For the present we can only recommend you to play 1. P to Q3, followed by 2. Kt to KB3 when giving P, and move 1. P to K4, 2. P to Q4, 3. P to QB3, and 4. B to B4 (if feasible), when giving odds of Kt, and a King's Gambit when giving the Rook; but if you think you have a strong and steady player to beat, then you must play very close, very hard, and very slow.

S. B. C.—1. Kt to K4 (ch), K to Kt3. 2. B to B5 (ch), K to R4. 3. B to R4 (ch), K × P. 4. Kt checks on B3 or 5, K escapes on Kt 6 or 5 accordingly.

Correct solutions received:—Problem 129, W. No. 130, W. Hanrahan. No. 131, W. Packer, Geo. W. Thompson, A. J. Champ, George Gouge, W., H. A. N., Z. Gibson, S. B. C., J. J. Cridlin.

"Tele Gossip" is the title of a new book by Mr. Francis George Heath, to be published shortly at the Leadenhall Press by Messrs. Field & Tuer.

The electric light is a great boon to fruit-growers near the cities in California. At Los Angeles, it is reported, several bushels of moths are killed every night, while at Sacramento it is believed that the blackbeetle has been nearly exterminated.

A Money-washing machine will soon be amongst the hygienic requirements. *Science et Nature* has raked up another danger in the matter which collects on coins which have been a long time in circulation. M. Reinsch, of Erlangen, has devoted much study to this matter, and has investigated old and recent coins of all metals from all the European States. Everywhere he has found micro-organisms of Algæ and Bacteria. Scraping away the matter which accumulates in the interstices of the relief with a needle, and placing it in a drop of distilled water under a microscope of 250 to 300 diameters, he found fragments of textile fibres, numerous starchy granules, especially of the starch of wheat, globules of grease, some unicellular Algæ, &c. But when a microscope of greater power was used, Bacteria were found among this detritus. There were long Bacteria with a vibratory or spiral movement, as well as those of a globular shape. Sometimes both forms were found on one coin, but as a rule each form was found separately.

Contents of No. 154.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, OCT. 24, 1884.

Contents of No. 156.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XLV.—COCOA AND THE COOKERY OF WINE.

A CORRESPONDENT writes to the Editor asking whether I class cocoa amongst the stimulants. So far as I am able to learn, it should not be so classed, but I cannot speak absolutely. Mere chemistry supplies no answer to this question. It is purely a physiological subject, to be studied by observation of effects. Such obsevations may be made by anybody whose system has not become "tolerant" of the substance in question. My own experience of cocoa in all its forms is that it is not stimulating in any sensible degree. I have acquired no habit of using it, and yet I can enjoy a rich cup or bowl of cocoa or chocolate just before bed-time without losing any sleep. When I am occasionally betrayed into taking a late cup of coffee or tea, I repent it for some hours after going to bed. My inquiries among other people, who are not under the influence of that most powerful of all arguments, the logic of inclination, have confirmed my own experience.

I should, however, add that some authorities have attributed exhilirating properties to the *theobromine* or nitrogenous alkaloid of cocoa. Its composition nearly resembles that of theine, as the following (from Johnstone) shows:—

	Theine.	Theobromine.
Carbon	49·80	46·43
Hydrogen	5·08	4·20
Nitrogen	28·83	35·85
Oxygen	16·29	13·52
	100·000	100·000

It exists in the cocoa bean in about the same proportion as the theine in tea, but in making a cup of cocoa we use a much greater weight of cocoa than of tea in a cup of tea. If, therefore, the properties of theobromine were similar to those of theine, we should feel the stimulating effects much more decidedly.

The alkaloid of tea and coffee in its pure state has been administered to animals, and found to produce paralysis, but I am not aware that theobromine has acted similarly.

Another essential difference between cocoa and tea or coffee is that cocoa is, strictly speaking, a food. We do not merely make an infusion of the cacao bean, but eat it bodily in the form of a soup. It is highly nutritious, one of the most nutritious foods in common use. When travelling on foot in mountainous and other regions, where there was a risk of spending the night *al fresco* and supperless, I have usually carried a cake of chocolate in my knapsack, as the most portable and unchangeable form of concentrated nutriment, and have found it most valuable. On one occasion I went astray on the Kjolenfjeld, in Norway, and struggled for about 24 hours without food or shelter. I had no chocolate then, and sorely repented my improvidence. Many other pedestrians have tried chocolate in like manner, and all I know have commended its great "staying" properties, simply regarded as food. I therefore conclude that Linnæus was not without strong justification in giving it the name of *theobroma* (food for the gods), but to confirm this practically the pure nut, the whole nut, and nothing but the nut (excepting the milk and sugar added by the consumer) should be used. Some miserable counterfeits are offered — farinaceous paste, flavoured with cocoa and sugar. The best sample I have been able to procure is the ship cocoa prepared for the Navy. This is nothing but the whole nut unsweetened, ground, and crushed to an impalpable paste. It requires a little boiling, and when milk alone is used, with due proportion of sugar, it is a *theobroma*. Condensed milk diluted and without further sweetening may be used.

In my last I promised the results of my investigations concerning the source of the sulphate of potash that I found replacing the natural tartrate in so many samples of sherry.

At first I hunted up all the information I could obtain from books concerning the manufacture of sherry, learned that the grapes are usually sprinkled with a little powdered sulphur as they are placed in the vats prior to stamping. The quantity thus added, however, is quite insufficient to account for the sulphur compounds in the samples of wine I examined. Another source is described in the books —that from the sulphuring the casks. This process consists simply of burning sulphur inside a partially-filled or empty cask, until the exhaustion of free oxygen and its replacement by sulphurous acid renders fu.t'er combustion impossible. The cask is then filled with the wine. This would add a little of sulphurous acid, but still not sufficient.

Then comes the "plastering," or intentional addition of gypsum (plaster of Paris). This, if largely carried out, is sufficient to explain the complete conversion of the natural tartrates into sulphates of potash, but such plastering is admitted to be an adulteration or sophistication, and the best makers deny their use of it. I obtained samples of sherry from a reliable source, which I have no doubt the shipper honestly believed to have been subjected to no such deliberate plastering; still, from these came down an extravagantly excessive precipitate on the addition of chloride of barium solution.

At last I learned that "Spanish earth" was used in the fining. Why Spanish earth in preference to isinglass or white of egg, which are quite unobjectionable and very efficient? To this question I could get no satisfactory answer directly, but learned vaguely that the fining produced by the white of egg, though complete at the time, was not permanent, while that effected by Spanish earth, containing much sulphate of lime, is permanent. The brilliancy thus obtained is not lost by age or variations of temperature, and the dry sherries thus cooked are preferred by English wine-drinkers.

Here, then, is a solution of the mystery. The sulphate of potash which is thus made to replace bitartrate is so readily soluble that neither changes of temperature nor increase of alcohol, due to further fermentation, will throw it down; and thus the wine-merchant, without any guilty intent, and ignorant of what he is really doing, sophisticates the wine, alters its essential composition, and adds an impurity in doing what he supposes to be a mere clarification or removal of impurities.

I have heard of genuine sherries being returned as bad to the shipper because they were genuine, and had been fined without sophistication. Are we to blame the wine-merchant for this? I think not.

My own experience of genuine wines in wine-growing countries teaches me that such wines are rarely brilliant; and the variations of solubility of the natural salt of the grape, which I have already explained, shows why this is the case. If the drinkers of sherry and other white and golden wines would cease to demand the conventional brilliancy they would soon be supplied with the genuine article, which really costs the wine-merchant less than the cooked product they now insist upon having. This foolish demand of his customers merely gives him a large amount of unnecessary trouble.

So far, the wine-merchant; but how about the consumer? Simply that the substitution of a mineral acid—the sulphuric for a vegetable acid (the tartaric)—supplies him with a precipitant of lithic acid in his own body; that is, provides him with the source of gout, rheumatism, gravel, stone, &c., with which *English* wine-drinkers are proverbially tortured.

I am the more urgent in propounding this view of the subject because I see plainly that not only the patients, but too commonly their medical advisers, do not understand it. When I was in the midst of these experiments I called upon a clerical neighbour, and found him in his study with his foot on a pillow, and groaning with gout. A decanter of pale, choice, very dry sherry was on the table. He poured out a glass for me and another for himself. I tasted it, and then perpetrated the unheard-of rudeness of denouncing the wine for which my host had paid so high a price. He knew a little chemistry, and I accordingly went home forthwith, brought back some chloride of barium, added it to his choice sherry, and showed him a precipitate which made him shudder. He drank no more dry sherry, and has had no serious relapse of gout.

In this case his medical adviser prohibited port and advised dry sherry.

The following from "The Brewer, Distiller, and Wine Manufacturer," by John Gardner (Churchill's "Technological Handbooks." 1883), supports my view of the position of the wine-maker and wine-merchant. "Dupré and Thudicum have shown by experiment that this practice of plastering, as it is called, also reduces the yield of the liquid, as a considerable part of the wine mechanically combines with the gypsum and is lost." When an adulteration—justly so-called—is practised, the object is to enable the perpetrator to obtain an increased profit on selling the commodity at a given price. In this case an opposite result is obtained. The gypsum, or Spanish earth, is used in considerable quantity, and leaves a bulky residuum, which carries away some of the wine with it, and thus increases the cost to the seller of the saleable result.

Having referred so often to dry wines, I should explain the chemistry of this so-called dryness. The fermentation of wine is the result of a vegetable growth, that of the yeast, a microscopic fungus (*Pencillium glaucum*). The must, or juice of the grape, obtains the germ spontaneously—probably from the atmosphere. Two distinct effects are produced by this fermentation or growth of fungus: first, the sugar of the must is converted into alcohol; second, more or less of the albuminous or nitrogenous matter of the must is consumed as food by the fungus. If uninterrupted, this fermentation goes on either until the supply of sufficient sugar is stopped, or until the supply of sufficient albuminous matter is stopped. The relative proportions of these determine which of the two shall be first exhausted.

If the sugar is exhausted before the nitrogenous food of the fungus, a dry wine is produced; if the nitrogenous food is first consumed, the remaining unfermented sugar produces a sweet wine. If the sugar is greatly in excess, a *vin de liqueur* is the result, such as the Frontignac, Lunel, Rivesaltes, &c., made from the muscat grape.

The varieties of grape are very numerous. Rusby, in his "Visit to the vineyards of Spain and France," gives a list of 570 varieties, and as far back as 1827 Cavalow enumerated more than 1,500 different wines in France alone.

From the above it will be understood that, *cæteris paribus*, the poorer the grape the drier the wine; or that a given variety of grape will yield a drier wine if grown where it ripens imperfectly, than if grown in a warmer climate. But the quantity of wine obtainable from a given acreage in the cooler climate is less than where the sun is more effective, and thus the *naturally* dry wines cost more to produce than the *naturally* sweet wines.

This has promoted a special cookery or artificial drying, the mysteries of which will be discussed in my next.

NOTES ON COAL.

By Richard A. Proctor.

(*Continued from page 297.*)

If we now turn to the consideration of the extent of the earth's surface occupied by those particular strata which belong to the coal period, we find evidence of the existence of enormous quantities of available coal. Professor Ansted mentions that a quarter of a million of square miles of the earth's surface "are covered with sandstones and shales of the carboniferous period among which coal is buried; and this coal is for the most part accessible." Now there are upwards of three million square yards of surface in a square mile; and, assuming an average total thickness of ten yards for all the distinct seams of each coal-field, we find for the total number of cubic yards of available coal the enormous figure 7,500,000,000,000. As a cubic yard of coal weighs nearly a ton, we may say that there are in round numbers seven billions of tons of coal available for the use of the human race. If we took the average number of human beings living at each moment during the next 3,500 years to be 2,000,000,000, and the annual consumption for all purposes to be at the average rate of one ton per human being, the supply would last for that enormous period.

But let us consider what portion of this vast supply falls to the share of this country—not including, of course, those coal-fields which lie in countries forming British territory, but not forming part of the British Isles; and let us compare our store of coals with our present rate of consumption and with the probable rate of consumption during coming years.

Some difficulty arises at the outset in determining what portion of the coal-fields actually existing in the British Isles may be regarded as available. We might, indeed, render the question more complicated by setting as a necessary part of the inquiry the determination of the actual expense per ton for mining, carriage, and so on, according as different parts of the coal-fields were being worked. But for obvious reasons this would not be the place for dealing with the subject in so general or so complete a manner. The sole point I shall here touch on, as bearing on the availability of the various coal-stores, is the probable depth to which coal-mining operations can be pushed.

It was held by many, in 1860–64,* that the coal-mines might be worked to a depth far exceeding the greatest which had then been reached. "The difficulties in the way of deep mining," wrote Mr. Leonard Lemoran, Surveyor of Mines, "are mere questions of cost. It is important to notice that the assumption of 4,000 feet as the greatest depth to which coal can be worked, on account of the increase of temperature is purely voluntary. The increase has been calculated at a rate for which there is no authority; and while we are saying our coal-beds cannot be worked below 4,000 ft., a colliery in Belgium has nearly approached that depth, and no inconvenience is experienced by the miners." But, unfortunately, this sanguine view has not been supported by recent researches. It will be known to our readers that in 1865 Commissioners were appointed for discussing the whole subject of our coal supply. Among their ranks were several of the most eminent geologists, as well as some of the highest authorities on the practical questions involved in the subject. The question of the possible depth to which our mines could be worked was necessarily one to which the Commissioners were bound to give very close attention; and we may fairly accept the result of their inquiries as representing the most trustworthy conclusion which has yet been reached on this particular point. Now, they stated that, according to the ordinary method of working, the depth at which the temperature of the mine would reach blood-heat (or 98° Fahr.) is about 3,000 ft. They expressed a belief that, by the "long-wall" system of working, a depth of 3,420 ft. might be reached before this temperature was attained; but whether this will prove to be the case or not remains to be seen. Now, although the human frame can bear for a while a greater heat than 100° or even 200° Fahr.,† yet it would be impossible to carry on such labours as are required in coal-mining, at a higher temperature than blood-heat, without great suffering and the loss of many lives.

Accordingly, although before the Commissioners began their labours, the total quantity of available coal in Great Britain was reckoned at 200,000,000,000 of tons, it is now generally admitted that, so far as known coal-fields are concerned, the quantity probably available must be reckoned at something less than 150,000,000 000 of tons. The Commissioners themselves found that in 1871 he had "an aggregate of 146,480,000,000 of tons, which may be reasonably expected to be available for use."

It will be observed that this quantity is about a forty-eighth part of the quantity probably available throughout the whole world; so that Great Britain possesses for her area a singularly large supply of the mineral.

Yet the consumption of coals in this country is so enormous that, although we are thus exceptionally well supplied, statisticians have already begun to look with anxiety upon the rapid exhaustion of our stores.

* This essay, as originally written, appeared in 1872, but it has, of course, been modified considerably.

† Brewster mentions that Chantrey's workmen used to enter the furnace which the sculptor employed in drying his moulds when the temperature was as high as 340°, "walking over the floor with wooden clogs, which are, of course, charred on the surface." Chantrey himself and five or six friends stayed for two minutes in the furnace, bringing out a thermometer which stood at 320°.

The questions at issue are exceedingly simple. Let it be granted that our total available supply amounts to 150,000,000,000 of tons. Then at the rate of consumption in 1872, amounting nearly to 120,000,000 tons per annum, this supply would last the nation 1,250 years. But large as our consumption is, it is not the actual rate which is alarming, but the annual increase of rate. Year by year our consumption is increasing. In 1860-64 it was under 84,000,000 tons, and the average rate of increase during the next ten years was more than 3,500,000 tons. Taking it at only 3,000,000, the supply, as estimated in 1872, would not last 280 years. For the increase at the supposed rate would, in 280 years, be no less than 840,000,000 tons, making a total annual consumption of 960,000,000. The mean between this and the rate in 1872 amounted to 540,000,000: and it will be found that 280 times 540 is greater than 150,000.

But startling as is the theory that our coal-supply will be completely exhausted in less than 270 years from 1884—a period corresponding to that between the commencements of the reigns of Elizabeth and our present Queen—there are those who entertain an even more disheartening view. According to them it is not even the rate of increase of the annual consumption which forms the most threatening feature of the case, but the rapidity with which this rate of increase is itself increasing.

Thus Mr. Hull, dealing with the coal supply as I have just done, took 1,500,000 tons for the average annual increase (admittedly, however, a low estimate). We have seen that the average annual increase ten or twelve years ago could not be set at less than 3,500,000. How, if in twenty years the average annual increase should have risen to 5,000,000? in half a century later to 10,000,000? and so on. It is clear, at least, that if changes such as these take place in the *rate* of increase, we have greatly overestimated in the above calculations the probable duration of our coal-supply.

Mr. Stanley Jevons, in discussing the subject in 1863, took the increase of increase into account with very startling results. He said: "We, of course, regard not the average annual arithmetical increase of coal consumption, but the average rate per cent. of increase, which is found by computation to be 3·26." Now, to illustrate the difference between this method and the other, we shall not take the actual figures, which are inconvenient for ready computation. Instead of doing so, we shall compare two simple progressions. One is the series 100, 110, 120, 130, 140, 150, and so on, increasing by ten at each step; the other is a progression increasing at the rate of ten per cent., and runs thus:—100, 110, 121, 133 (not counting fractions), 146, 161, and so on. It will be observed that the corresponding terms of the two series differ more and more from each other as we proceed: the difference is but one at the third term, and amounts to eleven at the sixth. It will be found to increase marvellously with a few more steps. Now, the difference between Mr. Stanley Jevons' method and Mr. Hull's is precisely analogous; only that whereas the rate per cent. just considered is *ten*, it is in the actual case about three and a quarter.

The fact really is, that the rate of increase corresponds precisely, in one case, to that of a capital of 120,000,000 sterling, increased each year by simple interest at the rate of $3\frac{1}{4}$ per cent., while, in Mr. Jevons' method of calculation, the increase is as that of a capital of 120,000,000 sterling, increased by compound interest at the rate of $3\frac{1}{4}$ per cent. per annum. To give an idea of the actual difference as respects the consumption at some distant epoch, let us take the year 1950. Then, according to the former method of viewing the matter, the consumption in that year will be 373½ millions of tons; according to the latter, the consumption would be no less than 1,446 millions.

Startling as this result may seem, the commissioners found that in the last year of the five during which their labours continued, the consumption corresponded much more closely with the anticipations of Mr. Jevons than with the theory of an arithmetical rate of interest. And they remarked thereon that, though "every hypothesis must be speculative, it is certain that, if the present rate of increase in the consumption of coal be indefinitely continued, even in an approximate degree, the progress towards the exhaustion of our coal will be very rapid."

This will readily be believed when we mention that, according to Mr. Jevons' method of calculation, adopting 3·26 as the rate per cent. of increase, 150,000,000,000 of tons as the total available supply of coal, and 120,000,000 as the present annual consumption, our coals would not last us quite 127 years from 1872.

I venture, however, to indicate reasons for believing that the rate of increase here contemplated cannot possibly continue during many years, and that even the assumption of an arithmetical rate of increase at the present mean rate over-estimates the annual consumption for any time far removed from the present.

(To be continued.)

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

ABOVE THE SURFACE.

THOSE insects that make their home *in* the pond in their early life only, when fully grown still haunt the neighbourhood, never straying far from the scene of their juvenile associations. Their movements will, of course, be very largely determined by the functions they have to perform. Those whose only business it is to found new families, and which so thoroughly devote themselves to this work as to have but little thought about their own sustenance, will evidently have no temptation to leave the arena of their family labours, but will hover about close to the pond till they have fulfilled their task, and then, after but a brief stage of enjoyment in the performance of parental duties, either die of old age, or more probably fall victims to the voracious appetites of predatory insects, or of insectivorous birds or fish. Such as these will either be found executing merry dances just above the surface, lurking amongst the rank vegetation that fringes the banks, or resting on overhanging trees, from which positions they may easily be dislodged by disturbing their place of retreat. But those that are destined for a longer existence, and so have to make vigorous onslaught upon nature on their own account, as well as to give birth to new generations, will often take foraging excursions into neighbouring woods and fields, though the procreative instinct will with them, too, suggest a speedy return to the water which is to be the nursery of their expected brood.

Coming under the former category are first the *Ephemeridæ*, or May-flies, whose larvæ formed the subject of part of our last paper. There is no mistaking a May-fly (Fig. 1). A most fragile creature, with four membranous and reticulated wings, of which the hinder pair are very much smaller than the others, and sometimes, indeed, absent altogether, with two or three long filaments at the tail generally much longer than the insect itself, and with the organs of the mouth in the most rudimentary condition possible—such is the insect that, in consequence of the sudden appearance and the as sudden disappearance of its myriad swarms, and the extraordinary brevity of its adult life, has attracted popular attention from the times of Greeks and Romans, to the present day, and has, more often than almost any other insect, been used to point a moral to human kind. The name Ephemeridæ, a Greek word meaning living *for a day*, indicates what is usually considered to be the extreme duration of their perfect existence. In captivity they have, it is true, been kept alive for upwards of a week; indeed Stephens reports having kept one for more than three weeks; but there is no doubt that, in a natural condition, this longevity would not have been attained, and in the majority of cases the perfect existence seems to last little more than a few hours. They have no power whatever of taking food, and are utterly defenceless, so that they have no chance of holding their own against the numerous foes that with hungry eyes are looking longingly upon them. Their sole business is to become mated and lay their eggs, and this exhausts all their energies. The antennæ are extremely short, but, as if to counterbalance this, the forelegs are sometimes extraordinarily long. The wings have a number of nervures running longitudinally at short intervals, and the spaces between

Fig. 1.

them are divided into tiny quadrilateral figures by numbers of short transverse nervures, so that the whole surface of the wing is composed of minute enclosed areas which are largest in the centre and smallest at the outer edge. Several species of these insects are known to inhabit the British Isles, but their preservation is a matter of considerable difficulty. Their texture is so fragile that such parts of the body as are of most importance in the separation of the species shrivel up to mere shapeless masses after death, if they are simply allowed to dry as is usually done with insects. A collection of them, therefore, is of but little value to a systematist unless they are preserved in spirit into which they have been plunged when fresh and soft.

They are remarkably regular in their times of appearance, and immense swarms arrive at maturity at almost the same instant, and few phenomena have excited more admiration and wonder than the sudden appearance of myriads of these insects where a few moments before not one was to be seen, and where their presence would be hardly likely to be expected; for, owing to their mud-loving propensities, they are seldom noticed during their long larva- and pupa-hood, and thousands may be close at hand without anyone except those who specially search for them being any the wiser. To the naturalists of a century and a half ago, coming fresh to the observation of nature at first hand, when, as yet there was but the most scanty literature on the subject, the sudden appearance of these gigantic swarms was matter of such intense interest, excitement, and delight, as in these more matter-of-fact days of ours, with the charm of novelty destroyed by an abundant literature, can scarcely be credited, and it is delightfully refreshing to place oneself for a time in communication with these great spirits of old and try to see things with the eyes with which they saw them. The renowned French naturalist, Réaumur, gives a most minute and graphic account of the first swarm of May-flies he witnessed, and the details are so remarkable that they are worthy of recapitulation, if for the thousandth time. It was in the year 1738 that the experience occurred to him. His garden was situated on the banks of the Marne, and on August 19 a fisherman informed him that on the previous day the flies had begun to appear along the river; or, as he expressed it, the "manna had begun to fall"—a metaphor commonly used to express the advent of the swarms. The illustrious naturalist, therefore, being determined to have a near view of the batching of the creatures, got into a boat about three hours before sunset, and, proceeding down the river, detached from the banks great masses of earth which contained abundance of pupæ, transferring them to a tub of water he had taken with him. Having stayed out till about eight o'clock, intently watching both banks and tub, but without seeing very many flies, he bethought him that, as a storm seemed to be brewing, terra firma would be preferable to an open boat. He therefore landed, and had the tub conveyed into his garden. But just at this moment the insects began to emerge from the tub in vast numbers, crowding up from the water on to every exposed piece of earth, in order to shed their skins and put on their wings. The scene must have been a most entertaining one; but, in the midst of it all, the rain came on so severely that the observer, ardent as he was, was obliged to beat a retreat, not, however, before covering up the tub with a cloth, that he might not lose his precious insects. The storm soon abated, and he again visited the tub, when he found the crowd of insects much increased, many of them having been drowned through their inability to find sufficient standing room under the cloth. By this time it was quite dark, so that the observations had to be conducted by torchlight; but the light proved a strong attraction to the multitudes of flies that were now emerging from the river, and they flocked round in such numbers that they soon completely covered the cloth which had again been thrown over the tub, and might even have been taken up in handfuls. The delighted naturalist and his attendants now made their way to the river, and here the spectacle was far more astonishing, for, as he says, "the myriads of ephemeræ which filled the air over the current of the river and over the bank on which I stood are neither to be expressed nor conceived. When the snow falls with the largest flakes, and with least interval between them, the air is not so full of them as that which surrounded me was full of ephemeræ. Scarcely had I remained in one place a few minutes, when the step on which I stood was quite concealed with a layer of them from two to four inches in depth. Many times I was obliged to abandon my station, not being able to bear the shower of ephemeræ, which, falling with an obliquity less constant than that of an ordinary shower, struck continually, and in a manner extremely uncomfortable, every part of my face. Eyes, mouth, and nostrils were filled with them." Multitudes, of course, were drowned, but as fast as the stream carried them away, new ones were ready to take their place. The swarms continually increased in density till between 9 and 9.30, when they reached their maximum; but in the succeeding half-hour their numbers rapidly diminished, and by ten o'clock the marvellous spectacle had completely vanished; the vast hosts that had filled the air so short a time before, having fulfilled their destiny, were now numbered with the dead. Other batches came forth some nights afterwards, but not again in such enormous numbers. The fishermen reckon three successive days for the greatest "fall of the manna," and during this time, of course, the fish hold a grand carnival, gorging themselves on the delicate morsels as they fall into the river.

It is remarkable that in Ceylon there is a species of May-fly the abdomen of which is luminous—sufficiently so, indeed, to enable one to capture the insect, even on a very dark night.

(To be continued.)

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE THIRD EVENING.—PARTICULARS OF THE WORLD IN THE MOON, AND PROOFS OF THE OTHER PLANETS BEING HABITABLE.

(*Continued from p.* 301.)

"I SHOULD rejoice," says the Marchioness, "at a wreck of these lunar folks, as much as my neighbours on the coast of Sussex. How pleasant would it be to see 'em lie scattered on the ground, where we might consider at our ease their extraordinary figures."

"But what," said I, "if they should swim on the outward surface of our air, and be as curious to see us, as you are to see them; should they angle or cast a net for us as for so many fishes, would that please you?"

"Why not," said the Marchioness, smiling. "For my part, I would go into their nets of my own accord, were it but for the pleasure of seeing such strange fishermen."

"You would be very sick," said I, "when you were drawn to the top of our air; for there is no respiration in all its extent, as may be seen on the tops of some very high mountains; and I admire, that they who have the folly to believe that fairies, whom they allow to be corporeal, and to inhabit the most pure and refin'd air, do not tell us that the reason why they give us such short and seldom visits is, that there are very few among them that can dive; and those that can, if it be possible to get through the thick air where we are, cannot stay half so long in it as one of your diving fowls can in the water. Here, then, are natural barricades, which defend the passage out of our world as well as the entry into that of the moon; so that, since we can only guess at that world, let us fancy all we can of it. For example, I will suppose that we may there see the firmament, the sun, and the stars of another colour than what they are here. All these appear to us thro' a kind of natural opticks, which change and alter the objects. These spectacles, as we may call 'em, are our air, mix'd as it is with vapours and exhalations, and which does not extend itself very high. Some of our modern philosophers pretend of itself it is blue, as well as the water of the sea, and that this colour neither appears in the one nor in the other but at a great depth. The firmament, say they, where the fix'd stars are placed, has no peculiar light of its own, and by consequence must appear black, but we see it through the air, which is blue, and therefore it appears to us blue; which, if so, the beams of the sun and stars cannot pass thro' the air without being ting'd a little with its colour, and losing as much of their own. Yet, were the air of no colour, it is very certain that through a great mist the light of a flambeau at some distance appears reddish, tho' it be not its true natural colour. Our air is nothing but a great mist, which changes the true colour of the sky, sun, and stars; it belongs only to the celestial matter to bring us the light and colours as they really are in all their purity; so that, since the air of the moon is of another nature than our air, or is diversified by another colour, or at least is another kind of mist, which varies the colours of the celestial bodies. In short, as to the people of the moon, their spectacles thro' which they see everything are changed."

"If it be so," said the Marchioness, "I prefer this abode before that of the moon, for I cannot believe the celestial colours are so well suited as they are here. For instance, if you put green stars on a red sky, they cannot be so agreeable as stars of gold on an azure firmament."

"To hear you, one would imagine, madam," said I, "you were chusing a petticoat or a suit of knots: but, believe me, nature does not want fancy. Leave it to her to chuse colours for the moon, and I'll engage they shall be well sorted. She will not fail to vary the prospect of the universe, at every different point of sight, and always the alteration shall be very agreeable."

"I know very well," said the Marchioness, "her skill in this point; she is not at the charge of changing the objects, but only the spectacles, and has the credit of this great variety without being at any expense: with a blue air she gives us a blue firmament; and perhaps with a red air she gives to the inhabitants of the moon a red firmament, and yet still it is but the same firmament, nay, I am of opinion she has plac'd a sort of spectacles in our imagination, thro' which we see all things, and which to every particular man change the objects. Alexander look'd on the earth as a fit place to establish a great empire; it seem'd to Celadon a proper residence for Astræa, and it appear'd to a philosopher a great planet in the heavens cover'd with fools. I do not believe the sights vary more between the earth and the moon than they do between one man's fancy and another's."

"This change in our imaginations," says I, "is very surprising; for they are still the same objects, tho' they appear different; when in the moon, we may see other objects we do not see here, or at least not see all there we do see here. Perhaps in that country they know nothing of the dawn and the twilight, before the sun rises and after the sun sets: the air which encompasses, and is elevated above us, receives the rays, so that they cannot strike on the earth, and being gross, stops some of them, and sends 'em to us, tho', indeed, they were never naturally design'd us; so that the daybreak and the twilight are a favour which nature bestows on us: they are lights which do not properly belong to us, and which she gives us over and above our due. But in the moon, where apparently the air is more pure, and therefore not so proper to send down the beams it receives from the sun before his rising, and after his setting, they have not that sight of grace (as I may call it) which, growing stronger by degrees, does more agreeably prepare them for the arrival of the sun; and which growing weaker, and diminishing by degrees, does insensibly prepare them for the sun's departure: but they are in a profound darkness, where a curtain (as it were) is drawn all on a sudden, their eyes are immediately dazzled with the whole light of the sun in all its glory and brightness; so, likewise, they are on a sudden surprised with utter darkness, the night and the day have no medium between them, but they fall in a moment from one extreme to the other.

(*To be continued.*)

ELECTROPLATING.

By W. Slingo.

XII.—SILVERING SOLUTIONS.

ONE cannot but be struck with the great beauty and variety of the works of art observable in any good electroplater's show-room. Nor can there be any doubt that the discovery and pursuit of the art of depositing silver electrically, has given a considerable impetus to the trade in silvered goods. As an involved consequence of the profit at first made, competition speedily set in, the result being a cheaper article with the maximum amount of tasteful embellishment. At the present moment, the industry has developed into truly gigantic dimensions, tons and tons of silver being utilised in the process.

The beauty of the work produced lends naturally a great charm to the process from an amateur's point of view. Nor are the experiments accompanied by an undue amount of trouble, while with the adoption of fitting precautions, failure is an unlikely result.

The first thing to be done in starting on a small scale is to prepare the solution which is to be placed in the electrolytic bath. Of course, the expense is greater than that involved in the deposition of copper, but it is not so great as to present a serious obstacle even to one of very restricted means. The chief outlay is at the beginning. A solution once made should last a long time in use without seriously deteriorating. The duration is practically governed by the quality of the ingredients. The silver which is deposited on the plated article appears at the expense of the silver plate used as the anode or positive electrode in the bath, because, although the particles of metal cannot be said to traverse the solution, there is, nevertheless, a particle dissolved off the plate for every particle that finds its way from the solution on to the article forming the cathode or negative electrode.

The last few lines render it almost superfluous to say that the silver employed should be of the finest. Impure silver or alloys will not do, but if no other is available, a purifying process must be resorted to. The simplest consists in dissolving the impure metal in nitric acid, adding the alloy grain by grain, until the whole is dissolved. Do not use too much acid, but start first with a very small quantity, and then, should it prove insufficient to dissolve all the metal, add a little more. When the solution is completed, add a little cold water, at the rate of half a pint to an ounce of metal. Then drop in a few pieces of copper, which the acid will take up, setting free the silver. This silver is then precipitated in a pure state on the surface of the copper, just as copper is precipitated on iron, when a piece of that metal is immersed in a sulphate of copper solution. The supernatant liquor which now consists of nitrate of copper, instead of nitrate of silver, mixed with nitrates of the various impurities, is next poured off carefully, and the deposited silver well washed in clean water.

Having procured the pure metal, dissolve, say an ounce of it, little by little, in a mixture consisting of rather more than an equal weight of good nitric acid (specific gravity 1·420) and about a quarter of an ounce of water. A "word to the wise" is, however, necessary here. In the first place, nitric acid is exceedingly corrosive. Coat sleeves and trousers vanish beneath it in a sometimes alarming fashion, and its effect upon a mahogany dining-room table is anything but entertaining, except in the eyes of a young "destroy-all." If it comes into contact with the skin it destroys it, turning it a yellow colour, which only disappears as the skin wears off.

This burning of the skin is accompanied with considerable heat and more or less pain. It is, therefore, necessary to be careful with it, to prevent it spilling. As it is volatile, the bottle containing the acid should be kept stoppered, and, as heat accelerates its evaporation, it should be kept in a cool place. There is, however, no fear of explosion, except with the most powerful acids, more powerful, in fact, than are likely to be procurable. Another point to be borne in mind is, perhaps, more important than either of those hitherto mentioned, and that is, that when a metal is dissolved in nitric acid, fumes of a most unpleasant and somewhat injurious character are evolved.

The merest tyro in chemical manipulation knows that when a metal, such as iron or zinc, is dissolved in sulphuric acid, a sulphate of the metal is formed, and hydrogen gas is liberated. This results from the metal taking the place of the hydrogen in the acid. The exchange is expressed thus—

$$\underset{\text{Zinc and}}{Zn} + \underset{\text{sulphuric acid}}{SO_4H_2} \underset{\text{produce}}{=} \underset{\text{sulphate of zinc}}{SO_4Zn} + \underset{\text{and hydrogen.}}{H_2}$$

With nitric acid the case is somewhat different. The metal, copper, for instance, first decomposes the acid forming the nitrate. Thus:

$$Cu + 2NO_3H = (NO_3)_2CuO_2 + H_2$$

Copper and nitric acid produce nitrate of copper and hydrogen,

but this hydrogen does not escape, owing to the unstable nature of nitric acid. A further decomposition takes place, in which the hydrogen splits the acid into water and oxide of nitrogen. Thus:

$$\underset{\text{Hydrogen and}}{3H_2} + \underset{\text{nitric acid}}{2NO_3H} \underset{\text{produce}}{=} \underset{\text{nitric oxide}}{N_2O_2} + \underset{\text{and water.}}{4OH_2}$$

This oxide escapes into the air and combines with an additional quantity of oxygen, forming nitrous anhydride and nitric peroxide, which appear as pungent brownish fumes. They are intensely irritating to the throat and nostrils, and this portion of the experiment should be conducted in a chimney with a good draught, or, failing that in the open-air. In the case of silver, a series of changes takes place similar to the above. The primary reaction of a metal on an acid may be considered identical in all cases, and to consist in the formation of the corresponding salt and hydrogen; the secondary reactions which occur, and which generally consist in the reduction of a further portion of the acid, depend entirely on the nature both of the acid and the metal employed, on the state of concentration of the acid, and on the temperature at which the reaction takes place. Thus, by the action of various metals on nitric acid, we may obtain at will either ammonia, nitrogen, nitrous oxide, nitric oxide, or nitric peroxide.

To return to the nitrate of silver solution, the whole of the silver being dissolved, a gentle heat is applied to drive off any superfluous nitric acid that may remain. The nitrate being evaporated almost to dryness, half a gallon of distilled or (failing that) rain water is then added. A pure nitrate of silver solution results. Ordinary drinking water is not available because of its impurities.

M. Beetz has made a standard cell, which is a modified form of Latimer Clark's mercurous sulphate cell. It consists of a tube in which a compressed cake of mercurous and zincic sulphates is placed; at one end of the cake the zinc pole is placed, and at the other end the mercury pole. On short-circuiting the following results were obtained:—Five minutes, 1·440 volts; one hour, 1·439 volts; four hours, 1·439 volts; six hours, 1·437 volts; twelve hours, 1·434 volts; forty-eight hours, 1·408 volts. The resistance was 15·700 ohms.

CHATS ABOUT GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

A. There are few subjects which seem more mysterious to me than the measurement of the lengths of curves, the areas of surfaces bounded by curves, and the determination of the volumes and surfaces of solid figures bounded by curved surfaces. Surely in all such cases you can suggest approximations to the real values, not those values themselves?

M. Well, in one sense, all mathematical results are approximations. We cannot even draw a straight line which really corresponds with the definition of a straight line. We are obliged to assume the existence of lines, surfaces, shapes, and so forth, which we cannot actually picture.

A. That is not what I mean. I am well content with the geometry of Euclid, which I regard as exact. What I like, indeed, in Euclidean geometry is the exactness of all its methods and results. Now, if I understand rightly what is signified by non-Euclidean geometry, it is a system of approximation to the truth, and not exact, like the geometry of Euclid.

M. I think you mistake altogether. What *do* you understand by non-Euclidean geometry?

A. Why, geometry dealing with matters outside those on which Euclid enters.

M. That is a mistake. The awkward term non-Euclidean geometry is not applied to geometry beyond or outside Euclid's, but to geometry inconsistent with ordinary geometry. Non-Euclidean geometry requires at our very entry into its domain that we should abandon the axioms, nay, the very definitions of Euclidean geometry. A straight line, for instance, in non-Euclidean geometry, by no means "lies evenly between its extreme points."

A. I have indeed been mistaken, then, on that point. I certainly want to hear no more about *that* geometry. The kind of geometry I was thinking of is geometry dealing with matters outside those dealt with by Euclid. We do not find in Euclid any reference to limiting values, infinity, vanishing quantities, and other such matters, which—to my mind—make the geometry of approximations (if I may invent an expression) unsatisfactory.

M. Are you quite sure of this? I think you are mistaken here also. To turn to the very beginning of his work, how does Euclid define parallel lines?

A. H'm—h'm. Well, certainly in a sense he does seem there to introduce the idea of infinity.

M. So I think. And does he not introduce the idea of limiting quantities in the twelfth axiom?

A. I cannot say that I see what you mean. He says that two lines referred to in the axiom will meet if produced far enough.

M. Yes; but he implies that *no matter how small* the deficiency of the "two angles taken together" from two right angles, those two straight lines will meet on that side where the angles are thus less than two right angles. The idea of a limiting value is here obviously introduced.

A. I see now what you mean. Let us consider this axiom for a moment. It has little to do, perhaps, with the subject we are upon; but I should like to have your opinion about this troublesome axiom. I suppose you agree with those who consider that is not in reality an axiom?

M. Certainly it is no axiom. The converse is demonstrated in the 17th proposition.

A. How so?

M. In that proposition it is shown that any two angles of a triangle are together less than two right angles. This might be put thus: If two straight lines falling upon a third straight line meet, the two inferior angles made by them with that third line, on the side towards which they meet, are together less than two right angles.

A. That is obviously the converse of the twelfth so-called axiom. And the 32nd proposition may obviously be regarded as proving *by how much* the two inferior angles fall short of two right angles—viz., by the angle at which the two straight lines are inclined to each other. But how could all this be corrected?

M. It is manifestly an incongruity to have definitions which imply propositions, and propositions which are the converse of axioms; and it is always undesirable to increase the number of axioms. It appears to me that the number of simple propositions should rather have been increased. After all, the ideas underlying the definition of parallel lines and axiom twelfth are simple enough. By accepting as admissible the definition of a right angle (for clearly there must be *some* position in which the angles on either side of the finite line are equal), and the axiom that two straight lines cannot enclose a space as really axiomatic, we can arrive, I think, at both the definition of parallel straight lines and at the proposition involved in the twelfth axiom, without any difficulty—without even assuming that new axiom which Simson proposed. Through a given point only one parallel can be drawn to a given straight line.

A. How would you do this?

M. I would define parallel straight lines as straight lines at right angles to the same straight line; and I would prove their fundamental property thus:—Let A B (Fig. 1)

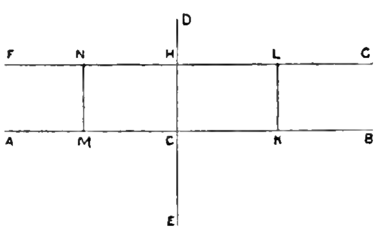


Fig. 1.

be a straight line, D C E a line at right angles to A B; and suppose that on A B, D C E lines have been superposed in the same way that a triangle is supposed to be superposed on another in the fourth proposition of the first book. Now suppose the superposed lines shifted, so that while the line superposed on D C E still coincides with this line, the line superposed in A C B is shifted to some other position as F H G. Then, when we note the equality of the angles F H D, D H G, A C D, D C B, we see that any line of reasoning by which it could be proved that H G, C B meet if produced towards G, B, would equally prove that these same lines meet if produced towards F, A. (We see this at once if we suppose the whole figure turned round H E as an axis till H F comes to the position H G, and C A to the position C B.) Hence if F G and A B, produced both ways, meet at all, they meet both towards F A, and towards G B, and so enclose a space. But two straight lines cannot enclose a space. Hence F G and A B do not meet, however far they may be produced both ways.

A. Does not this demonstration indicate also some properties of parallels?

M. It indicates several, among others the equidistance of parallels. Thus suppose the points K and M on A B carried to L and N by the shifting motion described, it is evident that K L = C H = M N.

A. And how would you deal with the present twelfth axiom?

M. Somewhat in this way. (I do not enter fully into these matters because you really want information on a different subject.) The lines D H E, A C B, F H G, Fig. 2, being the same as in Fig. 1, let K H L be any straight line falling within the angle C H G, (so that the angles H C B and C H L are together less than two right angles). Then if we take any point L on K H L, and make L M = H L = M N = N O, &c., and draw perps. L G, M P, N Q, O R, &c., to H R, it can be readily shown that M P = 2 L G, N Q = 3 L G, O R = 4 L G and so on. Hence, however

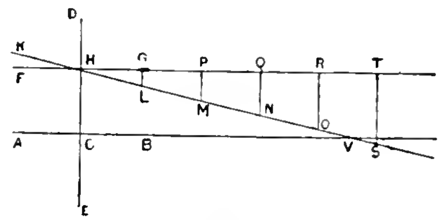


Fig. 2.

small L G may be, we must at last arrive in this way at a distance—as S T, greater than H C, or such that S lies on the side of A C B remote from F H G. Hence at some point—as V—between H and S the line H S must intersect the line A B produced. This *proves* what Simson wanted as an axiom,—that through the same point H there cannot be two straight lines H T and H M, both parallel to another straight line A B. Then, as Simson showed, we can deduce the 12th axiom as the general proposition of which the above is a special case. But you will find all that you need on that point in the Notes to Todhunter's School Euclid.

A. Let me see; how did we get upon this subject of the 12th axiom?

M. It is a case of a limiting value. The axiom asserts, and as we have seen, it may be proved, that, no matter how small the angle by which the "two angles taken together" fall short of two right angles, the lines will meet if produced far enough. Now in all the problems we shall have to consider, if we are to discuss the subject you have suggested, we have in fact to infer the *exact* value of some curve, surface, volume, or the like by showing that such value does not differ from that definite value by any quantity that can be assigned,—however small.

A. Before we leave this question of Euclid's manner, may I ask whether he ever directly uses the method of limits. I see that he indirectly does so in the twelfth axiom.

M. He uses it in showing that a straight line at right angles to a diameter of a circle, through its extremity, is a tangent to the circle. For there he shows in effect that no matter how near a point be taken on the circumference, to the point through which the perpendicular is drawn, the line joining the two points is *not* at right angles to the diameter: we only get the right angle when the second point actually *merges into* the first.

A. Still, that is not the way Euclid puts it.

M. True. But in the twelfth book (which I should like to see much more read than it is) Euclid definitely adopts the method of limits, both in proving that circles are to each other as the squares, and that spheres are to each other as the cubes, of their diameters. His method is as follows: If a sphere (for example) does not bear to another sphere the ratio of the cube of the diameter of the first to the cube of the diameter of the second, then must the first sphere bear this ratio to another sphere differing from the second,

—say, smaller than it. Now let this other or third sphere, and the second, be supposed concentric, the second being the outermost. Euclid shows then (in his spider-web problem, which no one now ever seems to read) that there may be enclosed within the outer sphere a polyhedron (call it P_2) not touching or cutting the inner one. Let a similar polyhedron be enclosed within the first sphere, and call this polyhedron P_1. Then if S_1, S_2, S_3 be the volumes, and D_1, D_2, and D_3 be the diameters of the three spheres, we have, from an already established property of polyhedra,

$$P_1 : P_2 :: D_1^3 : D_2^3$$

But $S_1 : S_3 :: D_1^3 : D_2^3$, by our hypothesis:

$\therefore$ $S_1 : S_3 :: P_1 : P_2$

or $S_1 : P_1 :: S_3 : P_2$

But S_1 is greater than the enclosed polyhedron P_1: therefore S_3 is greater than P_2, or a sphere is greater than a polyhedron within which it wholly lies: which is absurd. Hence the sphere S_1 bears to the sphere S_2 the same ratio which the cube of the diameter D_1 bears to the cube of the diameter D_2.

A. Ah! Thanks. I think I follow you. But I hope the demonstrations of arc-lengths, surfaces, volumes, &c., will be simpler.

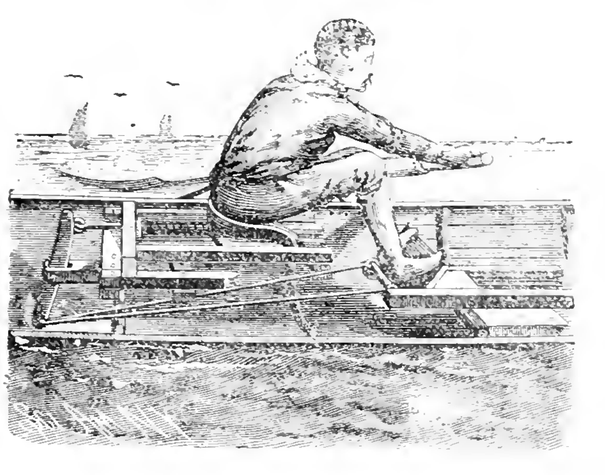
M. Nay, if you have followed me at all attentively, the proof is simplicity itself. However, the demonstrations we have now to consider will be direct instead of indirect, and simplified by the introduction of certain considerations not noted by Euclid. They will also, of course, be properly illustrated. Next time we meet we will enter upon them.

A. Willingly.

(*To be continued.*)

SEAT AND FOOT-BOARD FOR ROWING-BOATS.

THE sliding-seat of the usual construction slides between two tracks held on a suitable frame. From the back of the seat projects a rod whose rear end is pivoted to the upper end of an upright lever pivoted to a bar projecting



from the rear of the frame. A spiral spring, surrounding the bar, is held between the rear of the seat and a cross-piece. The foot-board is secured to a cross-piece sliding in longitudinal grooves formed in plates in the boat. The lower end of the lever is connected by rods with the foot-board. The pressure of the spring can be varied by a collar on the rod back of the seat.

When the oarsman makes a stroke, the seat is moved back and the spring is compressed, and the rod is moved in the same direction, when, by means of the lever, the foot-board is moved in the opposite direction. As the oarsman recovers, the spring expands, and pushes the seat back, while the foot-board is drawn forward, thereby relieving the oarsman of the necessity of pulling back the seat, and enabling him to expend all his force and power on the stroke. The recovery being very rapid, fast rowing is admissible.

This invention has, says the *Scientific American*, been patented by Mr. James J. Turpel, of Halifax, Novo Scotia.

HOW TO RIDE A TRICYCLE.

By John Browning,

Chairman of the London Tricycle Club.

HOW to ride a tricycle *easily*, that is what I mean. In the early spring of this glorious summer, I was walking with my wife on the esplanade at Brighton, and looking towards Hove I saw a gentleman riding towards us on a rear-steering tricycle. His legs were going up and down like the beams of an engine, and his shoulders were working as hard as his legs. He was an immensely powerful man, standing little, if anything, short of 6 ft. in height, and weighing about 16 st. I said to my wife "He will tear that machine to pieces before long," but I had little idea how soon my prediction would be fulfilled. for within a minute of the words being spoken, he fell off the machine, and, on going to his assistance, I found that he had torn the iron seat off the spring. Part of the metal-plate had given way, the bolts were wrenched off, and one of the strong metal straps had broken. Yet, with all the strength he was exerting, he was not travelling at more than six miles an hour. Had the same amount of strength been skilfully applied, it would have urged him along at the rate of twelve miles an hour, at least. I have never before or since seen so bad a rider; but there are very few riders who apply their strength to the best advantage, and obtain the speed they should get in proportion to the work they are doing.

Many riders have complained to me that, while they can ride eight or nine miles in one hour, they cannot, without great difficulty, ride more than about forty miles in a day. Should they be possessed only of the most moderate staying power, if they will act on the following hints they will soon find the distance they can travel greatly increased. They will then know that they have tired so soon because they have not studied how to ride easily :—

First, I would recommend all those who wish to thoroughly enjoy riding, and to obtain the utmost benefit to their health from the exercise, to restrict their pace to about five or six miles an hour on a Sociable, or six to seven miles an hour on a single machine, and the distance they ride to from thirty to forty miles in a day on a Sociable, and from forty miles to fifty miles in a day on a single machine.

I have known of two or three cases of people giving up riding, after a very short experience, because they found that they could not ride at the rate of nine or ten miles an hour "for even half a day." They had been misled into believing that this would be easy work for them. Apparently it had never occurred to them that, as they would have to climb up many hills, and travel over rough roads, and, at times, drive against the wind, their pace would often be reduced to between five and six miles an hour. and that, therefore, to drive at the rate continuously of nine or ten miles an hour they must, to compensate for this reduced speed, make a pace a great part of the way of from twelve to fifteen miles an hour, and this although they were only novices in riding.

Nothing in my experience hinders a novice in his progress to good riding so much as trying at once to ride very fast. Let him strive only to ride *as easily as possible*, and, after a time, if he rides a good machine, the pace will come without proportionately increased exertion.

Even if you intend to ride quickly, never start quickly; do not start at more than five or six miles an-hour for the first few miles, particularly if you start directly after breakfast, and purpose riding for the whole day.

As I have mentioned rough roads, let me say at once that the way to ride those as easily as possible is to have good large rubber tyres on your wheels. No tyres should be used less than $\frac{3}{4}$ of an inch in diameter for the driving-wheels of single machines, and $\frac{7}{8}$ths are better. The small wheels should have tyres $\frac{1}{8}$th larger than those on the driving-wheels. The rubber tyres of the Sociables should be $\frac{1}{8}$th larger than the sizes I have recommended for single machines.

Large tyres will be found advantageous in many ways; they will not be nearly so liable to come off as small tyres, and they will not be cut to anything like the same extent by sharp stones. Their durability will, therefore, be found very great.

Mud is, of course, a great obstacle to easy riding. I have only one hint to give in connection with it. If the mud is stiff—not slushy—ride where the mud is the wettest. I constantly see people riding on the driest part of the road under these circumstances, where the work is twice as hard.

Hill-riding is, of course, hard work; but practice and skill in time make it comparatively easy.

Two-speed gearings are the greatest boon to those who wish to ride easily. My advice is, never ride any machine without one. In former articles I have described those I consider the best.

If you wish to ride without fatigue, *never pull at your handles*. Whenever you are on rising ground, or working through mud, or over loose stones, or against wind, lean well forward, resting on your handles, instead of pulling at them. This position has the great advantage for hill-riding that there is no fear of the machine capsizing backwards; and for making progress against the wind it is the best. because it diminishes considerably the surface of the body presented to the wind.

Whenever you find that leaning forward does not give sufficient power, rise from your seat or saddle and stand on your pedals, if you have not far to go under such difficulty; but if you have, dismount at once, for you will find pushing the machine much easier than riding, and the change of motion acts as a rest.

In dismounting on a steep hill, do not trust to your break, as there are very few breaks which will stop a machine when it is running backwards. Lean well forward and stop by pedalling forwards if it commences to run backwards, steering at the same time, so that the tricycle will turn straight across the hill.

Clutches are a great assistance to easy riding, and help a rider considerably in surmounting short, steep hills, especially if there is a short, steep down-hill before coming to them.

When the machine has a clutch, or clutches, the feet can be held still at any time and the pedals act as foot-rests. In running down a slight incline, the pedals may be driven quickly at intervals, and the machine may be made to travel at a good pace, and yet the rider may rest himself the greater part of the time.

An illustration will best show the use of the clutch. Riding one morning near Croydon, a tricyclist overtook me and passed me, evidently using some exertion to do so.

I have made it a rule never to race with any one, so I did not quicken my pace, but after a time I came up with the rider at the top of a steep hill; having a clutch on my machine, I pedalled very quickly just at the top of the hill, then held my feet still until I was three-quarters of the way down, and at this point pedalled again quickly, and rode all the way up the opposite hill without difficulty, probably at the rate of seven or eight miles an hour. I could not with safety have taken my feet off my pedals and caught them when rushing down the hill. My antagonist tried to pedal fast down the hill, and missed his pedals, and letting his machine come nearly to a standstill, he came on dead-centres about half way up the hill, and had to dismount and push up the rest of the way, and he did not attempt to pass me again. I doubt if I should have got away from him had it not been for my clutch.

Clutches are invaluable on a Sociable when you are riding with a lady, for it frequently happens that a lady tires quickly, and then, if she cannot pedal as quickly as the gentleman, she actually helps to stop the machine; with a clutch this is impossible.

The last hints I can give here as regards easy riding, are to ride on a saddle well over your cranks, and to use a crank with a short throw. The first Sociable I had was furnished with a crank nearly $6\frac{1}{2}$ in. long; now I am riding with a crank barely 4 in. long. Short cranks are not nearly so tiring as long ones, unless the machine is geared too high. Of course, for working up a steep hill long cranks are the best, but the excessive motion of the legs continuously, to so great an extent, becomes fatiguing. For this reason, using plenty of ankle-play, so as to reduce the rise and fall of the knees, will be found very advantageous. On a future occasion I may write a short article on pedalling, as I cannot at fitting length refer to it here.

If my readers expect me to tell them how to ride fifteen or sixteen miles in an hour, and a hundred miles within ten hours on a right-away, give-and-take road, I am sorry I cannot assist them. Two or three members of my club can do this, and I know half-a-dozen men altogether who can accomplish it; but I doubt if they could help any one else to do it, if they wished to. Their great pace is the result of youth, health, strength, and incessant practice, and coupled with these a determination, whenever they ride at such a rate, to spare neither themselves nor their machines, come what will.

DICKENS'S STORY LEFT HALF TOLD.

A QUASI-SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from p. 314.*)

THE next chapter is one of the most interesting in the book, and is worthy of Dickens's best days. It contains several points well worth noticing in reference to the development of the plot.

In the first place, we note that Crisparkle has come up "by the very first train to be caught in the morning," so that there is no fear lest Jasper should be in town too, for he must stay for the morning service at Cloisterham. He has consulted with Mr. Grewgious. It is noteworthy, by the way, how thoroughly Grewgious takes the management of everything at about this time. They all defer to him, and his whole manner shows that he is master of the situation.

A visitor is announced, and Crisparkle, not knowing whom it may be, is for not seeing him. But Grewgious advises that, whoever it may be, he should come in. "It is a business principle of mine," he says, "not to close up any direction, but to keep an eye on every direction that may present itself. I could relate an anecdote in point, but that it would be premature." What is clear from this, is that a time is approaching when Mr. Grewgious will have a good deal to disclose. What is not clear, is the nature of the special experience he refers to. It bears of course on the Drood mystery, or its disclosure could not be spoken of as premature. But, among the scores of things it *might* be, one cannot well guess what it was. Possibly Mr. Grewgious refers to the unexpected use he had found for Bazzard, or perhaps to the events which had suggested the "Datchery assumption." Be this as it may, Mr. Grewgious is obviously preparing for disclosures which will astonish many, and crush Jasper to the ground.

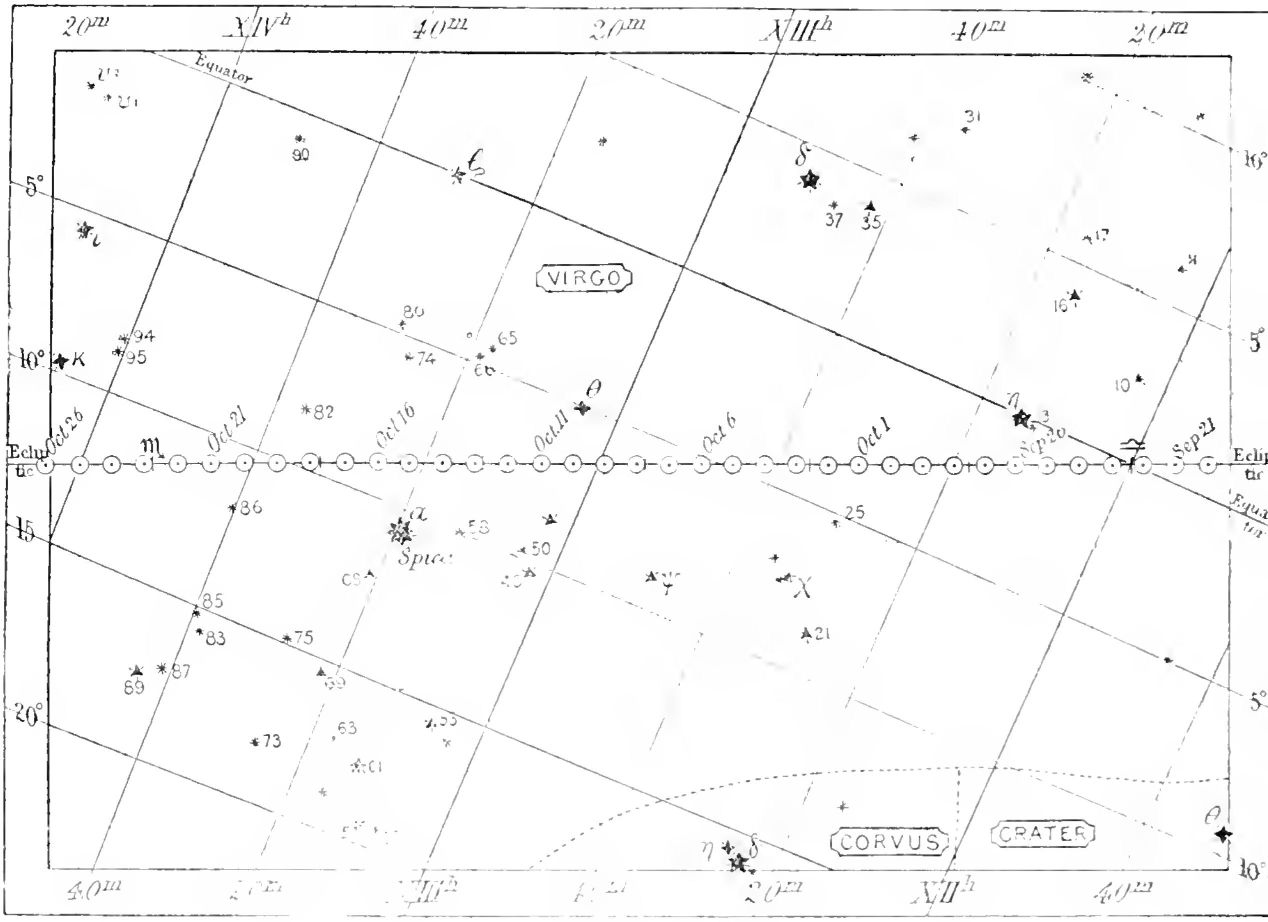
The meeting of Tartar and Crisparkle is a rare bit of "Dickens." So also is the behaviour of Grewgious at this point ("I am proud to make your acquaintance. I hope you didn't take cold. I hope you were not inconvenienced by swallowing too much water. How have you been since?" This is as funny as anything in Pickwick, though not—like so much in Pickwick—overdrawn). Mr. Grewgious presently has an idea. He has seen that Tartar is the very man to help Neville and Helena. He is the very man too to defeat "our local friend" ("on whom I beg to bestow a passing but hearty malediction, with the kind permission of my reverend friend").

We learn here that Grewgious's watch of Neville has led him to suspect, possibly to *know*, that Jasper employs some "hanger-on of Staple" to watch Neville during his own absence at Cloisterham. I am half inclined to imagine —though I must confess I have scarcely any evidence to support the notion—that Grewgious has cleverly arranged matters so that Bazzard has fallen into Jasper's way, and been employed by him on this very service. If Jasper had so met Bazzard, hanging about after his manner, and had suggested such work to him, we can imagine that Grewgious's first idea when he heard of it would have been to tell Bazzard indignantly to reject the proposition; but on second thoughts he might have found here "a direction which had chanced to open," and had applied his business principle of keeping his eye on every direction presenting itself. In such a case that would assuredly have been "an anecdote" very much "in point," but which it would have been premature to relate. And this would have been a detail thoroughly in Dickens's style,—Jasper trusting Bazzard with full knowledge of his own whereabouts (and Grewgious seems better able to follow Jasper's movements than otherwise we could expect), employing him to traduce Neville to Landless, and, in fine, delivering himself up, not knowing what he was doing, to an employé of his enemies. This would be good. But I think I see my way to something better yet, and still more in Dickens's style. What if Bazzard tried to play a double game, something after the manner of Silas Wegg, whom, of all Dickens's characters, he most resembles, and if Grewgious allowed this to go on in such sort that the discomfiture of Bazzard became as interesting a minor feature of the dénouement as the discomfiture of Silas Wegg in the dénouement of "Our Mutual Friend." However, this is necessarily mere guesswork; not, like most of the considerations I have brought foward, a direct result of the analysis of the evidence.

The closing parts of this chapter and the whole of the next bear strongly on the development of the story. Tartar's rooms are placed at Rosa's service for her interview with Helena, and also, be it noticed, at the service of such "comers and goers", as Mr. Grewgious may wish to visit the Landlesses without being seen by Jasper's spy. Tartar undertakes to visit Neville daily, to see whether Jasper—in his plan for isolating Neville from all friends and wearing his daily life out grain by grain—will communicate in some way with Tartar to warn him off from Neville. We see opportunities here for abundance of interesting matter. Indeed, one wonders how Dickens was to have got into the other half of the work all that seems promised in the later parts of the first half.

Of course, it is made clear that Rosa and Tartar have fallen in love at first sight. We know certainly too that this love is to "end well," though its course may not run smoothly all the way. But even in entering on this part of the story, by which the fortunes of Rosa, the chief heroine, are to be disposed of, Dickens does not fail to throw some sidelight on the main plot of his story, though they are only to be caught by the keener-sighted. Thus just after we have been told, in Dickens's fashion, that Rosa thinks more of Tartar than Edwin were he still affianced to her, (or did he still love her though no longer affianced) would approve (I mean in the words relating to Rosa's hat), the two start, arm in arm, Crisparkle walking in front. If Edwin is dead, or Rosa so supposes, this would not be an occasion for thought of him, especially as Rosa had no reason up to the time of Edwin's disappearance, to suppose he loved her more than others did. But if Edwin is alive and Rosa knows it, if further Edwin has told Grewgious and Grewgious Rosa that he—Edwin—now loves her, but she has been unable to respond as he would wish (though not saying that she can never care for him except as a brother),—this moment, when she is just entering "the country of the magic beanstalk" the dreamland of love, would bring Edwin to her thoughts. As Helena, a little later, recognising Rosa's love for Tartar, "seemed to compassionate somebody"—that somebody being Neville—so Rosa, recognising, though half unconsciously, her nascent love would at the moment compassionate another—that other being Edwin. "'Poor, poor Eddy!' thought Rosa, as they went along." Consider how full of meaning all this is. Dickens was not so poor an artist as to throw in the thought of Edwin's mysterious disappearance, or even his supposed death, at the moment of Rosa's incipient love for Tartar. It is certain that Rosa thinks of another's love, not of another's death, at this moment. She must know, then, that Edwin loves her and—now, for the first time—that his love is hopeless. She must know, therefore, that he is alive. All this corresponds well with what we have already become assured of, and therefore is not new. But it is worthy of notice how Dickens multiplies sidelights for observant readers, and how little he fears lest the careless reader should detect his meaning.

Helena's love for Crisparkle is shown in the second of these two chapters relating to Rosa, Tartar, and Neville Landless. "I could believe any such thing of Mr. Crisparkle," she says, with a mantling face, supposing Rosa to have spoken of Crisparkle saving Tartar's life ("more blushes in the beanstalk country"). We learn from this way of speaking, not only that Helena loves Crisparkle (we already know he loves her), but that their love, like that of the other pair, is to end well. For Neville, then, and for Edwin, we have no such promise. Yet we feel that the end of these two, though both are unfortunate in love, is not to be the same. Neville is to die, Edwin is to remain



Day Sign for the Month.

unmarried. The sympathy of Grewgious for both these young men is in great part due to his own past hopeless love for Rosa's mother.

If the pen had fallen from Dickens's hand just here, all that need have been known to make the drift of the story clear would have been told. We should be certain that Jasper was to be brought to condign punishment, Neville to be cleared though he was to die young, Edwin to become the valued friend of Tartar, Crisparkle, Helena, and Rosa, and these four to enter on that "happy marriage" condition which has been regarded from time immemorial as the appropriate fate of the heroes and heroines of happily-ending novels. We should regret our loss in the absence of those chapters in which the progress of events to this happy end would have been pleasingly narrated. But as to the general nature of the dénouement we could have no manner of doubt.

More, however, was written, and in what was written we have evidence even as to some of the details which would have appeared in the closing chapters.

(To be continued.)

Cats at Elevated Stations.—Notwithstanding the affection of cats for the tiles, they do not thrive at great heights. A scientific observer, who has recently tested the matter at a lofty station (12,000 ft. above the sea) on the Wahsatch Mountains, in Utah, finds that cats become subject to fits at such heights. The affection is partly due to the increased action of the heart and lungs, partly to the direct effect of diminished pressure.

ZODIACAL MAPS.

By Richard A. Proctor.

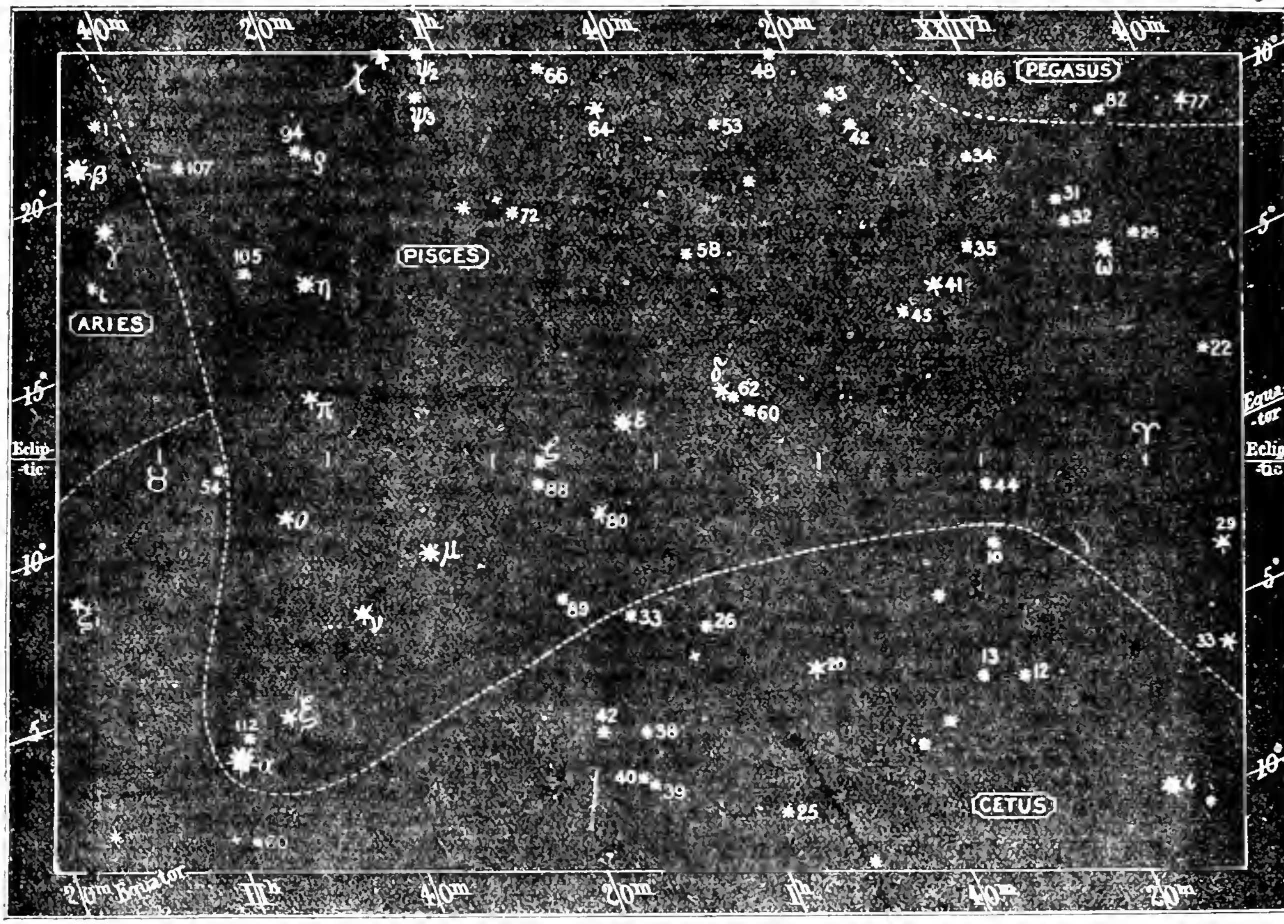
We give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

THE INTERNATIONAL HEALTH EXHIBITION.

XXI.—ANTISEPTICS AND DISINFECTANTS (*continued*).

In our last communication we gave a brief account of some of the more important inventions which come under the title of our present subject. Their mode of application, in a few instances, calls for the assistance of specially constructed apparatus, and amongst these James Robertshaw's "Improved Disinfecting Tripod" * is noteworthy as a remarkably convenient instrument for the application of sulphurous acid gas in cases where the fumigation of tenements is imperative. The instrument consists of three wooden rods arranged somewhat after the fashion of a photographer's tripod camera-stand. To the summit is affixed a brass rod crowned with a pan-shaped holder for the re-agent, and the entire system is so con-

* Of 3 and 5, Simpson-street, Manchester.



Night Sign for the Month.

structed that the pan may be elevated to a height of about 11 ft., and securely locked, so that it cannot possibly become displaced. The slide, moreover, can be fixed in any desired position by means of a wheel-nut, which works on a screwed taper portion inside the nut: this taper portion of the slide is cut into six divisions, and by screwing the nut down, it causes the taper portion to contract and grip the slide, thereby holding it in any position. An item of the utmost value in the exhibition of sulphurous acid for fumigating purposes is secured by the use of this appliance. It may be raised close to the ceiling of the room with absolute safety, the re-agent may then be ignited, and the fumes will descend, in virtue of their gravity, to do their work of disinfection. We may sum up the advantages to be gained by its use by calling it simple in construction, portable, effective in employment, and free from all the dangers which prevail when sulphurous acid gas is ordinarily used.

Two other fumigating methods of value are those introduced by McDougall Brothers, of 10, Mark-lane. The first of these provides for a generation of carbolised vapour; it consists of a small petroleum oil stove that burns without smell and requires no chimney, but yet suffices to produce the slight heat required for the expulsion of the carbolic vapour. It is designated a germicide.

McDougall's apparatus for the application of sulphurous and carbolic fumes in combination, is worthy of the attention of everybody interested in sanitary reform. He has introduced two methods for the fulfilment of his design. The first consists in the admixture of two powders, termed "McDougall's Disinfecting Powder" and "Acid Powder," respectively; no ignition is required, and the whole process is economical, trustworthy, and free from all dangers. The other plan we do not think quite so good as the foregoing, inasmuch as it requires the use of liquid sulphuric acid and a powder, the application of which in the hands of servants is apt to become somewhat dangerous; yet nevertheless, it is an advance on all former methods.

In conclusion, we would direct the attention of our readers to the exhibit of the London Patent Automatic Disinfector Company, of 53, Queen Victoria-street, London, E.C., whose apparatus for the healthy maintenance of soil-pipes in houses deserves more than ordinary mention. Appended we give a quotation from their prospectus:—

The invention of this automatic apparatus fully supplies a want long felt in every household, however good may be the sanitary arrangement as regards closets and drains; indeed, its advantages must be patent to the most casual observer. The application of the apparatus effectually neutralises and destroys the foul gases, while disinfecting and deodorising all objectionable matter, and not only deodorises, but is a test of the cleanliness of the closet itself, as well as the purity of the water in the cistern; and by copiously flushing the drains with a powerful disinfectant every time the w.c. is used, and always leaving disinfectant remaining in the pan all germs of disease are destroyed that would otherwise inevitably escape into the house.

The apparatus is applicable to any kind of closet or urinal, is fixed entirely out of sight without disturbing the pipe, the cost of which is £1. 12s. 6d. It will contain sufficient disinfectant for 10,000 gallons of water, which, under ordinary circumstances would be more than sufficient for one year, and can be re-charged in less than five minutes at a cost of 2s. 6d. without disturbing the woodwork of the w.c. It is specially valuable for private houses, hotels, public offices, factories, ships, and railway stations, hospitals, schools, public institutions, &c., for which special prices will be quoted when taken in large numbers.

Carbolic, or any other soluble or liquid disinfectant which may be desired, can be used. It is of the most simple character, cannot possibly get out of order, and, being made of copper and brass, will last for many years.

The importance of the subject of disinfectants and antiseptics to the inhabitants of this vast metropolis and other large communities need not be urged. It is part and parcel of the great sewage question which has of late disturbed us. We are of opinion that an evil of such magnitude cannot be suppressed by extraordinary measures: no discussion in the Houses of Parliament, no voting of large sums of money can be adequate to the wants of the case. We are confident that nought but a careful co-operation of the householders and landlords will avail. If each one would apply himself to the healthy conduct of his abode, to the application of the remedies we have discussed under the head of disinfectants, the annoyance would be abated. Thereafter a gradual process of reform might be introduced in the construction of healthy houses, and we may rest assured that ere long a trustworthy and lasting system of sanitation will be established in our midst.

In our next we shall enter into the details of some of the most valuable advances that have been made with regard to the protection of our homes from filth, infection, and disease.

"OUR BOYS" IN THE ARENA.

IT has been sagely remarked that "all work and no play makes Jack a dull boy." Now, owing to certain misgivings of our own as to his identity, we are unable to consult the author of this trite remark in the matter, yet we have no hesitation in saying that the applicability of the adage may be extended to boys generally, even though they may not rejoice in the possession of so thoroughly downright a name as Jack. However that may be, the spirit of the proverb has been liberally accepted by the directors of the Polytechnic Institute for Young Men, the aims and objects of which were discussed in an article recently printed in these pages.

We do not propose here to revert at any length to the educational advantages offered to young men by the Institution; the soundness of that portion of the scheme projected by Mr. Quintin Hogg and his coadjutors was sufficiently demonstrated in the article above referred to, and may at present be dismissed with a confirmation of Mr. Slingo's assertion, that the "idea is to foster and promote every feeling, every exercise, every train of thought, which is calculated to help a man in his effort to become a good citizen and an honour to his race."

Our special object is to draw attention to the *social* advantages held out to young men as inducements to them to become members of the Institute; for it appears to us that the ultimate success of the undertaking is to a great extent dependent upon the maintenance of a spirit of *camaraderie* amongst its members. This was readily perceived by Mr. Hogg and his friends, and their untiring efforts have been directed to the formation of various clubs in connection with the Institute, each one of which is calculated to form a strengthening link in the chain of companionship which binds the members to each other. Already there are clubs in full swing for swimming, rowing, cricket, football, lawn-tennis, and bicycling; there is an excellent gymnasium; a Volunteer company has been recruited; and the members of the Institute have also established three bands—brass, drum and fife, and orchestral. Besides these, there are, of course, the usual chess and draught clubs, debating societies, &c.

At the first blush it may perhaps be thought that there are "too many irons in the fire," but this supposition vanishes when we consider that three thousand members are enrolled on the books of the institute. These numbers are quite sufficient to warrant the hope that the clubs will be, to a great extent, self-supporting, and, as a matter of fact, all of them are now in a flourishing condition. It would be strange, too, if this were not the case, considering the munificent help rendered by the patron of the scheme. For instance, a swimming-bath has been provided by Mr. Quintin Hogg at an outlay of £8,000, the same gentleman having also purchased a cricket-field for the members, of such a size that Lord's ground sinks into complete insignificance in comparison with it.

Nor are these athletic and other amusements pursued at the expense of the more serious work. On the contrary, it is manifest that, being properly managed, they can but act as incentives to study. The annals of our Universities afford abundant testimony to the pre-eminence as scholars of those who were foremost in the field and on the river. It can hardly be denied that the activity of the brain is promoted by a healthy condition of the body: and this being so, opportunities for recreation should be doubly welcome to those who are studiously inclined. In short, the importance of physical exercise cannot too strongly be impressed upon the young men of to-day. Then, again, it must not be overlooked that the existence of these clubs is in itself a security for constant attendance at the classes of instruction, simply through the *esprit-de-corps* thereby promoted amongst the members. For these, as well as for other equally important reasons, the value of these branches of the Institute cannot well be over-estimated; and, therefore, we are glad of the opportunity of offering a few words of encouragement to those directly concerned.

A few evenings since we were present, at the Royal Albert Hall, during a performance given by members of the Institute gymnasium, the popularity of which latter is amply testified to by the fact that upwards of sixty members took part in a programme consisting of the usual features—singlestick and dumb-bell exercises, vaulting, horizontal and parallel bars, boxing, fencing, &c. We must say that the proceedings were carried out in a manner highly creditable to all concerned: indeed, it is no exaggeration to assert that some of the items on the programme could not easily have been excelled by professional gymnasts. We were much struck by the smart and picturesque evolutions performed during the "maze," and the vaulting over the "horse" was also very effective. But where all was so well done, it would be invidious to further particularise, so we will content ourselves on this head by acknowledging the evident ability of the gymnasium instructor, Colour-sergeant Barber. As we watched him in the arena, strictly and impartially using his judgment, and witnessed the near approach to perfection displayed by his pupils, we mentally invested him with Artemus Ward's oft-reiterated description of the gentleman in "black close," who brought the skittish Octoroon under his notice; for (having regard, of course, only to his capabilities for his post) Mr. Barber was, to our mind, "apeerently as fine a man as there was ennywhares." We wish the gymnasium and its kindred institutions all success.

No excuse need be offered for presenting these remarks, even to those of our readers who are not personally interested in the matter; for surely we are merely writing in furtherance of our motto, "Let knowledge grow from more to more," in thus making widely known the inducements—nay, let us rather say enticements—offered to youths by the Polytechnic Institute to enable them to qualify as valued members of society. Those of our readers, on the other hand, who may desire further particulars, should read, if they have not already done so, the article on the subject which appeared in No. 153 of KNOWLEDGE, or make application to the secretary of the Institute, Mr. Mitchell, who will gladly enrol candidates for admission into the ranks of "Our Boys," as the members are felicitously designated by those who have their welfare at heart.

We cannot, in conclusion, refrain from again insisting on the undoubted advantages offered to young men by Mr. Quintin Hogg and those who assist him in carrying on this great work. No more fruitful or attractive enjoyment can be found for a youth's leisure time than is to be obtained under their auspices; and if he cannot derive tangible advancement from becoming a member of the Polytechnic Institute, where he can obtain for a trifling fee the best possible instruction, technical as well as theoretical, in many departments of study, combined with the comfort to be found in *really* sociable surroundings, then all we can say is, "Jack" must be a very "dull boy" indeed.

Editorial Gossip.

I HAVE seen with regret that Dr. Kinns, author of a work entitled "Moses and Geology," (which I have not read) has been troubled by remarks which the acting editor made, in all good faith I am well assured, on his lucubrations. In rejecting, however, as utterly inadmissible, the line of reasoning followed by Dr. Kinns, I am quite at one with my friend the acting editor. Dr. Kinns submitted to me, when KNOWLEDGE was as yet very young, the outline of his reasoning, and a most stupendous miscalculation of the probabilities in favour of his particular interpretation of the real meaning of the account of the creation in the first chapter of Genesis. Those who are curious in the matter can find (I cannot) my reply to Dr. Kinns in some of the earlier columns of "Answers to Correspondents." Suffice it that I did not give insertion to reasoning which seemed to me most obviously illogical, and that—probably—the glimpse of his idea which Dr. Kinns then gave me prevented me from even thinking of reading the work which he subsequently brought forth.—R. P.

I CAN hardly imagine a more serious attack on the account in Genesis, than that which Dr. Kinns has in effect made while seeming to defend it. To suppose the account erroneous in several important respects implies only that, whether inspired or not in matters relating to religion, the writer of the book of Genesis was not inspired in regard to scientific matters; but to suppose the account can really be interpreted as Dr. Kinns suggests, is to suppose that a person (not Moses, whoever he was) inspired with knowledge of all the facts, was so unskilful as a writer that every single reader had misunderstood him till Dr. Kinns came along with his help to clear up the meaning of a divinely-inspired penman. This, of course, is monstrous on the face of it.—R. P.

BUT while I am thoroughly at one with the gentleman who has kindly acted as editor for me during my absence from England, in rejecting unhesitatingly the argument which runs through Dr. Kinns' work (as I understand), I saw with regret a charge of ignorance brought against Dr. Kinns, and with pleasure its ultimate withdrawal. For my own part, I should feel loth to accuse any one of ignorance, being so thoroughly ignorant myself—in multitudes of special departments of science. Every man living, however well informed he may be in some subjects, is grossly ignorant in a much greater number. I do not even know an astronomer who is not ignorant in some departments of his own subject, nor any chemist, geologist, botanist, entomologist, or other specialist who—if really a master—will not admit that there are departments of his special subject about which he knows very little. How much more ignorant must he be of subjects outside the few he can have made his own.—R. P.

THE only ignorance which is really contemptible is that crass ignorance which can see no knowledge worth having outside the petty domain which any one man can conquer. It was such folly, not mere ignorance about this or that subject, to which Molière referred in the well-known lines :—

> J'ai cru jusques ici que c'était l'ignorance
> Qui faisait les grands sots, et non pas la science—
> Vous avez cru fort mal; et je vous suis garant
> Qu'un sot savant est sot plus qu'un sot ignorant.
>
> —R. P.

I HAVE found that even my "Easy Star Lessons" and "The Stars in their Seasons" require to be supplemented by a simpler guide to a knowledge of the heavens. My "Half-Hours with the Stars," originally prepared for my friend Mr. Hardwicke, as a simpler version of my "Constellation Seasons," is rather rough, and not quite simple enough. It was never intended as more than a test of the young student's requirements in that direction. I propose now to bring out fortnightly (or rather twice a month) a series of still simpler star-maps, showing the position of all stars of the first three magnitudes, over the whole heavens for every night in the year. With 24 such maps for the year, the student can always find a map showing the stars as they are actually situate, *within less than half-an hour* of the moment of observation. These maps will thus form a series which might be very correctly called "Half-Hours with the Stars," seeing that if the observer continues his survey on any night in the year for half-an-hour, he will be able to select a map showing the stars precisely as they are at some part or other of that half-hour. The series will be called, however, "First Star-Lessons." The maps will be drawn for the latitude of mid-Britain. They will commence in November, so that if any alterations of plan suggest themselves, the complete series on such improved plan may begin next January.—R. P.

I HAVE by no means forgotten my promise respecting maps showing the stars with constellation figures. But all things cannot be done at once. I have an immense amount of astronomical mapping to get through before I have completed my proposed work in that direction; but those who follow the progress of KNOWLEDGE patiently will find all done—if I live—in due course.—R. P.

ERRATA.—In the "Face of the Sky," on p. 303, the times of rising of Saturn are erroneously given. They should really be 8h. 10m. p.m., on October 10, and 7h. 15m. p.m. on the 24th.—Letter 1457, last paragraph, "Whether science will ever directly," read "indirectly."

Reviews.

SOME BOOKS ON OUR TABLE.

The Alpine Winter Cure. With notes on Davos Platz, Wiesen, St. Moritz, and the Maloja. By A. T. Tucker Wise, M.D., L.R.C.P., M.R.C.S., &c. (London: Baillière, Tindall, & Cox. 1884.)—Within the memory of a very large proportion of the readers of these lines, consumptive patients were invariably dispatched to a warm climate for the relief or cure of the fell disease with which they were attacked. Now the pendulum has swung to the opposite extremity of the arc, and intense dry cold appears to be the latest remedy for phthisis. Dr. Wise's book is a guide to a few winter resorts in the Engadine, and he decides in favour of the Maloja as the most salubrious spot, and that furnished with the greatest number of conveniences and appliances for the patient afflicted with incipient consumption. He gives exhaustive meteorological details in connection with this locality, and explicit directions for getting there. The sufferer from incipient phthisis who is prepared to face an occasional minimum temperature of 7·5 Fah. may consult his little book with advantage.

In the Watches of the Night. By Mrs. Horace Dobell. Vol. III. (London: Remington & Co., 1884.)—Since the publication of the second volume of verses, which we reviewed on p. 75, Mrs. Dobell (like the woman in Mark) seems to have "nothing bettered, but rather grown worse." Opening her third volume, as we did its predecessor, absolutely at random, the first words our eyes light upon are these:—

The Blue Moon.

Oh, yellow moon, of whom our poets sang,
Hast thou, then, altered thy fair face of old?
Now as a *cheese* in a *pink* sky to hang;
A *Stilton* cheese—all covered with blue mould.

This may be poetry, but, for the life of us, we cannot discern it.

The Art of Solving Problems in Higher Arithmetic. By Rev. J. Hunter, M.A. (London: Longmans, Green, & Co., 1884.)—In this very well-executed work Mr. Hunter explains and illustrates various devices applicable to the solution of the more intricate types of arithmetical problems: artifices, of course, akin to those by which algebraical equations are solved. His book may be commended to all who wish to work questions in Higher Arithmetic at once with intelligence and facility.

Leaves from my Note Book. By Thomas Allen Reed. (London: F. Pitman. 1884.)—This is a history of Mr. Reed's own life as a reporter, printed in reporting phonography, beneath which appears a verbatim transcript in "language understanded of the people." One catches something of the author's enthusiasm for his art from its perusal.

We have also on our table *Society, The Medical Press and Circular, The American Naturalist, The Journal of Botany, Bradstreet's, The Railway Review, The American Druggist, The Gardening World* (a new and, apparently, excellent paper), *The Tricyclist*: from Messrs. Cassell & Co., *An Old Testament Commentary*, by the Bishop of Gloucester and Bristol, *European Butterflies and Moths, History of the Franco-German War, The Library of English Literature, The Countries of the World, Cassell's Household Guide, Cassell's Popular Gardening*, and *The Book of Health*. Also *The Hindu Excelsior Magazine, The Church of England Temperance Chronicle*, and a *Catalogue of the Exhibits from the Department of Education of Japan*.

THE FACE OF THE SKY.

From October 24th to November 7th.

By F.R.A.S.

The student will not neglect his daily watch on the Sun for spots, faculæ, &c. Maps X. and XI. of "The Stars in their Seasons" may be consulted for the configuration of the night sky. Mercury is a morning star during the succeeding fortnight, but is approaching the Sun and getting into a bad position for the observer. In fact, he comes into superior conjunction at 8 o'clock at night on November 4. Venus is a morning star, too, and a brilliant object before sunrise. Mars is invisible, but Jupiter is coming into view now in the east in the early morning, rising about 56 minutes after midnight to-night, and about a quarter past twelve o'clock on the night of November 7. No phenomena of his satellites occur at anything like convenient hours for the ordinary amateur during the next fourteen days. Saturn is visible during all the later working hours of the night, and is in every respect a splendid object now. He is, as stated a fortnight ago, still a little above ζ Tauri, which he is approaching. Uranus has left us for the season. Neptune has scarcely moved perceptibly from the position in which we left him. The Moon enters her first quarter at 1h. 51·4m. a.m. on the 27th, and will be full on November 3 at 8h. 37.8m. a.m. No less than eight occultations of stars will happen at convenient hours during the period covered by these notes, so that the juvenile or incipient astronomer who possesses a telescope has a treat in store for him. On October 27th the 6th mag. star 8 Aquarii will disappear at the moon's dark limb at 8h. 41m. p.m. at an angle of 109° from her vertex, to reappear at her bright limb at 9h. 50m. p.m. at a vertical angle of 343°. On the 30th, 11 Piscium, a $6\frac{1}{2}$ mag. star, will disappear at the dark limb of the moon at 7h. 26m. p.m., at a vertical angle of 120°, reappearing at her bright limb at 8h. 37m., at an angle of 274° from her vertex. Later on on the same night, at 10h. 27m., 14 Piscium, a 6th mag. star, will disappear at the moon's dark limb, at an angle from her vertex of 152°, and reappear at her bright limb at 11h. 35m. p.m. at a vertical angle of 302°. On November 4 63 Tauri, of the 6th mag., will disappear at the moon's bright limb at 9h. 40m. p.m., at a vertical angle of 66°, reappearing at her dark limb at 10h. 44m. p.m., at an angle from her vertex of 246°, two minutes after the occultation of 63 Tauri (*i.e.*, at 9h. 42m. on the same night; the $6\frac{1}{2}$ mag. star B.A.C. 1351 will disappear at the bright limb at an angle of 36° from the vertex of the moon, reappearing at her dark limb at 10h. 38m. p.m., at an angle from her vertex of 278° On November 5, 115 Tauri, a 6th mag. star, will disappear at the Moon's bright limb at 10h. 2m. p.m., at an angle of 101° from her vertex, and will reappear at her dark limb, at a vertical angle of 194°, at 10h. 46m. p.m. Lastly, on November 7, 68 Geminorum, a star of the $5\frac{1}{2}$th mag., will disappear at the bright limb of the Moon at 11h. 14m. p.m. at an angle of 35° from her vertex, to reappear at her dark limb at 12h. 14m. p.m., at a vertical angle of 237°. The Moon in Sagittarius all day to-day, to-morrow, and until 6h. 30m. p.m. on October 26, when she enters Capricornus. This she crosses by noon on the 27th, and passes into Aquarius. She continues in Aquarius until 10 a.m. on the 30th, when she enters Pisces, her passage across which great constellation is not completed until 11 a.m. on November 2. She then passes into Aries, which it takes her until midnight of the 3rd to cross. Entering Taurus at this hour, she travels through it until 9 a.m. on the 6th, entering at that hour the narrow northern strip of Orion. Leaving this at 8 o'clock the same night, she passes into Gemini, in which constellation she still remains when these notes terminate.

THE ECLIPSE OF THE MOON.

Dr. Wilson writes from Chester:—"In Chester, eclipse on Oct. 4 was different from any I ever witnessed. The moon's brightness and light, which were specially clear, were not sensibly diminished during the time she was in penumbra, but in umbra she was as effectually obscured the whole time, as if blotted out of existence, although the sky was quite clear, and on emergence into penumbra she shone out again with full brilliance. But at Broxton, only about twelve miles S.S.E. from Chester, she was distinctly seen of the usual copper colour all through the umbra. A brilliant meteor, of greenish colour, was seen here last night (Oct. 12) in N.W. at 10.30 p.m."

Dating from Worthing, Mr. Ernest Overington says:—"I commenced observations about half an hour before the first contact with the shadow, and continued them up to half-past eleven. During the first part of the partial phase, the part of the moon in the shadow was faintly visible in my instrument (a three-inch achromatic) with just a faint tinge of green. As it approached totality it grew a little brighter, but the green tinge disappeared and gave way to the usual coppery colour. During the total phase the moon was faintly visible, and both to the naked eye and through the telescope appeared of a coppery colour, which colour she retained up to the time I discontinued observations, the only time she appeared green being for a short time after the commencement of the eclipse."

From Wellington College, Mr. P. H. Kempthorne writes:—"Having observed, in more than one account of the eclipse of Saturday week, that the moon was said to be invisible, or nearly so, during totality, I think it may be worth while to state that here the outline was visible to the naked eye at all times. The disk was of a dull coppery hue. My 8½-in. mirror showed a fair amount of detail. The surface, in colour, was that of a bright copper-kettle somewhat irregularly tarnished by common use. The darker portions did not altogether correspond with the darker portions of the lunar orb."

And E. C. R., from County Meath:—"The eclipse was well seen here as in most places, and several observers who saw the commencement tell me that they were unable to see the moon at all when they looked for it between 9.30 and 10 that night. This seems strong evidence to show that none of the light usually seen on the eclipsed surface of the moon is due to phosphorescence caused by its long exposure to sunlight."

[Here, again, we have the most curious discrepancies as to the visibility of the moon during totality, and the colour of the earth's shadow. That some of them had their origin in local atmospheric causes is pretty obvious; but this explanation is far from reconciling them all.—Ed.]

Miscellanea.

Camels are, it is said, to be employed as the motive power on the last section of the railway built by Russia through the Trans-Caspian desert, toward India.

It may be mentioned that on the 10th inst. a twelve-coach Midland Scotch express ran clean through Bedford station before it was stopped, in consequence of the failure of the leak-off vacuum brake.

It is stated that Mr. W. F. Brearey has succeeded in inducing the authorities of the International Exhibitions at South Kensington to include aëronautics in the programme for next year, and it is probable that some experiments in balloon steering will be made.

The Earl of Rosebery is to be the first president of the projected Scottish Geographical Society, and the inaugural address will be given in Edinburgh towards the end of December by Mr. H. M. Stanley. The promoters of the society will aim at establishing a magazine which shall be a popular record of the leading geographical events of each month.

Royal Victoria Hall and Coffee Tavern, Waterloo Bridge-road, S.E.—The committee of the above hall have been enabled to arrange another series of penny science lectures. On Tuesday, Oct. 28, J. W. Groves, Esq., will lecture on "Plant and Animal Mimics," and on Tuesday, Nov. 4, the Rev. W. Tuckwell will lecture on "A Bank Holiday on the Hills."

The London and North-Western Railway now includes four separate lines laid upon 114 miles, and three lines upon 28 miles of its railway. The Midland Company has 66 miles of four lines, and 21 of three lines. The Great Northern is laid with four lines for 24 miles, and with three lines for 30 miles. There are now over 400 miles of railway in England laid with three or more sets of rails, and the estimated cost of the widening has been twelve millions.

At a meeting of the Birmingham Tame and Rea District Drainage Board held last week, the Works Committee announced that thirteen contracts had been entered into for various operations, ten of which were already completed and the others far advanced. Alderman Deykin stated that the Board had now practically arrived at the close of their operations, and that at that moment the whole of the sewage of Birmingham was flowing into the river Tame in a perfectly innocuous condition.

Lectures on Sanitary Matters.—Miss Barnett, of the National Health Society, 14, Berners-street, W., has again started on a lecturing tour in the provinces. Manchester, Carlisle, Keswick, Workington, Cockermouth, and many other towns are to be visited. Her subjects are likely to prove attractive at a time when sanitary precautions are more than ordinarily needed:—"How to oppose the Cholera," "Prevention of the Spread of Infectious Diseases," "Air and Ventilation," "Good Food," "Sensible Dress," "Management of Infants," and kindred subjects, are all treated in a simple, practical manner, and we cannot help wishing that such teaching could be constantly and thoroughly carried out in every town and village of the United Kingdom. That "Prevention is better than cure," is a motto we should all do well to remember.

A New Caoutchouc.—It is reported, says *Engineering*, that the attention of the Indian Government has been drawn to a tree in Southern India, from which large supplies of caoutchouc can be drawn. This is the "Tuchmig" of the Chinese, or *Prameria glandulifera* of botanists. Unlike the South American tree, from which the caoutchouc is tapped by piercing the bark, the gum is obtained from the new source by breaking the boughs and drawing it out in filaments. If the new caoutchouc is at all equal to the old in insulating properties, it will form a timely discovery, for the introduction of electric lighting has created an increased demand for india-rubber coated wires. Indeed, several inventors have lately been engaged in trying to manufacture a substitute for gutta-percha and india-rubber out of oxidised oils, that is to say, oils treated with chloride of sulphur, mixed with asphalte, ozokerit, and other insulating substances.

A Singular Experiment.—The *Fish Culture Journal* states that the truth of the assertion recently made by an American authority to the effect that brandy acts as an immediate means of revivifying fish on the point of expiration, has been completely vindicated by Mr. W. Oldham Chambers, secretary of the National Fish Culture Association, who conducted an experiment in the presence of several gentlemen at South Kensington on the 1st inst. Taking two Prussian carp from the tanks of the Aquarium, he deposited them in separate dry cans, adorning one with blue ribbon to distinguish it from the other, which was selected for the administration of spirituous liquors. After a lapse of four hours the fish were placed in water, evident signs of expiration being apparent in both cases. A small quantity of brandy and water was then given to the carp selected for the imbibition of intoxicating liquors through the medium of a feather, and no sooner was the fish replaced in water than it was quickly restored to vigour and strength. The carp enlisted under the banner of the "Blue Ribbon League" to all appearances died half an hour after its more fortunate associate, and was taken out of the water and thrown on the ground. About four hours later, however, the fish was picked up by Mr. Chambers, who observed it by appearance to be *in rigor mortis*. He at once operated on the seemingly inanimate fish by opening its mouth and pouring a dose of brandy and water down its throat and again putting it in the water, when, to his astonishment, he noticed slight signs of animation. For five minutes the unfortunate object of the experiment floated helplessly on its side, when presently, to the still greater amazement of Mr. Chambers and those who watched the experiment, it gradually asserted itself in the water, and with considerable effort made use of its fins—feebly at first, but afterwards energetically. Both the resuscitated fishes, who show no signs of their late prostration, are now in the tanks as usual. [These experiments, however, although remarkable, are not altogether new, similar ones having been performed by the authorities of the Brighton Aquarium.—Ed.]

Railroads of the United States.—The seventeenth annual issue of "Poor's Railroad Manual," which has just appeared, fully maintains the high reputation heretofore attained by this publication. It is a complete compendium of information touching the railroads of the United States, giving their length, equipment, share capital, funded and floating debts, cost of roads and equipment, traffic operations, earnings and payments, &c. All who have investments in such property, or who think of thus employing their means, cannot fail to do so with a better understanding after looking over the facts presented in this volume. There were 6,753 miles of railroad built in the United States in 1883, making a total length of 121,592 miles of road built up to the 1st of January last. America has nearly half the railroad mileage of the world, Germany, Great Britain, France, Russia, and Austria following next in order, but the length of American railroads considerably exceeds that of all the European lines combined. The total amount of liabilities of American railroads, on account of stock and debts, is now 7,495,471,311 dols.—an enormous amount, certainly; but it appears that their net earnings for 1883 were 4·19 per cent., which is an extremely good average, when it is remembered how largely their stocks and bonds have been watered. The "Manual" estimates the actual cost of these railroads at only about one-half of the amount of their funded and floating debts, and that they are thus really paying an annual interest equal to 9 per cent. of their cost. The railroad freight transported in 1883 amounted to 400,453,439 tons, the value of which, at only 25 dols. to the ton, would have exceeded 10,000,000,000 dols. The total length of all tracks was 149,183 miles, of which 78,491 miles were laid with steel rails. The number of locomotive engines employed was 23,823; of freight cars, 748,661; of passenger cars, 17,899; of baggage, mail, and express cars, 5,948.

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

MIND AND BRAIN.

[1467]—I see that your correspondent, "F. W. H.," "in the interest of truth only," has attempted an answer to the query which I put in my former letter. In the same interest, I could have wished that the answer were more satisfactory, and more to the point. For where, I ask, lies any *true* analogy between the purely mechanical action of light waves passing through a prism, so producing colour, and the production of intangible thought from the brain by the conscious effort of the human will? Such similes are, almost, proverbially dangerous and misleading. "F. W. H." has entirely missed my point. If his comparison has any bearing whatever upon the subject, the lecture which he supposes, on geology, or astronomy, or theology, might be likened to the ray of light which, being brought to bear upon the prism of the brain, produces certain differently coloured thoughts, so to say, in its passage through the brain of the hearer. But my question is, whence come the stimuli when the force of extraneous circumstances fails to account for them? Whence comes the power, which, in the form of will, uses the brain as its instrument, and compels it, without any assistance from external surroundings, to vibrate in such a manner as to do the particular work, to produce or evolve the special chain of thought which I will it to do? Whence, in a word, arises this dominating power of will over the vibrations of the brain in the production of thought? The letter of F. W. H. has thrown no light whatever upon this question. S. F. B. Pettin.

Does the thought produce the vibration of the brain, or does the vibration of the brain produce the thought?

WOLF'S COMET.

[1468]—During a short interval of clear sky, I picked up the new comet last night in my 2¾-inch. It is conveniently near ε Pegasi now, and appears like a nebulous patch. A. N. S.

[1469]—I obtained a good view of this object last night. With 6-in. reflector it appeared as a slightly elongated nebulosity with central condensation, and perhaps just a suggestion of a tail. Determining its position from ε Pegasi, I found it approximately R.A. 21° 33′ (N.B., 12° 26′, instead of 12° 5′ as given in the Dunecht circular quoted in Knowledge). The declination was corrected for the time given, viz., 11h. 6m. p.m., and is, I feel sure, correct within an outside error of 2′. E. S. Beaven.

Warminster, Oct. 12, 1884.

SHOOTING STARS AND METEORS.

[1470]—Mr. W. H. S. Monck seems to misunderstand my letter (1405).

I did not say that under the conditions alluded to the orbits of the shooting stars would not be altered; on the contrary, I believe they would. I only submitted on ocular grounds that the earth could not be their centre.

I think it is generally supposed that the great bulk of meteors which enter the earth's atmosphere, after disintegration by vaporisation, solidify in the form of dust, and so imperceptibly reach the earth's surface, while a small remainder, undergoing a trifling disintegration fall in a solid heated mass as aërolites. Eye-witness.

INFLUENCE OF MOONLIGHT.

[1471]—As I can speak from personal experience, I shall have much pleasure in giving you my opinion upon the subject. When a youngster, twenty years ago, I had the same impression as your correspondent's friend had, and implicitly believed that sleeping under the direct rays of the moon caused blindness, and I remember reading of a girl that, I believe, quarrelled with her parents and slept in a corn-field all night, and it was said that she became blind, during the night, from the action of the rays of the moon, but I cannot vouch for the truth of it. My opinion was completely modified when I was forced, from too much company in my bunk (of the heavy dragoon tribe), to seek rest on deck for six weeks, whilst the ship I was in was at Hong-Kong and Foo-Chow (I was a sailor then), and I remember I used to try to get where the moon did not shine upon me fair, but I never could, for what with the swinging of the ship and course of the moon, I repeatedly awoke with the moon shining full in my face, and suffered no ill-effects of the same. My opinion is that, if the sleeper has his eyes closed, no harm will come to him; but, if in the habit of sleeping with his eyes open or *partially* open, then the rays of the moon *may* have an injurious effect, for the bright light in Egypt causes ophthalmia. I can say nothing about the fish not keeping. I may mention that the dew fell very heavily, and that nearly all the crew slept on deck, but not one that I knew was affected.—I remain, dear sir, yours truly, R. J. Symonds.

[1472]—In reply to the question of your correspondent at p. 305, as to the influence of moonlight, it is one to which I have given my attention as a medical man, resident in India over twenty years, and during several voyages there and back. I have never been able to make out that the light of the moon had any influence whatever, but came to the conclusion that all the evil effects attributed to it arose from muscular rheumatic affections produced by sleeping—not in the moonlight—but in a draught or cold air. Sailors who, after a hot day in the tropics, lie down to sleep with their heads in an open port, are subject to attacks of the kind, and if the moon should have happened to shine in on their faces they attribute all the results to it, instead of to the effect of the cold air. What is called in the tropics moon-blindness, is quite a different matter. This occurs among weakly and badly-fed natives from other very obvious causes, and is a weak condition of the eye, which prevents them seeing well after dusk. B. M., F.R.C.S.

THE ECLIPSE OF THE MOON.

[1473]—In reference to your remarks in "Editorial Gossip," in your last number, on your own observation of the lunar eclipse, permit me to state I observed the same phenomenon, excepting the green-tinted ring. I did not observe the ingress, being engaged within doors. A friend entered and said the eclipse was total. I immediately went out and found that my friend did not clearly distinguish the difference betwixt *umbra and penumbra*, which I never before saw so clearly defined. Just before totality I again went into my room, not staying there more than two or three minutes, when, on returning to the garden, I had some difficulty in finding the exact place of the moon, so thoroughly was she obscured—any trace of light was absent. I have previously observed during an eclipse the moon's peculiar hue, but on this occasion I could not see the dark body of the moon without considerable effort. The skies were cloudless.

During egress, I could well observe that the diameter of shadow was much larger than the diameter of moon, but when about six-tenths of moon's disc only was in shadow, the segment of moon's bright side did not appear as any part of a circle, but rather of a parabolic curve.

Was this appearance an optical illusion, or was it more likely to arise from defective vision? Pardon my intrusion.

William J. Davies.

[The moon's diameter may be taken to be 2,160 miles; that of the earth's shadow at the moon's distance from us on the night of the 4th, as 5,879 miles. Does Mr. Davies mean that the moon's limb or the edge of the shadow on her surface showed parabolic curvature?—Ed.]

EXPOSITORY THOUGHTS ON THE CREATION.

[1474]—I have read the very unfair and indiscriminate critical notice of this my book, in your number of August 29 last, and in common justice to me I hope you will be kind enough to insert this letter in answer thereto, in an early issue of your periodical.

Passing by your general summary of the work as "hopeless nonsense," as scurrilous in the extreme, to say the least of it, I beg to say that I do *not* in my preface "*deprecate* adverse criticism on the somewhat incoherent grounds that the work was written when the writer was but temporarily engaged in his calling; that neither leisure nor learning properly so called has been brought to bear upon it; that the life experience of its writer has been mainly gained in another and far different sphere—viz., in a department of the legal world; and to a consequent lack of sufficient knowledge of natural history and other branches of learning and research;" *nor* do I "put forward my ignorance of the subject on which I treat as a reason why I should be tenderly dealt with."

The words in the preface, "when the writer was but temporarily engaged in his calling," refer to the *time when the work was written;* the statements, respectively, that "neither learning nor leisure (properly so-called) has been brought to bear upon it, and that the life-experience of its writer has been mainly gained in another and far different sphere," &c., are, *inter alia*, adduced as reasons for the admission made that the writer "lacked sufficient knowledge of natural history and other branches of learning and research necessarily involved in his wide-ranging subject," *to deal therewith* in a comparatively *exhaustive manner.*

I refer the critic to the preface, and ask his candid acknowledgment whether this my construction of it is not a fair one.

I do not put forward my "ignorance of the subject" as a reason why the book should be tenderly dealt with, but, rather, *some* of the various circumstances which were unfavourable for enabling me to treat the matter fully, and as an entirety; and, by-the-bye, I do not ask for *tenderness*, the words are "in the hope that it will meet with a *fair*, and favourable, and even a *kind* reception.

Lest your readers should be misled by what the critic styles my "polytheistic exordium," I would merely say that the first chapter of the work states that "the teaching of revelation respecting God is that there are three persons, all equal, save in point of age, who, together form the God-head—*i.e.*, the Christian triune God, the Father, Son, and Holy Spirit," and that such first chapter also gives in evidence of such statements various texts of Scripture.

Respecting the criticism of the meaning of the word "day," I still adhere to my opinion that each day was an Age, and each Age was 100,000 years in duration.

I may hereafter, in another work, present my views with respect to the words, "the evening and the morning were the first (and each succeeding) day;" but I do *not* calmly put Exodus xx.—8, 9, 10, and 11 verses out of sight altogether; on the contrary, I, in effect, affirm in Chapter ii. that the seventh day referred to in Exodus was sanctified as a memorial time of rest from usual labour, exercise, and occupation.

The critic then (professing to give a sequence of *my facts*) asserts that the *female* deity, by a corporeal act, originated the compound elements of nature, which are five in number (and he names them), and states that "then the wind, salt, &c., began moving and rotating. Globules were poised in space." Now, I submit with all confidence and firmness that such assertions are inaccurate in an eminent degree; such statements present a garbled distortion of facts, and tend to pervert the judgment of the public respecting the book, and to injuriously affect the reputation of the author of it.

The work *really* states that the corporeal act was wrought conjointly by God the Holy Spirit and God the Son, and that its result was the poising in space of a number of globules, &c. (or the origination of the compound elements of nature), and that these compound elements or these globules (see p. 23) immediately began to move rotatorily and in circles from left to right, or west to east, &c.

The air, at first thin, the critic says, became thick; the book says, *after a lengthy period, gradually* the temperature rose from the intense coldness which first prevailed, and the air became more dense, and that still *by steps* advancing in its density it reached its ultimate degree of thick unctuous vapour.

The critic then says "the sea began to be developed, and that by virtue of the generating elements composing it, and those of air being in constant and two-fold motion, there gradually started into being multitudes of animalculæ, and microscopic life." The book gives the gradual natural steps by which the unctuous vapour *gradually* formed the seas, and then (in the fifth chapter), it states that "immediately the sea began to be developed, or soon after, by virtue," &c.

Then with an audacity most unbecoming his official capacity, the critic states, "With this start, the transition to shell-fish, and many marine creatures. . . . who attained unto immense size" presents no difficulty at all, or, at all events, as little as the method in which their deposits formed at last by far the greater portion of the earliest earth-crust, namely, that composed of chalk and lime; whilst the book says, "As the sea *gradually* further formed, *larger* and *higher creatures* in *natural* and *graduated order*, such as *zoophites, mollusca*, and *radiata*, became evolved," and that "*before* the *close* of the *first era*, there doubtless became evolved many marine creatures (now extinct) who attained unto immense size, and that in course of many thousands of years the deposits o such marine living creatures, and the remains of such as died would constitute a vast amount of matter, which, decomposing and disintegrating would go to form at last by far the greater portion of the earliest earth-crust," &c.

The critic then makes contemptuous reference to the assumption that the icthyosauri, plesiosauri, and megatheria existed during the third age. I submit that I have endeavoured to give a sequentiality of reasoning in the work in evidence of my contention.

The critic's equally supercilious reference to the alleged mode by which the air was formed does not produce in me any change of opinion respecting it; in fact, I am convinced that I am right. I notice, however, that he omits a by no means unimportant point respecting the component globules or vesicles, viz., their form. The book states their form was twofold—spherical and spheroidal.

The critic then proceeds to make the erroneous statement or implication that, according to the author, the sparrow and redpole were created on the third day (or era), with certain other species of birds which he names. The book makes no such statement; but says, in guarded language, that there existed during, or at the end of such age, the *first* species of the penguin tribe, the *first* species of the petrel genus, the *first* species of the crane tribe (or ancient Dinorni), and the *first* species of small aërial birds included in the insectivora genus, ending in the ultimate forms of sparrow and redpole in the *fifth* species, &c. The first species of the small aërial birds is described in the seventh chapter as being *white* of *two varying shades*, like the binary-coloured earth-crust of the period (the author submits that such species was the plovers).

If the critic had carefully read and well considered the work, he would have discovered that only one species (of five) is declared to have been evolved in one age; therefore, the sparrow and redpole (being the *fifth* species of the small aërial birds) would not be evolved until the present (or seventh) age.

Pursuing his disdainful way, the critic next sceptically questions the sequence or locality (or both) of the formation of the primordial metals of the three several genera, and, instead of giving reasons for his scepticism, he emphasises the metal, brass, by adding three points of exclamation thereafter, by way of showing, as I assume, and that bombastically, his own superior intelligence to that of the writer.

The writer, nevertheless, is not shaken in his views respecting the metals, which, he submits to the public, he has put forth clearly and in well-defined language in his treatise.

Then the critic, towards the close of his review, makes a curt and scornful allusion to the natural evolution or generation of Adam solely by a female gorilla, and also to that of Eve as set forth by the writer. The writer, however, notwithstanding such despisal thrown upon his views concerning such evolution, begs to say that he holds them as firmly as before, because he is *convinced* that they are *really true*, distasteful and humiliating as they *may appear* now, after thousands of years, to many of the excellent, the refined, and highly cultivated of our race.

After indulging in some general scurrilous and vulgar abuse, the critic ends by proffering the writer certain gratuitous advice, and refers him to Matt. xv., 14. Having been obliged to make this letter inconveniently long, the writer does not propose to animadvert upon such abuse; and, with respect to the advice, as it is of no service to him, the writer declines to take it, but suggests to the critic that, as in its appropriateness it rightly belongs, or is more suitable, to him, that he should keep it, and may it do him good.

J. R. Smith.

[An apology may seem necessary for occupying so much space with the above letter; but I am moved to insert it by two considerations. The first is the unfairness of condemning any man unheard. The second, the opportunity it affords the readers of the original review of judging for themselves, in the light of Mr. Smith's verbal emendations, how far the severity of his critic was justified. Mr. S. seems to consider that he proves an assertion by reiterating it. His wonder that the reviewer put three notes of admiration after brass as a "primordial metal," may possibly diminish when he learns that brass is an artificial alloy formed of copper and zinc by human hands, and that it *never* occurs in a native state. The oily and watery globules, the wind and salt, &c., may safely be left to speak for themselves.—Ed.]

FUNGOID GROWTH ON DEAD FLY.—THE ECLIPSE.

[1475]—Probably the fly, about which "St. John" wants an explanation (Letter 1419), died from an attack of its fungoid parasite, *Empusa muscæ*.

The insect in question would likely be glued to the ceiling by a viscid fluid exuding from the tubular hairs surrounding its pulvilli, and which ordinarily enables the fly to walk in any position, but continues to flow after the victim, from the destruction of its viscera, &c., has become too weak to move; it then becomes covered with a white powdery efflorescence, consisting of the stems and sporangia of the fungus.

The fly has dropped from some cause, fallen upon its back, and scattered the fungoid growth about the place where it struck.

Empusa muscæ appears to be the aërial form of *Sapsolegnia ferax*, the fungus which has caused so much destruction to salmon in many rivers of late years; hence, those who have aquaria should on no account feed fish with flies, as this practice may introduce a supply of germinating spores certain to kill the inhabitants.

Anent note on eclipse of 4th inst., p. 302, "Editorial Gossip," here at Newcastle-on-Tyne, the moon's place at totality could only be distinguished by a faintly luminous spot. A field-glass was required in order to bring the dusky disc into view. The night was fine, with some haze, but the more conspicuous stars were all visible. M. H. Robson.

[1476]—Your correspondent, St. John, in the last number of Knowledge, mentions having found a dead fly surrounded by a multitude of spores. He may be interested to know that flies at this time of year are often killed, as his evidently was, by a fungus (*Empusa muscæ*). This fungus attacks house-flies and completely fills their bodies, which become very much swollen with its spawn or mycelium. The segments of the body are stretched far apart, and the fungus protrudes through the thin connecting membrane, which is thus studded by numberless small, transparent bodies, shaped much like a child's ninepin, but with no neck, packed close together. When ripe, the head or spore is apparently thrown off with some little force, and forms the dust-like appearance round the fly. I was examining a fly, attacked by this fungus, under the microscope the other day. Between the segments were white bands about the same width as the segments, which were entirely covered with these little glass-like ninepins, and formed a very beautiful object. G. S. S.

FOOD OF THE DRONE-FLY.

[1477]—Mr. H. J. Slack in "Pleasant Hours" for this week, Oct. 17, speaking of the drone-fly says: "Unlike the biting insects, the beetles, no solid particles suit these creatures."

I should like to call Mr. Slack's attention to the fact that all the members of the drone-fly group (*Syrphidæ*), eat the pollen of flowers. The pollen, though small, is I think, quite solid. I have in my possession micro-slides showing the stomachs of various flies of the Syrphidæ, containing pollen of various flowers on which the flies have fed. In dissecting dung-flies, and very large blue-bottle-flies that have fed upon dung, I have noticed very small particles of solid matter in the stomach. If Mr. Slack has not noticed this fact, I shall be pleased to send him a few micro-slides for inspection upon receipt of Mr. Slack's address. John Moore.

ESTIMATING DISTANCES.

[1478]—With reference to the excellent method quoted in your paper lately from *La Nature* of finding distances by a silhouette cut to size, I find an easy way of measuring distance when any people are in sight is to reckon a furlong distance to a man of average height when he appears half a degree high—*i.e.*, the breadth of either the sun or the moon against the sky. Half a moon high will, of course, mean double the distance—viz., a quarter of a mile. C. T. B.

LIFE AFTER DEATH.

[1479]—I read with much pleasure the letter of your correspondent, Mr. Selwyn Thorne, for I, too, take a deep interest in the question of a future life. But I do not see how Mr. Thorne could solve the problem, even for himself, by "shuffling off this mortal coil." He could only know that there is a future life, *if there is*; if there is not, he would not know that he had ever wondered or questioned about the matter at all, or, indeed, that there had ever been a *he* to wonder or a *question* to be solved. To quote the words that Mr. Howells, the novelist, puts into the mouth of one of his characters, "if we awake, we shall know it; if we do not awake, we shall not even know that we have not awakened."

A boy was drowned while bathing here at Worthing a few weeks ago. His body was brought to shore after it had been some time in the water. Every means were taken to reanimate it; but, unlike the case spoken of by your correspondent, these means were quite unavailing. Now, are we to believe that in the one instance the soul or spirit of the man was merely dormant within his body, while, in the other case, the boy's spirit was alive and awake, and conscious outside his body? If so, at what moment did he awake? Was he, perhaps, looking on at the futile efforts of those engaged in trying to bring him back to life in this world?

It would be pleasant to be able to believe something of this sort, but as you say, sir, in your review of Mr. Reynolds's book, "belief is *not* voluntary"; in spite of the preachers there is no such thing as *wilful unbelief*. A man has no choice but to believe what seems to him to be true. M. T. H.

[1480]—We would have no cause to complain of your very wholesome rule which excludes theological subjects from the pages of Knowledge, if that rule were impartially enforced. I trust you will excuse me if I say (since I say it in no unfriendly spirit), that while you exclude the theological, you insert much that is anti-theological, and, in this, I think that we who believe at once in religion and in science, have some cause of complaint. The letter, for example, which appeared under the above heading is distinctly of this class. It is plainly an attack upon theologians—"those who teach the doctrine of a hereafter." Now, is this fair?

But more on this subject, as on every other, the scientific man and the theologian take entirely different methods. Your correspondent has adopted the theological, not the scientific, method, and then you, Mr. Editor, in your note, tie our hands and tell us that we must not reply by the same method. Science bases its conclusions on *phenomena*. Theology bases its conclusions partly on phenomena, but chiefly on *testimony*. Now, the reasoning of Mr. Thorne is altogether founded on testimony, and that of the most unsatisfactory and unreliable kind—*negative* testimony. We have some *positive* testimony on the same subject, but your rule excludes it—it is not "purely scientific." Neither is the reasoning of your correspondent.

Now, meeting Mr. Thorne, not on his own ground, but on the ground which you say must be occupied in this discussion, let me present some considerations both for him and for your readers.

1. The scientific conclusion from all that Mr. Thorne relates (admitting the correctness of his relation) is that the question remains untouched. As regards the mind and soul, there are no phenomena, therefore science gives no judgment in the matter. It could not be otherwise, for—

2. Admitting for the moment that the man was really dead, and that he had actually passed into another life, we can only argue here from analogy, and analogy would lead us to believe that in the time he would have gained no knowledge, and that his memory would retain no impression of that new life. For, in this world, at all events, it is only when impressions have been often repeated that the mind is affected. The mind of the newly-born infant does not even receive the idea of light for some time. In after years the mind is able easily to receive impressions of *combinations* of objects which have been made already familiar by repeated presentation; but, as far as we can know, if an unfamiliar phenomenon were to appear once, and only once, it would make no impression whatever either on mind or memory. And this is exactly what must have happened in the supposititious case before us. The man received no impression, because the mind was not prepared for such a sudden change.

3. But, as a matter of fact, the man was not dead. He was only unconscious. It is simply ridiculous to say that because a man is in a faint he is practically dead. If so, the number who were dead and have come to life again would be large indeed. I have myself gone through the process more than once. We would find, too, that it is not in every case that the mind in returning has no account to give of its period of seeming absence from the body.

4. To persons who, like Mr. Thorne, form their opinions on this subject from the evidence casually obtained on occasions like that which he narrates, we may fairly adduce the testimony of those who declare that they have been visited by deceased persons at the time of, or immediately after, death. Such evidence is at least as trustworthy as the merely negative testimony that "no symptom of change whatever" passed over the man who was unconscious. To us (poor theologians, who cannot argue scientifically) who believe that there is something more certain on which to found our belief than the testimony of unconscious or hysterical individuals, it matters little whether we receive such evidence or not.

Ballyboy Rectory, King's Co. John Healy, Clk., LL.D.

[By "much that is anti-theological." I can only conceive that Dr. Healy must refer to scientific conclusions opposed to his own views. How many scientific men, who are entitled to be listened to, now dispute the great antiquity and primitive savagery of the human race, and the doctrine of evolution? All of which my correspondent would doubtless regard as "anti-theological" in a high degree. Yet in this they have facts and not merely testimony to appeal to. I say boldly that there is no evidence in existence as so the appearance of a deceased person, upon which a magistrate would dare to send the veriest tramp to gaol for fourteen days. For the rest, Dr. Healy's argument is temperate enough, and worthy of all serious attention, and on that account I insert his letter at length.—Ed.]

[1481]—The following question seems to me to need an answer before it is possible to enter into the discussion initiated by Mr. S. Thorne, with any hope of its being a fruitful one.

Briefly this:—Let atoms of hydrogen, oxygen, nitrogen, carbon, phosphorus, and so forth, be arranged in precisely the positions they occupy in a human body—let motions be communicated to them precisely similar to the vibrations which the molecules of a normal human body are executing—will, or will not, the result be a sentient being?

I am unwilling to obscure the issue involved in the bare question by adding any hint at present with reference to my own opinion on the subject. F. G. S.

LETTERS RECEIVED AND SHORT ANSWERS.

P. Nevill. Thanks for cuttings; but the connection seems somewhat remote.—E. K. H. Oh, dear, no, it can "*not* be said that there were no occultations visible," as there were thirty stars between the 9th and 11th magnitudes over which the moon passed. But, *cui bono?* That rising of Saturn was a slip of "F.R.A.S.'s" to which his attention has been called.—J. B. Dimblery. Thanks; but your chronological vagaries occupy too much space in your account of the Eclipse.—W. Jennings and W. Warsop. Delayed through your omission to address the *Publishers.*—J. H. B. I can quite understand "the leading organ of the wine trade" being irate with Mr. Mattieu Williams for his articles on the Cooking of Wine; nor do I suppose that the said organ loves me much more for my reproduction of some very remarkable items from a certain "Trade Circular" some time ago in "Editorial Gossip."—F. J. Wardale. The second edition of "Orbs around us" expresses the matured views of the conductor of this journal on the subject. See concluding paragraph (in capital letters) with which the Correspondence Column is headed.—E. S. Beaven suggests the Conservation of Mental Force as a contribution to the (now closed) question of Life after Death. Many thanks for the addendum to your letter.—R. Webb. Mr. Baker, 244, High Holborn, London.—E. Bradshaw considers that Transmigration supplies a solution of the Life after Death difficulty.—Thomas J. George. Mr. Proctor has entirely ceased to lecture. See Knowledge for July 18, p. 62.—H. A. Bulley. If you merely mean to indicate that psychical phenomena are influenced by the size, texture, and, notably, by the intricacy of the convolutions of the brain — yes; but there is a long step from this to the system of Gall and Spurzheim. — J. R. Smith. — Your letter marked for insertion. — John C. A. Stewart sends an account of a boy named Carroll, one of the crew of the ill-fated *Europa*, who refused to go in the ship on the day she sailed, on account of a dream that she sank after a collision (which, of course, she did).—Augustine Lee. You talk about "magnetic" sleep, &c., as though it was an objective, instead of a purely subjective phenomenon. You leave the question just where you found it.—More Light. You are quite right as to Dr. K. ignoring the refracted light from the photosphere. That from the Corona could not possibly illuminate the Moon's surface sufficiently to admit of its being analysed spectroscopically.—C. E. Doyle, T. H. S., F. W. H., and Jas. Spiers. You will see that the enormous mass of correspondence received on the subject has compelled me to close the controversy. — E. C. R. sends a list of the colours of prominent afterglows observed in County Meath between January 7 and October 11. They seem to have varied from white through red and pink to crimson.—Inquirer.—Undoubtedly a man reads English from *his own* left hand to his right: the only legitimate sense in which that word can be used. You surely would not say that (in a northern latitude) the sun travels from right to left from his rising to his setting?—J. N. Dawson. Write to Messrs. Watsons, 313, High Holborn. Thanks for offer of the cricket score, but we are utterly overburdened with matter.—E. Howarth. See reply to "E. K. H." above.—Arthur A. West. Thanks, but as you will see, already sufficiently replied to.—Rev. C. Carus-Wilson writes that he cannot definitely answer Mr. Beaufort's question, as he does not make his own tea; but that, weak or strong, the effect was the same.—Chas. Rice. Yes; but the only thing requiring elucidation is the mathematical reason why.—M. B. The system is really genuine, and would, I believe, be of service to you.—Selwyn Thorne, Rev. Wm. Fitzgerald, C. Ridley, Dr. Dyrter, and others, will see from the announcement with which this column concludes on p. 329, that the "Life after Death" controversy has now terminated. Such thoughtful letters as Mr. Ridley's, and one or two more which have reached me, cause me to regret that they did not arrive before these pages were closed to them.—Thos. Radmore. The only possible interpretation that I could place upon your original communication was that you imagined that the fore and after-glow were—or would be—in some way affected by the Lunar Eclipse. If you intended to express the exact converse of this I can only deplore that my limited knowledge of English prevented me from understanding you. Unless there is some novelty in your observations I should hardly care to insert them merely in corroboration of others already published, considering how much of interest is at present crowded out of our pages.—James Gillespie, 105, St. Michael-street, Dumfries, once more sends me an exposition of his "theory," filling a penny memorandum-book. This is, at least, the third time I have acknowledges the receipt of these essays here, and once or twice I have even pointed out the egregious fallacies underlying Mr. G.'s assumptions. It is, however, pretty evident that he does not read Knowledge, and expects a reply by post, which neither he—nor any other correspondent—will ever receive. If any of our readers are acquainted with Mr. Gillespie, they will confer a favour upon the Editor of this journal by inviting that gentleman's attention to this reply.—Samuel P. Cheeseman. Received.—J. N. A. We do not give the prices of books. They must be sought in advertisements proper.—Patrick McManamin. The article you send me is simply a very clumsy reproduction of the famous Lunar Hoax, of which the details will be found in "Myths and Marvels of Astronomy." There is no such a person as "Dr. Blendmann" in the Berlin observatory. No lunar photograph could by any possibility be taken through an object glass blackened with camphor smoke; nor would the most perfect one yet obtained bear magnification to the extent of 55 feet. There is not a scintilla of truth in the rubbish reproduced by the Mayo paper.—W. I am really grieved that my omission to insert your lengthy communication has made you so very angry.—Delta. The succession of the strata, the distances, magnitudes of the heavenly bodies, &c., are all correct, and this is all. As for the *deductions* from these, I am still thoroughly in agreement with you.—Pal. "Eye-Witness" treated the question from a purely scientific point of view, and, from such, quite fairly. Are you unable to distinguish between faith and *knowledge?*—Otto Overbeck. Thanks; but while certain of your subjects are foreign to those to which these pages are devoted, those which are more appropriate are already in the hands of competent members of our regular staff.—A Phrenologist. Wait until the series of articles is completed.—Eye-Witness. The mind and brain discussion must cease; it is drifting into a theological stage.—Faciebat. Yours is the only request, so far, received for an explanation of a graphical mode of representing the details of a Lunar Eclipse. The existence of a large amount of carbonic acid in the atmosphere during the epoch of the coal vegetation has been disputed, but certainly never "exploded." No; the "Workshop at Home" articles are not finished. The next will appear almost immediately.—Edward Preston. Received.

Whist.—Club Deuce. Undoubtedly a misdeal.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

IMPROVED LAMPS AND LANTERNS.

Mr. Joseph Rogers, of 16, Hanover-square, London, has patented an improved make of lamps and lanterns, in which, it is claimed, colza, or other vegetable or animal oils, may be burnt with a perfectly steady flame without the use of a chimney-glass, while at the same time a much more brilliant light is obtained than with the ordinary lamps with a less consumption of oil and wick. For this purpose a plate is slid into the bottom of the lamp upon which is an oil reservoir, preferably of the kind known as a bird's fountain, which supplies the oil to a wick tube projecting some distance up from the plate. Surrounding the wick tube is a tubular enclosure, also fixed to the plate, to the top of which is hinged a cap having a slit or opening arranged at such a height as to be a certain distance above the top of the wick. In the annular space between the enclosure and the wick-holder numerous perforations are formed in the base plate through which air can pass into the annular space, and in passing upwards the air is heated to a certain extent by contact with the heated wick tube and enclosure, and is then caused by the cap to impinge against the flame, thus ensuring perfect combustion and a very brilliant, steady, and practically smokeless flame. The bottom of the lamp is formed with perforations for the entrance of the air, and perforations are likewise made in part of the base-plate surrounding the enclosing tube of the burner.

A NEW BAG CLIP.

Messrs. John Southgate & Sons, of 75 and 76, Watling-street, London, have invented a new clip for the well-known "Gladstone" and other bags, designed to take the strain off the centre of the lock by holding the ends of the bag together. The originally-designed clip, which consisted of a metallic disc at each side, which was turned down so as to tighten upon the bag, was always untrustworthy, because it would work loose at any time; and then, again, anybody could easily and quickly undo it. An improvement on that was a sliding clip catching a hasp like that of a lock inside. This hasp constituted one of its defects, as also its liability to work loose, so as not to keep its place at all when tilted up. Messrs. Southgate & Sons, have now invented a clip which is claimed to be an improvement on anything else of the kind. It consists of a hinge on one side of the bag, which catches by pressure over a metallic catch or fastening on the other side, and to be undone requires the two sides of the bag to be pressed tightly between the finger and the thumb. It acts exactly like a spring-latch, one spring being in the upper part of the hinged clip, which resists slightly the attempt to push it down, and the other consists in the resisting power of the bag's mouth itself, which is sufficient to act as a permanent spring.

AN IMPROVED LAWN-MOWER.

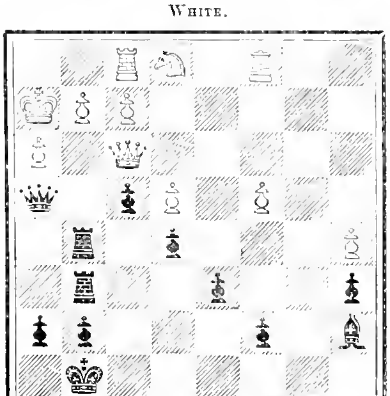
What is claimed to be an improvement in lawn-mowing machines has been invented by Mr. Thomas Knowles, of Turtin, near Bolton, in the county of Lancaster. The inventor says, in effect, that his invention is designed to produce a machine capable of cutting grass growing at the edges of lawns, or even the grass in borders or verges. To effect this purpose revolving blades, acting in conjunction with fixed knives, are placed on opposite sides of the frame of the machine. To this frame are secured bearings supporting an axle rotating therein, and carrying rollers at the ends. This shaft or bearing is connected with suitable gearing, or chain and gearing combined, so that motion can be transmitted from the axle carrying the rollers to the shafts on which the knives are mounted. The machine is propelled in the usual way by a handle. The rollers rotating the knives are placed in such a position that the blades operate on the grass to be cut previously to the drums pressing on the grass, and this, the inventor claims, gives facility for cutting grass on edges and narrow borders.

Our Chess Column.

By Mephisto.

ENDING FROM ACTUAL PLAY.

White.



Black.

White.	Black.
1. R to KKt6	P × R
2. R × P	Q to K2
3. R × RP (ch)	P × R
4. Q to Kt6 (ch)	K to R sq.
5. Q × P (ch)	Q in.
6. Q × R (ch)	Q in.
7. Q × Q check mate.	

The following amusing game at odds was recently played at Purssell's:—

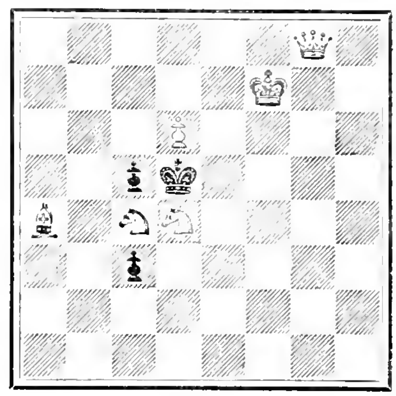
Remove White's King's Knight.

White. Mephisto.	Black. Mr. S.
1. P to K4	P to K4
2. P to Q4	P × P
3. B to QB4	Kt to KB3
4. Castles	Kt to B3
5. P to K5	P to Q4
6. P × Kt	P × B
7. R to K sq. (ch)	B to K3
8. P × P	B × P
9. Q to R5	Q to B3
10. Q to QKt5	QR to QKt sq.
11. B to Kt5	Q to Kt3
12. Kt to Q2	P to QR3
13. Q to QB5	KB to KB sq.
14. Q to Q5	KR to KKt sq.
15. Kt to K4	B × Q ?
16. Kt to B6 (ch)	K to Q sq.
17. R to K8 mate	

PROBLEM No. 133.

By B. G. Laws.

Black.



White.

White to play and mate in three moves.

SOLUTION.

Problem 131, p. 308.

1. K to B3	K to Q4	2. Kt to Kt4 mate
	B × Kt	2. K × P ,,
	Kt moves	2. K moves ,,
	P moves	2. K moves ,,
	P to K4	2. P to Q5 ,,

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

M. Strong.—A pawn can only be taken *en passant* immediately after moving two squares, not afterwards. Although we can put eight Queens on the board without checking each other, we do not know the rule by which it is done. Perhaps some of our readers may know.

H. W. Sherrard.—Problem received with thanks. With your kind permission we shall make use of it somewhere else, as no suimates are to appear in Knowledge.

Correct solutions received.—Problem 131, Donna, M. T. Hooton, A. W. Overton. No. 132. J. J. Cridlan, John Watson, H. A. N., W., Geo. W. Thompson.

Contents of No. 155.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, OCT. 31, 1884.

Contents of No. 157.

IVY.

By Grant Allen.

THOUGH every one of us has been perfectly familiar with common ivy from his boyhood, upward, I wonder how many people have ever noticed its pretty bunches of thickly-clustered, pale yellowish-green flowers that form such large and prominent masses in the early autumn. They are just now in full blossom, and are attracting, as usual, the flies and bees in great numbers to their abundant store of easily-accessible honey. Let us stop for a while beside some knotted stem that clambers close against some low wall, and examine this old, familiar favourite in the new light cast upon it by the discoveries of modern biological science.

Ivy is a native English evergreen creeper, one of the very few large-leaved evergreens really indigenous to our islands; for though the laurels, and aucubas, and laurustinuses, and rhododendrons of our shrubberies have made us now perfectly at home among the class by naturalisation, yet almost all our true British evergreens are more or less needle-leaved conifers, such as the Scotch fir, the yew-tree, and the juniper. Holly, an undoubted native of England, and box, which is very probably an introduced alien, are its chief compeers in this respect. In its truly wild state, the lower branches of ivy creep along the soil, while the main stems climb up trees, walls, or rocks, to which they adhere by means of small fibrous root-like excrescences. This is one out of the many ways adopted by comparatively feeble plants to raise themselves, half parasitically (so far as support alone is concerned, I mean) up the stout trunks of other and more sturdy woodland competitors. Compare it, in this respect, with the straggling arched-branches of the common blackberry bramble, loosely festooned by means of their curved and hooked prickles over the blackthorns and May-bushes in the wastes and hedges; or with the little sucker-like supports of the virginia creeper, clinging fast to the tiny crannies and asperities of a brick wall here in England, as it clings in its native woodlands to the chinks and rugosities in the bark of trees; or with the twining tendrils of the pea, really abortive leaflets, that twist twice or thrice or even oftener round the twigs and branchlets of the supporting bushes; or with the curling leaf-stalks of the canary creeper, where the petiole of a true and active leaf performs the same clasping function. In every case, the end to be attained is the same—the plant endeavours to raise itself by means of some tree, shrub, or bush, above the competing mass of foliage on the ground below, and to reach the open air and free sunlight overhead; but by what an immense variety of means it attains in various cases this desired result! Any trick of habit, be it hooked hair (as in goose grass), or twining stems (as in convolvulus), or mouth-like suckers (as in dodder), or twisted leaf-stalk (as in clematis), that happens to aid in this object, is immediately seized upon by natural selection, and developed and encouraged into an organic peculiarity of the whole species. In our little English flora alone, to go no further, it is an interesting study to look at all the cases above enumerated, side by side with those of bryony, tamus, wild madder, dog-rose, cinquefoil, vetches, hop, and periwinkle, whose diverse modes of obtaining this single end should be noticed in detail by the country walker.

The leaves of ivy form by far the most conspicuous part of the plant to most ordinary outside observers. Their shape is very characteristic, so much so that the epithet "ivy-leaved" has been given to many other plants, such as the ivy-leaved ranunculus, the ivy-leaved veronica, and the ivy-leaved toadflax. It is a noteworthy fact, too, that all the plants possessing foliage of this peculiar broadly-lobed form are trailers or climbers; and in most of them the leaves habitually form a single layer—lie one deep only—over the wall, or tree-trunk, or soil on which the plant is creeping. In short, this form of leaf seems specially adapted for climbing plants; its angles dovetail neatly into one another, and the tip of each fills the hollow at the stalk of its neighbour, so that every leaf obtains the full benefit of the sunlight on all its parts, without interfering with the equal illumination of its like-minded fellows. I do not say that this is the only, or even the best, way for obtaining that result; but it is one way, and a sufficient way; and that is all that natural selection can, as a rule, succeed in securing. One has only to look at a mass of wild ivy creeping up a wall or tree in order to see how admirably the whole body drapes the entire space it covers, leaving very few interstices, yet seldom casting a shadow over any part of its own surface. I say "wild ivy," because many of the cultivated exotic varieties in our gardens, being grown for the sake of their luxuriant leafage alone, under artificial conditions, in richly-manured soil, produce copious masses of over-lapping leaves very different from the native parsimony of the indigenous field species.

Observe, however, that the leaves upon the upper flowering branches are extremely unlike in form to those which cover the naked wall with their bright verdure. These upper shoots rise freely into the air, and have rounded or oval leaves, not at all "ivy-shaped," disposed pretty equally on every side, so as to catch the open sunlight into which they have raised themselves. The upper leaves often somewhat resemble lime-leaves or laurustinus-leaves in general outline; and they clearly show how much the shape of the foliage depends upon the surrounding conditions of air and sunshine. Where these conditions of growth are supplied one-sidedly, as on the wall, the foliage is all turned outward, and so shaped as to economise every portion; where they are equally diffused all round, the foliage grows out alike on every side, and avoids mutual interference by its spiral arrangement along the central axis. Very starved ivy, on a dry wall, has usually very reduced and deeply-divided leaves, with finger-like lobes; very luxuriant ivy, when it overtops its support, has usually very full and rounded leaves, often with no perceptible lobes, and sometimes almost circular in shape.

Why is ivy evergreen? I believe for this reason. It is not a plant of very cold countries: it won't grow in North Germany, Russia, or Siberia, and Britain is almost its northern limit. Southern Europe, Northern Africa, and Western Asia are its favourite dwelling-places. In the wild state, it is chiefly a woodland plant, clambering up the trunks of trees in the great forests. Hence it is shaded during a greater part of the year by the leaves on the deciduous trees, and it has to lay by the material for its growth and flowering and fruiting in autumn, winter, and spring, when the boughs above have lost their foliage. As a matter of fact, even in England, its growth is most luxuriant in late autumn, it flowers in October and November, it goes on putting forth fresh leaves and wood as long as the season permits it, it ripens its berries through the winter, and it begins leafing again as soon as the spring is once more with us. In more southern countries it works uninterruptedly from October to May, and lies by almost dormant during the long dry summer. It is thus essentially a winter plant, and that, I take it, is why its leaves are evergreen.

The curious and pretty yellowish green flowers are worth a moment's consideration. They have each five small petals, and five stamens, with a very broad disk in the middle, surrounding the central stigma. This disk secretes quantities of honey, which stands in little drops upon its surface, and can be readily distinguished with the naked eye and tested with the tongue. The honey attracts large numbers of flies, bees, and wasps, but especially the hive-bee, which, in England at least, is certainly (so far as I have noted) the chief fertiliser, though Continental observers give this *rôle* in Italy and France to the flies and beetles. The stamens mature first, so as to prevent fertilisation from the same flower; and in this state the petals are simply expanded, and the honey abundant. Bees visiting such flowers carry away pollen on their heads for the next they visit. Afterwards the blossoms reach their second state, the petals roll backward, the stigma ripens, and the honey decreases greatly in quantity. Bees visiting these maturer flowers rub off upon them the pollen they have brought from the ripe stamens of neighbours in their first state. Inconspicuous as the blossoms are, individually, their habit of massing in large clusters, and their smell of honey, seem to stand them in good stead of brilliant petals; for they are much resorted to by all the insects that still fly about in late autumn.

After fertilisation, the berries begin to grow as best they may through the winter; but they do not ripen or assume their bluish-black tint till the next year. They are then much eaten, and their seeds dispersed, by birds, which find these dusky hues very attractive, as in the sloe, the blackberry, the whortleberry, and the privet. A southern variety in our gardens, however, has prettier berries of a bright yellow colour.

OUR TWO BRAINS.

By Richard A. Proctor.

(*Continued from p.* 310.)

But perhaps the most remarkable illustration of a double life is one which was brought before the notice of the scientific world a few years ago. I refer to the case published by Dr. Mesnet, and mentioned in Dr. Huxley's remarkable lecture at Belfast on the hypothesis that animals are or may be automata. I do not purpose to quote Huxley's account in full, as no doubt many of my readers have already seen it, but the following facts are necessary to show the bearing of the case on Sequard's theory: "A sergeant of the French army, F——, twenty-seven years of age, was wounded at the battle of Bazeilles, by a ball which fractured his left parietal bone. He ran his bayonet through the Prussian soldier who wounded him, but almost immediately his right arm became paralysed; after walking about two hundred yards his right leg became similarly affected, and he lost his senses. When he recovered them, three weeks afterwards, in hospital at Mayence, the right half of the body was completely paralysed, and remained in this condition for a year. At present, the only trace of the paralysis which remains is a slight weakness of the right half of the body. Three or four months after the wound was inflicted, periodical disturbances of the functions of the brain made their appearance, and have continued ever since. The disturbances last from fifteen to thirty hours, the intervals at which they occur being from fifteen to thirty days. For four years, therefore, the life of this man has been divided into alternating phases, short abnormal states intervening between long normal states."

It is important to notice here that although this case somewhat resembles that of Brown-Sequard's two-lived boy, we have in the soldier's case a duality brought about by a different cause, an accident affecting the *left* side of the head—that side, as we shall presently see, which is regarded as ordinarily if not always the seat of chief intellectual activity. The soldier's right side was paralysed, confirming the theory that so far as the bodily movements are concerned the left brain chiefly rules the right-hand organs of the body, and *vice versâ*. But the man had recovered from his paralysis, so that either the left side of the brain had been partially restored or else the right brain had acquired the power of directing the movements of the right-hand organs. But the periodical disturbances came on three or four months after the wound was inflicted, that is, more than half a year before the paralysis disappeared. We have, then: 1st, three weeks of unconsciousness, during which we may suppose that the left side of the brain was completely stunned (if we may apply to the brain an expression properly relating to the condition of the man); secondly, we have three months during which the man was conscious, and in his normal mental condition, but paralysed; thirdly, we have more than half a year during which a double mental life went on, but the left side of the brain was still so far affected that the right side of the body was paralysed; and lastly, we have more than three years of this double mental life, the bodily functions in the man's normal life being, it would appear, completely restored.

Assuming, then, Wigan's theory for the moment, we have to inquire whether the man's normal condition implies the action of the uninjured right brain, or of the restored left brain, and also to determine whether the recovery from paralysis has resulted from a more complete restoration of the left brain, or from the right brain having acquired a power formerly limited to the left brain. The fact that the man's normal mental condition returned as soon as consciousness was restored does not show that this condition depends on the action of the left brain, for in the unconscious state both brains were at rest. Rather it might seem to imply that the right brain was the brain active in the normal mental state, for the continued paralysis of the right side showed that the left brain was not completely restored. Yet it has been so clearly shown by other and independent researches that the left brain is the chief seat of intellectual activity that we seem forced to adopt the opinion that this man's normal condition depends on the action of the left brain. And we may perhaps assume, from the length of time during which the right side remained paralysed after the left brain had resumed a portion of its functions, that the other portion—the control of the right-hand organs—has never been recovered at all by the left brain, but that the right brain has acquired the power, a result which, as we shall presently see, accords well with experience in other cases.

It would almost seem, on Wigan's hypothesis—though I must admit that the hypothesis does not explain all the difficulties in this very singular case—that the right brain having assumed one set of functions belonging to the left, from time to time tries, as it were, to assume also another set of functions belonging to the left—viz. the control of mental operations, the weakened left brain passing temporarily into unconsciousness. The matter is, however, complicated by peculiarities in the bodily state, and in sensorial relations during the abnormal condition. The whole case is, in fact, replete with difficulties, as Professor Huxley well points out,* and it seems to me these difficulties are not much diminished by Wigan's theory.

Let us consider some of the facts of the man's twofold life:—"In the periods of normal life the ex-sergeant's health is perfect; he is intelligent and kindly, and performs satisfactorily the duties of a hospital attendant. The commencement of the abnormal state is ushered in by uneasiness and a sense of weight about the forehead, which the patient compares to the constriction of a circle of iron; and after its termination he complains for some hours of dulness and heaviness of the head. But the transition from the normal to the abnormal state takes place in a few minutes, without convulsions or cries, and without anything to indicate the change to a bystander. His movements remain free and his expression calm, except for a contraction of the brow, an incessant movement of the eyeballs, and a chewing motion of the jaws. The eyes are wide open, and their pupils dilated. If the man happens to be in a place to which he is accustomed he walks about as usual; but if he is in a new place, or if obstacles are intentionally placed in his way, he stumbles gently against them, stops, and then, feeling over the objects with his hands, passes on one side of them. He offers no resistance to any change of direction which may be impressed upon him, or to the forcible acceleration or retardation of his movements. He eats, drinks, smokes, walks about, dresses and undresses himself, rises and goes to bed at the accustomed hours. Nevertheless, pins may be run into his body, or strong electric shocks sent through it without causing the least indication of pain; no odorous substance, pleasant or unpleasant, makes the least impression; he eats and drinks with avidity whatever is offered, and takes asafœtida, or vinegar, or quinine, as readily as water; no noise affects him; and light influences him only under certain conditions. Dr. Mesnet remarks that the sense of touch alone seems to persist, and indeed to be more acute and delicate than in the normal state; and it is by means of the nerves of touch, almost exclusively, that his organism is brought into relation with the outer world."

Such are the general phenomena presented by this curious case. As respects the details of the man's behaviour under particular circumstances, I refer the reader to Professor Huxley's paper in the *Fortnightly Review* for November, 1874. But one peculiarity is so noteworthy, and, rightly understood, gives so special an interest to Wigan's hypothesis, that I must quote it at length, together with the significant remarks with which Professor Huxley introduces the subject. "Those," he says, "who have had occasion to become acquainted with the phenomena of somnambulism and mesmerism, will be struck with the close parallel which they present to the proceedings of F. in his abnormal state. But the great value of Dr. Mesnet's observations lies in the fact that the abnormal condition is traceable to a definite injury of the brain, and that the circumstances are such as to keep us clear of the cloud of voluntary and involuntary fictions, in which the truth is too often smothered in such cases. In the unfortunate subjects of such abnormal conditions of the brain, the disturbance of the sensory and intellectual faculties is not unfrequently accompanied by a perturbation of the moral nature which may manifest itself in a most astonishing love of lying for its own sake. And in this respect, also, F.'s case is singularly instructive; for, although in his normal state he is a perfectly honest man, in his abnormal condition he is an inveterate thief, stealing and hiding away whatever he can lay hands on, with much dexterity, and with an absurd indifference as to whether the property is his own or not. Hoffmann's terrible conception of the "Doppelt-gänger" is realised by men in this state, who live two lives, in the one of which they may be guilty of the most criminal acts, while in the other they are eminently virtuous and respectable. Neither life knows anything of the other. Dr. Mesnet states that he has watched a man in his abnormal state elaborately prepare to hang himself, and has let him go on (!) "until asphyxia set in, when he cut him down. But, on passing into the normal state, the would-be suicide was wholly ignorant of what had happened."

If Wigan and Sequard are right in regarding the changes of opinion with which most of us are familiar as differing only in degree from the duality of a lunatic's mind who has sane and insane periods, and mental indecision as differing only in degree from the case of a lunatic who "is of two minds," knowing that what he says is insane, a curious subject of speculation arises in the consideration of the possible duality of the moral nature. The promptings of evil, and the voice of conscience resisting these promptings, present themselves as the operation of the two brains, one less instructed and worse trained than the other. "Conversion" is presented to us as a physical process, bringing the better trained brain into action in such sort as to be the only or chief guide of the man's actions.

(*To be continued.*)

* I may in passing note that the case of Brown-Sequard's double-lived boy throws some light on the question whether the soldier is conscious in his abnormal state. Professor Huxley says justly that it is impossible to prove whether F. is conscious or not, because in his abnormal condition he does not possess the power of describing his condition. But the two conditions of the boy's life were not distinguished in this way, for he was perfectly rational, and could describe his sensations in both conditions. The only evidence we can have of any other person's consciousness was afforded by this boy during his abnormal state. But what strange thoughts are suggested by this twofold consciousness—or, rather (for twofold consciousness is intelligible enough), by this alternate unconsciousness? To the boy in one state, what was the other life? *Whose* was the life of which he was unconscious?

Thermal-Coloured Rings.—M. Decharme, whose experiments on the flow of currents in pipes and their hydro-dynamic analogy to electric currents have attracted much attention, has also recently drawn attention to the fact that thermal-coloured rings bear a striking resemblance to electro-chemical-coloured rings. When a copper plate is exposed to the flame of a spirit lamp or a Bunsen burner, an irisated or rainbow-coloured corona is produced about the heated point. Under good conditions these colours are fixed and unalterable in the air. These rings are, according to M. Decharme, quite similar to Nobili's electro-chemical rings; like the latter, they succeed each other in waves, the colours being in the same order, namely, that of Newton's rings viewed by transmission. —*Engineering.*

THE WORKSHOP AT HOME.

By a Working Man.

In treating of the dovetail joint on p. 233, I mentioned the "mitre and key :" I shall begin to-day by saying something about mitreing. Now, a mitre-joint in carpentry means one in which the faces in contact are at an angle of 45° with the length and width of the article in which they occur, as in Fig. 20, where T is the top and S the side of a

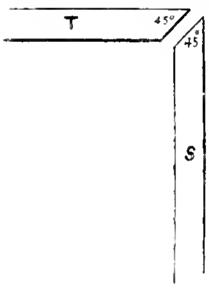


Fig. 20.

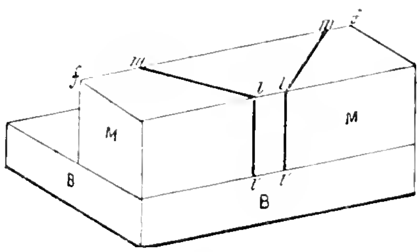


Fig. 21.

picture-frame, each bevelled off at the angle shown. If each bevel is perfectly accurate, it is easily seen that each of the four pieces of the frame will be truly square to the adjacent and parallel to the opposite one. We have, then, first got to cut them truly to this angle, and then to finish them with a plane without destroying it. They are usually cut in what is called a mitre-box, or mitre-block. Fig. 21 shows a mitre-block which the amateur can make for himself. In it B B is a sound piece of $1\frac{1}{2}$ inch deal, with its upper surface planed up very true and flat. This may be a foot long and 7 inches wide. A block of beech-wood preferably (but deal will do) of the same length, but measuring $3\frac{1}{2}$ inches in width and depth when finished, must also be very carefully planed up, with its sides accurately at right angles, the square (Fig. 7, p. 154) being repeatedly applied to test it as the work proceeds. This being worked up true is firmly attached to the face of the base board by glue and screws, as shown at M M, with which, as seen, it forms a step. It must here be particularly remarked that the depth from the top of the block, M M, to the bottom resting on B, though given above as $3\frac{1}{2}$ in., must not quite equal the depth of the blade of our tenon-saw. Hence, if the latter measures less than this from the teeth to the metal rib at the back, the *height* of M M (not its width) must be reduced. It now remains to make two saw-cuts (or "kerfs," as workmen call them), as guides for our saw. The plan of the mitre-block shown in Fig. 22 will explain the way of doing this. First, by the

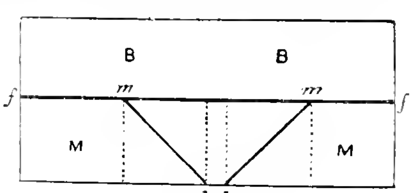


Fig. 22.

aid of our rule, square, and pencil, we draw the two squares shown in the figure, of which each side will obviously be $3\frac{1}{2}$ in. long (that being the width of M M) upon it, and join the two corners of these squares, *l m*, *l m*, by straight lines, each of which will quite evidently be at an angle of 45° with the top of the block. We now place the square adjacent to the points *l l*, and draw the perpendiculars, *l l'*, *l l'*, on the back of the block. Finally taking a sharp saw, of which the blade is perfectly flat, we saw with the utmost care down *m l l'*, through the block, M M (the use of screwing as well as gluing now becomes manifest), and a little way—say $\frac{1}{8}$ in. or $\frac{1}{4}$ in.—into B B. If now we want to cut a mitre, we simply hold the piece of wood tightly against the face, *f f*, of the block, pass the saw into either of the guide-lines, and saw right through it. By fitting a diagonal stop at the end of a piece of board, as shown in Fig. 23, and turning a

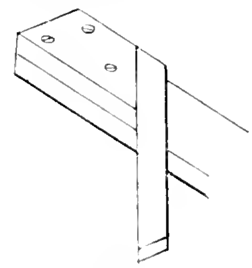


Fig. 23.

trying-plane on its side, with its bottom against the edge of the board, the sawn ends may be smoothed up quite true.

As an easy lesson in mitreing, the beginner may try to make a small picture-frame out of the cheap moulding to be bought in many parts of London. Having determined the dimensions of his frame, he must mark them off on the moulding, and saw them in the mitre-box, as explained above. *He must carefully study the direction of his mitres* though, noting that the inner edges of his frame must be the shorter ones, or he may find that he has sawn two parallel to each other on the same piece of wood! In the absence of the special cramps of the professional picture-frame maker, he may nail strips of wood on to a plank, three of them actually in contact with three of the sides of his frame, and the fourth a little way from the other, and *very* slightly inclined to it, driving a wedge-shaped piece of wood, planed to a corresponding slight slope, between this and the frame, after the latter has been glued up and put together on the plank. When the glue is dry, a saw-kerf may be made in each corner, and a bit of glued veneer driven in just as in our "mitre and key" work, on p. 233. It may be taken that, for the purpose of the ordinary amateur, the tenon and mortice, the dovetail and the mitre-joints are the only ones he is at all likely to have occasion for.

DICKENS'S STORY LEFT HALF TOLD.

A QUASI-SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from p. 342.*)

The scenes within the Billickin serve to show how little of his humorous power Dickens had lost—indeed, they are as good as anything in the same style he ever wrote : but they throw no light on the development of the story.

But the chapter significantly called The Dawn Again (the first is called The Dawn, but one is the dawn of the plot, the other the dawn of the discovery) is full of light.

It shows us, first, Crisparkle and Jasper face to face, Jasper as the denouncer and pursuer of Neville Landless and Mr. Crisparkle as his consistent advocate and protector.

Jasper is moody, solitary, and reticent. The frank Minor Canon cannot approach him. Mr. Crisparkle cannot guess whether Jasper supposes he has terrified Rosa into silence, or supposes, on the contrary, that she has imparted to any one the particulars of his interview with her. The following sentences seem to be intended to convey the precise truth about the views of Rosa, Crisparkle, Neville, and Helena, on the question of Jasper's guilt:—"The dreadful suspicion of Jasper which Rosa was so shocked to have received into her imagination, appeared to have no harbour in Mr. Crisparkle's; if it ever haunted Helena's thoughts or Neville's, neither gave it one spoken word of utterance." Compare this with what is said of Grewgious, noting that to have said more would have been to reveal all he meant to conceal:—"Mr. Grewgious took no pains to conceal his implacable dislike of Jasper, yet he never referred it, however distantly, to such a source; but he was a reticent as well as an eccentric man; and he made no mention of a certain evening when he warmed his hands at the Gatehouse fire, and looked steadily down upon a certain heap of torn and miry clothes upon the floor."

The scene at the opium-eater's den introduces the dawn of the day of reckoning for Jasper. He has been so long away that the old woman has forgotten him. He used to go there for comfort; "When I could not bear my life I came to get the relief and I got it," he says: "it *was* one! It *was* one!" He has come for relief again, and we may be sure he was to come at least once more. "The Princess Puffer has learned how to mix the drug so as to make him talk." "I heard ye say once when I was lying where you're lying," she says, "and you were making your speculations upon me, unintelligibly. But don't ye be too sure always: don't ye be too sure, beauty!" All this enables us to anticipate her share in bringing Jasper to justice, and enables us also to guess what Drood wants, to make Jasper's punishment complete. It must be remembered that though Edwin knows more than any one, except Mr. Grewgious, about Jasper's villany he does not know all. In particular he has still to learn whether Jasper attacked him in a sudden access of fury or whether the crime was premeditated. He knows Jasper was lying when he pretended love for "his dear Ned;" he knows Jasper loved and loves Rosa after the evil manner of his kind; but he does not know that Jasper had planned murder for months and had gone the journey which was so pleasant to the villain, "hundreds of thousands,—what do I say?—millions and billions of times." On the question of premeditation much will depend; but we may be sure that when Edwin learns with what intensity of premeditation Jasper had gloated over the crime, he will be ready to inflict on the villain the full horror of that punishment which lies within his power.

I pass over the light thrown upon the mystery itself by Jasper's words when under the influence of opium; for I have already considered his wanderings in this aspect, as the matters to which they relate arose. The chief importance of the scene lies in the light which it throws on the *dénouement*.

I am inclined to think that the place in Aldersgate-street where Jasper puts up, would have turned out in the sequel to be Bazzard's home. But there is no direct evidence on this point.

The opium woman's pursuit of Jasper brings her to Cloisterham, and to the very gateway where Jasper enters; but she only sees "a postern staircase on one side of it, and on the other side an ancient vaulted room, in which a large-headed, grey-haired gentleman is writing, under the strange circumstances of sitting open to the thoroughfare and eyeing all who pass, as if he were toll-taker of the gateway: though the way is free." Mr. Datchery's watch on Jasper is close, but it is no such watch as a professional detective would have kept. We note in passing that his "low voice" as he says "Halloa!" when he sees her, suggests that he has seen her before.

The burst of triumph in which she thanks him when she learns Jasper's name and office and that she can see and hear him in the Cathedral, does not escape the watchful Mr. Datchery, any more than it would have escaped his other self Edwin Drood. He thinks something may come of this and lounges after her, clasping "his hands behind him, as the wont of such buffers is," in other words, making himself as much like the sauntering listless young lad she had met near that self-same spot as a grey-haired man could look. It is clear that in some dim unconscious way she is reminded of the Eddy she had so earnestly warned half a year before. His hands are presently taken from behind him with a purpose. "His purposeless hands rattle the loose money in the pockets of his trousers." Whenever Dickens speaks of an action as purposeless, we may be sure he wishes to draw attention away from its purpose. Not suffering our attention to be thus withdrawn we see at once what Mr. Datchery wanted. "The chink of the money has an attraction for her greedy ears." She asks for money for her "travellers' lodging." "You know the place," he says (who had reason probably to know it well himself), "and are making directly for it," and, still rattling his loose money, he asks "if she has been often in Cloisterham." "Once in all my life." "Ay, Ay?" (These "ays" are as significant as those of Mr. Grewgious, in his conversation with Mr. Crisparkle in Chapter XVII.—they mean earnest attention, though intended to suggest the idea of an abstracted mind.) They have now reached the entrance to the monk's vineyard, and the place where the former interview had taken place. "An appropriate remembrance is revived in the woman's mind." (These are Dickens's own words.) She stops at the gate and says energetically, "By this token, though you mayn't believe it, that a young gentleman gave me three and sixpence as I was coughing my breath away on this very grass: I asked him for three and sixpence and he gave it me." "Wasn't it a little cool in you to name your sum?" hints Mr. Datchery, still rattling. "Isn't it customary to leave the amount open. Mightn't it have had the appearance, to the young gentleman—only the appearance—that he was rather dictated to?" If it is not Edwin Drood who talks thus quaintly, the passage was not written by Dickens. The old woman somehow feels that it is the same person, and asks for the same sum, telling him this time what she wants it for. He changes countenance when he learns that it is for opium, but he does not recognise the full significance of the fact. (This appears presently.) He counts the money very slowly, to give her opportunity to talk. I repeat the scene which follows, because it is so full of significance that it cannot be too often studied by those who wish to know the real plot of this interesting story:—

"It was Christmas Eve, just arter dark, the once that I was here afore, when the young gentleman gave me the Three and six."

Mr. Datchery stops in his counting, finds that he has counted wrong, shakes his money together, and begins again.

"And the young gentleman's name," she adds, "was Edwin."

Mr. Datchery drops some money, stoops to pick it up, and reddens with the exertion as he asks:

"How do you know the young gentleman's name?"

"I asked him for it, and he told it me. I only asked him the two questions, What was his Chris'en name, and whether he'd a sweetheart? And he answered, Edwin, and he hadn't."

Mr. Datchery pauses with the selected coins in his hand, rather as if he were falling into a brown study of their value, and couldn't bear to part with them. The woman looks at him distrustfully, and with her anger brewing for the event of his thinking better of the gift; but he bestows it on her as if he were abstracting his mind from the sacrifice, and with many servile thanks she goes her way.

John Jasper's lamp is kindled, and his lighthouse is shining when Mr. Datchery returns alone towards it. As mariners on a dangerous voyage, approaching an ironbound coast, may look along the beams of the warning light to the haven lying beyond it that may never be reached, so Mr. Datchery's wistful gaze is directed to this beacon and beyond.

I am unable to understand how any one can read this scene without feeling certain that Mr. Datchery is Edwin Drood, that he has purposely recalled the scene of which Drood alone knew anything, that he is moved when his own old name is mentioned, and still more when the thought of Rosa is brought before him. I feel for my own part as certain of this as though Dickens had said as much in so many words. What a detective would have had to do with such ideas as trouble Datchery, or how they can be associated with Bazzard's dull selfishness, or in fine with any one except Drood himself, passes my comprehension.

(To be continued.)

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

XI.

It would exceed the limits and purport of these papers to follow the extension of the belief in spirits to its extreme range; in other words, to belief in controlling spirits in inanimate objects, which were advanced *pari passu* with man's advancing conceptions to place and rank as the higher gods of polytheism. Such belief, as already indicated, is the outcome of that primitive philosophy which invests the elements above and the earth beneath with departmental deities, until, through successive stages of dualism, the idea of a Supreme Deity is reached, and the approach is thus made towards a conception of the unity and unvarying order of nature.

The arbitrariness with which the gods are credited will have reference when the part played by dreams as media of communication between heaven and earth, and as warnings of coming events, is dealt with. Now, the intervals which have passed between the appearance of former chapters make it desirable to focus the conclusions which thus far have been reached, and to ask whether the evidence gathered together has justified them.

It has been shown that races have existed, and exist still, at so low a level that their scanty stock of words has to be supplemented by gestures, rendering converse in the dark next to impossible. Such people are bewildered by any effort to count beyond their fingers; they have no idea of the relation of things, or of their differences; they have no power of generalisation by which to merge the accidental in the essential. They believe that their names and likenesses are integral parts of themselves, and that they can be bewitched or harmed through them at the hands of any one who knows the one or has obtained the other. As an important result of their confusion between the objective and the subjective, we find a vivid and remarkable belief in the reality of their dreams. The events which make up these are explained only on the theory that if the body did not move from its sleeping place, something related to it did, and that the people, both living and dead, who appeared in dream and vision did in very presence come. The puzzle is solved by the theory of a second self which can leave the body and return to it. For the savage knows nothing of *mind*. The belief in this other self is strengthened (possibly, more or less created) by its appearance in shadow or reflection, in mocking echo, in various diseases, especially fits, when the sufferer is torn by an indwelling foe, and writhes as if in his merciless grasp. The belief in such a ghost-soul, as to the form and ethereal nature of which all kinds of theories are started, is extended to animals and lifeless things, since like evidence of its existence is supplied by them. The fire that destroys his hut, the wind that blows it down, the lightning that darts from the clouds and strikes his fellow-man dead beside him, the rain-storm that floods his fields, the swollen river that sweeps away his store of food—these and every other force manifest in nature add their weight to the influences rude man has drawn. The phenomena which have accounted for the vigour of life and the prostration of disease account for the motion of things in heaven above and the earth beneath, and the barbaric mind thus enlarges its belief in a twofold existence in man to a far-reaching doctrine of spirits everywhere. Step by step, from ghost-soul flitting round the wigwam to the great spirits indwelling in the powers of nature, the belief in supernatural beings with physical qualities arises, until the moral element comes in, and they appear as good and evil gods contending for the mastery of the universe. Passing by details as to the whereabouts of the other self and its doings and destiny in the other world which the dream involves, and following the order of ideas on scientific lines, two queries arise:—

1. Does the evidence before us suffice to warrant the conclusions drawn from it as to the serious and permanent part which dreams have played in the origin and growth of primitive belief in spirits; in short, of belief in supernatural agencies from past to present times? In this place, the answer is brief.

If dreams, apparitions, shadows, and the like, are sufficing causes, then, in obedience to the Law of Parsimony (as it is termed in logic), we need not invoke the play of higher causes when lower causes are found competent to account for the effects. If it seems to some that the base is too narrow, the foundation too weak for the superstructure, and that our metaphysics and our beliefs regarding the invisible rest upon something wider and stronger than the illusions of a remote savage ancestry, the facts of man's history may be adduced as witness to his continuous passage into truth through illusions; to the vast revolutions and readjustments made in his correction of the first impressions of the senses. There is not a belief of the past, from the notions of savages about their dreams and ghost-world to those of more advanced races about their spirit-realms and its occupants, to which this does not apply. In the more delicate observations of the astronomer he must, when estimating the position of any celestial body, take into account its displacement through the refractive properties of the atmosphere, and must also allow for defects of perception in himself due to what is called "personal equation." And in ascertaining our place in the scale of being, as well as in seeking for the grounds of belief concerning our own nature, we have to take into account the refracting media of dense ignorance and prejudice through which these beliefs have come, and to allow for the confirming errors due to personal equation—fond desire.

2. Does the theory of evolution in its application to the development of the spiritual nature of man, and to the origin and growth of ideas, find any breach of continuity? In its inclusion of him as a part of nature, in accounting for his derivation from pre-human ancestry by a process of

natural selection, and of his unbroken development from the embryo to adult life, it embraces the growth and development of mind and all that it connotes. In the words of Professor Huxley, "As there is an anatomy of the body, so there is an anatomy of the mind; the psychologist dissects mental phenomena into elementary states of consciousness, as the anatomist resolves limbs into tissues, and tissues into cells. The one traces the development of complex organs from simple rudiments; the other follows the building up of complex conceptions out of simpler constituents of thought. As the physiologist inquires into the way in which the so-called 'functions' of the body are performed, so the psychologist studies the so-called 'faculties' of the mind. Even a cursory attention to the ways and works of the lower animals suggests a comparative anatomy and physiology of the mind; and the doctrine of evolution presses for application as much in the one field as in the other."*

Any coherent explanation of the operations of nature was impossible while man had no conception or knowledge of the interplay of its several parts. Now, by the doctrine of continuity, not only are present changes referred to unvarying causes, but the past is interpreted by the processes going on under our eyes. We can as easily calculate eclipses backwards as forward; we can learn in present formations of the earth's crust the history of the deposition of the most ancient strata; we read in a rounded granite pebble the story of epochs, the fire that fused its organic or inorganic particles, the water that rubbed and rolled it; we reconstruct from a few bones the ancestry of obscure forms, and find in the fragments the missing links that connect species now so varied. And the like method is applied to man in his *tout ensemble*. His development is not arbitrary; what he is is the expansion of germs of what he was.

Till these latter days he has, on the warrant of legends now of worth only as witnesses to his crude ideas, presumed on an isolated place in creation, and excepted his race from an inquiry made concerning every creature beneath him. The pride of birth has hindered his admission of lineal connection between the beliefs of cultured races and the beliefs of savages, and pseudo-scientific writers still confuse issues by assuming distinctions between races to whom spiritual truths have been revealed and races from whom these truths have been withheld. But the only tenable distinction to be drawn nowadays is between the scientific and pre-scientific age in the history of any given race.

* Hume, p. 50.

TRICYCLE EXHIBITIONS.

By John Browning,

Chairman of the London Tricycle Club.

Within the last few days a statement has been published that a meeting of tricycle manufacturers has been held, and that it was decided by a majority of *one* not to support either of the tricycle exhibitions next year. Seventeen firms voted against supporting an exhibition, and sixteen in favour of doing so. An agreement was drawn up and has been signed by the seventeen firms pledging themselves not to exhibit at any show of tricycles in London in the spring of next year.

I have taken the trouble to ascertain the opinions of many well-known tricyclists on this subject, and I have found that, without exception, they view it with regret and disappointment, and I might, without exaggeration, say with consternation.

I am at a loss to understand why the manufacturers have come to such a decision, unless it be that they are dissatisfied with the arrangements which have been made for them by those who have organised and conducted previous exhibitions.

If this be the case, it is a pity they did not appoint a committee of their number to arrange for an exhibition to be carried out on their own lines.

Of course, there are strong temptations to avoid the loss of time and trouble, and the expense of sending machines to such an exhibition, if they can arrange with their competitors in trade to stay away. But they cannot arrange that tricycle dealers and agents and makers of inferior machines shall also stay away. The result will almost certainly be that we shall have one or more poor exhibitions, instead of good ones.

Agents will be more likely to exhibit second-class machines than first-class, because there is generally a much larger profit to be made in dealing in them; and in consequence, the first-rate manufacturers and the cycling public will both be sufferers, which cannot surely be what they desire.

In any case, it is obvious that the manufacturers who do not exhibit will lose a number of orders. Many people who already have tricycles are looking forward to the exhibition for the opportunity of obtaining what they anticipate will be better ones; and unless they see all the new machines and are able to compare them, they will content themselves with their old mounts, and that amount of business will be sacrificed.

I know personally dozens of riders, mostly of considerable means, who come to London from great distances for the purpose of attending the tricycle exhibitions. A goodly number of these make purchases either at the time or not long after. The opportunity and the temptation being removed, they will keep their money in their pockets.

Two-speed gearings and Tandems will, no doubt, be largely in demand next season, but this demand would be greatly increased if they were well exhibited.

For these reasons, it is to be hoped that the leading manufacturers may yet reconsider their decision, and not pursue a course which will check the progress of cycling and the improvement of cycles, disappoint their patrons, and play into the hands of their less worthy competitors.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER V.—THE EARTH'S ROTATION.

(*Continued from page* 316.)

In 1820, Dr. Benzenberg began a series of experiments in St. Michael's Tower in Hamburg. The height he was able to command was 340 ft. But he preferred to limit the fall to the portion of the tower which was completely closed, and thus he commanded a range of fall of about 235 ft. only. The balls he used were 1½ in. in diameter, made of an alloy of equal parts of lead and tin, and a small proportion of zinc. They were carefully turned and polished, so that there might be no irregularity of figure to occasion any departure from the line of fall. He tested them specially for this purpose, by floating them in mercury, and rejected all those which showed any tendency to float in one position rather than in another. So carefully did he consider all the possible sources of error in the result that he would not even allow the liberation of the balls to be effected by burning the thread, as Guglielmini had done, lest slight draughts of air thus occasioned might cause the ball to oscillate before being detached. The mode of liberation he actually employed was ingeniously devised to prevent the balls from being in any way influenced by the act of liberation. The suspending thread passed through a vertical aperture in a block, and was clasped above by nippers, opening in an horizontal plane.

He dropped, first, a number of balls experimentally, to gauge the requirements of the problem. At last, when all the arrangements had been made which these experiments suggested, he dropped 31 balls. Of these

21 fell towards the east.
8 ditto west.
2 neither towards the east nor west.
16 fell towards the south.
11 ditto north.
4 fell neither towards the south nor north.

The actual deviations carefully summed gave the following results :—

Sum of deviations towards the		north	46·4 lines,
Ditto	ditto	south	92·6 ditto
Ditto	ditto	east	174·5 ditto
Ditto	ditto	west	50·5 ditto
Balance of deviations towards the		south	46·2 ditto
Ditto	ditto	east	124·0 ditto

As there should be no deviation towards the south, we must take the observed deviation in that direction as measuring the probable errors in the series of experiments. This leaves to be accounted for an obvious tendency towards the east—that is, in the direction according with the theory of the earth's rotation. The mean deviation towards the east is $\frac{124}{31}$, or four lines. Calculation shows that the mean deviation should have been 3·85 lines, so that theory and observation agreed very closely.

But Benzenberg thought the southerly deviation too considerable to render his experiments satisfactory. He therefore made new experiments in an abandoned coal-pit at Schlebusch, in Westphalia, with an available fall of 262 ft. He carefully covered the entrance of the pit, and blocked up all its lower passages before commencing his experiments. He then dropped twenty-nine balls. The results were as follows :—

Sum of deviations towards the		north,	124 lines
Ditto	ditto	south,	103 ditto
Ditto	ditto	east,	189 ditto
Ditto	ditto	west,	42 ditto

or a mean northern deviation of 0·7 lines and a mean easterly deviation of 5·1 lines. The calculated easterly deviation for a fall of 262 ft. is 4·6 lines; so that in this experiment, as in the preceding, theory and observation agreed very closely together. As in these experiments, also, a balance of deviation towards the north was observed, while in the former the balance of deviation was towards the south, we see the more reason to regard northerly and southerly deviations as the result of those errors which can never be altogether avoided in experiments of the sort.

Lastly, a long and most convincing series of experiments was carried out on the same plan by Professor Reich in the mines of Freiburg. He was able to drop balls to a depth of no less than 488 ft., and he made no less than 106 experiments. There was a balance of southerly deviation of 48·76 lines, and a balance of easterly deviation of 1093·92 lines; so that the mean deviation towards the south was but 0·46 lines, while the mean deviation towards the east was 10·32 lines.

Here, then, we have in all a series of 166 experiments, with a result pointing very definitely to an easterly deviation in bodies falling from a great height. We are compelled to conclude that this cannot be accidental. It must arise from some real cause or other. The earth's rotation accounts most satisfactorily for it, whereas no other explanation seems to suggest itself as even possibly explaining the phenomenon. Thus we are again led to the conclusion that the earth rotates upon its axis from west to east.*

The evidence of the earth's rotation, derived from the oscillations of a free pendulum, is also singularly powerful and interesting. But this has been already fully considered in a former number (*see* Knowledge, June 6, 1884, p. 413.)

* For a complete account of the theory of the method here considered, the mathematical reader should refer to Worms' admirable treatise on "The Earth and its Mechanism," to which I have been indebted for most of the above facts. It is worthy of notice that in all the 166 experiments considered above, there was not a single instance in which a ball fell either exactly below the point of support, or exactly where it should have fallen, according to theory. We can very well understand this, of course, when we remember the multitude of circumstances (individually minute, yet collectively appreciable) which affect the progress of a falling body, let our precautions to ensure accuracy be what they may. It will be admitted that the balls let fall in these experiments had a much better chance of falling undisturbed than a ball fired in the open air from a gun of any sort, fixed in a vertical position, could have of rising straight to its highest point, and then falling straight down again. Yet the paradoxist "Parallax" gravely assures his pupils that he once fired forty balls from an air-gun tied in a vertical position, and that two of these fell back into the muzzle of the gun. I would not be so rude as to say with Dante, "Io non vidi, ne credo che sia;" rather would I imitate the politeness of the Frenchman, who, on a similar narrative being related to him, said: "Aha! my good sir, thanks; you have seen this, therefore I believe it. I would not have believed it had I seen it myself." For all I know to the contrary, the similar narrative was "Parallax's" famous canal experiment.

MATCH-LORE.

In Shelley's wonderful version of the Homeric Hymn to Mercury, we learn that

> Mercury first found out for human weal,
> Tinder-box, matches, fire-irons, flint and steel.

We can give no further particulars of these early inventions, but our readers may be interested in tracing the lines of modern improvement. Old folks can remember when "Any matches to-day; buy my matches," were common London cries, and the articles offered for sale were strips of deal about six inches long and more than half an inch wide. They were pointed at each end, and dipped in melted brimstone. A piece of greasy rag well charred by partial burning, constituted the tinder, usually kept in a circular tin box with a cover that held a candle, and accompanied with pieces of black flint, and a steel implement like a miniature hoe with a horizontal handle like a flat-iron. This was held in the left hand, the flint struck smartly against its edge, and a shower of sparks sent down upon the tinder. The performer blew gently upon the first portion that ignited, put the match to it, and set the brimstone alight. A round tin damper was then pressed upon the timber to put it out, and the operation was finished. It was an easy one for most folks to learn, but some clumsy hands boggled over it, and could elicit neither spark nor flame. To this day some smokers use a flint, and Amadou tinder, made of a fungus, *Polyporus fomentarius*, beaten out and steeped in a solution of saltpetre; but few of these, or of the old operators in our grandmother's kitchens ever knew that they were producing objects well worth seeing under the microscope.

If a shower of sparks, struck with flint and steel, is caught on a sheet of paper, and the particles viewed as opaque objects in a strong light, a number of bright metallic balls will be seen. They are portions of steel melted by the heat of the concussion, and they cause the timber to ignite.

The first attempts to obtain a substitute for the tinder-box by chemical means was made with matches like the common lucifer, first dipped in brimstone, and then in a mixture of chlorate of potash and lump-sugar. Chemists used to sell them in square tin receptacles, usually ornamented by washing the metal over with dilute nitric acid to make it crystallise in fern-like patterns, and then covering with a transparent varnish of gold or ruby tint. In front of the match-holding part was a smaller compartment to hold a little bottle, at the bottom of which was some fibrous asbestos moistened with sulphuric acid. The match was lit by bringing it in contact with the acid.

The next plan was to make Prometheans, as they were called, by rolling up in the end of a paper spill a tiny glass vesicle containing sulphuric acid, and surrounding it with a little lump sugar and chlorate of potash. A slight blow broke the vesicle and ignited the preparation. These things were neither cheap enough nor handy enough to become popular, and they soon disappeared to give place to deal matches, coated at their tips with brimstone overlaid with chlorate of potash and sulphuret of antimony. These could be ignited by drawing them briskly through a folded card to which sharp sand was glued. Phosphorous matches succeeded these, and for many years the sort in general use was made at the cost of terrible injury to the workmen making them, as continuous exposure to phosphorous fumes causes disease of the jaw-bones and other evils.

Phosphorous is one of those curious substances which can exist in what are called allotropic states; that is to say, their molecules are capable of arrangement in different patterns, with variations of their properties. Common yellowish-white semi-transparent phosphorous is highly poisonous, as well as extremely inflammable. It can be crystallised from its solutions. By keeping it melted in an atmosphere of carbonic acid for many hours, it is turned into red amorphous phosphorus, which is much less inflammable; does not flame at ordinary temperatures; and does not poison the workmen. There are other modes of producing this condition; and in one of its states phosphorus is black. All the best makers now use the innocent varieties of phosphorus for their matches, and the safety kinds have the phosphorus on the black cards stuck on the boxes, or supplied with them. Neither the match nor the phosphorus in this state can be ignited by accident, but when they meet with the excitement of friction, a quick blaze is obtained.

Although not belonging to match-lore, two interesting substitutes for matches may be noticed in connection with them. In 1824 Professor Döbereiner discovered that platina, in a finely-divided state, ignited a mixture of hydrogen with oxygen, or common air, on coming in contact with it. This gave rise to Döbereiner's lamp, still seen in some chemists' windows. It consists, as now made, of a small glass vessel inside a larger one. Hanging down towards the bottom of the inside vessel is a piece of zinc. Dilute sulphuric acid is put into the outer vessel, and rises up in the inner one. The chemical action which ensues evolves hydrogen, which fills the inner vessel, expelling the dilute acid. On turning a stop-cock connected with the hydrogen reservoir, the gas escapes and strikes against a little ball of platina-sponge, which ignites it. As soon as any gas goes out of the reservoir a fresh supply of dilute acid enters, and again acts upon the zinc until enough gas is given off to drive out the fluid and stop the process. This apparatus is so pretty and neat that it would, no doubt, have been in much favour, but for the difficulty that its action is very uncertain unless the platina-sponge is new and is perfectly clean.

Volta appears to have invented a lamp that bore his name, and consisted in an apparatus for the production and storage of a small quantity of hydrogen, which was lit on its issue in a fine jet by an electric spark obtained from an electrophorus. We recollect seeing one of these lamps many years ago. It was in the form of a handsome mahogany box, about fourteen inches high, with a little brass dragon mouth for the flame to come out of. At the bottom of the box was a drawer containing an electrophorus, to be excited by striking it with a fox-tail. The hydrogen part of the apparatus was analogous to that of the Döbereiner lamp. On turning a key the gas was allowed to escape, and, at the same time, the electrophorus yielded its spark. In a very dry country such a machine would work well, but in our damp one the electrophorus did not keep its power. S.

RAMBLES WITH A HAMMER.

THE GEOLOGY OF CRICCIETH AND PWLLHELI.

By W. Jerome Harrison, F.G.S.

It is, I regret to say, fully two years since the appearance in Knowledge of my papers on the geology of Llandudno and Rhyl. Still, the delay has not been without its advantages, for it has enabled me to examine more carefully the region which I am now about to describe—Criccieth having been my headquarters for a few weeks during the summer of 1883, and Pwllheli for a similar period during the present year.

How to Get There.—The two picturesque Welsh towns whose names stand at the head of this article lie snugly within the northern curve of Cardigan Bay. They are well sheltered by hill ranges—mountains they may be fairly called—on the east, west, and north, but the coast slopes southwards to the sea, while the waves which lave the shore can trace their parentage to the Gulf Stream.

Criccieth is rapidly becoming fashionable. Artists found it out long ago, and this year it has been crowded with visitors. But Pwllheli, the terminus of the Cambrian Railway, is a typical Welsh town. It is rather hard on its worthy inhabitants to wish that it may remain comparatively unknown and unvisited, yet there is a strong temptation for those who know it well to—keep their knowledge to themselves. Travellers from the North or from the Midlands will reach either town most expeditiously by travelling through Chester to Bangor. From Bangor a branch of the London and North-Western runs due south to Afonwen, a little junction where there are no houses. Criccieth lies about four miles east of Afonwen, and Pwllheli the same distance to the west, each forming stations on the railway—the Cambrian—which encircles Cardigan Bay. Another route is to travel by the Great Western from Ruabon to Barmouth (through most lovely scenery), and then northwards from Barmouth by the Cambrian line. But, whatever route the traveller adopts, his ride will be a long one if he proceeds direct from any of our great towns. Yet is the long journey not without its compensation, for the "cheap tripper" is left behind, and the negro minstrel troubleth not.

The Geologist's Equipment.—Let the man who means to examine Welsh rocks provide himself with a stout pair of thick-soled, wide-across-the-toes, lace-up boots; a good "shooting boot," with a *few* nails, answers well. Flannel, next the skin of course, with a stout, dark, tweed suit, soft hat, large mackintosh, and a good large bag to carry his specimens. I use a gamekeeper's bag, although it sometimes attracts undesirable attentions. Two hammers are desirable—a heavy one, weighing about 3 lb., and provided with a long ash handle to cope with the massive, tough, and often rounded rocks, and a light ½ lb. trimming hammer, to reduce specimens to shape in the field; geological hammers are square in the face, and should be made of good steel. A cold chisel (as the solid iron chipping tool is called) is useful for detaching fossils from the rocks, while a magnifying glass (Browning's platyscopic lens is the best) is very necessary to examine minerals, &c. Of other requisites, the coloured map of the district, executed by the Geological Survey is most useful; Sheet 75 (in four parts or "Quarter Sheets," price 3s. each) includes the district in which we are more directly interested. A pocket-compass is very useful in this rather lonely region, where it is quite the exception to find a labourer or field-hand who can speak English; the compass may form part of a clinometer, an instrument with which we can measure the dip or slant of any set of rocks. A tape-measure is handy, when it is desired to measure the thickness of the strata, or the depth of the rock-sections exhibited in cliffs, cuttings, &c. A note-book and pencil ought certainly to be carried, in order to note down, on the spot, the particulars relative to each quarry or other exposure. All these articles may be procured from Mr. Gregory, of Charlotte-street, Fitzroy-square.

How to Collect Rocks.—Every specimen collected ought to be capable of identification, as to the exact locality from which it came, at any future time. Such particulars may be noted in pencil upon the paper in which the rock, fossil, or mineral is wrapped, or upon a slip of paper placed with the specimen; but a better plan is to carry a series of gummed and perforated numbers, and to attach one of these to each specimen as it is secured, copying the number in the note-book, and adding the locality, date, &c. Each specimen should be wrapped up separately (best in thin, tough brown paper) so that it may not grate against and scratch its fellows. Remember that small angular bits of rock are of little use; try to obtain neat, oblong specimens—3 inches long by 2 broad, and 1 inch thick is a useful size—and let them be of fresh unweathered stuff taken from the middle of a block, and as far below the surface as possible.

There is only one book which treats specially of the rocks of Carnarvonshire—Ramsay's "Geology of North Wales," Stanford, 21s.; but it is a splendid work of 600 pages and many illustrations. The author, Sir A. C. Ramsay, late head of the Geological Survey, knows the ground well, having either mapped, or aided in mapping, a large portion of the district: and although we may not always agree with his theories, yet his facts are numerous and reliable.

Rocks of the Lleyn Peninsula.—The projecting mass which forms the northern horn of Cardigan Bay and the western half of Carnarvonshire, is known as the Lleyn Peninsula. Viewed broadly it consists of certain extremely hard rocks, usually called *igneous*, because they are supposed to have been at one time liquefied by the action of heat, surrounded by softer sedimentary strata which mantle round the unstratified igneous bases, forming an undulating plain. The geological age of all these rocks is indicated in the following table, the oldest or first-formed being placed at the bottom.

Bala Beds, 1,000 feet ?...... .... Arenig Slates, 300 feet ?.........	Lower Silurian Formation.
Tremadoc Slates, 0 to 200 feet .... Lingula Flags, 1,200 to 2,000 feet.........	Cambrian Formation.
Schistose Rocks, Porphyritic .... Felstones, &c., thickness unknown	Pre-Cambrian Formation.

Pre-Cambrian Rocks.—A fierce conflict has long raged, and is still raging, as to whether there are any rocks in Wales of older date than the Cambrian strata. Strange to say, the dispute has resolved itself into one between "official" and "non-official" geologists. The new chief of the Geological Survey—Professor A. Geikie—upholds the views of his predecessor (Sir A. C. Ramsay), and is supported by his colleagues in arguing *against* the existence of such rocks; while Dr. Hicks, with Professors Hughes, Bonney, Lapworth, Blake, Callaway, and others, ardently assert that at various points—as around St. David's, in South Wales, and at several spots in North Wales, and Anglesea—very ancient strata do exist, comparable in age with the Archæan Gneiss of the Hebrides, and the Laurentian Rocks of Canada, the very bottom beds of the earth's crust.

But, it may be asked, if the officers of the Geological Survey deny the existence of pre-Cambrian rocks in Wales, what age do they assign to the rock-masses whose claim to that high antiquity was first upheld by Dr. Hicks? To this the reply would doubtless be, that each case, each locality where such rocks are said to occur, must be dealt with separately, for the explanation that might be applicable to one example would very probably not answer elsewhere. Still, the Survey views of the so-called pre-Cambrian rocks may be summed up under two heads:—(*a*) They are *altered* Cambrian strata, Cambrian rocks which have been so baked and pressed, and altered by chemical action at some former time when they were deep down, far below the surface, that their appearance has been quite changed, and any fossils which they may once have contained have been destroyed; or (*b*) they are intrusive, igneous rocks which have invaded, while in a liquid state, the strata lying above them. The first explanation would be used when the "pre-Cambrians" are of a schistose or slaty nature; the latter, when they are felsitic or granitic in appearance. Let us examine such of the rocks that lie within an easy drive of Pwllheli or of Criccieth, as would probably be classed by the "new school" with their pre-Cambrian beds.

The little town of Nevin lies seven miles north-west of Pwllheli, with which it is proposed to connect it by a railway, although it is difficult to see where the traffic to pay dividends on such a line is to come from. The mail-car affords a ready means of transit between the two towns, leaving Pwllheli at eight in the morning and returning from Nevin between four and five in the afternoon; or a trap may be hired from the Madryn Arms at a very reasonable rate. Reaching Nevin the geologist finds himself on the shore of Carnarvon Bay, and overlooking the splendid natural harbour of Porth-Dinlleyn. From the western side of this bay a rugged promontory juts into the sea. The rocks of this headland are marked as "serpentine" on the Survey Map; but Prof. Bonney has lately shown them to be compact diabases, very probably ancient lavas. In such a case as this we must remember that the Survey Map was executed thirty or forty years ago, when the modern method of investigation of rock structure by means of the microscope was unknown. In the case of this Porth-dinlleyn rock it is chiefly by the study of slices cut to the one-thousandth of an inch in thickness that we are able to ascertain its real nature.

The beds traversed by these lavas are volcanic breccias, consisting of dust ejected from some vents then in activity, but also containing innumerable angular blocks of all sizes, all non-compacted with a greenish, patchy-looking rock. South of Porth-Dinlleyn, green and grey compact schistose rocks, traversed by numerous veins of white quartz, extend for twelve miles from Edeyrn to Braich-y-pwll. The beds incline to the westward, dipping at angles of from thirty to fifty degrees. This strip of pre-Cambrian rocks is from two to four miles broad. On the west and south is the sea, while its eastern boundary is marked by a dislocation, or line of fault, so that the true relations of the strata to the succeeding Cambrian beds cannot be traced. On the Survey Map the entire strip is coloured as "altered Cambrian," but it is difficult to conceive of any agency which could so completely alter so great a thickness of strata, in addition to which there is clear evidence that these most ancient rocks are largely volcanic in their nature and origin, while the Cambrian rocks of Wales exhibit no traces of such action.

Bardsey Island consists of similar hard schists to those of the mainland, all much contorted. It is best reached by boat from Aberdaron.

(*To be continued.*)

THE INTERNATIONAL HEALTH EXHIBITION.

XXII.—THE PRESENT ASPECT OF THE SEWAGE QUESTION.

THAT the old adage, "prevention is better than cure," seems at last to have gained ground as a principle of the first importance amongst modern sanitary engineers, is amply testified to by the many valuable measures which have of late been brought into operation, and prominently placed before the notice of the public at the Exhibition which has just come to a close.

"The Rivers Pollution Prevention Act, 1876," enacts "that any person who causes, or knowingly permits, any noxious or polluting liquid proceeding from any factory or manufacturing process to fall, flow, or be carried into any stream shall be deemed to have committed an offence against that Act." As an outcome of this measure, a company, entitled the "Manufacturers' and Mill-owners' Mutual Aid Association," has been instituted, under the presidency of the Hon. C. W. Wentworth Fitzwilliam, M.P., of Alwalton, Peterborough. It has been expressly established to provide means whereby manufacturers, mill-owners, and others may be enabled to carry into effect the provisions of the Acts in force for the prevention of pollution of rivers; and we would here call the attention of sanitary authorities, riparian owners, occupiers of factories, mills, mines, and other analogous industries to the advantages held out by the Association.

Taking it for granted that the majority of the manufacturers are at a loss how to proceed in the elimination of noxious liquid matters proceeding from their works, and how to counteract the evils by a judicious outlay, the company have established a skilled staff, supplemented by an adequate capital, to supply their wants. A sample of the effluent water may be sent to them for reporting upon at an agreed rate, and the result of investigations will include an estimate of the cost for the entire prevention or mitigation of the nuisance; at the same time an explanation is given of the advantages likely to accrue through the working of the process in each special instance. The Association, moreover, either performs the required work, or advances money for its fulfilment.

We may add that the process which has been applied by them for many years, with the highest degree of success, is one of ordinary straining, conducted in such a way as to retain and separate all fluids of an oily nature, in addition to solid particles. The straining is carried on through a succession of frames, with suitable filtering cloths stretched upon them, and has been in operation at Messrs. S. H. Johnson & Co.'s exhibit for the Association in the grounds of the Exhibition. Numerous models and actual machines for the purification of rivers and streams, with samples of water before and after treatment, and many valuable products gained therefrom, testify to the worth of the processes employed. We may also remark that the filter-case of the excellent Carbon Paper Water-Filter of Messrs. Johnson, of Stratford, E., has been constructed upon the principle of their larger straining apparatus, now adopted by the Association.

We thus see how easily a compliance with the Act of Parliament for the prevention of Rivers Pollution may be established; and we trust that all those interested in the question may be led to inquire more particularly into the details of the benefits to be derived from the Association by an application to its secretary at 5, The Sanctuary, Westminster, S.W.

Sewage contamination, such as that which flows into the Thames and other rivers of importance, has for some time past been a sore subject of discussion. Many are the plans that have been suggested from time to time to effect a complete cure. Amongst these, the extension of main sewers to carry away the offensive products far out into the sea, the distribution of the sewage over the land, &c., have failed to attract any attention, because they are calculated to overcome the evils by a substitution of enormous expenditure without any adequate return.

We believe that the question admits of solution in a mitigation or abatement, rather than in a wholesale prevention. In the instance of diseased conditions, the enlightened physician does not seek to make a radical cure of the case he has diagnosed, but rather to adopt a process of gradual reduction. Here we have a kind of sewage disease which has been going on year after year for a considerable period of time, and we hold that the treatment, to be effectual, must involve a process of time, so as to keep up an equilibrium in the administration of benefits for the public; in short, Peter must not be robbed to pay Paul.

Dwelling-houses are being erected in every direction around London with marvellous rapidity. Why cannot the Local Boards of each district compel each new builder to dispense with sewers for excrementitious matters, and make use of the earth-closet and ash systems of the Manchester Corporation, Morrell, and others? The waste products would certainly entail an increment in the staff of their dustmen; but then it can be clearly shown that they may be turned to profitable account, and thus add to the available funds of each district for the benefit of its poor and helpless. In course of time the suburbs would become healthy without aggravating the evils of the metropolis, and there would then only remain the sewers of the latter to contend against. Then, too, extensions of the systems could in time be put into operation, so as to lessen the sewage, by a disuse of the water-system in existing houses and the introduction of the earth and ash processes. Gradually the reform would work inwards, until the great centre of the city itself is subjugated.

In the meantime, however, other methods of value are available, and if they are also brought into use, we cannot really see why the Thames water should not be rendered permanently wholesome. Amongst these, we may mention that of the Native Guano Company (Limited), of 29, New Bridge-street, Blackfriars, E.C., called the "A.B.C. process for the prevention of pollution of rivers by the purification and utilisation of sewage," exhibited under group 3, class 22, at the Exhibition. The Company deservedly obtained a Gold Medal and Diploma of Honour at last year's

"Fisheries Exhibition." We had occasion at the time of that display to accord them a favourable notice in these pages; but for the benefit of our readers we may briefly allude once more to their system :—

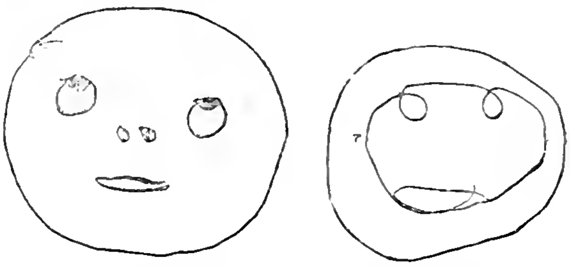
It consists of the addition of their patented "A.B.C." mixture to the sewage, with the result that all the offensive products are precipitated and subside. The water then is permitted to flow off, freed from smell and perfectly innocuous. The precipitated products are next collected, dried, and sold under the name of native guano. Of the value of this last-named product, we can only speak from what we have seen at the Exhibition, where a goodly supply of vegetables, &c., grown on a soil manured with the native guano, daily decorated the flanks of their stalls We have no doubt that the company would be glad to forward their large pamphletful of testimonials to any anxious inquirer. So we find that there is a process of considerable value open to the Board of Works in dealing with the sewage question—a process which would not involve any but initial expenses, and which, we are assured, would ultimately be both valuable to the community at large, and become eventually eminently lucrative.

We hope in future to continue these articles in the form of papers which shall deal with this and other unnoticed departments of the Exhibition in detail, and which may be of interest or value to our subscribers.

THE SOCIETY FOR PSYCHICAL RESEARCH.*

THE four reports of the Society for Psychical Research which have been issued at intervals during 1882 and 1883 have now appeared in the form of a handsome volume, and it cannot be denied that they constitute a formidable body of evidence in favour of certain beliefs which have hitherto been looked upon with peculiar suspicion and distrust. A brief *résumé* of the testimony does not do it justice, for it derives its weight from the cumulative effect of its large amount. No one who is interested in bringing fresh regions of ignorance under the domain of scientific investigation should fail to read the proceedings for himself.

The society was organised on Feb. 20, 1882, but several of its members had been engaged in private research in the same direction for some years before. Its object was stated to be the investigation of an important body of remarkable phenomena, resting upon the testimony of many competent witnesses, including observations recently made by scientific men of eminence in various countries, and *primâ facie* inexplicable on any generally recognised hypothesis. The distinction of its founders is such as to completely dissociate it from the race of the long-haired, and to insure at once respectful consideration for whatever facts it vouches for. They include such names as Balfour Stewart, Arthur Balfour, Professor Barrett, Edmund Gurney, F. W. H. Myers, Archbishop French, and Professor Henry Sidgwick (the president). The members are not committed to any theory, and are not advocates of any cause. It is their intention to remove, if possible, what they justly say is a great scandal, the existing state of absolute doubt as to whether phenomena testified to by a large number of generally credible witnesses, and of great scientific importance if true, can be properly authenticated or not. Their experiments are conducted with the most rigid precautions against deception and mistake, and, what is equally important, recorded with scientific precision. Six committees were formed for the consideration respectively of thought-reading, mesmerism. Reichenbach's experiments in regard to a peculiar sensitiveness to electric currents, apparitions and haunted houses, physical phenomena, and the collection and collation of existing materials bearing on the history of these subjects. Of their several reports, those of the committee on thought-reading, or thought-transference, as they call it later, are the most striking. The significance of the term "thought-transference" is limited to the communication of a vivid impression or a distinct idea from one mind to another, without the intervening help of the recognised organs of sensation. No account is taken, very naturally, of experiments in which there is physical contact between the persons concerned, or in which there is the slightest possibility of conveying information by sight or hearing. The extreme perfection to which a code of signals may be brought leads the committee to distrust all observations where two particular persons are necessary for the results



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obtained. Their most remarkable subjects for thought-transference have been found in a family in Derbyshire, that of Mr. Creery, a clergyman of high-character, whose integrity has, as it happens, been exceptionally tested.

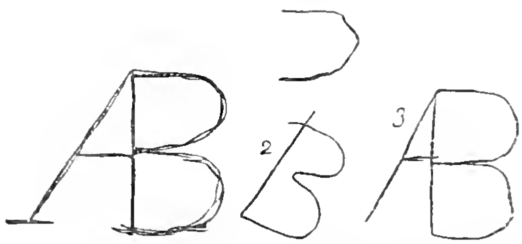
He has five daughters, of ages between eleven and eighteen, all thoroughly healthy, and as free as possible from morbid or hysterical symptoms. All these children except the youngest are able to designate correctly, without contact or sign, an object fixed on in the child's absence—not, indeed, every time, but far more frequently than probability would allow as the result of chance. The child, on returning to the room, stands close to the door, amid absolute silence, with her eyes on the ground; often she does not return, but guesses from the adjoining room, with the door closed. The children have been experimented upon at their home by the committee, by Professor Barrett, by Mr. and Mrs. Sidgwick, and by Professor Balfour Stewart, as well as at the houses of different members of the committee at Cambridge and at Dublin. The objects guessed have been chiefly cards from a full pack, and numbers between ten and one hundred, but remarkable success has been obtained, also, in guessing names chosen at random, as in the following list :—

William Stubbs: "William Stubbs."
Sophia Shaw: "Sophia Shaw."
Timothy Taylor: "Tom Taylor—Timothy Taylor."
Isaac Harding: "Isaac Harding."
Albert Snelgrove: "Albert Singrore—Albert Grover."
Tom Thumb: "Tom Thumb."
Cinderella: "Cinderella."
Chester: "Manchester—Chester."
Pipe: "Plate—paper—pipe."
Cork: "Fork."
Corkscrew: "Corkscrew."
Tongs: "Fire-irons—poker."

From the summary of results, it appears that, out of every 610 trials with playing-cards, there were 118 correct guesses on the first trial, and 76 on the second; or that,

* From the *Scientific American Supplement*.

counting the first trial only, there was 1 correct guess out of every 5·17 instead of 1 out of every 52, as would be given by chance alone. Of 260 numbers, 68 were guessed correctly the first time, and 35 the second time, or on the first trial, 1 out of every 3·82; whereas from chance would have given only 1 out of every 90. Where the trial is counted as a failure, it frequently happened that the suit, or the number of pips of the card, or one figure of the number, was guessed correctly. The partial successes, as in the guesses for "pipe" and "tongs" given above, strike us as



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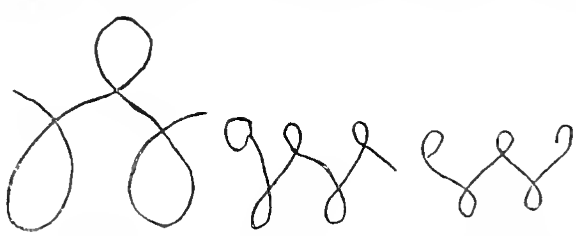
even more remarkable, and more likely to throw light upon the subject, than the complete ones. The children, when questioned, agree in saying that two or three ideas of similar objects come before their minds, and that, after a moment's reflection, they select that which stands out with the greatest vividness. Their power, instead of improving with use, has been gradually diminishing. At first, especially when they were in good humour, and excited by the wonderful nature of their guessing, they seldom made a mistake. They have been known to name seventeen cards right in succession.* Their gradual decline of power somewhat suggests the disappearance of a transitory pathological condition. On the other hand, a larger number of good subjects has been found than there was reason at first to look for.

Much more remarkable than experiments with cards or numbers, where there is at least an appreciable chance of getting right by accident, are those in which an impression of a drawing is conveyed from one mind to another, without contact or any conceivable use of the ordinary means of communication. In these experiments, Mr. Blackburn, an associate of the society, who is described as a very painstaking and accurate observer, is the operator; and Mr.



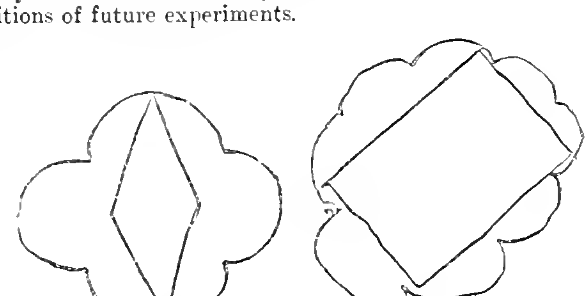
Original. Reproduction. Original as Mr. Blackburn remembered it.

Smith, a young mesmerist of Brighton, is the subject. Mr. Smith is seated, blindfolded, at a table in one of the rooms of the society; paper and pencil are within his reach, and a member of the committee is seated by his side. Another member of the committee leaves the room, and outside the closed door draws some figure at random. Mr. Blackburn is now called out, the door is closed, and the drawing is held before his eyes for a few seconds. Closing his eyes, Mr. Blackburn is led back into the room, and placed, standing or sitting, behind Mr. Smith, at a distance of some two feet from him. After a brief period of intense mental concentration on Mr. Blackburn's part, Mr. Smith takes up the pencil, and, amid the absolute silence of all present, reproduces as nearly as he can the impression he has received. Mr. Blackburn keeps his eyes closed (sometimes they are bandaged as an aid to concentration); and he has not touched Mr. Smith, and has not gone in front of him, nor in any way within his possible range of vision, since he re-entered the room. Sixty pages of the drawings and reproductions are given—facsimiles of the originals, from which they have been photographed on the wood blocks. The reproductions are rude copies of the

Original. Reproduction.

Mr. Smith had no idea that the original was not a geometrical diagram. He added line *b* some time after he had drawn line *a*, 'seeing a line parallel to another somewhere.'

drawings such as a child might make, blindfold, of a picture he had just seen; but in every case the resemblance is recognisable, and sometimes it is very exact. A particularly good one was made, when, with a view of removing all doubt as to possible auditory communication, Mr. Smith's ears were stopped with putty, a bandage was tied round his eyes and ears, a bolster-case was fastened over his head, and over all was thrown a blanket, which enveloped his entire head and trunk; and Mr. Blackburn sat behind him as still as it is possible for a human being to sit who is not concentrating his attention on keeping motionless to the exclusion of everything else. To profit by a code of signals in this case, Mr. Smith would have had to extract the putty from his ears, and still smothered in bolster-case and blanket to detect periodic variations in Mr. Blackburn's breathing imperceptible to the committee, and to interpret them into a description of a very irregular figure. This hypothesis seems to the committee an extreme one, but they intend to meet it by still further varying the conditions of future experiments.



Original. Reproduction.

The record is given of another set of experiments made upon two young ladies at Liverpool, under the strictest conditions, by Mr. Guthrie and Mr. Birchall. The following were among the guesses :—

A gold cross : "It is yellow—it is a cross."
An egg : "Looks remarkably like an egg."
A penholder, with thimble inverted on the end : "A column, with something bell-shaped turned down on it."
Letter Q. : "Q."

* The chance of doing which, by accident, is as 1 to 52^{17}.

A dark-crimson apple: "It is round—a dark-red shade—like a knob of a door?"—"It is an apple."

A key: "A little tiny thing, with a ring at one end, and a little flag at the other, like a toy-flag." Urged to name it, replied, "It is very like a key."

A pair of scissors standing open and upright: "It is silver?"—"No: it is steel."—"It is a pair of scissors standing upright."

The usual phenomena were obtained by the committee on mesmerism, but with the utmost precaution against collusion and fraud. The cases which do most to stagger a cultivated scepticism are those in which the subject remains in a perfectly normal condition, with the exception of *local* effects produced on him without contact, and without any possibility of expectation on his part. The following experiment was repeated thirty or forty times without a single failure. The subject was blindfolded and seated at a table on which his ten fingers were spread out before him. A screen formed of thick brown paper quadruply folded was placed in front of him, extending far beyond him in all directions. Two of his fingers were then selected by one of the committee, and slightly pointed out to the mesmeriser, who proceeded to make very gentle passes over them; and, to prevent the communication to the subject of a sensation of change of temperature or a current of air, a member of the committee made, as nearly as possible, similar passes over two others of his fingers. After a minute or less, the two fingers mesmerised proved to be perfectly stiff and insensible; the points of sharp instruments might be plunged deep into them, or a lighted match might be applied to the sensitive region around the nail, without producing a sign or a murmur.

It is difficult to suppose that an ordinary youth, sitting with relaxed limbs in quiet unconcern, would be able to control, by the exercise of his will, every sort of reflex start or twitch when a naked flame is applied to one of the most sensitive parts of his person. To meet such an objection, however, the experiments were repeated with other subjects with equal success—one of them a delicate woman, whose shrinking from pain was such that the prick of a fork on one of her unmesmerised fingers would cause a half-hysterical cry. The hands of the subject may even be mesmerised when he is in the mesmeric sleep; and then the usual clap and call restore him to consciousness, but do not permit him to remove his hands from the sofa, to which they seem to be glued, until after they have been separately released.

We pass over the report of the Reichenbach committee, of the literary committee, and of the committee of haunted houses, but not because they do not contain a great deal of very interesting and striking matter. The addresses of the president, too, are models of clear, careful, and forcible writing; and the proceedings, as a whole, cannot fail to produce a strong effect upon a reasonably unprejudiced reader, especially when it is considered that all this is in addition to the varying amount of testimony and experience that has been for years in the possession of nearly all of us. In no other subject has there been such a long dispute over the reality of the phenomena; even the witnesses to globular lightning have gained credence for themselves at last. No other subject, as is perfectly natural, has been so inextricably mixed up with fraud and chicane, and has fallen, in consequence, under such a weight of obloquy. There has usually been, besides a peculiarly "unwashed" flavour about the possessors of these mysterious powers which are denied to people in general. The travelling mesmeriser has not been an attractive specimen of humanity, and to that fact has been allowed more than its due effect. In other undecided scientific questions, weight of authority has counted for something, but not the weight of a man's family connections. Even when it was said that such unexceptionable witnesses as De Morgan, and Wallace, and Crookes had become convinced that certain facts not generally admitted were really facts, one could not help believing that they differed in some way from the ordinary sane scientific man, and that some peculiar crookedness of mental vision was the source of their strange belief. Another refuge of incredulity has been national and sectional distrust; it was chiefly outside of the centres of learning that such things went on. Mr. Sidgwick was once told by a German, that they happened only in England or America, or France or Italy, or Russia, or some half-educated country, but not in the land of *geist*. If this society does not at once convince all the world of the truth of its phenomena, it has at least accomplished the feat of suddenly elevating them into the region of respectability; and hereafter any one can admit his belief in them without shamefacedness. Now that mesmerism and mind-reading have ceased to be exclusively the property of travelling shows and after-dinner entertainments, and have become a subject of experiment in laboratories, it is to be hoped that their extent and limitations will be speedily defined, and that the vagueness and haze in which they have hitherto been enveloped will soon be replaced by definite knowledge.

BRITISH SEASIDE RESORTS.

FROM AN UNCONVENTIONAL POINT OF VIEW.

By Percy Russell.

(*Continued from p. 317.*)

I STATED in my initial paper that the total coast-line of England and Wales approximated nearly to two thousand miles, or a fourth of the diameter of the globe. If, however, we add to this the still more sinuous coast-line of Scotland, we shall find that the length reaches 2,700, obviously very greatly in excess of England, a country double the size of Scotland; and if, again, we add for the very indented coast of Ireland over 2,000 miles more, it will be perceived that to thoroughly explore the very irregular coast-line of these islands is nearly equivalent, in point of extent, to a direct journey across half the world at the equator!

The character of all coast-lines naturally depends on the geological formation of the land itself. Wherever immense masses of mountain offer a hard front to the sea, there the coast must necessarily be bold and wild, with great headlands, and probably promontories. If the shore, however, lies low, and is composed of soft alluvial deposits, then the tide will generally hollow a bay, more or less crescent in form, and a broad and strong river flowing through such flat land to the sea is sure to produce estuaries: while if the water comes from mountains that terminate only with the shore, we have the fiords of the Norwegian peninsula or the great sea-lochs of Scotland.

The shore of North Britain, abounding in deep indentations, and having on its western side a large number of precipitous, rocky islands, tells its own wild story of elemental warfare, and of the strenuous endeavours of the stormy seas of the north to cut not only into but through the land. Indeed, so numerous are the creeks, bays, and Firths, that in no part of Scotland is the sea more than forty miles away.

The aspect of the shores varies greatly on the east and west. On the latter side we find great mountain masses stretching out at sea into grim peninsulas of terrible rocks, and having a great many openings, long, but narrow, in which the sea rushes with the form of a river and the force of the ocean. On the east, the coast-line is very much shorter, and the character of the land is much less harsh. Sandstones and clays abound, and, although some of the cliffs are mountain-like, the aspect of the shores is infinitely less wild and romantic, and there is an absence, too, of those islands which form so prominent a feature on the west. To some extent, indeed, we have here much of the contrasts found between the shores of western England, Wales, and the eastern counties; but in Scotland it is much more marked, as we here enter a zone of fiercer tempests and of wilder storms, while the sapping action of frost is, of course, much more marked.

From the Solway Firth to the terrible and appositely-named Cape Wrath, the coast is swept by the Atlantic, and, in a great measure, protected by the various great islands and groups of islands which, in fine and warm weather, imparts an indescribable charm to our own archipelago, which, if it wants the historic associations of the isles of Greece, possesses undoubtedly very great beauties of its own, and not a few majestic memorials of the historic past.

The Solway Firth and the Firth of Clyde are both remarkable for beauty, but the latter is in many respects unsurpassed. Passing seawards from Greenock, in the distance may be discerned the grand amphitheatre of the Argyllshire and adjacent mountain opening ever and anon into stupendous gorges, between which the sea flows into many a far-off Highland vale.

Right out in the Firth of Clyde lies Arran—a mass of mountains and heath, and soaring northwards into singularly grand, jagged peaks. The culminating point is Goatfell, known in Gallic as Gaoth Bheinn, or Beinn Ghaoith—in other words, the Wind Mountain, a well-merited name, and forming something like a pyramid 2,865 feet high. Down the sides of this great land and sea mark are the wild, picturesque, beautiful glens of Rosa and Sannex, and at the foot is Brodick Bay. The principal harbour is Lamlach Bay, the best, perhaps, on the Forth, and having very good hotel accommodation. In the vicinity may be seen a mass of fine columnar basalt, a thousand feet high; and southwards are some good waterfalls, one fall a hundred feet high. South-east lies Kildonan Castle, and all along these stately basaltic formations are huge caverns, in one of which, tradition says, Robert the Bruce lay concealed a considerable time.

Geologically, Arran is full of special interest, as here may be seen, and easily too, a greater succession of strata than in any other region of the United Kingdom of like area. Devonian sandstone, trap-rocks, carboniferous strata, silurian rocks, and oolite, may all be studied to great advantage, and beside all this grandeur of rock and precipice, there are many sheltered fertile spots of singular beauty. Rivers, properly speaking, there are none, but the mountain torrents are numerous, and one of them makes a splendid leap into the sea of 300 feet over a perfect precipice. Various antiquities abound. There are plenty of cairns, monoliths, and Druid remains, and in the ruins of Loch Ranza Castle may be seen what was a residence of Scotland's ancient Kings.

The Mull of Cantyr forms another remarkable feature of this wild and romantic coast. It is a promontory forming the extreme end of a peninsula some forty miles long, and, in places, only half a mile wide, and reaching to within nearly twelve miles of the Irish coast. Then comes Islay, westward still, with its spine of mountainous hills, rising from 800 to 1,500 feet high, and its great distilleries, which give a special character to this region: and passing Islay we reach the noble Firth of Lorn, which, sheltered from much of the fury of Atlantic gales by the great island of Mull, corresponds to the vast Moray Firth of the east coast, and, ultimately, contracts into Loch Linnhe, which, in its turn, narrows into other lochs.

Mull, after the Isle of Skye, is the largest of all the Inner Hebrides, and includes great part of Argyllshire, while off its western extremity lies the most famous, in many respects, of all the western isles of Scotland, Iona—which is believed, by the way, to have obtained its name through the mistaken reading of *n* for *u*, the original word *Ioua*—the island; further yet out in the Atlantic is Staffa, that wondrous table-land, with its steep cliffs, its basalt columns and extraordinary caverns, the most famous being, of course, Fingal's Cave, with its mighty nature-built arch, its ocean floor flashing strange lights against the calcareous stalagmite of the marvellous roof.

Scott, some of whose poetry has been called, with a contempt that is, in reality, very great praise, a guide-book to the Highlands, alludes to this part of the west coast in a well-known passage, where he speaks of—

> Ulva dark and Colonsay,
> And all the group of islets gay
> That guard famed Staffa round.

Let it not be supposed that the word "gay" is merely inserted for the sake of rhyme. There is reason, too, and, set in the bright sunny seas of summer, few places in Great Britain are more worthy to be called gay. On Iona, for example, the land is so fertile that barley, sown prior to June 15, is ready for the sickle in August, and, in the dark ages, the prolific crops reaped from these western islands, whenever the inhabitants bestirred themselves, were generally held as miraculous testimonies to the holy labours of St. Columba in these wild and barbarous regions.

Mull is triangular in form, and has an area of 237,000 acres. The surface is chiefly mountainous, and there ar many lakes, while Ben More rises to the height of 3,185 ft. There is much fine moorland, and woods exist in the north: but during the fierce gales that blow over from the Atlantic, it is not, it must be confessed, quite the place for ordinary tourists.

The Hebrides, or Western Islands, are really the Ebudæ of Ptolemy, and were first colonised, it is said, in the ninth century from Norway. The Gulf Stream greatly mitigates what would otherwise be a rigorous climate, and snow rarely lies long on the ground near the sea-level. The Islands number nearly 500, but not more than 130, at most, are inhabited, and the entire area has been roughly estimated at 3,000 square miles. In few places, if any, in the three Kingdoms is such sublime and imposing scenery to be found. Skye, which in Gaelic is expressively called *skianach—i.e.* winged—presents a most remarkable appearance against the horizon. The Coolin mountains stretch from north-east to south-west, and soar up into the lofty peak of Scoor-nan-Gillean, 3,183 ft. above the sea-level. Here is to be seen the famous Loch Coruisk, which is nearly walled in by mountains 3,000 ft. high. Justly, indeed, does Scott speak of "Skye's romantic shore, where Coolin stoops him to the west." Glen Sligachan is often cited as being the grandest glen in all the Highlands, and between Loch Staffin and Rhu-nam-Brarin the coast is marked by a splendid series of fine basaltic formation, which, in reality, surpasses the Giant's Causeway or Staffa even, but which is, popularly speaking, even now little known. These magnificent cliffs are interrupted by many beautiful waterfalls and abound in caves, besides the historic cavern, near Portree, which sheltered Prince Charles. The only drawback to the full enjoyment of these lovely islands of the western coast of North Britain arises from the frequent heavy mists and rains; but in fine weather the tourist will feel that he who has not seen the Hebrides knows not the principal mountain beauties of the British isles.

The Orkney Islands, divided from the north of Scotland by the tempest-scourged Pentland Firth, have a much milder climate than is popularly ascribed to these far-away regions. The Gulf Stream even here exercises considerable thermal power, and for a series of years the mean temperature of even January and February has been no lower than 39°. The rocks, which form the prominent features of these strange islands, are of the Old Red Sandstone formation, except only in a granitic district near Stromness. The group numbers about seventy islands, and, as in the case of the Hebrides, many of them are uninhabited. Some of the islands are low, and the steep cliffs generally rise to the west, and the heights of Hoy are justly reckoned as among the most remarkable sea-cliffs in all Scotland. The Shetland Islands, over a hundred in number, are far away in the terrible North Sea, fifty-six miles north of the Orkney group. They are for the greater part simply heaths, forbidding and inexpressibly dreary, fenced as well as they need be against the terrible Atlantic gales by giant cliffs.

Returning again to the mainland from Duncansby Head to Cape Wrath, the shores present much the same wild, rugged front, cleft by deep fissures, and jutting out wherever the cliffs are hardest, into grim, fortress-like promontories. The east coast is chiefly noticeable for the Moray Firth and the Firths of the Tay and Forth. The Moray Firth is a great indentation of the German Ocean; another estuary of the Tay forms with it the two great striking features of the east coast, until proceeding south we reach the famous Firth of Forth—the great estuary of the River Forth, which lies between the counties of Clackmannan, Perth, and Fife, on the north; and those of Sterling, Linlithgow, Edinburgh, and Haddington on the south. Close to Tantallon Castle the Firth is fifteen miles wide, and it encloses the isle of May, the historic Bass rock, and receives into its broad waters some of the most famous of Scotch rivers. The most fertile and richly-cultivated lands in Scotland lie along its shores, and the whole region is rich in romance and history.

I have specified some of the great headlands of the coasts of Scotland, but not all; and I here give a list of the principal, which, taken alphabetically, are, —Ardnamurchan Point, in the west of Mull; Buchan Ness, Aberdeenshire; Cape Wrath, Sutherlandshire; Duncansby Head, Caithness; Dunnet Head and the Ord, in the same county; Fife Ness, the eastern extremity of Fifeshire; Kinnaird Head, Aberdeenshire, north of Buchan Ness; Mull of Cantyre, already mentioned; and the Mull of Galloway. Then there are Tarbet Ness, north of the entrance to the Moray Forth, and Whiten Head. On the extreme south-east, St. Abb's Head marks the first headland of Scotland north of the English shore.

Such are the salient natural features of the physical geography of North Britain, taking a very rapid and slight survey of the coast generally. It is impossible but that such a swift flight should be in many ways full of omissions. Much that is worthy of great detailed notice has been unavoidably passed over with, perhaps, a word of allusion. This remark applies indeed to the general sketch given of the shores of England on the west. The object of the writer will be fully gained, however, if some readers are induced by these papers to seriously consider the question whether, before seeking foreign shores for the picturesque, the new, and the grand, they have really made themselves familiar with the many beautiful and, in some cases, extraordinary features of their native coasts.

(To be continued.)

Reviews.

SOME BOOKS ON OUR TABLE.

Handbook for the Dominion of Canada. Prepared for the Meeting of the British Association at Montreal, 1884. By S. E. Dawson. (Montreal: Dawson Bros.) 1884.—Although this capital handbook is stated to have been prepared for this year's meeting of the British Association at Montreal, it happens, fortunately for the reviewer into whose hands it falls so late, that its interest is scarcely of the ephemeral character which its title would seem to indicate. In fact, Mr. Dawson has produced a guide-book which will prove invaluable to the Canadian traveller after the memory of the visit of the British Association to the Dominion shall have become but dim and faint. The history, geology, botany, and meteorology of Canada are all discussed. The fullest details as to railways, steamers, and other modes of conveyance given; numerous plans for excursions furnished; full descriptions of the chief cities and towns given, with hotel charges, cab fares, lists of churches, restaurants, and amusements, &c.; in fact, everything that is necessary to enable the tourist to visit the country with pleasure, profit, and economy. The maps are very good.

An Important Question in Metrology, &c. By Chas. A. L. Totten, M.A., 1st Lieut. 4th U. S. Artillery. (London: Trübner & Co.).—It is really pitiable to find a man possessing a certain amount of ability, like Mr. Totten, wasting precious time in the way involved in the compilation of such a book as that before us. For he is one of those Pyramid fanatics, who find in the great Tomb and Observatory at Ghizeh, an inspired canon of weights and measures for all time. The way in which he juggles with figures, suggests the familiar feat of keeping a number of knives and gilt balls in the air all at once; which, glittering and flashing before the eyes of the spectators, appear to be multiplied by twenty. A single example, taken at random, will suffice to show the physicist how utterly untrustworthy our author is in the most simple of his facts. Opening his book at p. 98, we find him alleging that the mean height of the atmosphere is 5·2414828 miles! Did he, we ask in some wonder, ever hear of twilight, of meteorites becoming incandescent on entering our atmosphere, or of the aurora borealis? The characteristic feature of the whole of the farrago before us, however, is what—for want of a better name—we must term its "cock-sureness." Mr. Totten knows the mean density of the earth better than Baily or anyone else, and is familiar with her dimensions within a hair's-breadth. May we venture to recommend him carefully to read the recent address of his illustrious countryman, Prof. C. A. Young, to the American Association for the Advancement of Science, whence he may gather that we do *not* yet know the size and shape of our globe with anything like rigid accuracy. He is very severe, in places, upon Mr. Proctor, whom he invites to disprove certain assertions; intimating in effect that if the conductor of this journal does not straightway refute them they must perforce be true. We would humbly submit that Mr. Totten himself might not be able at once to offer disproof that the inhabitants of Venus subsist on Bacon's "Novum Organum" and stewed eels, but that such disability would hardly afford irrefragable evidence that the dwellers (if any) in the planet of Love were so nourished. The whole work is a saddening example of the *circulus in probando*.

Our Insect Allies. By Theodore Wood. (London: Society for Promoting Christian Knowledge. 1884).—We may commend Mr. Wood's pleasantly-written and very readable little book to all—and they are but too many—who regard insects merely as things to be knocked down, trodden on, crushed, or otherwise killed as soon as may be. For the interested reader of his pages (and we venture to predict that every reader of them will be interested) will learn what real and enduring service is rendered to mankind by many despised and insignificant creatures, which he has probably heretofore only regarded as pests and nuisances, and objects for immediate destruction. In successive chapters Mr. Wood treats of burying-beetles and their kin; the blow-fly, and the flesh-fly; dor beetles and their work; scavengers of the water; "blight" and its enemies; predaceous insects; wood-boring beetles and their allies; and in a "Miscellaneous Chapter," of various other insects. This little volume is suited to readers of all ages, and will be perused with pleasure and profit by every one who opens it.

The Eton French Translator. Selected by H. Tarver. (London: Edward Stanford. 1884).—M. Tarver has, in the work before us, made a capital selection of very heterogeneous extracts from various French writers, for translation into English. They are of all degrees of difficulty—from the simplest narrative prose to the most technical and idiomatic descriptive writing. The advantage of this to the student will be appreciated by all who are familiar with the present mode of conducting examinations in French for military and civil appointments.

Farewell Discourses delivered at South Place Chapel, Finsbury, London. By Moncure D. Conway, M.A. (London: E. Waller. 1884.)—The seven sermons or discourses which make up Mr. Conway's volume were seemingly those with which he concluded his ministerial career at South Place Chapel. That they are absolutely heterodox goes without saying. That they are eloquent, interesting, and very readable is equally undeniable; and that they contain many a pregnant passage calculated to stimulate thought and inquiry, the reader will speedily discover for himself. He may, though, be warned that Mr. Conway never hesitates about treading upon the theological or social corns of anybody whatever.

The Origin of Man. By Edward B. Aveling, D.Sc. (London: Progressive Publishing Company. 1884.)—When Dr. Aveling confines himself to the purely scientific aspect of the evolution of man, we have nothing whatever to say against his little pamphlet. On the contrary, as a *précis* of the cumulative proofs of human evolution it leaves little to be desired. But he is not content with leaving his indisputable facts to speak for themselves; he must needs interlard his exposition with small sneers at what an immense majority of mankind hold as sacred. No better illustration of the pettiness of these could be given than that afforded by the fact that the name of the Deity is spelt with a small "g"! Were the blot to which we refer removed, his little book might be confidently recommended.

Landlords' Rights and Englishmen's Wrongs. By Alfred McDonnell. (London: W. Reeves.)—Here is another of the "Whole-hog" type of disputants, who, in common with the Vegetarians, Anti-Vaccinators, Teetotallers, *et id genus omne*—imagines that carrying out his own "fad" is all that is needful to secure the lasting happiness and prosperity of society in this country. His assertion that land (and we would here confine ourselves to agricultural land) does not bear its due share of taxation, will be estimated in its true light by all those who know how the charges for roads, police, education, the relief of the poor, &c., &c., fall one and all on the land. Should Mr. McDonnell live until land in England ceases to be private property, Methuselah will be a baby to him!

Miscellanea.

The Metropolitan Asylums Board is advertising for tenders for lighting by electricity the three hospital ships now moored in the River Thames at Long Reach, near Dartford, and the Administrative buildings on shore. The specification has been prepared by Dr. J. Hopkinson, F.R.S.

M. Mueseler's and M. Marsaut's safety lamps have been pronounced by the Committee of the Midland Institute to be, when fitted with "bonnets" or protectors, the only safety lamps which are perfectly safe under all conditions. The results published have been determined with currents of fire-damp moving with a velocity of thirty-five feet per second.

The Queen has been pleased to accept a copy of the new edition of the work entitled "Pottery and Porcelain: a Guide to Collectors," by Mr. Frederick Litchfield, the well-known expert in London pottery. That the book has come as a boon to collectors of old china is proved by the fact that since its first publication by Messrs. Bickers & Son, in 1880, two editions have been called for.

To remove ink-stains from carpets, Bœttger recommends the use of a concentrated solution of sodium hypophosphite. Recent stains should be thus easily removed, old ones must be rubbed with the solution for some time. For old ink-spots, the carpet may be moistened with hot water (and, if convenient, kept over boiling water, and finely-powdered oxalic acid rubbed upon the spot). Ammonia water should be in readiness, and the acid neutralised, if the original colour of the carpet is affected. In the case of marking-ink stains, the fabric may be soaked in a solution of calcium chloride and rinsed in ammonia water.

Snow-Water Impurities.—Under the heading of "The Beautiful Snow," the *Microscope* points out the kind of organic impurities found in snow, which, added to what we recently quoted on the same subject, very conclusively shows the fallacy of the idea that melted snow forms a good substitute for distilled water. The impurities are as follows: Living infusoria and algæ, bacilli and micrococci, mites, diatoms, and great numbers of fungi spores; also fibres of wood, mouse hairs, pieces of butterfly wings, skin of larvæ of insects, cotton fibres, pieces of grass, epidermis, pollen grains, rye and potato flour, grains of quartz, minute pieces of roofing tile, and bits of iron and coal!

The Royal Courts of Justice were to be reopened on Friday, the 24th inst., but the electric light was not ready for use on that day. It had been expected that the new machinery for generating the current, in the course of erection under the Central Hall, would be completed in time, and consequently the entire plant previously in use was disposed of and removed by the Office of Works; but it was afterwards discovered that it would be impossible to set the new machinery in motion until some weeks had elapsed after the reopening of the Courts, so that the Central Hall, the various courts, and the corridors had to be lighted by candles and temporary lamps.

A paper was read at Montreal "On the Liquefaction of Oxygen and the Density of Liquid Hydrogen," by Professor Dewar, F.R.S. The problem of liquefying oxygen and hydrogen, and consequently others of the so-called permanent gases, having been solved by Cailletet and Pictet, the author has since been employed studying the physical characters of these gases in the condensed state. The critical pressures and temperatures at condensation have been determined, and the relation of one to the other is shown to be constant. The merits of various cold-producers that could be employed in the process were discussed. Condensed ethylene he considered the best, then condensed nitrous oxide and carbonic acid. The lowest temperature that could be obtained by carbonic acid is about 115° C., and by nitrous oxide 125° C.

The Moon Eclipse.—The discrepant reports of the appearances of the moon during the late eclipse, indicate a great difference in the local atmosphere of various places, besides suggesting puzzling questions of other kinds. At 420 feet above sea-level, in Ashdown Forest, when viewed with the naked eye, 6¼ withdrawing telescope, or good opera-glass, the shadow was smoky black; no copper tint anywhere, and the brightest parts completely blotted out of recognition. Not an outline of Aristarchus could be seen in the telescope as soon as the shadow crept over it. At this height, after the eclipse, the moon looked to the naked eye like a rather dull comet that had lost its tail.

The Song of Sixpence.—Perhaps many who often repeat "Sing a song of sixpence," have never heard this explanation of its meaning:—"The four-and-twenty blackbirds represent the twenty-four hours. The bottom of the pie is the world, while the top crust is the sky that overarches it. The opening of the pie is the day dawn, when the birds begin to sing, and surely such a sight is fit for a king. The king, who is represented as sitting in his parlour counting his money, is the sun; while the gold pieces that slip through his fingers as he counts them are the golden sunshine. The queen who sits in the dark kitchen, is the moon, and the honey with which she regales herself is the moonlight. The industrious maid, who is in the garden at work before the king—the sun—has risen, is day dawn, and the clothes she hangs out are the clouds, while the bird, who so tragically ends the song by 'nipping off her nose,' is the hour of sunset. So we have the whole day, if not in a nutshell, in a pie."

Attitudes after Death. On Sept. 12, 1642, Cinq-Mars (Henri d'Effiat, Marquis of Cinq-Mars, Grand Écuyer of France) was beheaded for high treason at Lyons. The official executioner having broken his leg, the job was done by a day-labourer of the town with a butcher's cleaver. He made Cinq-Mars kneel and clasp the block, which was a substantial stump of a post, firmly in his arms, and, bending his body down, placed him so that his neck was well situated on the summit of the stump. The executioner then went to his left side, drew his cleaver from a bag, and delivered a blow which all but severed the head, leaving only some of the skin of the throat, which was divided by a second blow, the executioner, for that purpose, laying hold of the head by the hair. Then he threw the head on the scaffold, but it rolled off and fell to the ground. It was remarked that between the two blows of the chopper, the body, still remaining on its knees, rose stark up against the block or post, and continued in that position until the headsman with great difficulty removed the arms from the block, to which they held the body as firmly attached as if they had been coils of rope. "Mémoires de Fontrailles."

The Action of Moonbeams.—The cases in which moonlight has been imagined to cause blindness to persons sleeping in its beams, so far as I have seen, always relates to exposure in the open air. On bright moonlight nights there is great radiation, and consequent chill of exposed parts. Possibly the light may stimulate the eye, and make it more susceptible of injury from this cause. It cannot be affirmed that moonlight is always found injurious to open-air sleepers. For example, Mr. Washington Teesdale informs me that, during many years of surveying in India, he was in the habit of sleeping outside his tent or bungalow, often in full moonlight, and never experienced injury from it. With regard to the moon's action in promoting the decomposition of fish or meat, the fact seems established that the exposed articles do spoil, but the why must be a subject of hypothesis until accurate experiments are made. Probably the cause of the mischief is the deposition of dew containing spores of microferments. Clear skies occur when the moon is out of the way, and the light of the moon might be admitted to a bit of meat or fish and the dewfall excluded. A few careful experiments suggested by these coincidences would elucidate the matter.

An Ancient Tunnel. The Governor of Samos, Abeddin Pasha, has at last succeeded, after years of work, in uncovering the entrances to a tunnel of which Herodotus speaks with admiration as the work of Eupalinos and Megaira, and which, according to the same authority, was built during the tenth century B.C. The tunnel, about 5,000 feet long, was intended to secure a supply of fresh water to the old seaport town of Samos, and consists of three parts. They are the tunnel proper, 5⅝ feet high and 6 feet wide; a canal about 5 feet deep and nearly 3 feet wide, which runs in the middle or on the side of the base of the tunnel; and the aqueduct running in this canal. The aqueduct consists of earthen pipes, each 2½ feet long, 32 to 33 inches in circumference, the sides averaging about 1½ inch in thickness. Every other joint has a hole, for what purpose has not yet been fully explained. Mr. Stamatiades, a Greek archæologist, believes that they were intended to facilitate the cleaning of the pipes, and to make the flow of water easier. The canal is arched over, but twenty-eight manholes were provided to admit the workmen who were charged with cleaning and repairing the aqueduct. The tunnel is not quite straight, forming an elbow about 1,300 ft. from one of the entrances. This elbow, according to Mr. Stamatiades, was caused by a mistake in the calculations of the engineers, who had none of the instruments used in tunnel-building nowadays. The tunnel starts near a small water-course, which may have been quite a stream in olden times, pierces the mountain Kastri, which was formerly crowned by the fort Samos, and ends a few hundred yards from the old town of Samos, about 10 ft. below the surface. From the mountain slope to the city, this subterranean aqueduct is protected by a massive stone structure, ending within the walls of the present convent of St. John. The preservation of this work—which is truly wonderful, considering the imperfect mechanical resources at the disposal of the builders—for nearly three thousand years is probably due to the care taken by Eupalinos, who, in all cases where the rock did not seem of sufficient firmness, lined the tunnel with several layers of brick, running on the top into a peaked arch.—*Iron.*

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

A PORTABLE SANITARY BUNGALOW.

At the late Medical Exhibition there was exhibited an interesting and seemingly a good invention, known as the Portable Sanitary Bungalow, for which some very important advantages are claimed. In the construction, rows of dwarf pillars, standing on separate stones, support a gridiron of creosoted balk girders, sustaining a platform of slate slabs, or other material. Shallow grooves in this receive the bottoms of the walls, formed likewise of slabs placed edgewise, and strengthened by inside and outside skirting, screwed together and into the floor. Similar mouldings above receive the tops of the walls, form the cornices of the rooms, and act as horizontal tie-rods. Others placed vertically divide the walls into panels, and bind them down to the foundation; the ceilings are wooden, the supporting joists form panels; these can be adjusted to the exigencies of the climate. Iron is used wherever practicable; the joints are secured by fish-plates, and by screwing home on a stay wool-packing are made air-tight. The drainage goes into a tank on wheels. It is claimed that this building is fire-proof, as there is nothing to burn, and it is damp-proof, being off the ground. In like manner it is free from vermin, and if erected on leasehold land does not revert to the freeholder: it is also virtually everlasting. The cost is stated to be very low. By increasing the height of the supporting foundation pillars good storage room can be obtained below. Further information may be had of the inventor, Mr. W. V. Brock, 82, Warwick-gardens, Kensington, W.

VENTILATED CARRIAGES.

We need no doctors to tell us how much illness, and sometimes with fatal result, is due to carriage draughts—a sort of penalty generally exacted on those who keep their own vehicles. The fact is, close carriages have no ventilation, and when shut up with tight windows are unwholesome to a degree, especially if full. Happily, a remedy for this evil has at length been found in the shape of an invention of Messrs. Hill & Sons, the well-known carriage-makers of London, Dover, and Folkestone. The invention consists mainly of a ventilating tube or shaft of a taper form, fixed immediately under the roof, from front to back, the narrowest end being in front. Along each side are arranged, obliquely, a series of apertures or air passages, which are covered at each end with sheets of fine gauze about an inch apart, so that each sheet being separated by a vacant space, intercepts any sudden rush of air that might enter the shaft, and, if not so interrupted, cause a down-draught; at the same time they allow the vitiated air to be drawn through the openings without hindrance. A small protected opening is made in front of the body of the carriage, and a larger one at the back, protected by a specially constructed metal plate, so made as to prevent wind or rain finding its way through the opening. By this arrangement and the peculiar form of the shaft, on a forward movement of the carriage, a current of fresh air passes through the shaft from end to end, and by its velocity and action tends to form a vacuum at each side aperture, causing the impure air to be sucked or drawn through the aperture into the shaft, whence it is expelled by the current of fresh air, through the widest or hind end of the shaft. For admitting fresh air to take the place of that carried off, small openings are made under the glass frames, concealed by curved shields of ornamental design to protect the occupants from draught, as well as to direct the fresh air against the surface of the windows to prevent the vapour which generally accumulates on them when the windows of a carriage are quite closed. Another great advantage is that when closing the door with all the windows up, the air, which would otherwise be compressed, escapes through the ventilating shaft, and so diminishes the concussion hitherto resulting from the sudden shutting of the door. This applies more especially to carriages where slam locks are used. The extra cost of this admirable apparatus to a new carriage is very moderate, and it is by no means large if it be required to apply it to existing carriages. At Messrs. Hill & Sons establishment, 17, Baker-street, Portman-square, London, the system can be inspected.

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

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 TRUTH ABOUT KOCH'S CHOLERA GERM."

[1482]—The able and brilliant *exposé* of "official" science in Germany by Professor Ray Lankester in the *Pall Mall Gazette* of October 6 (*Pall Mall Budget*, October 10) is worthy of special note.

Dr. Robert Koch, as an official scientist, makes a "dogmatic" declaration to the effect that a certain micro-organism is the specific organism that is the immediate exciting cause of cholera. A "dogmatic" declaration this, because the chain of causation involved in the question has not been displayed in the only recognised efficient manner, that is by the "culture test." Professor Lankester delivers judgment thus:—"The pressure upon him [Koch] urging him to announce a definite result was irresistible. He has formulated such a result on the most flimsy grounds; his Government has rewarded him, and for some time official science in Germany will not dare to expose the worthlessness of his theory." Has ever before the "endowment" of scientific research faced such a crushing, even damning, indictment? A scientist having a grand record of able work done yields, according to Professor Lankester, to the "irresistible" pressure of the string-holders of the endowment-purse, under whose *ægis* he has elected to work, and formulates on flimsy grounds, and at a critical moment, a theory having possibly momentous social and international bearings. This is indeed serious, but worse follows. The debasing *ægis* of the endowment-purse is irresistible, according to Professor Lankester; for he himself does not believe there is a single fearlessly honest "official" biological microscopist in all Germany. He writes:—"For some time official science in Germany will not dare to expose the worthlessness of his [Koch's] theory." The implication is, indeed, damning to all endowment of research. The implication being that whenever an "official" scientist formulates a theory on flimsy grounds all other "official" scientists of the same nation will not "dare" to expose the worthlessness of such theory.

Whether Professor Lankester's case against Dr. Koch be good or (as for many good reasons may be hoped) bad does not affect this matter of the debasing tendency of endowments. For, obviously, his case depends on his knowledge of the tone and tendency of mind amongst European "official scientists," nearly as much as on facts. And few Englishmen are better positioned than he to have such knowledge.

Somewhat oddly, in the midst of this tremendous indictment of endowment of research, there are sandwiched three numbered paragraphs that read best if the whole article be viewed as an elaborately, solemn, cynical joke. In the first paragraph, State authorities are actually advised to undertake the study of the relations of bacteria to disease! The second paragraph contains a congratulation (that reads beautifully from the cynical joke point of view) that the Indian Government is actually "officially" investigating the cholera germ matter. And the third paragraph, a (comically cynical) warning to all on the "flimsy" "official" theory of Dr. Koch. But, read seriously, these three paragraphs have no logical connection with the rest of the article, so they may be taken for what they are worth.

FRED. W. FOSTER.

MIND AND BRAIN.

[1483]—Mr. Peppin is not satisfied with my answer, which, in fact, had reference only to Mr. Peppin's assertion that Büchner mistook cause for effect. But clearly, Mr. Peppin's letter (1467) shows his own uncertainty whether the thought produces the vibrations, or the vibrations thought; in fact, he puts to myself the question he had previously decided. The simile I adduced cannot, and was not meant to be, "absolutely" true. But it appears to me that in the case of transmission of light to the prism and sound to the ear, the process in both cases is purely mechanical. Further the effect of the transmission of these vibrations is in both case intangible; or does Mr. Peppin consider colour something material, that can be weighed or measured?

Whence comes the power of the brain to transform sound into thought—exactly whence the power of a prism to transform light into colours comes from; it is their innate property—in fact, it is their nature to.

In the case of the lecture, I should say that its influence, *i.e.*, the thoughts produced in our brain through the vibrations caused by the sound of speech from the will, which is certainly not independent of it. F. W. H.

THE LUNAR ECLIPSE.

[1484]—Allow me to corroborate the testimony of M. de Boë, given in Captain Noble's letter (1451). While watching the eclipse through an $8\frac{1}{2}$ in. Calver's reflector, I observed a peaked appearance exactly at the spot and the stage marked in his diagram. In my case also there was surely no illusion, since four of us all saw it distinctly, and it was noticeable with a smaller hand-telescope as well as with the larger. *Was* the moon on the horizon of the Cordilleras at that moment? A rough calculation which I made at the time seemed to show that the shadow of part of the ocean was then being cast upon her, but I suppose I was wrong. Can the appearance have been due to any peculiarity in the *atmosphere* on the horizon?

I should have described the colour during totality as dusky ashen-grey, rather than phosphorescent green.

Liphook, Hants, Oct. 21. C. W. LEADBEATER.

The calculation of the position of the Cordilleras was seemingly made by M. de Boë himself, whose mathematical attainments are quite equal to his observational powers. I have no time to recompute it.—ED.]

[1485]—After reading what you say in a recent number, it occurs to me to say that in the "dirty white" of the moon's disc during totality, there was, as seen here, I think, a faint taint of green, but I know nothing to compare it to, except a sodden poultice of flour!

I asked Dr. Copeland, of Dunecht, what he saw, and he replies that he and his assistant were too busy watching "occultations during the total phase to permit of studying the colour of the moon. I only recollect that about the end of totality the moon's limb was of a lovely primrose colour, and that many of the markings were visible." I did not see this. WM. MILLAR.

THE RECENT ECLIPSE—γ AQUILÆ—THE AFTERGLOW.

[1486]—Premising that I and two friends here—we all three obtain our own copy of KNOWLEDGE, and are therefore entitled to three votes—shall be very glad to read an account in your columns of a graphic method of predicting eclipses, I would say that we in Tonbridge saw the last eclipse splendidly. The points we noticed were:—

1. The dark aspect of the moon during totality.
2. The sharp termination of the umbra of the earth's shadow.

The constellation Aquila is very full of interest to the amateur observer, but what is the colour of γ Aquilæ? We consider it to be a dark red, but it is not marked as such in your new "Star Atlas." Our telescope was a very good achromatic, but, after neglect for some time, it is anything but a good achromatic now. Would such a defect in the telescope be sufficient to account for the red colour? We anxiously await the new maps announced in the last edition of KNOWLEDGE.

As I write, the brilliant colours of the sunset attract my attention. They have changed from pink to red; thence to a brighter golden colour, and then pink again. E. A. TINDALL.

[γ Aquilæ is yellow.—ED.]

MAY-FLIES.

[1487]—With great interest I read Mr. Butler's paper on the above. In spite of their short period of existence, I have, when fishing, observed these flies settle upon my coat and there shed their skins completely, *i.e.*, covering of wings included. At the close of the day I have been plentifully sprinkled with these whitish cast-off coverings. Is not this an exceptional peculiarity with respect to these flies? F. W. HALFPENNY.

SCIENCE AND THEOLOGY.

[1488]—You mistake entirely what I mean by anti-theological. It is somewhat ungracious of me to be fault-finding, seeing that your pages have given me, in common with your many readers, so much pleasure, and that there is after all so little room for finding fault. But perhaps you will allow me to point out what I mean. It is of more importance than a mere personal explanation—it is the statement of a misunderstanding which has long existed between scientific men and theologians—a misunderstanding that in the interest of both parties ought to be cleared up. Let us take up the current number of Knowledge. I object to (as anti-theological) the assumption (p. 345) that Moses was not the author of Genesis. The question is open to debate, but we may fairly object to anyone who has not made a special study of the subject settling it for us in this off-hand style. Again, I consider it anti-theological to have so many views of works like that of Mr. Smith's (referred to in letter 1474), as if these were representative of theological literature. A religious journal might as well take the theories about the Great Pyramid and the Scientific Societies for the investigation of ghost stories as representative of the minds of the great scientists. And, again, let us take the note which you append to my letter in your last issue. Because I am a clergyman you assume that I must reject scientific doctrines which have facts and not merely testimony to appeal to. Now, as a matter of fact, I do not reject these doctrines. I can scarcely say I believe in them, for I have not given these subjects sufficient study; but, for the present, I am quite content to bow to authority and accept these conclusions if they are accepted by the majority of "scientific men who are entitled to be listened to." But when the scientific men tell me further that I am on their authority (since I have not the leisure nor the ability to make the investigation for myself) to give up all my old beliefs and hopes, then I say that they are asking too much. They are seeking to become my religious teachers as well as my scientific directors; and I most strongly object to them as the former, though I am quite ready to admit them as the latter.

I once wrote a paper on the theological aspect of Darwinism, and read it at an assembly of clergymen. It was an appeal to theologians for the independence of science. I wish I could induce you to relax your rule sufficiently to insert it in Knowledge, for it also advocates the independence of theology. Nothing can possibly be gained by a theologian telling a scientific man that he is an atheist; nor, on the other hand, should a scientist say to a theologian that he objects to scientific conclusions (particularly when he does not object) simply because they are opposed to his own views. John Healy, Clk. LL.D.

Ballyboy Rectory, King's Co.

[Would that all theologians exhibited the impartial and judicial spirit of Dr. Healy. I venture to think, however, that he is mistaken in his view that scientific men (legitimately so-called) ask him to give up all his "old beliefs and hopes." All that men of science claim is the right to pursue their investigations untrammeled by any consideration of whither the results may conduct them; and that no thought of such results being—in theological language—"opposed to revealed religion" should be suffered for a single instant to operate in influencing decisions to be arrived at strictly by the study of evidence. That, however, which they demand for themselves, they must in common justice grant to the theologian. I am only prevented from inserting Dr. Healy's proffered essay by the certainty that it would call forth a flood of correspondence of a very pronounced anti-theological character, which I could hardly, in fairness, refuse to insert.—Ed.]

VACCINATION.

[1489]—In your impression of October 10 appears a letter by "F. S." under the head of "Vaccination."

I have read it several times with the object of discovering why it was written, and have only so far been able to guess.

I can see nothing wonderful nor useful in the information that out of a family of twelve, eleven were inoculated with small-pox and only one was vaccinated. Nor do I see anything extraordinary in the fact that this one, along with two or three unfortunate clergymen, subsequently took the disease.

Although it tends to do so, vaccination does not prevent small-pox—not even in clergymen—but it does form an almost perfect safeguard against death from that disease.

In the old days inoculation produced the disease in a more or less mild form, and the subject was, of course, not liable to any recurrence; but the *deaths* from small-pox, when this was practised, increased to an alarming extent, as the *practice itself* spread the disease, everywhere creating new centres of infection.

During the months of last December to April a village of more than a thousand inhabitants was attacked by small-pox, and came prominently under my notice.

Thirty-six persons were taken ill. Of these three were unvaccinated, and died. The remainder, who were vaccinated, all recovered. (Think of that, "F. S." !)

It is interesting to notice in villages and towns attacked how sluggish is the spread of the disease, how few it attacks, and how very few of that number are young children.

Thanks to vaccination, and the fact that young children are more immediately under its influence. W. Seebee.

ANOTHER FIGURE PUZZLE.

[1490]—Can you explain the enclosed problem? I cannot make it out at all. You will see there is a curious superstition connected with it, and I should be extremely obliged if you can elucidate the mystery for Lover of Things Occult.

8	1490	1493	1
1492	2	7	1491
3	1495	1488	6
1489	5	4	1494

The Asiatics regard the above arithmetical problem as the most potent talisman in existence, those who wear it being supposed to have full command over demons, fairies, and enchanters.

[No, I cannot explain the "arithmetical problem," for the simple reason that I do not see the connection between the figures Perhaps some of our readers may be more perspicacious.—Ed.]

TRICYCLE TRACKS.

[1491]—In connection with this subject (the ridge left in the centre of the track when passing over a dusty road), perhaps you will kindly give me room to state a fact, not previously mentioned in your columns, as far as I have observed. The wheels of ordinary carriages leave very distinct ridges in the centre of the tracks. Of course, they have iron tires. I also found that the wheels of a perambulator, having convex iron tires, leave tolerably distinct ridges, even when driven at an ordinary walking pace. The properties of indiarubber have nothing to do with the formation of the ridges in these cases, and they can only be caused by suction, as previously pointed out by some of your correspondents.

Oct. 18, 1884. Starch.

THE FLIGHT, SOARING, AND POISING OF BIRDS.

[1492]—A great deal has been written on the flight of birds generally, and much labour has been expended in attempting to explain the mechanism by which such wondrous results are produced; but, as far as my reading goes, no writers have demonstrated that the great class, *Aves*, may be divided into distinct groups characterised by their *modes* of flight. Thus, I might say, we have the flappers, cleavers, flutterers, soarers, and poisers; and flapping and cleaving may be combined in the same bird, as may also cleaving and poising, and flapping and poising. By flapping, I mean the steady up and down movement of the wing in an arc, say of 45°; cleaving is the rapid movement of the pinions, as if in swimming; fluttering is a very rapid, almost invisible, flapping, and is accompanied by flight in undulations or bounds. Soaring is practised by birds with great expanse of wing, and is virtually the momentum acquired by flapping; poising is a species of flutter in which the wings vibrate rapidly, with their apices upwards.

Let us now watch a *Raptor*, say the common kite of this country, and we observe that as it sails overhead, its large spread of wings, terminating in segregate feathers, like fingers, flap leisurely up and down between the soars, and you fancy the movement ought to *raise* instead of propel the bird. Throw up a bone, and you will at once see it cleave the air with its wings, as if swimming, moving exactly as the gentle *Columbidæ* always do.

The cranes, herons, and storks all move leisurely with flapping wings, and the exertion must be fatiguing, for all rest themselves by soaring. If we turn to the flying mammals, we find propulsion effected by up and down flaps of the webbed arms, without an attempt at air-cleaving or soaring. The flying fox (*Pteropus rubricollis*) affords a familiar illustration of this leisurely mode of flight;

mynas, parrots, and starlings, which are social birds, all fly fast, and by cleaving—they never soar.

The wagtails have a jerky, cleaving flight, as if they were always winding up for a fresh exertion; it consists of dips and rises.

That singular bird the Darter or Snake bird (*Plotus anhinga*(?)), quite at home in the water, is equally at sea on the wing, flying clumsily and laboriously, and resting repeatedly in soars. Our egrets, as a rule, fly leisurely, with steady flap, but I have seen flights of them adopting the soar as well, as if the exception ran in families.

Dragon-flies flap and soar, the former when on the feed, and the latter when sunning themselves. Flying-fish both soar and flap; pea and guinea fowl flap awkwardly in rising, and soar on alighting; white ants flap in swarming. But some birds, strange to say, seem to progress by soaring, *i.e.*, apparently irrespective of momentum, and this power is exhibited in these in an astonishing manner. Take any one of the many instances I can adduce, and the phenomenon is equally marvellous.

A bright, cold-weather day, and a cobalt sky above you, and perhaps half a mile up in the cærulean, you see a couple of adjutants and half a dozen condors and vultures soaring, their keen eyes the while watching the earth. Watch the adjutant. Having lost his momentum he flaps his enormous wings once or twice and then treats you to circles and circles of soar, apparently endless, until you marvel whence his power comes. And so with his companion condors and vultures.

On one occasion I was travelling eastward by rail, and noticed an adjutant soaring towards the line, and half a mile off on my left, when he had crossed above, and I again looked out on my right, he was still soaring, and certainly had not flapped in the interval. What is this wonderful power? It is difficult to believe that a mile soar is the momentum of one or two flaps of powerful wings. It may be so, for on *good* ice you may *momentumise* a mile with a few good flaps, so to speak, of your skate-clad feet, and that, too, in the face of friction.

Then, too, these soarers have a less dense resisting medium at their favourite heights, and so a powerful flap gives a prolonged momentum. The poisers are very wonderful in their action, and are best illustrated by the kingfishers; the adjutants overcome gravity by soaring; another vastly smaller and weaker bird do so by poising, which consists of a stationary position, secured by rapid and invisible flutter-flapping, the points of the wings being directed upwards. The extraordinary thing is that, with this immense display of muscular power, they should remain absolutely stationary until the plunge; so stationary that you can cover the kingfisher with your gun for a minute or more. Another wonderful thing is its power of instantly overcoming momentum; thus, baffled in the plunge, the kingfisher will take two or three bounds in flight, *and then instantly poise exactly at the right elevation.* Terns poise, but not so steadily and persistently as the kingfishers, nor with the same muscular action.

Other poisers are the sun-birds and moths, while probing flowers for honey, but their movements are not so striking as those of the kingfishers. R. F. H.

LETTERS RECEIVED AND SHORT ANSWERS.

Ghost of a Little Boy. Such a slip as that of − 5 hours for + 5 hours in no sense invalidates the argument of "C. R.," that for a ghost to appear at the instant of the death of its owner it must do so at a different hour in America to that at which such owner gave it up in England.—A. R. Pannett. The British Association Catalogue has been for years out of print, and is only procurable at a very high price indeed. Mr. Wesley, of Essex-street, Strand, London, would be the likeliest man to procure you a copy. I do not know where "Mädler's Comet Catalogue" is to be had, but there is a very good one in Chambers's "Descriptive Astronomy."—G. Pinnington (23, Chichester-street, Chester) should forthwith make the acquaintance of J. Murray (of Newcastle), and exchange views with him. "Pompey and Cæsar am berry much alike, 'specially Pompey."—Miss de Jersey Moore. The conductor of this journal is so dunned for his autograph that he has been reluctantly compelled to make a rule to refuse it; and regrets, extremely, that he can make no exception in your particular case.—J. B. Do you seriously suppose that the conductor of Knowledge would suffer his name to appear continually were it not true?—J. McLagan. "Physical science" is such an extremely comprehensive term that the only reply I can give to your query is the form in which it appears is: All. Lyell's "Students Elements of Geology" ought to suit you for the purely geological part of your subject, which, though, is now made a very heterogeneous one.—H. C. Halle. *Vide* letter by B.M., F.R.C.S.—William Runtz. I am wholly unable to help you. I have never heard of the person you name publishing anything but the grossest and most scurrilous abuse. See concluding paragraph (in capital letters) at the head of the correspondence columns.—F. H. "Better late than never" sends the seventieth or eightieth answer received to Mr. Sidder's Figure Puzzle.—S. E. Thornton. The best college in which you can study to become an Electrical Engineer is the School of Submarine Telegraphy and Electrical Engineering, 12, Prince's-street, Hanover-square, W.—William Millar. We need not trouble Mr. Mattieu Williams. It is merely a form of puffing advertisement. The moon was in her descending node at the time of the recent eclipse.—Veritas. I cannot undertake to answer questions which should be submitted to a solicitor. Law can only find a place in these columns in its aspect of a branch of sociology.—Fleming, Wilson, & Co. Mr. Ganga Ram's pamphlet was reviewed on p. 75 of the current volume of Knowledge.—Some Anonymous Correspondent sends me two religious rhymes utterly inappropriate to these columns, either for insertion or review.—J. Lury asks Mr. Browning to describe the various two-speed tricycle gears now in use, with their weight, mode of fixing, &c. He also seeks a definition of "a steep hill," as understood in the Eastern Counties.—J. O'Neill. Thanks. It will be utilised.—J. P. B. I know of no single cheap Encyclopædia of the comprehensive character you require. Nichols' "Cyclopædia of the Physical Sciences" is an excellent book of reference in a small compass, and I have some idea that its publishers also issued a corresponding one of the Natural Sciences. Maunder's "Treasury of Knowledge" contains a Gazetteer, a précis of history, and a mass of other information. Perhaps, though, your best plan would be to try and get a second-hand copy of the old "Penny Cyclopædia." It is a perfect repertory of information, although the Physics are not quite up to date.—Maximilian Strong. Our Lord was undoubtedly born four years before the "Anno Domini" of the calendar. Suetonius says that Tiberius was born 42 B.C.; and, as he was 54 when he became emperor, his reign must have commenced A.D. 12.—Ferrarius. Your quotation is from Pope's "Essay on Criticism." "Pierian" was an expression applied to the Muses, &c., from Pieria, a tract of country in Thessaly.—W. Stringfield. Dr. Gerber's book was sent to us for notice by the Messrs. Trübner, whose name was printed on the title-page, whence the Reviewer copied it.—L. P. asks if any of our readers have tried the Hamiltonian method, and, if so, with what results?—Henry Morley. You can no more multiply a sum of money into itself than you can trees by trees, or paragraphs by chimney-pots.—W. H. K. S. You are confusing in a very odd way "a refusal to consider evidence" with wilful unbelief. A man ignorant of evidence cannot be said, in any legitimate sense, to have any belief at all. What is meant is this. The object before me possesses the attributes of whiteness, flexibility, semi-transparency, and so on, and the sum of these I call a sheet of paper. Suppose now that you were to tell me that my salvation depended on my belief that it was really (say) a roast goose. If this were so, my damnation must be inevitable; and yet this is scarcely an exaggeration of what is often described from the pulpit as "wilful imbecility."—W. Received.—C. Carus-Wilson. I regret the blunder, for the rectification of which steps have been taken.—E. W. Young protests against the vulgarism of "don't" being used for "doesn't," in connection with a singular nominative.—T. Harrison. "Fontenelle" will be continued. I condole with you sincerely on having to listen to such stuff as that of which you send the report. The person you refer to will get no more unpaid advertisements in these columns.—C. Hunter. I regret my inability to supply Knowledge to your League gratis. If I began by doing so there are numerous associations throughout the kingdom who might equally claim to receive it for nothing.—J. M. Coates. As yours is one of several requests for a description of a graphical method of predicting a Lunar Eclipse, one shall appear in due course.—Dr. Davey. Your book shall receive attention.—Thos. Radmore. Thanks for your friendly letter. I shall always be glad of any original observations of interest.—Thos. Baugh. Certainly not. How could the subject himself, or any spectator (real or imaginary) be examined or cross-examined? Science cannot possibly deal with such a case.—W. S. C. I should scarcely think that a patent is now in existence for the mere use of asbestos in a gas fire. Gas fires are *not* "all unhealthy."—C. H. Kesteven. Doubtless the fish decomposed from radiation and moisture.—A. M. D. I have never in my life heard either of the man or of his "philosophy."—Nemesis. Shall receive immediate attention.

WHIST.—J. E. Buckbarrow. You appear to refer to (what I imagined was as dead as Queen Anne) Long Whist. With regard to the question you raise, the law was explicit: "Honours can only be called at eight points, and then *only by the player whose turn it is to play.*" The fact of his adversaries standing at nine points does not affect this rule, one way or the other.

Our Chess Column.

By Mephisto.

THE CHESS SEASON.

After a period of natural reaction following upon the excitement f the London Tournament, Chess seems to be gaining an increased hold upon the popular fancy. This conclusion is based on the all-round activity and enterprise manifest in Chess circles at the present time.

The Chess season of 1884 85 has set in. From all sides notes of martial ardour are sounded. Challenges have been issued and accepted, and the first matches have been contested. In London there are two trophies to be played for by the various local clubs, viz., the Staunton Medal, offered by Mr. Edw. Marks, and the Baldwin Hoffer Challenge Cup.

The City of London Chess Club has taken possession of new rooms at the Salutation, Newgate-street, and has arranged its annual handicap of 100 players. The Club has also challenged the St. George's Chess Club to a match of twenty players aside. This challenge has been accepted, and the interesting contest will take place on January 19, 1885. M. Rosenthal, of Paris, having paid a visit to this country, has played 24 members of the Norwood Chess Club simultaneously, and has also given similar performances at Manchester. Zukertort has made his first public appearance in this country after his return from America by playing 24 members of the City Club. We believe the Club has made arrangements for similar exhibitions by other players.

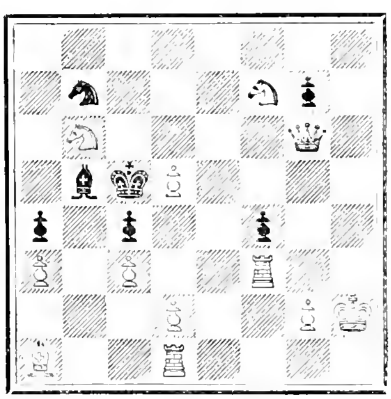
Reports from the provinces announce the meeting of the Surrey, Sussex, Sheffield, Yorkshire, and Scottish Chess Associations, also of various other Chess clubs, all reports show signs of increased vitality and vigour. The great event up North will be the match between Yorkshire and Lancashire, which will be played at Manchester on Nov. 8. The competing teams will be composed of 160 players. Finally we hope to see the newly-formed British Chess Association show signs of life this season, and thus contribute its share to rendering the next few months—what to all appearances they will be—productive of enjoyment and recreation to Chessists.

PROBLEM No. 134.

By F. Healey.

(A problem that will never lose its charm nor fade from our memory.)

Black.



White.

White to play and mate in three moves.

SOLUTION.

Problem 132, by W. Furnival, p. 330.

1. R to KR sq.!	P × P, or	1.	P to R4
2. B × P	K × B (*a*)	2. B to B sq.	P moves
3. R to R5 mate		3. B to B4 mate	

(*a*) if K to B3

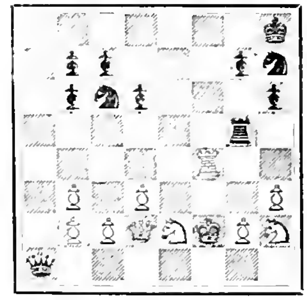
3. Kt to B5 mate

The following interesting termination occurred in a game recently played at Gatti's between two strong players.

Position after Black's 19th move.

Mr. Weightman.

Black.



White.

Mr. Laws.

The game proceeded as follows:

White.	Black.
20. Q to K3	R to K4
21. Q to B3	Q × P

(It will be well to remember that taking the opponent's QKtP in the middle of the game, mostly puts the Queen out of play—as in this case, a frequent source of danger.)

22. Kt to Kt4	R to K sq.
23. R to K1	R to KB sq.
24. Kt to B4	Q × P (ch)
25. K to Kt3	

(White is playing a bold but deep game; he has some sinister designs on the Black R by Kt to Kt6 (ch), or maybe he is trying to compose a problem.)

	K to Kt sq.
26. R to QB4	

(With the object of gaining Q5)

	Q × KtP
27. Q to Q5 (ch)	R to B2
28. Q to K6	P to QKt4
29. Q to Kt6	

(A powerful stroke, threatening destruction by Kt × P (ch), K to R sq., Kt × R (ch), &c.)

	Kt to K4

(This looks very good; it is, however, of little use. If 29. K to B sq. 30. Q × Kt, P × R. 31. Kt to Kt6 (ch), K to K sq. 32. Q to Kt8 (ch), K to Q2. 32. Q × R (ch), &c., would be equally bad. Now White forces the game in an ingenious and vigorous manner.)

30. Kt × P (ch)	K to B sq.
31. Kt to K6 (ch)	K to K sq.
32. Kt × KtP (ch)	K to Q sq.

(K to B sq. would only have delayed the issue for a few moves.)

33. Kt × R (ch)	Kt × Kt
34. Kt to K6 (ch)	K to K sq.
35. Q to Kt8 (ch)	K to Q2
36. Q × Kt (ch)	K to B sq.
37. Q mates.	

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions received:—M. T. Hooton, A. E. R., W. Parker Geo. W. Thompson, John Watson, S. B. B., A. W. Cunard, W.

H. W. Sherrard.—Thanks.

W. Parker.—*The Chess Players' Chronicle.*

Problem, No. 133, by B. G. Laws, p. 352.—This problem admits of several solutions, and is therefore incorrect.

Contents of No. 156.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, NOV. 7, 1884.

CONTENTS OF No. 158.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XLVI.—THE COOKERY OF WINE-DRYING.

THE reader will understand, from what has already been stated concerning the origin of the difference between natural sweet wines and natural dry wines, that the conversion of either one into the other is not a difficult problem. Wine is a fashionable beverage in this country, and fashions fluctuate. These fluctuations are not accompanied with a corresponding variation in the chemical composition of any particular class of grapes, but somehow the wine produced therefrom obeys the laws of supply and demand. For some years past the demand for dry sherry has dominated in this country, though, as I am informed, the weathercock of fashion is now on the turn.

One mode of satisfying this demand for dry wine is, of course, to select a grape which has less sugar and more albuminous matter, but in a given district this is not always possible. Another is to gather the grapes before they are fully ripened, but this involves a sacrifice in the yield of alcohol, and probably of flavour. Another method, obvious enough to the chemist, is to add as much albuminous or nitrogenous material as shall continue to feed the yeast fungus until all, or nearly all, the sugar in the grape shall be converted into alcohol, thus supplying strength and dryness (or salinity) simultaneously. Should these be excessive, the remedy is simple and cheap wherever water abounds. It should be noted that the quantity of sugar naturally contained in the ripe grape varies from 10 to 30 per cent.—a very large range. The quantity of alcohol varies proportionally when the must is fermented to dryness. According to Pavy, "there are dry sherries to be met with that are free from sugar," while in other wines the quantity of remaining sugar amounts to as much as 20 per cent.

White of egg and gelatine are the most easily available and innocent forms of nitrogenous material that may be used for sustaining or renewing the fermentation of wines that are to be artificially dried. My inquiries in the trade lead me to conclude that this is not understood as well as it should be. Both white of egg and gelatine (in the form of isinglass or otherwise) are freely used for fining, and it is well enough known that wines that have been freely subjected to such fining keep better and become drier with age, but I have never yet met a wine-merchant who understood why, nor any sound explanation of the fact in the trade literature.* When thus added to the wine already fermented, the effect is doubtless due to the promotion of a slow, secondary fermentation. The bulk of the gelatine or albumen is carried down with the sediment, but some remains in solution. There may be some doubt as to the albumen thus remaining, but none concerning the gelatine, which is freely soluble both in water and alcohol. The truly scientific mode of applying this principle would be to add the nitrogenous material to the must.

I dwell thus upon this because, if fashion insists so imperatively upon dryness as to compel artificial drying, this method is the least objectionable, being a close imitation of natural drying, almost identical; while there are other methods of inducing fictitious dryness that are mischievous adulterations.

Generally described, these consist in producing an imitation of the natural salinity of the dry wine by the addition of factitious salts and fortifying with alcohol. The sugar remains, but is disguised thereby. It was a wine thus treated that first brought the subject of the sulphates, already referred to, under my notice. This, although sold to my friend at a good price, was a concoction of the character known in the trade as Hambro' sherry. It contained a considerable quantity of sugar, but was not perceptibly sweet. It was very strong and decidedly acid; contained free sulphuric acid and alum, which, as all who have tasted it know, gives a peculiar sense of dryness to the palate.

The sulphuring, plastering, and use of Spanish earth, described in my last, increase the dryness of a given wine by adding mineral acid and mineral salts. In a paper recently read before the French Academy by L. Magnier de la Source ("Comptes-Rendus," vol. 98, page 110), the author states that "plastering modifies the chemical characters of the colouring matter of the wine, and not only does the calcium sulphate decompose the potassium hydrogen tartrate, with formation of calcium tartrate, potassium sulphate, and free tartaric acid, but it also decomposes the neutral organic compounds of potassium which exist in the juice of the grape." I quote from abstract in *Journal of the Chemical Society* of May, 1884.

In the French *Journal of Pharmaceutical Chemistry*, vol. 6, pp. 118-123 (1882), is another paper, by P. Carles, in which the chemical and hygienic results of plastering are discussed. His general conclusion is that the use of gypsum in clearing wines "renders them hurtful as beverages:" that the gypsum acts "on the potassium bitartrate in the juice of the grape, forming calcium tartrate, tartaric acid, and potassium sulphate, a large proportion of the last two bodies remaining in the wine." Unplastered wines contain about two grammes of free acid per litre; after plastering, they contain "double or treble that amount, and even more."

A German chemist, Griessmayer, and, more recently, another, Kaiser, have also studied this subject, and arrive at similar conclusions. Kaiser analysed wines which were plastered by adding gypsum to the must, that is to the juice before fermentation, and also samples in which the gypsum was added to the "finished wine," *i.e.*, for fining, so called. He found that "in the finished wine, by the

* The wine trade has two rival magazines, both very high priced, exclusively devoted to its interests, besides others that are partially so.

addition of gypsum, the tartaric acid is replaced by sulphuric acid, and there is a perceptible increase in the calcium; the other constituents remain unaltered." His conclusion is that the plastering of wine should be called adulteration, and treated accordingly, on the ground that the article in question is thereby deprived of its characteristic constituents, and others, not normally present, are introduced. This refers more especially to the plastering or gypsum fining of finished wines (Biedermann's *Centralblatt*, 1881, pp. 632 and 633.)

In the paper above named, by P. Carles, we are told that "Owing to the injurious nature of the impurities of plastered wines, endeavours have been made to free them from these by a method called 'deplastering,' but the remedy proves worse than the defect." The samples analysed by Carles contained barium salts, barium chloride having been used to remove the sulphuric acid. In some cases excess of the barium salt was found in the wine, and in others barium sulphate was held in suspension.

Closely following the abstract of this paper, in the *Journal of the Chemical Society*, is another from the French *Journal of Pharmaceutical Chemistry*, vol. 5, p. 581-3, to which I now refer, by the way, for the instruction of claret-drinkers, who may not be aware of the fact that the phylloxera destroyed all the claret grapes in certain districts of France, without stopping the manufacture or diminishing the export of claret itself. In this paper, by J. Lefort, we are told, as a matter of course, that "Owing to the ravages of the phylloxera among the vines, substitutes for grape-juice are being introduced for the manufacture of wines; of these, the author specially condemns the use of beet-root sugar, since, during its fermentation, besides ethyl, alcohol, and aldehyde, it yields propyl, butyl, and amyl alcohols, which have been shown by Dujardin and Audigé to act as poisons in very small quantities." In connection with this subject I may add that the French Government carefully protects its own citizens by rigid inspection and analysis of the wines offered for sale to French wine-drinkers; but does not feel bound to expend its funds and energies in hampering commerce by severe examination of the wines that are exported to "John Bull et son Île," especially as John Bull is known to have a robust constitution. Thus, vast quantities of brilliantly-coloured liquid, flavoured with orris-root, which would not be allowed to pass the barriers of Paris, but must go somewhere, is drunk in England at a cost of four times as much as the Frenchman pays for genuine grape-wine. The coloured concoction being brighter, and skilfully cooked, and duly labelled to imitate the products of real or imaginary celebrated vineyards, is preferred by the English *gourmet* to anything that can be made from simple grape-juice.

I should add that a character somewhat similar to that of natural dryness is obtained by mixing with the grape-juice wine a secondary product, obtained by adding water to the *marc*—*i.e.*, the residue of skins, &c., that remains after pressing out the must or juice: a minimum of sugar is dissolved in the water, and this liquor is fermented. The skins and seeds contain much tannic acid or astringent matter, and this roughness imposes upon many wine-drinkers, provided the price charged for the wine thus cheapened be sufficiently high. After this, according to Gardner (Churchill's Technological Handbook, "The Brewer, Distiller, and Wine Manufacturer"), "the same marc is treated in a similar manner with a fresh quantity of sugar solution, and sometimes undergoes as many as three or four separate macerations, each successive infusion occupying a rather longer time. It will be easily understood that wine thus prepared costs less than very small beer, though its retail selling price may be regulated by the "*étiquette*" or label (from which I suppose our word ticket is derived) that is finally pasted on the bottles.

The special bouquets and curious flavours demanded by connoisseurs can be more easily added to mixtures largely composed of these second and third runnings than to simple grape-juice having its own grape flavour, just as the juniper flavour is more easily added to "silent spirit" than to whisky or cognac. We may thus obtain a clue to the mysterious fact that the market is well supplied with wines bearing the names of celebrated vineyards, of which the whole produce is bought by special contract by certain continental potentates. Many of these château vineyards are so small that they cannot actually produce one-tenth of the wine that is *commercially* derived from them.

FERTILISATION OF BROAD-BEANS.

By Grant Allen.

The bean inquired about by "E. W. P.," he now writes, is the ordinary garden broad-bean, *Vicia faba*. He is sure that whatever insect pierces the corolla, bees do not. But *bees* is almost as indefinite an expression as *beans*. There are many beans and many bees, belonging to many genera and species. The common garden bumble-bee (*Bombus hortorum*) is the most frequent visitor of the broad-bean in England; though several other Bombi also enter it in the proper manner, and suck the honey which is secreted at the base of the tube formed by the petal-claws. These are the legitimate callers, and they fertilise the flower in the ordinary fashion, by rubbing off pollen from one blossom, and depositing it on the stigma of the next one visited. The great hairy bumble-bee, however (*Bombus terrestris*), not taking the trouble to enter the flower by the front door, as he ought to do, bites a hole through the tube formed by the calyx and corolla, and extracts the honey through it—of course, without correspondingly benefiting the flower. Müller has caught him positively in the act, both in the case of *Vicia faba* and of *Vicia sepium*: and I have personally verified either observation. *Bombus terrestris*, indeed, is a very powerful and lazy bee, much given to thus cutting the Gordian knot by biting holes and stealing honey, instead of getting at it by the mouth of the corolla, in the regular fashion. Müller records a case in which he watched "a female bumble-bee (*B. terrestris*) examining a columbine; she made several vain attempts to suck the honey, but after awhile, having apparently satisfied herself that she was unable to do so, bit a hole through the corolla. Having thus secured the honey, she visited several other flowers, biting holes through them, without making any attempt to suck them first; conscious apparently that she was unable to do so. He also observed a similar instance in relation to *Primula elatior*" (Lubbock). In my own garden, this same *Bombus* frequently bites holes through the long spurs of the common "nasturtium," or Indian cress (*Tropæolum majus*), and less often through the analogous curved organ in the Canary creeper (*T. Canariense*). As to the true hive-bees (*Apis mellifica*), they are comparatively rare visitors of the broad-bean, and they almost always effect their entrance through the holes previously bitten by the hairy bumble-bee. If "E. W. P." will get any local entomologist to point him out *Bombus terrestris* (one of the most marked and most easily recognised of our wild bees), and will then watch carefully whenever he sees one hovering about his broad-beans, he will probably succeed in tracing to their real source the bitten holes which he notices in the blossoms.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

I.—INTRODUCTION.

IN the vicinity of the delightful gardens at Kew, as doubtless elsewhere in suburban London, many beautiful villas of moderate proportions are now being erected. We were attracted to one of these tenements by a board, set forth in prominence at its outer gate, upon which, in black and white, the architect announced his commercial shrewdness by stating that the house in question was constructed upon the principle of the "Sanitary House" at the late Health Exhibition.

The placard invited inspection, and, impelled by a curiosity adequate to the boldness of the enterprising builder, we entered. Our surmise was that the vaunted building was extremely similar in outward appearance to its neighbours, which were flourishing long before the Health Exhibition sanitary abode was even in embryo. We confess that we were delighted to find the essential sanitary details, such as the drainage from the roof, the position of the soil, pipes, cisterns, &c., exactly what they "ought to was," as little Bouncer would have had it (Cuthbert Bede); but we were somewhat disappointed with those minor, yet nevertheless, essential things, which in their totality go to make up a comfortable, and, *ergo*, a healthy home. Freedom from draughts, one of the necessities of a modern dwelling, is to a very large extent dependent upon the suitable construction of the windows, doors, and fireplaces. As a solitary example, let us draw attention to those brethren of costermongers who vend sausage-shaped "ropes of sand," enveloped in crimson cloth by way of heralding "Father Christmas," to keep out the cold. They at once point to the inefficient structure of the accepted and prevalent type of window-frame; and, again, when the lower sash of the window is raised, the inevitable consequence is a violent gust of wind, caused through the narrow instead of a deep bead on the window-cill. Door draught-preventers, suitably devised hearth-stones and fireplaces, and adequate ventilating apparatus, are other items which call most urgently for attention, and here we invariably find one and all are almost shamefully neglected.

It shall be our duty, in our observations upon the framework of the modern dwelling to lay great stress upon all those measures, the greater number of which are the outcome of recent inquiries, and which tend alike to economy, cleanliness, and health. In doing so we shall have occasion to notice all the most valuable inventions, whether new or old, that are considered to be of importance from a sanitary point of view, and we invite the suggestions and co-operation of our friends to enable us, through their remarks, to make these articles of the highest possible practical value to our subscribers.

It is an incontrovertible fact that, next to a thoroughly sound and healthy abode, the questions of dress and foods affect the well-being of civilised communities most profoundly. Of the first of these, there is scope for almost illimitable research. We are at the outset made aware of the fact that our bodies, or rather the average human frame of modern Europeans, has through many generations been contorted to adapt itself, from time to time, to the extravagances of what is popularly called the "fashion of the times." The remarks of the talented director of the British Museum in *Nature* and elsewhere, under the heading of "Fashion in Deformity" (we here quote from memory), are familiar to all students of biology. That a tendency towards rational reform is not far distant may be gathered from the numerous dress associations that have lately come into existence. Not only should the form of the habiliment be considered, but the texture of the material employed to meet the requirements of each special case is almost as deserving of inquiry. And here we have ample scope for noticing some truly valuable innovations.

Foods act more directly upon the health of our bodily economy than either houses or dress. Without encroaching upon the ground of our valued contributor, Mr. Mattieu Williams, we hope to be able to adduce evidence as to how the various organs of the body are affected by diets in those minute interchanges which constitute the histological physiology of life; to give an outline of the morphology and physiology, or the correlated structure and functions of the substances which are commonly used as foods and stimulants upon the organs and tissues of the human frame, and to criticise the most deserving of those preparations which have recently been brought forward for the benefit of the public.

"On earth there is nothing great but man. In man there is nothing great but mind,"* such was the motto of the distinguished metaphysician of the school of Edinburgh, the late Sir Wm. Hamilton, Bart. The culture of the mind depends to a very considerable extent upon the manner of inculcation, especially with regard to the young. In household economics, therefore, it is imperative that parents and guardians ought to be cognisant of the many advances that have recently been made in this department, so that they may be enabled to extend to their children the most approved and tested methods for their highest benefit. The very furniture—the desks, seats, tables, and books; their shapes and sizes, are all matters of no inconsiderable importance; and we shall have a good opportunity of placing before the public some of the most reliable information which it has been our good fortune to compile upon this interesting subject. Thus will our endeavour have been fulfilled; we sincerely trust with some degree of benefit to the readers of our "Chapters on Modern Domestic Economy."

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p. 336.*)

"THE rainbow likewise is not known to the inhabitants of the moon; for if the dawn is an effect of the grossness of the air and vapours, the rainbow is formed in the clouds, from whence the rain falls; so that the most beautiful things in the world are produced by those which have no beauty at all. Since then there are no vapours thick enough, nor no clouds of rain about the moon, farewel dawn, adieu rainbow. What must lovers do for similies in that country, when such an inexhaustible magazine of comparisons is taken from them?"

"I shall not much bemoan the loss of their similies or comparisons," says the Marchioness, "for I think them well enough recompensed for the loss of our dawn and rainbow; for by the same reason they have neither thunder nor lightning, both which are formed in the clouds. How glorious are their days, the sun continually shining! how pleasant their nights, not the least star is hid from them! They never hear of storms or tempests, which certainly are plain effects of the wrath of Heaven. Do you think then they stand in need of our pity?"

"You are describing the moon," I replied, "like an

* Ought this not to be: "On earth there is nothing so great as man: in man there is nothing so great as mind"?

enchanted island; but do you think it so pleasant to have a scorching sun always over our heads, and not the least cloud to moderate its heat? Tho' I fancy 'tis for this reason that Nature hath made great cavities in the moon: we can discern 'em easily with our telescopes, for they are not mountains, but so many wells or vaults in the middle of a plain; and how do we know but the inhabitants of the moon, being continually broil'd by the excessive heat of the sun, do retire into those great wells? Perhaps they live nowhere else, and 'tis there they build 'em cities; for we still see in the ruins of old Rome that that part of the city which was under ground was almost as large as that which was above ground. We need but take that part away, and the rest would remain like one of these lunar towns; the whole people reside in wells, and from one well to another there are subterraneous passages for the communication of the inhabitants. I perceive, madam, you laugh at me; yet, if I may be so free with a fair lady, you deserve it much better than I: for you believe the people in the moon must live upon the surface of their planet, because we do so upon ours; but quite the contrary; for, as we dwell upon the superficies of our planet, they should not dwell upon the superficies of theirs. If things differ so much in this world, what must they do in another?"

"'Tis no matter," said the Marchioness, "I can never suffer the inhabitants of the moon to live in perpetual darkness."

"You will be more concern'd for 'em," I reply'd, "when I tell you that one of the antient philosophers long since discover'd the moon to be the abode of the blessed souls departed out of this life, and that all their happiness consisted in hearing the harmony of the spheres, which is made by the motion of the celestial bodies. And the philosopher pretending to know exactly all they do there, he tells you that when the moon is obscured by the shadow of the earth, they no longer hear the heavenly musick, but howl like so many souls in purgatory; so that the moon, taking pity of 'em, makes all the haste she can to get into the light again."

"Methinks, then," says the lady, "we should now and then see some of the blessed souls arrive here from the moon, for certainly they are sent to us."

"I confess, indeed," said I, "it would be very pleasant to see different worlds. Such a voyage, tho' but in imagination, is very delightful. What would it be in reality? It would be much better, certainly, than to go to Japan, which at best is but crawling from one end of the globe to t'other; and after all to see nothing but men."

"Well, then," says she, "let us travel over the planets as fast as we can. What should hinder us? Let us place ourselves at all the different prospects, and from thence consider the universe. But, first, have we anything more to see in the moon?'

"Yes, madam," says I, "our description of that world is not quite exhausted. You must remember that the two movements which turn the moon on herself, and about us, being equal, the one always presents to our eyes that part of which the other must consequently deprive us, and so she always to us wears the same face. We have then but one moiety of her which looks on us; and as the moon must be supposed not to turn on her own center, in respect to us, that moiety which sees us always, and that which never sees us, remains fixed in the same point of the firmament. When it is night with her, and her nights are equal to fifteen of our days, she at first sees but a little corner of the earth enlightened, after that a larger spot, and so almost by hourly gradations spreads her light till it covers the face of the whole globe; whereas these same changes do not appear to us to affect the moon, but from one night to another, because we lose her a long time out of our sight."

"I would give anything that I could possibly fathom the awkward reasonings of the philosophers of their world upon our earth's appearing immoveable to them, when all the other celestial bodies rise and set over their heads within the compass of fifteen days. It is plain they attribute this immobility to her bigness, for she is forty times larger than the moon; and when the poets have a mind to extol indolent Princes, I doubt not but they take care to compare their inactivity to this majestic repose of the earth: however, this opinion is attended with one difficulty; they must very sensibly perceive in the moon, that our earth turns upon her own center. For instance, suppose that Europe, Asia, and America present themselves one after another to them in miniature, and in different shapes and figures, almost as we see them upon maps: now this sight must be a novelty to such travellers, as pass from that moiety of the moon which never sees us, to that which always does. Ah! how cautious would they be of believing the relation of the first travellers, who should speak of it after their return to that great country, to which we are so entirely unknown!"

"Now, I fancy," says the Marchioness, "they make a sort of voyage from one side of their country to the other, to try to make discoveries in our world, and that there are certain honours and privileges assigned to such as have once in their lives had a view of our great planet."

"At least," replied I, "those who have had this view obtained the privilege of being better lighted during their nights. The residence in the other moiety of the moon must of necessity be much less commodious in that respect. But now let us continue the journey we proposed to take from one planet to another, for I think we have had a pretty curious survey of the moon; at least you have seen all I can show you."

(To be continued.)

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

ABOVE THE SURFACE—(*continued*).

THE caddis-flies, which we left a short time ago, just emerging from pupahood, may now engage our attention. Of these insects we have upwards of 150 species already recorded from the British Isles, but, no doubt, others exist which have not yet fallen into the hands of the very small band of entomologists specially interested in the group. The larger kinds, which in some cases reach an expanse of wing of almost two inches, are nocturnal in habits, concealing themselves by day amongst herbage and on the trunks of trees. But many of the smaller ones may be seen during the daytime flitting backwards and forwards with an uncertain kind of movement just above the surface, seeming sometimes to be trying how near they can approach the water, without actually touching it. All these insects are delicate in texture, their four membranous wings being easily damaged, and their soft bodies, like those of the May-flies, shrivelling up in an unsightly manner after death, a peculiarity which does not tend to lessen the difficulties that, at the best of times, beset the discrimination of the species. The wings, which are always some shade of brown or black, are sometimes, like those of moths, adorned with patterns, and as, in many respects, they closely resemble the latter insects, for which, indeed, they are often mistaken, it will be best first of all to point out the differences between the two orders, *Lepidoptera* (moths) and *Trichoptera* (caddis-flies).

On placing examples of each side by side, with wings expanded, a superficial glance will detect little more difference than that the wings of the caddis-fly, especially the hind pair, have a semi-transparent and somewhat glossy and iridescent appearance which is absent from those of the moth, and the most important structural differences will need microscopic work for their complete determination. Applying the microscope first to the wings, we find that in the moth the pattern is due not to the colour of the wings themselves, but to innumerable minute appendages in the form of tiny scales attached to the wing by the pointed end only, lapping over one another like slates on the roof of a house, and producing by their different colours a sort of mosaic pattern, the elements of which are so small that the mosaic effect is lost when viewed simply by the naked eye. On removing the scales, which can be done by gently brushing with a camel's hair brush, we find that the true wing consists of a transparent, colourless membrane with nervures forming its framework. Examining the caddis-fly in the same way, we see that the nervures are more numerous, and that such pattern as there may be, which is generally not a great deal, is produced partly by the coloration of the membranous wing itself, and partly by minute *hairs*, not scales, scattered more or less thickly over the surface. These differences will generally suffice for the separation of moths from caddis-flies; but there are a few moths that, so far as appearance and clothing of wings are concerned, approach very near to the Trichopterous type, the wings being semi-transparent, glossy, and iridescent, and the scales attenuated to such a degree as to be scarcely distinguishable from hairs, a condition best exemplified in the common pale brownish moth, *Nudaria mundana*. The antennæ of a caddis-fly are generally proportionately longer and stouter than those of a moth and are carried, pointing straight forward in front of the head. In the organs of the mouth (Fig. 1) there is a

A B

Fig. 1.—Side view of head of moth (A) and caddis-fly (B); *a*, base of antennæ; *lp*, labial palpi; *m*, maxillæ; *mp*, maxillary palpi.

great difference. The moth carries a pair of long, flexible appendages closely applied to one another, and curled up in a flat coil which is placed in a vertical plane underneath the head; no such coiled apparatus exists in any other kinds of insects. On each side of this coil is a jointed organ, clothed more or less thickly with scales, the pair of which form between them a sort of groove, into which the coil fits. These two pairs of organs are called respectively maxillæ and labial palpi, and are the principal organs of the mouth in the Lepidoptera. The maxillæ, which can be uncoiled at pleasure, carry along their inner edge, which is grooved, numerous short hooks, those of one side interlocking with those of the other, and thus forming a central tube, up which the liquid food taken by the insect must pass in order to enter the mouth, an aperture between the bases of the maxillæ. In the caddis-fly the only organs distinctly perceptible are two pairs of delicate, jointed appendages, the maxillary and labial palpi. Though its larva possessed a pair of stout jaws, and was able to make good use of them, the perfect insect is, equally with the moth, entirely destitute of any such organs; the moth's coiled maxillæ, however, sufficiently distinguish the insect. In a few moths the maxillæ are quite rudimentary, the palpi being almost the only recognisable mouth organs; this manifestly approximates the mouth in appearance to the Trichopterous type, and there is a noteworthy instance in which even competent entomologists were for a time misled by this condition. The insect in question is a small, whitish moth, called *Acentropus niveus*, which, as it is a genuine lover of ponds, will come in for more lengthened notice later on; it was bandied about from one order to the other, at one time being considered a caddis-fly, at another a moth, till, the discussion having waxed hot and strong, it found a final resting-place amongst the Lepidoptera.

Some of the caddis-flies, viz., those of the family *Leptoceridæ*, are remarkable for the enormous length of their antennæ, which are sometimes four or five times as long as the body. It is these little creatures, some of them sooty black in colour, that form dancing groups just above the surface of the water. By entomological beginners they are sure to be mistaken for moths, especially as there is a well-known family of moths of the same size, of similar shape, with equally disproportionate antennæ, and with their colours, too, sometimes not unlike those of the Leptoceridæ. Attention to the structural characteristics mentioned above will, however, infallibly lead the observer to their true systematic position. It should constantly be borne in mind that mere superficial resemblances count for nothing to the systematist; insects that *look* something alike in general appearance are not necessarily at all related, for there are numerous instances of mimicry between species belonging to altogether different orders; an examination, therefore, which pays more attention to general effect than to matters of detail, will often fail to detect either real points of similarity or of disagreement; and students of entomology should be very careful in forming an opinion as to an insect's systematic position without the closest scrutiny of all essential parts, assisted by at least a hand-lens, and, if necessary, even by the compound microscope.

Caddis-flies are to be found during the summer months. They fly with a heavy, zigzag sort of flight, and when in the net often simulate death, bringing the wings close alongside the body (the hind pair, which are much larger than the fore, being folded up like a fan), relaxing their hold, and falling over on their side. But any attempt to secure their persons will speedily convince them of the futility of this pretence, and elicit spasmodic struggles for liberty.

There are some other water-frequenting, winged creatures, such as the stone-flies, willow-fly, and alder-fly, that, like the caddises, are used as bait by anglers, and are therefore sometimes confounded with them. These, however, though in habits resembling the subjects of the present paper, are pretty easily seen, by examination of the wings, not to belong to quite the same group: their wings are more or less closely reticulated by means of a number of *transverse* nervures in addition to the longitudinal ones (those of caddis-flies being chiefly longitudinal), and are only *very* slightly hairy, generally, indeed, imperceptibly so, without considerable magnification; and, in consequence, are more transparent than those of caddis-flies. Most of them, too, carry two long filaments at the tail, which the true caddis-flies never do. These insects, together with a number of others, such as May-flies, dragon-flies, snake-flies, and lacewing-flies, constitute the wonderfully mixed assemblage known as the order Neuroptera—a group with which some people associate the caddis-flies. The stone-flies and willow-fly, together with the angler's "Yellow Sally," constitute the family *Perlidæ*, a group of that section of the order called Pseudo-neuroptera. The alder-fly belongs to the *Sialidæ*, a family of another section called Planipennia, which contains also the beautiful lacewing flies, or "golden-eyes." But a more detailed notice of these must be reserved for our next paper.

(*To be continued.*)

FRENCH BALLOON EXPERIMENTS.

By Richard A. Proctor.

I HEARD with suspicion rather than surprise of the apparent success of Captains Renard and Krebs in directing a balloon against the wind. It is so manifest that the balloon is unsuited for aërial navigation that I took it for granted there could have been very little wind, if any. Possibly, even, an upper current in a different direction from the lower one favoured the aeronauts during that first experiment. When there was a breeze worth mentioning, and its direction adverse, the experiment failed, as it was bound to do. When we consider the nature of the task which a balloon-director has to achieve, we readily see that the problem is a hopeless one. To support the weight of a man, a balloon must have more than a thousand times a man's volume. To support an engine, the balloon must have at least six thousand times the volume of the engine. To support several men and an engine equal in weight to several more, the balloon must have theoretically a volume of forty or fifty thousand cubic feet; but really a much greater volume, because of the weight of the balloon itself, the necessity of carrying ballast, and so forth. Again, the hydrogen is not pure, and it is not at atmospheric pressure, but at greater pressure, as the distension of the balloon shows. A spherical balloon would have to be nearly 60 feet in diameter to contain 100,000 cubic feet, or thereabouts, of gas. Such a balloon would present to the wind an effective resisting surface of about 2,700 square feet, and certainly no force of propulsion which any engine carried by such a balloon could produce for more than a few minutes, would suffice to resist the action of the wind on such a surface when there was anything of a breeze. By giving to the balloon a fish-like shape, as Captains Renard and Krebs did, the propulsion of the balloon directly in the teeth of the wind is of course made easier; but, as in the great majority of cases there would be no advantage in going directly against the wind (it is always as unlikely that that would be the best course, as a course directly with the wind), the fish-like shape is disadvantageous rather than otherwise, for it enormously increases the resisting surface when the wind is abeam. A great mistake, indeed, is made by those who compare the movements of a balloon in the air with the movements of a fish in the sea. They seem to suppose that the fish shape will be a help against the action of the wind; but this is as absurd as it would be to suppose that a fish placed in the midst of a current or river carrying it bodily along would be helped by its shape to resist the action of that current. The fish can swim athwart the current or river, but all the time it shares the motion of the stream in which it is placed. Until it is shown to be possible to urge a monstrous balloon through the air at a rate considerably exceeding that of a stiff breeze, nothing is to be hoped for from balloon-supported propellers. Of course, this is hopeless; but a propulsive action, much less effective, would suffice to keep afloat a flying machine supported (as a condor or an albatross is supported) by a widely-extended horizontal surface.—*Newcastle Weekly Chronicle.*

ELECTRO-PLATING.

By W. Slingo.

XIII.—SILVERING SOLUTIONS (*continued*).

THE process of dissolving silver in nitric acid may be dispensed with by purchasing the nitrate of silver prepared in the crystalline form. It is a rather dear way of going to work, but if a good price be paid at a good shop, purity may be relied upon, and this is more than can always be said for an amateur's work. Experience, however, would very speedily put matters right in this direction. Care should be taken that the nitric acid is of good quality, as impurities are certain to lead to waste, if not disaster. Hydrochloric acid, one of the more generally present impurities of nitric acid, precipitates a portion of the silver as the chloride, which portion is consequently wasted.

Having prepared the nitrate of silver solution, a solution of cyanide of potassium is added gradually; the latter solution being made by dissolving about a quarter of a pound of cyanide of potassium in a pint of water. The effect of the cyanide of potassium upon the nitrate of silver is to convert it into the cyanide of that metal, which, being insoluble in water, falls to the bottom of the vessel. The liquid then becomes nitrate of potassium instead of silver. Care must be taken not to add too much of the cyanide of potassium solution, in consequence of its having the power of dissolving the cyanide of silver. If too much should be accidentally added, it is best to neutralise it by the addition of an extra quantity of nitrate of silver solution. These operations are best conducted in a glass vessel, so as to enable the progress of the precipitation of cyanide of silver to be carefully watched. When the precipitation ceases, and the whole of the silver has been allowed to settle at the bottom of the vessel, the clear supernatant liquid is gently decanted, and the precipitate washed a few times. The washing process consists in simply pouring a quantity of water on to the cyanide of silver, and, after allowing a settlement, pouring it off again. It is advisable to "test," or try, the solution as the cyanide is added. Although the white cyanide of silver forms a somewhat dense precipitate, it nevertheless takes some time to settle, the worker is consequently liable to mistake the degree to which he has converted the silver solution.

One tolerably sure indication that the necessary amount of cyanide of potassium has been exceeded is that, where the superfluous cyanide passes, it clarifies the solution by redissolving the suspended particles of cyanide of silver. The safest plan, however, is to allow the sediment to settle, and then to remove a little of the clear supernatant liquid, and, placing it in a test-tube or other small glass vessel, add a drop or two of the cyanide of potassium solution; the slightest cloudiness supervening is a sure indication that some of the silver remains unprecipitated, and accordingly more of the cyanide of potassium solution should be added to the main bulk of the nitrate of silver solution, and after a short time a further test should be taken in the manner above indicated. Should it happen, however, that the addition of the cyanide to the test-tube fails to precipitate any silver, there may possibly be already present an excess of the cyanide. This will be proved if, on the addition of nitrate of silver, cloudiness ensues. Of course, more nitrate must be added than would be necessary to neutralise the few drops of cyanide added for testing purposes.

A little stronger solution of cyanide of potassium is now poured gradually over the precipitated cyanide of silver until the whole of it is again dissolved, a glass stirrer being continually used to facilitate the solution. A small quantity of the cyanide of potassium—say about three-quarters of an ounce—is then added to expedite the subsequent solution of the silver anode. The solution is next diluted with about a gallon of water, and then filtered to remove any impurities that may be present. It is then ready for the bath.

As hinted in the previous article, the amateur may experience some difficulty in procuring the cyanide of potassium, but a double salt—viz., the ferrocyanide—he should experience no difficulty in getting. With this he may make his own cyanide. The following is the process generally adopted :—Take a quantity of ferrocyanide of potassium, pound it fine, and gently heat it in an iron pan, with constant stirring, until quite dry; treat a quantity of the best carbonate of potash in a similar manner. When they are perfectly dry, add about three parts of the carbonate to eight parts of the ferrocyanide, and thoroughly mix them; heat the mixture rapidly in an iron ladle or crucible, until it melts into a clear liquid, when gas will be evolved from its surface. It should be maintained at a moderate or dull-red heat about fifteen or twenty minutes, and until the end of a cold iron rod dipped into it shows a white sample. The fusion should not be continued until the evolution of gas ceases, or the product will be of a grey colour. It should be kept covered as much as possible. By allowing it to stand undisturbed a few minutes at the latter part of the operation, and occasionally tapping the sides of the ladle or crucible, the iron of the ferrocyanide will settle at the bottom as a fine black powder. The colourless cyanide of potassium may then be poured off into a cold iron pan, or upon a thick and cold iron plate. It should be broken up while still warm, and preserved in a well-stoppered jar. The black sediment, which contains much cyanide of potassium, should be scraped out of the vessel while it is still hot and carefully preserved, as water will at any time dissolve out the cyanide. If the process has been well conducted, the product will be of a clear, white colour, or at most but very slightly grey. A larger proportion of cyanide of potassium is obtained by this process than when ferrocyanide alone is employed, because in the former case one-third of the cyanogen (that which was combined with the iron) combines with the potassium of the carbonate of potassium; whilst, in the latter case it is lost. The cyanide produced by the fusion of the ferrocyanide of potassium alone is of a greyish-black colour, and is termed "black cyanide."

Except where special preparations are made to produce a deposit having a bright surface, a dead or unpolished surface is produced, and if a bright surface is required, mechanical means are resorted to in order to obtain it. For some work, however, a dead surface is preferable, and it decidedly has beauties of its own. For such purposes a good solution is made by converting an ounce of silver into the nitrate by the method described in the previous article, and dissolving the crystals in three pints of distilled water. The silver is then precipitated (as the chloride of silver) by the addition of a strong solution of common salt. Having well washed the precipitate, it is next dissolved by the addition of a strong solution of cyanide of potassium, care being taken not to add much more than will dissolve the chloride of silver. The liquid is then filtered through two or three papers, and sufficient distilled water added to make one gallon of solution.

This solution answers very well, as above-mentioned, for dead work; more especially is this the case when the solution contains a larger proportion of water than that above-mentioned, when the battery power is weak, and when the anode is small. The deposition of silver under such circumstances would be much slower, and the particles would adhere more firmly to the object being coated.

A bright surface is imparted to the silver as it is deposited in the following manner: — An ounce of bisulphide of carbon is put into a pint bottle containing a strong silver solution with more cyanide of potassium than is necessary to dissolve the silver. The bottle, after being well shaken, is stood aside for a few days, and is then ready for use. A few drops of the solution may be poured into the plating bath occasionally, until the surface of the deposited silver attains a sufficient degree of brightness: care being taken, however, to add the bisulphide solution very sparingly or the depositing solution may be spoiled. This process is most applicable where bright surfaces are required, but which, owing to their irregularity, or to the fragile nature of the object, cannot be burnished in the manner to be presently described.

CHATS ABOUT GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

(*Continued from page 339.*)

A. I suppose geometrical measurements relating to curves, surfaces, volumes, &c., begin with the lengths of arcs?

M. We may begin with them, though the simplest methods and the best illustrations relate to surfaces.

A. How is that?

M. You will see if you consider what has to be done in the two cases. Always in measuring curved figures we have to conceive them divided up into great numbers of small parts, these parts being *not* affected by curvature. Now an arc cannot really be divided into straight lines; for no parts of it are straight. But we can divide a plane surface bounded by curved lines into great numbers of rectangles, triangles, &c. So we can divide a volume having a curved surface, into prisms, pyramids, parallelopipeds, &c. A curved surface is as awkward in this respect as an arc, for no part of it is plane.

A. Can you give me illustrations of your meaning?

M. Readily. In fact we must start from general illustrations of these peculiarities.

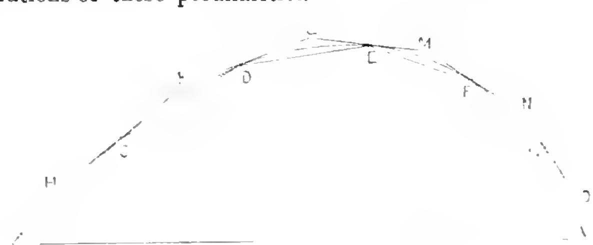


Fig. 3.

A. What then is the difficulty with arcs?

M. Suppose A E B (Fig. 3) is an arc we have to measure. We cannot divide this arc into straight portions no matter how small. If we set a number of points C, D, E, F, G, along the arc, we see that the straight lines A C, C D, D E, E F, F G, G B together, come nearer to the true length of the arc than A B. For while these straight lines together are less than the curved lines A C, C D, D E, &c., together,—that is, less than the arc A E B—they are greater than A B, and so come nearer to the arc in length. So, if we divide the arc A C into a number of small ones, the chords of these together will be nearer in value than the chord A C to the arc A C. And so of the other arc C D, D E, E F, &c. Thus we get nearer and nearer to the length of A B, by taking a greater and greater number of chords along its length. Still this does not *prove* that we can approach the length of the arc within any quantity, however small, that may be indicated. For you may draw nearer and nearer to a quantity yet always remain separated from in by a finite quantity.

A. That sounds paradoxical.

M. Well, take the quantity 3. Suppose you take 1, add $\frac{1}{2}$ to that, $\frac{1}{4}$ to the sum, $\frac{1}{8}$ to that sum, and so on continually. Are you not continually approaching the value 3 (or indeed 4, or 5, or any number over 2)? Yet as your sum never exceeds 2, you are always separated from 3 by the finite quantity 1.

A. Still in the case illustrated by Fig. 3 it really looks as though you could get as near as you please to the length of the arc A E B, by increasing sufficiently the number of chords.

M. It looks so, and it is so; but you cannot easily prove it.

A. I observe in your figure a number of straight lines A H, H K, K L, L M, M N, N O, O B outside the arc A B. What do they mean?

M. They are tangents at A, C, D, E, F, G and B. It is tolerably obvious not only that A H, H K, K L, L M, M N, N O, and O B together are greater than the arc A B, but that by increasing the number of such tangent lines, we can approach the length of the arc A B as nearly as we please.

A. Yes; only you approach it from the other side, from outside, as it were. The real length of the arc lies between the sum of the chords and the sum of the tangents.

M. Precisely; and if we can show that these sums draw nearer and nearer to each other, and are finally separated by a length which may be made less than any that can be assigned we shall have obtained a satisfactory way of measuring arc lengths.

A. And I notice that so far as the set of outside lines are concerned we may be said to be following the natural way of measuring. For if we wished to measure the length of such a curved arc as A E B we should apply to it a fine string or a delicate chain, extended from A to B; and diminishing the number of our tangents A H, H B, &c., corresponds exactly to making the links of our measuring-chain shorter and shorter, which would naturally make the chain a more and more delicate measurer. But now *can* you prove that the outer and inner sets of short straight lines approach each other indefinitely?

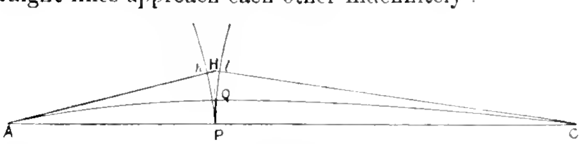


Fig. 4.

M. It will go near to be thought so presently. Let A C, Fig. 4, represent the A C of Fig. 3, A H the tangents at A and C (not necessarily equal). Draw H P square to A C, and with centres, A C, describe circular arcs, P *k*, P *l*, to the lines A H, H C. Then obviously the two lines H A, H C together exceed A C, by the sum of the two short lines H *k*, and H *l*. But since the arc A C, by the very nature of a curved arc, changes continuously through all the directions included within its length, the angles H A C, H C A, may be made as small as we please by bringing C near enough to A in Fig. 3. We can always magnify it to any size we please in Fig. 4. But P H is a tangent to the circles of which P *k* and P *l* are arcs; and it is obvious that the nearer we bring A H and C H to A C, the smaller *k* H and *l* H must become, and they can be made as small as we please, while A H and H C never become less than A P and P C. Therefore the excess of A H, H C together over A C may be made indefinitely small compared with A C. So that the sum of the excesses of A H, H K, K L, L M, &c., in Fig. 3, over A C, C D, D E, E F, &c., may be neglected compared with the sum either of A B, C D, D E, E F, &c., or of A H, H K, K L, L M, &c.

A. But may not these little "excesses," as you call them, though each is very small, made up an appreciable quantity through their number. As you increase the number of divisions you get more of these little bits.

M. That makes no difference. We make the ratio of each such pair as H *k*, H *l* in Fig. 4, to each part as A C, exceedingly small,—as small in fact as we please. The ratio of all of them together to all such lines as A C, C D, &c., together, cannot be greater than the ratio of the largest pair, like H *k*, H *l* to the chord corresponding to A C.

A. Illustrate this numerically.

M. Suppose you break up the number 1,000,000 into a million small parts pretty nearly equal, each therefore about equal in value to unity. Now, if from each of these quantities you take off a very minute fraction, say, one-millionth, you have a very large number—a million—of these millionths of unity (or thereabouts); but all together they cannot amount to more than one, a very small proportion of your original number. If you increase the number of parts of your original number to a billion, and take off a trillionth of each part, the sum of these billion trillionths will be just a trillionth of the original number. It matters not how great the number of these parts you take; if the ratio of each to that from which it is taken be very small, the sum of all of them will bear just that small ratio to the original total.

A. Is there any assumption at all, then, in your reasoning about arc lengths?

M. There is; though no one can really doubt its fairness. I have assumed that A H and H C together, are greater than the arc A Q C within these lines and touching them at A and C.

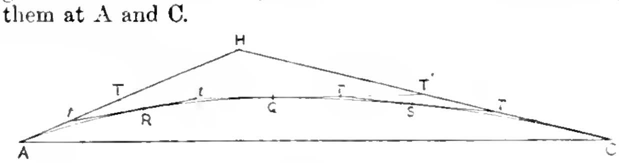


Fig. 5.

A. But obviously they are greater. Why, you can draw a tangent T Q T′ to some point Q in the arc A Q C (Fig. 5). Then the broken line A T T′ C is nearer to the arc A Q C than the broken line A H C, and is manifestly less than A H C (since T Q T′ is less than T H, H T′ together). Then we can draw the shorter tangents *t* R *t′*, T S T′; and so on, getting continually nearer and nearer to the arc A R Q S C, and at each step diminishing the total length of the tangent chords.

M. Your reasoning is accurate. But still you require finally an assumption, when your drawing of tangents comes to an end. However I think we may fairly regard the assumption that *any* tangents as A H, H C are together less than the arc A Q C as to all intents and purposes axiomatic.

A. We have had a good deal of trouble over our preliminary inquiry into arcs. Can plane surfaces bounded by curved lines, and solids bounded by curved surfaces be more easily dealt with?

M. Much more easily. We will take them next; and consider also the more difficult case of curved surfaces. After that preliminary inquiry we will consider a number of cases of interest, in the measurement of various curves, surfaces bounded by curves, volumes, curved surfaces, and so forth, taking very simple cases first.

A. But will you not give me some examples of measuring arcs.

M. I must first explain how, instead of the chords and tangents shown in Fig. 3 we have usually to employ other approximations to the length of curved arcs.

(To be continued.)

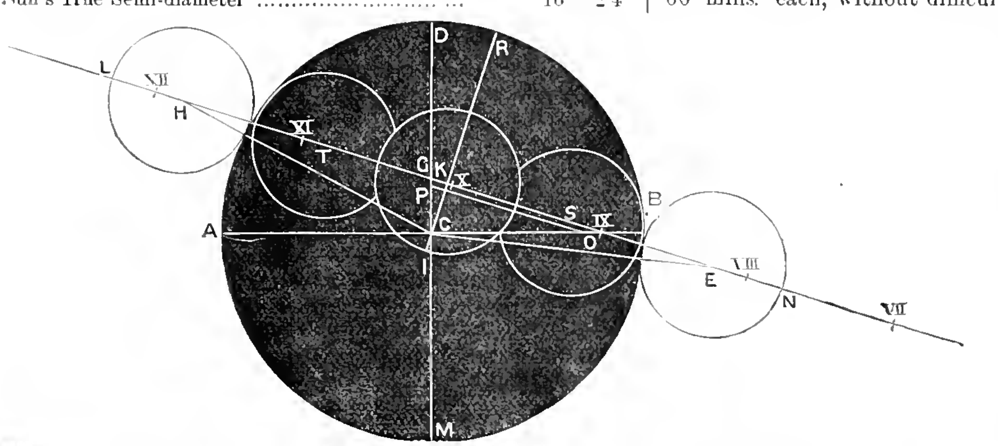
GRAPHICAL PROJECTION OF AN ECLIPSE OF THE MOON.

IN compliance with a request preferred by several subscribers, we propose to explain the method of graphically projecting a Lunar Eclipse from the details given in the *Nautical Almanac*; and, in order to render the principle perfectly intelligible, we have given all the successive steps (including the simple calculations) in the production of the subjoined diagram of the recent eclipse of Oct. 4, which has attracted so much attention.

First let us see what the *Nautical Almanac* furnishes us with. Turning to page 401, we find :—

Elements.

	h.	m.	s.
Greenwich Mean Time of Opposition in R.A., Oct. 4	10	8	5·1
Moon's Right Ascension	0	44	25·02
	°	′	″
Moon's Declination	N 4	57	57·9
Sun's Declination	S 4	46	33·6
Moon's Hourly Motion in R.A.		31	13·5
Sun's Hourly Motion in R.A.		2	16·7
Moon's Hourly Motion in Declination	N	10	52·9
Sun's Hourly Motion in Declination	S		57·7
Moon's Equatorial Horizontal Parallax		59	23·0
Sun's Equatorial Horizontal Parallax			8·9
Moon's True Semi-diameter		16	12·5
Sun's True Semi-diameter		16	2·4



Now then to begin our figure.

First, the figure of the earth is a spheroid, and not a sphere, so that her shadow is not rigidly circular. Hence, to have a mean radius, we will reduce the Moon's horizontal parallax to a latitude of 45°. This reduction we find to be, in the proper tables, 5″·9, so from 59′ 23″·0 we take 5″·9, leaving the reduced parallax 59′ 17″·1. The semi-diameter of the earth's shadow = Moon's horizontal parallax + Sun's horizontal parallax − Sun's semi-diameter—*i.e.*, in this case, 5° 9′ 17″·1 + 8″·9 − 16′ 2″·4 or 43′ 23″·6. To this we must add 1-60th, say, 43″·4, on account of the earth's atmosphere, and we shall finally get 44′ 7″ for the semi-diameter of the shadow. Take, now, any scale of equal parts (one of 40 to the inch, or 1½ inch to 1°, was employed in constructing our diagram above), and with 44·1 of them as radius, from centre C describe the circle A D B R. This will represent a section of the shadow of the earth at the Moon's distance. Draw the diameter A C B to represent a parallel to the equator, and make C G perpendicular to it = 11′ 24″·3, the difference between the Moon's declination and that of the centre of the shadow. We must be careful to take G *above* C, because the Moon's centre is north of that of the shadow. The beginner will note that, as the Sun's declination is south, that of the earth's shadow must be north. Taking the hourly motion of the Sun in R A from that of the Moon (2′ 16″·7 from 31′ 13″·5) we get 31′ 56″·8 or 1916″·8 as the hourly motion of the Moon in R A from the sun, which we may now consider a fixture; but it must first be reduced to the arc of a great circle by multiplying by the cosine of the Moon's declination. This is done in three lines by logarithms. Thus :—

1916″·8	log.	3·2825768
4° 57′ 57″·9	cos.	9·9983668
1909″·6 or 31′ 49″·6		3·2809436

So we make C O = 31′ 49″·6, and C P, perpendicular to it, = 9′ 55″·2, the Moon's hourly motion from the centre of the shadow in declination, observing to place P above C, because the Moon was going northward with reference to the shadow. Join O P, and parallel to it, through G, draw the line N G L. This gives us the Moon's path with respect to the shadow. On N L let the perpendicular C K fall. Now, at 10h. 8m. 5·1s. the Moon's centre was at G. To find where it was at 10h. (marked X on N G L) we say as 60m. : 8m. 5·1s. :: O P to G X. We take the corresponding measure off our scale, and, extending it from G, so find X. Then, in a perfectly obvious way we set off the distance O P on either side of our 10 o'clock point, and sub-divide these hours so graduated as minutely as we choose. Those in our figure might be so divided into 60 mins. each, without difficulty. Then will the times corresponding to E K and H represent the beginning, middle, and end of the eclipse respectively. Circles described round E K and H, with a radius = the Moon's semi-diameter (16′ 12″·5), will show the position of the Moon at these instants. R T shows what is known as the magnitude of the eclipse. If, with C as a centre, and a radius = C B − the Moon's semi-diameter, we describe a circle cutting L N in S T, the instants of the Moon's reaching these points are those of the beginning and end of total darkness.

Erratum.—In the reply to "W. H. K. S.," column 2, p. 373, in our last number "wilful imbecility" should be "wilful unbelief."

THE FISH RIVER CAVES, NEAR SYDNEY, AUSTRALIA.

By J. E. Richter.

These caves are situated about 80 miles west of Sydney, Australia, and are some 3,000 ft. above sea-level, in an interesting mountainous locality. They were first discovered by a party of settlers in 1866, while in pursuit of bushrangers.

Apart from the cave sights, that attract so many visitors, the locality surrounding affords an interesting study to the geologist and student of nature. A wall or ridge of limestone, hard as flint, and several hundred feet in height, stretches across country for several miles, sometimes as a ridge, at other places as an arch or bridge spanning streams. One of these creeks, containing a stream measuring several square feet in section, disappears under the limestone, embouching again a mile or so further down. Its subterranean course has never yet been traced. Contiguous to its course, little doubt exists of many undiscovered caves, possibly surpassing in beauty those at present shown to delighted visitors. In ages past this ridge of limestone, now so high above the sea, and eighty miles from it, was the bottom of the warm ocean, the abode and regenerative ground of the myriad tribe of shell-fish. Unearthing a detached piece of limestone from the red soil, different forms of shell are discernible over the surface of it, a substance in the soil eating or corroding certain parts of the limestone more than others, leaving the shell forms raised above the surface of it. Viewing these forms, it is significant that none of the shells originally forming a part substance of this limestone were larger than one and a half inches in any section. The line of junction of the limestone with other rocks is visible at several places. On the western side an indurated Silurian schist formation closes in upon it. At the other, softer schists. Another creek, after having worn out a passage for itself through this wall of limestone, immediately joins the stream beforementioned; and it is near the junction of these streams the caves are situated, so far discovered, and as shown to the visitor by the caretaker —the caves having been wisely reserved by the Government of New South Wales from any private proprietary speculation or interference. Where these streams have bored a passage through several hundred yards of this wall of limestones, traces are left sufficiently numerous to show that said streams had originally worked through at a much higher level; in after ages grinding deeper to the present bed.

These caves are singularly attractive. The intricate galleries, halls, and passages in their subterranean scenes are so truly magnificent that a person having once seen them is desirous of viewing them again and again, new features being presented to his view at each visit and at every turn. The strange forms that have been assumed by the drippings from the limestone are almost infinite, and are in beauty unsurpassable in their own character elsewhere. When lighted up by the incandescent magnesium wire, or other strong light, these sublime chambers, so strangely formed by Nature's hands, present a gorgeous spectacle, filled as they are with drooping sprays, coral growths, delicate pendants, gigantic columns, handsome shawls, huge curtains, and shadowy arches of the most fantastic kind. There is a good coach-road from the railway at Tarana to the caves, thirty-six miles.

The cavernous limestone of the Fish River is bluish-brown in colour, compact and hard; fractures easily under the hammer, leaving an edge sharp as that of flint. It is capable of taking a high polish, almost equal to that of the New Zealand greenstone, so much used in jewellery ornamentation at the present time in Australasia. At different places about the caves, where the configuration of the surface has forced the many animals of the kangaroo species, large and small, to travel on any narrow trail, the limestone is worn so smooth and polished by the feet of these indigenous animals that the face of the visualist is reflected to him as in a mirror at favourable spots.

The length of the numerous caves in their various turns and curves, ascents and descents, would probably measure several miles, taking about three days to view, while the student may spend three days more to advantage inspecting the many strange overground features of the neighbourhood, including the unique surrounding woodland scenery, typically Australian.

The fissured condition of some of the limestone in this locality is due to volcanic upheaval disturbance. Many of the smaller fissures have been filled since the upheaval by silicates and spar, some coloured, denoting the presence of oxides of iron and probably other metals, from which also the hard carbonates deposited in such lovely and various forms on the walls, or dependent from the domes and arches of the caves below, have obtained their variegated and diversified colours. Some of these silicates present an example of that rare combination, stratification and crystallisation.

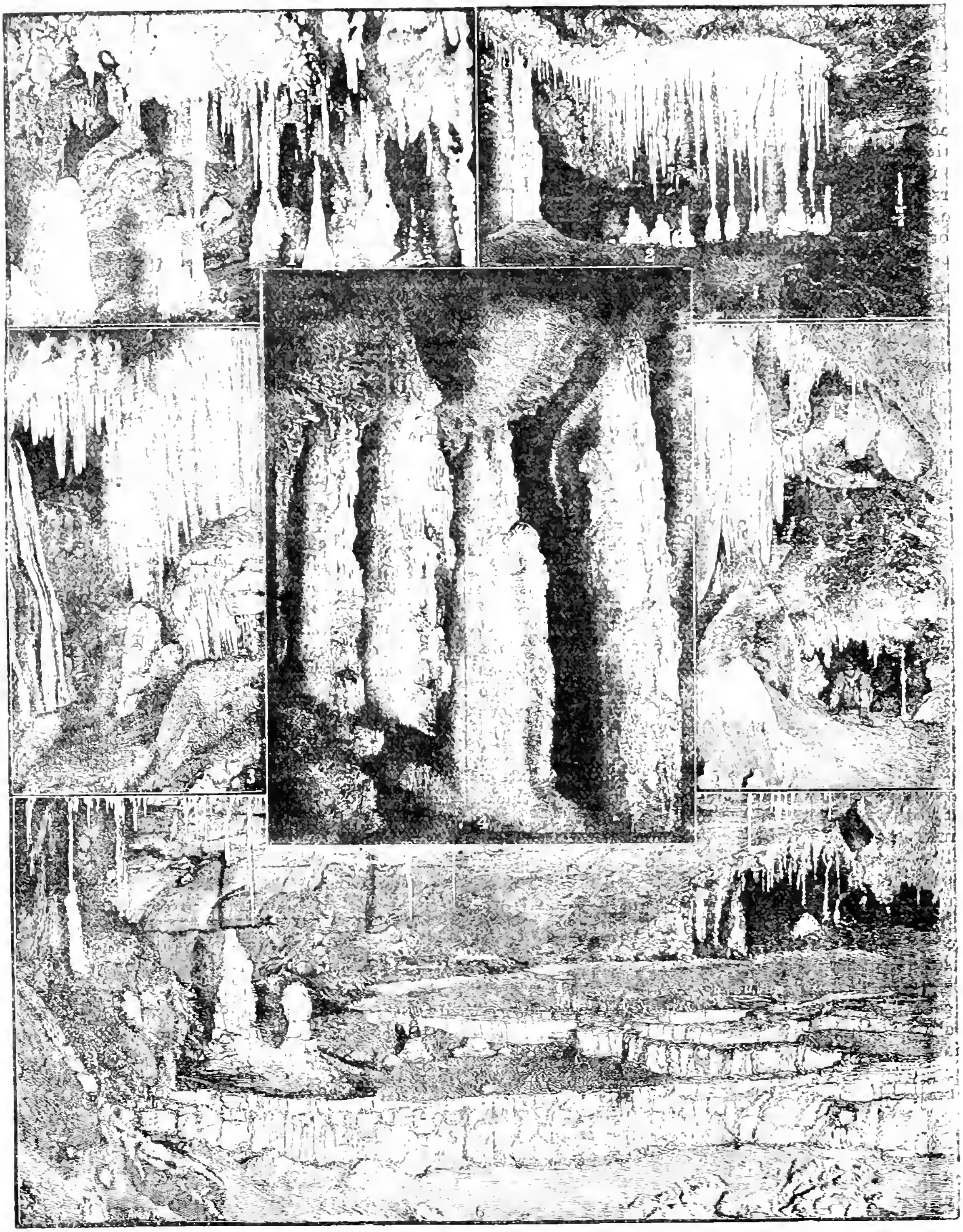
For two or three years after discovery the more accessible caves were partly despoiled by iconoclastic-inclined visitors breaking away the best stalacites and carrying them off to adorn their homes. Then the Government assumed charge of these marvels of nature, since which time the caves are locked at their various entrances by iron gates, and can now only be seen by the guidance of the caretaker, whose service is free of charge, the material for displaying light and cost of sustenance while there being the only charges made. Much improvement has been and is being made throughout to enable visitors, including ladies, to better see the many wondrous sights without the physical exertion that was necessary in former years.

Trenches have been dug in many places, so that one can now walk along upright where once it was necessary to crawl along on hands and knees, or wriggle along, caterpillar fashion, through passages that measured but 10 or 12 inches from floor to roof. Bridges have been thrown across chasms and pools, wire-ladders and stairs have been fixed at difficult ascents or descents, iron or wire-rope railing guards the more dangerous side-lines and pits, and rocks and other obstructions have been cleared away.

It would be difficult, as it would be unwise, to compare these caves with the Mammoth Caves of Kentucky or the more recently-discovered Luray Caves of Virginia, each having its own characteristics—the Mammoth, for their vastness and rosette-covered walls; the Luray, for their tessellar pendent features; the Fish River, for their spiked and filigree glasswork and shawl-draped roofs and walls.

The student of nature, accustomed to find the most exquisite symmetry, form, and colour where light and warmth are in most abundance, is surprised to find here, as in other caverns, that the most charming forms, figures, and colours have been slowly created in these underground corridors, in a temperature not more than 60° Fahr., and in darkness as intense as that of some parts of the Black Tartarus, as believed in by the ancients. This silent, enduring evidence rather upsets the assertions of those theorists who assert that the richest colours are not producible except by the aid of light or heat, or both conjointly.

In some of these caves we were often confronted by what at first sight has the appearance of the filigree work of the



1. Lolly Cave. 2. Nelly's Grotto, Imperial Cave. 3. Lucinda's Columns. 4. Columns, Nettle Cave. 5. The Shawl Cave. 6. Crystal Salt Pass.

glass-blower, as if a member of that craft had traversed it with a portable apparatus, and had in a haphazard fashion practised his art here and there in the most whimsical places, on walls, stalactites, in niches, on the arch under one's feet, and on the dome 50 ft. above.

In some places our attention was attracted to side floors, apparently thickly strewn with potatoes or turnips, covered by a half-inch of what appeared newly fallen snow. It is not snow, but a soft fungus or down closely resembling it; and, unlike a few minutes' fall of snow, is the gradual growth or decay of ages, no doubt the product of disintegrated carbonates, the potatoes being concretionary nodules, probably formed from the same substance. Near these and at other places the walls present the appearance of an irregular patchy Beton concrete work, or the whitewashed dab plastering to be met with on the outside walls of the houses of the German peasant—at other places, as if boys had been throwing small snowballs at the walls, which had stuck there, white as snow, a portion of it as soft too.

As illustrating the indestructibility of matter, the limestone, extremely hard though it be, wastes away in the presence of aqueously-saturated air, and under certain conditions on contact with water, and is deposited at lower levels in all those strange and curious forms that so exult visitors.

The caves that have their entrance from outside are but four or five in number: the Elder Cave, Nettle Cave, Lurline Cave, Lucas Cave. The Imperial Cave, the finest of all the number, was discovered but two years ago. All other caves are but sub-caves of these. The Lucas Cave is singular in its form, winding downward as it does until, at its further end, we find ourselves directly under the entrance portion, but 200 feet lower.

Let us pause a little, and think over the evidently extraordinary slow growth of that grotto of stalactites before us. From long continued observation, extending over a century, in the limestone caves of Europe and America, the results go to show that it takes a thousand years to make a foot in length of the slowest forming stalactites. It is equally certain, however, from the results of observations in the same caves, that the same length has been aggregated in 100 or 200 years, but the conditions under which each was formed being different. From one falls a drop of water but once in two or three minutes, much of the water previous to its falling as a drop being evaporated on its coming in contact with air or a current of air. From the other the water falls in an almost continual trickle. At the Fish River Caves the only observation as yet taken was by the guide, who informed us that, at the entrance to the cave, and previous to the path being lowered, he had accidentally broken the tip off a stalactite 8 in. long by striking it with his head sixteen years ago. The new growth, the growth of sixteen years, was but $\frac{3}{5}$ in. in length by $\frac{1}{8}$ in thickness, the thickness of the stem where broken off being about $\frac{3}{8}$ in. At the time of our visit, one to two minutes elapsed between the falling of each drop of water from it. At this rate it must have taken 360 years to form this stalactite of 8 in. length previous to its breakage.

At one place, measuring about 150 square feet, we counted 36 stalactites to the square foot, from an inch to 15 inches long, making about 5,000 delicate pendants in this sequestered nook. The longest stalactite noted in these caves was about 20 feet or less, and the tallest stalagmite about 10 feet, many of the latter assuming most peculiar shapes, as of human-like figures, hooded monks and nuns, of robed statues and statuettes, of fish standing on their heads or tails, of candlesticks, as in Fig 2, to the right in Nelly's Grotto.

Throughout our subterranean travels, number of pools and basins from 4 inches to 20 feet in diameter, filled with water as clear as the distilled element, continually met our view, and in the strangest and most unexpected of places, too; on top of a mound, on shelves or ledges, on terraces, or in niches; while in vicinity of Fig. 6 is a sheet of water usually less than 6 inches in depth, 100 feet long, its bottom glistening with pearls and other concretionary forms like nodules, marbles, birds' eggs, &c., interspersed with patches of diminutive coral forms, a sight so dazzling to the eye that if continued becomes almost painful.

The Shawl Cave, Fig. 5, Nature has devoted to the display of shawls, and there are curtains from ten to twenty feet long, quarter to half-inch thick, and two to five feet wide. Some are nearly white, while others are more or less beautifully striated in white, pink, yellow, and brown, like the markings visible in agates and other precious stones. A light placed behind these curtains reveals some to be opaque, others translucent, and all extremely handsome. A tiny stream of water trickles down the edge of each shawl.

The Crystal Salt Pans, Fig. 6, are a number of shallow basins filled with beautiful semicircular sheets of gleaming water (basins dry when photographed), each basin being a terrace, and catching the overflow of water from the one above it. It was only after a second investigation that we could realise that the ruffled margins and corrugated brims to these calcareous pools were built up by deposition of material contained in the water itself, the deposit strangely taking place only at the point of overflow. These basins are sometimes dry, when they present the appearance of a number of evaporated salt-pans at a salt factory, the bottoms of the basins being then covered with shining crystals. Viewing the pillars to the left reminds the visitor of the ruined monumental columns met with in Italy, Palestine, or Greece.

Fig. 1, Lolly Cave, is an overcrowded curiosity shop, the most splendid gems hidden from view by inferior articles.

Nelly's Grotto, Fig. 2, is an assemblage needing no comment.

Solidified or petrified cascades and waterfalls are numerous throughout the caves. A few are spotless white in colour, others leaden blue, some striated in various shades of white, pink, and yellow, while more are of a transparent black or brown. The latter is also the prevailing colour about the diamond wells, where the carbonates are coated with a surface of crystals, the crystals being large.—*Scientific American.*

DICKENS'S STORY LEFT HALF TOLD.

A QUASI-SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from p. 358.*)

After the interview with the opium-eater, Datchery returns to his lodging, but merely to get his almost superfluous hat, that he may go out and seek the Deputy. He hails this promising youth by his seldom-used nickname Winks; and we find that the acquaintance between the two has been established on a familiar footing. ("Always kindly," Drood was, we were told in Chapter XIV.) "We two are good friends; eh, Deputy?" he says. "Jolly good." "I forgave you the debt you owed me when we first became acquainted, and many of my sixpences have come your way since; eh, Deputy?" "Ah! and what's more, yer ain't no friend o' Jarsper's. What did he go a histing me off my legs for?" "What, indeed?" says the quaint and Droodlike Datchery, whose talk here reminds one of Dickens's own talk with a little Irish boy, as described in a letter to Forster. Datchery gives Deputy a shilling to find out where the old opium woman lives. Hearing that she is going to the Cathedral in the morning, he "receives the communication with a well-satisfied, though a pondering face." As yet he has learned little from his meeting with the opium woman, except that she knows Jasper, that she is not very friendly towards him, and that opium is the secret of the strange resemblance he had noted six months before between her look and Jasper's. He opens the cupboard where he keeps the score of his reckoning against Jasper. A few uncouth streaks only are chalked on its inner side. He sighs over the contemplation of the poverty of the score, and is uncertain what addition to make to the account. What he has learned *may* be of use to him, but he cannot yet see his way to profiting by it. "'I think a moderate stroke,' he concludes, 'is all I am justified in scoring up,' so suits the action to the word, closes the cupboard, and goes to bed."

It is very different with the events of the following morning. Observe the contrast between Datchery's feelings in the two cases. We have just seen that he sighed at the poverty of the score in the evening, yet with some doubt whether he *might* not be justified in attaching importance to what he had discovered. After the morning's experience, we are told in the very last words Dickens ever wrote that, before sitting down to his breakfast, Datchery "opened his corner cupboard, took his bit of chalk from its shelf, added one thick line to the score, extending from the top of the cupboard door to the bottom; and then fell to with an appetite." No sigh now at the poverty of the score, no moderate stroke added thereto, but a thick stroke from top to bottom of the cupboard door. Surely a statement inviting our most careful attention to the events which have led to Datchery's satisfaction.

Let us see, then, what happened that morning:—

Mr. Datchery attends the morning service at the Cathedral, and from a stall glances about him for "Her Royal Highness the Princess Puffer." The service is well advanced before he "has made her out in the shade." She is behind a pillar, carefully withdrawn from the Choirmaster's view, but regards him with the closest attention." All unconscious of her presence, he chants and sings. *She grins when he is most musically fervid, and — yes, Mr. Datchery sees her do it!—shakes her fist at him behind the pillar's friendly shelter." Mr. Datchery looks again to convince himself.* YES, AGAIN. *She hugs herself in her lean arms, and then shakes both fists at the leader of the choir.* And at that moment, outside the grated door of the choir . . . Deputy peeps, sharp-eyed through the bars, and *stares astonished from the threatener to the threatened.*" Mr. Datchery has learned that the old woman knows Jasper for a hypocrite, and for some reason hates him (even more intensely than "good Mrs. Brown hated Mr. Carker"); and observe how carefully Dickens shows 1st, that Datchery learns this for the first time, and 2ndly, that it is news also and strange news to the Deputy. If Deputy had not stared astonished (as Datchery noted) at the old woman's demonstrations, he might have doubted, as Datchery might, whether Deputy had not told her how Jarsper had ill-treated him, and so excited her sympathies on his behalf; but we see that Datchery recognises in her an entirely independent knowledge alike of Jasper's evil nature and of some at least of his evil deeds. What the extent of her knowledge may be, he now inquires:—

"Well, mistress," he says, "you have seen him?"
"I've seen him, deary; I've see him!"
"And you know him?"
"*Know him!* BETTER FAR THAN ALL THE REVEREND PARSONS PUT TOGETHER KNOW HIM."

Here is the end. So much learned about the opium-eater's knowledge, Datchery's doubts and anxieties of overnight are replaced by satisfaction and good hope of success in his scheme for the punishment of Jasper.

It is clear that Datchery's plans depend on such information as he now sees that the old opium woman can obtain for him. Overnight he had no reason to suppose that she knew more of Jasper than that he was a slave to opium. Now he sees that in some way, doubtless through the effects of that drug, she has learned much about Jasper, and knows him to be the villain he is. From her, then, he may now hope to learn what he wants,—how far Jasper's attack was premeditated, what was the precise nature of his plot in all its details, and precisely in what way Jasper's punishment may be made most terrible.

It remains only that we consider what was the course thus indicated as that along which the main plot of the story was to have run. What was the particular punishment which Edwin Drood and Mr. Grewgious were preparing to inflict upon the hypocritical villain, who, pretending love for Edwin, had endeavoured not merely to kill him but to destroy all trace of him.

But first let it be noticed what a favourite idea with Dickens was the thought of a watch kept on a villain or a hypocrite by one whom he despised as powerless to injure him. Even in this specific form, the idea appears at least a round dozen of times in Dickens's novels, while the general idea of an unsuspected patient watch may be identified about twice as often. In "Barnaby Rudge" we have the murderer Rudge watched for years by the brother of the murdered man (on whom suspicion of the murder had been cast). In "Nicholas Nickleby" Ralph is watched to the last and all his plans foiled by the despised Brooker. In "Martin Chuzzlewit" the favourite idea appears in two important parts of the plot,—we see Jonas Chuzzlewit the murderer tracked to his doom by Nadgett whom he regards as little better than an idiot, and Pecksniff the hypocrite watched by old Martin whom he supposes to be decrepit and a dotard. Dombey is watched by the contemned Carker, Carker is tracked to the death by the despised Dombey. Blandois-Rigaud is hunted down by Cavaletto, Mademoiselle Hortense watched night and day by Mrs. Buckle, and Magwitch by his hated fellow-convict Compeyson. The "Tale of Two Cities" turns wholly on a patient watch maintained by despised folk on the descendants of those who had oppressed them. In "Our Mutual Friend" a man supposed to be dead watches the actions of more than one wrongdoer; in "Hunted Down" a murderous hypocrite is patiently watched to the death by one whom he supposes to be dying; in "A Trial for Murder," a murderer is watched by the spirit of the murdered man; and in "No Thoroughfare" the murderer (as he himself supposes) is confronted at the end by his supposed victim.

We need not wonder if it shall appear that the denouement of Edwin Drood was to turn on the watch kept on a murderer by a man supposed to be dead and not merely buried but destroyed in his tomb. The culminating horror of "a dead man rising from the tomb to confront him" on which Dickens dwells in the last scene of Jonas Chuzzlewit's villany, was to be actually wrought into the plot of "Edwin Drood."

(To be continued.)

H.M.S. *AGAMEMNON.*

THIS vessel, which is an armoured citadel turret ship of the *Inflexible* type, has recently been ordered to proceed to the Mediterranean. She has been hurriedly prepared for sea service after being nearly nine years in process of construction and undergoing alterations and modifications of various kinds. Her estimated cost has been enormously exceeded, and we recommend any member of Parliament, who wishes to learn something really worth knowing of how money is spent upon our ships of war, to move for a return of the estimated and actual costs of all the ships recently added to the Navy, with the cost also of alterations and additions made to the vessels now in progress. This information would show how much of the present wasteful expenditure is caused. The *Agamemnon* is one of those vessels which has enormously exceeded her original estimates, and has been nearly nine years building instead of the four—the time at first estimated. It may be supposed by some that an approximation to perfection is reached as a result of all this vast expenditure of time and money. This is not the case, however, with the *Agamemnon*. She is going upon active service with steering power so defective as to make her a terror to her officers, and dangerous, in some circumstances, to herself. Her movements are of a very erratic and uncontrollable character, and she cannot be kept properly in command by the helm. Steering is one of the most important qualities for a fighting ship to possess, and constitutes one of the prime elements of efficiency. The *Agamemnon* is being sent upon active service with this essential quality disgracefully and dangerously deficient. It is said that if the officers find that they can do nothing with her she is to put into Malta for alterations. How can Malta do what it has been impossible to do here in nine years? or, if not impossible, why was it neglected here? The cause of the defective steering is plainly to be seen in the form of the stern, which is so ingeniously contrived that the water is prevented in almost every possible manner from properly acting upon the screws and rudder. We commend a study of this stern to naval architects as an example of what should be avoided in designing the after-part of a ship. A model should be obtained for every naval museum.—*Engineering*.

Reviews.

SOME BOOKS ON OUR TABLE.

Annual Report of the Smithsonian Institution for the Year 1882. (Washington: Government Printing Office. 1884.)—Anyone who may feel even a lingering doubt as to the ample sufficiency of private enterprise and munificence for the encouragement and development of scientific research, may surely have that doubt dispelled at once by the perusal of the massive volume now lying before us: for its 829 closely printed pages contain records of investigations, explorations, and researches of the greatest possible importance; of the distribution of publications invaluable to the student of science; and of what may fairly be termed the effective general superintendence of the various branches of physical and natural science in the United States by an Eclectic Council, without any appeal to the national exchequer at all. Apart, however, from its instructive character in this respect, the latest Smithsonian Report may well be read for the vast mass of matter of the highest value contained in its appendix, which is made up of reports on recent progress in every department of science, besides papers specially relating to anthropology. Everybody who wishes to be *au courant* with the present condition of scientific knowledge should read this magnificent tribute to the wisdom and generosity of James Smithson.

The Church of England Sunday Service Book. Continuously arranged for 1885. Morning. (London: Henry Frowde, Oxford University Press. 1884.)—This is neither more nor less than a sequence of the complete services for the fifty-two Sundays of the forthcoming year exactly as they will be read in every church in the kingdom. All church-goers are familiar with the perfectly needless trouble inflicted on them by having to turn backwards and forwards through the ordinary Prayer-book, and will doubtless welcome this very much more simple and intelligible arrangement. The very low price at which the work under review is issued, places it within the reach of all.

Results of Rain and River Observations in New South Wales during 1883. By H. C. Russell, B.A., F.R.A.S (Sydney: Thos. Richards. 1884.) *New South Wales: Physical Geography and Climate. New Double Stars.* Same author.—In the two first works, whose titles head this notice, Mr. Russell deals exhaustively with the climate of New South Wales, and furnishes information of interest and importance to the settler. His "Catalogue of 130 New Double Stars" forms a valuable contribution towards our, at present not very perfect, knowledge of the Southern Heavens.

The Amateur Review. No. 1, October, 1884. (Crouch Hill: S. C. Collins. 1884.)—Abundantly justifies its title.

The Voice, Musically and Medically Considered. By Armand Semple, B.A., M.B. Cantab, &c. (London: Baillière, Tindall, & Cox. 1884.)—Every one who sings, or who proposes to acquire that delightful accomplishment should read Dr. Semple's instructive little pamphlet. Professing in this, his first, part to deal with musical considerations alone, our author yet interpolates something as to the anatomy and physiology of the human vocal organ. He classifies the various voices from bass up to soprano-sopracuto; discusses "timbre," the various registers, and the common defects of the voice; and points out in simple language the methods of rectifying them. He has given the musician a very useful little book indeed.

Reed Farm. By Mr. Robert O'Reilly. (London: Hodder & Stoughton. 1884.)—In these days of exaggerated and but too often prurient sensationalism, it is a positive relief to a healthy mind to take up a book so purely natural in its story and so innocent in its teaching as this. "Reed Farm" is a story about simple working people and their surroundings. As we turn its pages, the scent of the spring blossom, of the summer hay, and of the autumn fruit seems to fill the air around us; while we realise the individuality of each of the characters throughout the tale. "Chris" might be an elder brother of "Tiny Tim;" indeed, his interview with Aunt Betsy (unfortunately, too long for extract here) reminds us strongly of the master who created the poor little crippled child of old Scrooge's clerk. One conspicuous merit of this really charming book is, that while a reverent spirit pervades it from end to end, the "goody-goody" element is wholly eliminated from it. It would be hard to find a more attractive birthday present for young people verging on manhood and womanhood than this.

Heath's Fern Portfolio. By F. G. Heath. (London: Sampson Low, Marston, Searle, & Rivington. 1884.)—Nothing more beautiful in the shape of botanical illustration than these life-sized and life-like drawings of the fronds of our British ferns has ever been issued. To the fern-collector Mr. Heath's work is indispensable, if it be merely on account of the facilities which it affords for the identification of varieties not very commonly met with. In fact, so admirably are the figures drawn and coloured as to be, for all practical purposes of comparison, equivalent to the plants which they copy with such minute fidelity. Even as an ornament for a drawing-room table the book is not without its value.

Our Difficulties and Wants in the Path of the Progress of India. By Syed Mohammad Hossain, M.R.A.C. of Lucknow. (London: W. H. Allen & Co.)—This work of a thoughtful native, written in excellent and readable English, will, we hope, find its way to the India Office. It is impossible to govern any country upon purely theoretical principles, and the practical lessons to be learned from the study of grievances from the point of view of the persons aggrieved are never lost upon the true statesman. Accepting Mr. Hossain's statements as in the main correct, there is apparently much that calls for reform in the details of our local Indian administration.

The Botany of Bermuda. By General Sir J. H. Lefroy, F.R.S. (Washington, 1884.)—This is a *catalogue raisonné* of the whole of the vegetable productions (fungi excepted) of Bermuda, by its quondam Governor, and forms a very useful contribution to botanical science.

Public Examination Scripture Manuals. The Church Catechism. By Arthur Riches, F.R.A.S. (London: Relfe Bros.)—The chief value of Mr. Riches' little book lies in the detailed explanation it gives of the various questions in the catechism, and of the replies to them; the illustrations of which are abundant and complete. The Revised Version of the New Testament is quoted throughout.

We have received, too, Dr. H. E. Armstrong's Address *On the Teachings of Natural Science*, delivered at the Health Exhibition on Aug. 5, in which the author, as we think legitimately, finds grave fault with the existing system of science teaching, and offers eminently practical suggestions for its improvement. Although Dr. Armstrong derives his illustrations from that branch of science with which he is especially identified, chemistry, yet his remarks may well be laid to heart by teachers of other scientific subjects.

THE FACE OF THE SKY.

From November 7th to November 21st.

By F.R.A.S.

The sun will be examined on every clear day with the telescope for the spots and groups of spots and faculæ which still continue to appear. Map XI. of "The Stars in their Seasons" shows the aspect of the night sky. On the night of the 15th, a maximum of χ Cygni will occur ("The Stars in Their Seasons," Map IX.). At and after midnight, from the 12th to the 15th, and especially on the 13th, watch should be kept for the shower of shooting stars which seems to radiate from a point to the right of ζ and γ Leonis ("The Stars in their Seasons," Map IV.), hence called the "Leonids." Mercury is, for all practical purposes, invisible during the next fortnight. Venus continues to be a morning star, but rises later and sets sooner every day. She is still very brilliant before sunrise. Mars is invisible. Jupiter rises about a quarter past 12 at night on the 7th and at 11h. 22m. p.m. on the 21st. Hence he is inconveniently situated for the ordinary amateur observer. We shall not give any details of the phenomena of his satellites until they begin to occur before midnight. Saturn is visible during practically the whole of the working night; he is still a little to the north of ζ Tauri ("The Stars in their Seasons," Map. I.). Uranus cannot be seen; but Neptune may be fished for in the confines of Aries and Taurus, in a blank region of the sky. The moon enters her last quarter at 11h. 22·4m. p.m. on the 9th, and will be new on the 17th at 6h. 11·7m. in the evening. Hence but little will be seen of her during the succeeding fourteen days. She will occult two stars only at convenient hours during that time. The particulars of the first occultation were given a fortnight ago, but we will repeat them here. To night, then, at 11h. 14m. the 5½ mag. star, 68 Geminorum, will disappear at the moon's bright limb at an angle from her vertex of 35°, reappearing at her dark limb 14 minutes after midnight at a vertical angle of 237°. To-morrow night (the 8th) B.A.C., 2,872, a 6th mag. star, will disappear at her bright limb at 12h. 16m. p.m., at a vertical angle of 50°, to reappear at her dark limb at 1h. 18m. the next morning, at an angle of 213 from her vertex. The Moon is in Gemini to-day, but crosses into Cancer at nine o'clock to-morrow morning (the 8th). Her passage across Cancer takes her until 11 p.m. on the 9th; when she enters Leo. Through this she travels until 5 a.m. on the 11th, when she descends into Sextans; re-emerging in Leo at 4 o'clock the same afternoon. She does not finally quit Leo for Virgo until 5 p.m. on the 12th. It is 2 a.m. on the 16th ere she has traversed this great constellation and entered Libra; her passage across which occupies her until 3 a.m. on the 18th. She then enters the narrow northern strip of Scorpio, leaving it at 1h. 30m. the same afternoon for Ophiuchus. This she traverses by 1 p.m. on the 20th, when she crosses into Sagittarius. She is still in Sagittarius when these notes terminate.

Miscellanea.

It is stated that Lieut. Greely is about to visit England with the view of publishing here his work on "Arctic Exploration."

The only Gold Medal for maps gained by any British exhibitor at the International Health Exhibition, South Kensington (Class 48, Education), has been awarded by the International Jury to Mr. Edward Stanford's exhibit in the Royal Albert Hall.

M. Alph. Favre has, says the *Athenæum*, constructed a map of the erratic phenomena and ancient glaciers on the northern slope of the Swiss Alps, and of the Mont Blanc range. This map is drawn to the scale of 1 : 250,000, and indicates the extreme development of the old glaciers, the glacial drift, erratic boulders, and moraines deposited during the period of glaciation.

Mr. Eltringham, boiler-maker, South Shields, has just lighted his works by means of twelve Brush arc lamps, driving the dynamo machine from his works engine. The work has been carried out by the Hammond Electric Light and Power Supply Company, and great satisfaction is expressed as to the way the installation has been made.

Professor Milne in the *Transactions* of the Seismological Society of Japan publishes a paper "On Earth Tremors," in which he deals with natural tremors and such as are artificially produced, and he describes the instruments constructed to record these minute movements. These motions appear to be more regular than earthquakes, and as yet the two disturbances cannot be connected. The new branch of science which is directed to the observation of these minute tremors is to be called micro-seismology.

"Put in a Penny and Pull out a Post-card Company."—A correspondent writes to the *Morning Post*:—"Will you allow me, through the medium of your columns, to thank the directors of the 'Put in a Penny and Pull out a Post-card Company' for their excellent invention, by means of which anybody can, by dropping a penny into the machine, obtain a post-card? Anxious to instruct a cousin of mine in the working of this invention, I yesterday dropped the required coin into a machine in the Central Gallery of the Health Exhibition, and was pleased to find that I was rewarded for my trouble by receiving no less than seven post-cards. I trust that more of these interesting and useful conveniences may shortly be scattered over the metropolis."

The editors of Dickens's correspondence have ascertained that a most interesting record of his connection with the *Daily News* is still in existence. This is a diary kept by the sub-editor, Mr. Dudley Costello, containing the directions given by Dickens from day to day as to the conduct of the journal. The subjects for leading articles are noted, and directions are given as to the persons by whom they are to be treated, and the manner of treatment. As the editor of *Household Words* and *All the Year Round* Dickens is known to have been most careful in selecting subjects and supervising his contributors, and it now appears that he had been equally vigilant when editing the *Daily News*. When these fresh particulars are made public, an interesting view will be given of a part of his career about which comparatively little is set forth in his biography.

Snake Mortality in India.—From a Government return issued within the last few days it appears that in the year 1882, 19,519 human beings lost their lives through the bites of venomous snakes in the presidencies and provinces of British India alone. This is a higher number than any reported in the previous seven years, but the increase may be more apparent than real, and due to the returns from outlying districts being more complete. The highest number of deaths is reported from Bengal—9,191; next come the North-West Provinces and Oudh, with 5,080; Bombay, with 1,190; the Central Provinces, with 1,058; the Punjab, with 929; and Madras, with 920. During the same year rewards amounting to £1,487 were paid for the destruction of 422,421 snakes.—*Medical Press and Circular.*

Death from Lightning.—At a recent congress of German medical men, held at Magdeburg during the end of September, a paper was read by Herr Heusner on the effects of lightning stroke on human beings, and the author showed that when the lightning discharge passed through the skin its passage was much easier, that is to say, the internal organs are much more conductive than the epidermis. This fact was pretty well known, but it is not so well-known that the brain and spinal cord are apparently conductors, and hence a lightning stroke on the head does not materially injure the brain beyond shattering the nerves, and causing temporary derangement. Most persons struck by lightning do not remember anything about the stroke; but others describe a sensation such as would be caused by their being struck a heavy blow, and some have likened the shock to what they would be supposed to feel if torn into small pieces. The subject is an obscure one, but happily it is now beginning to engage the attention of physiologists as well as physicists.—*Engineering.*

THE success of the Health Exhibition was not assured from the outset. But curiosity to know what it would be like helped it in its early days. The opening ceremony was performed to time; but the inflow of visitors, through the incompleteness of the arrangements and the known arrears, was slack. The third week of May, however, found the public current flowing in on a par with the like period of the year before. From this time forward the popularity of the Healtheries exceeded that of the Fisheries. In June the weekly totals were 151,000, as against 73,000 in the previous year. From June to the end of July the superiority of numbers became still more marked, the weekly totals rising to 170,000, as against 94,000 in 1883. In August the average weekly totals were 171,000, as against 115,000. The proportion in September rose yet higher, being 187,199 to 107,103. Since then the ratio of the totals has been further increased, the three weeks to October 18th averaging 216,615, against 127,698. The following week's total was 260,575. The grand total of the Fisheries returns was 2,703,051 at its close on October 31st. The grand total of the Health Exhibition returns up to the close amounts to 4,167,683.

ROYAL VICTORIA COFFEE HALL, WATERLOO-BRIDGE-ROAD, S.E.—On Tuesday, 28th ult., a lecture was given by Mr. J. W. Groves at the above hall on "Plant and Animal Mimics," S. Morley, Esq., M.P., in the chair. The lecturer explained that the mimicry in question was unconscious, and its end was usually either to protect the animal or to enable it to reach its prey unperceived. Thus the lion was the colour of the desert sands, so was the camel. The tiger was striped so as to be hidden among the brownish leaves and stems of the bamboo. The leopard's spots made it difficult to be seen among the shadows of foliage. Turning to fish, the flounder, sole, and many others were marked and coloured like the sand and shingle. Among birds, the ptarmigan was not only coloured in summer so like the heather that the dogs pass close to her without perceiving her, but her winter plumage was white like the snow, and the colours of most hen birds were adapted for concealment while they are sitting. But in the insect world protective resemblance was carried to its highest perfection. The leaf insect was hardly distinguished from the leaves it frequents, and the stick insect, used in the manufacture of artificial flowers. Some insects were protected by having such an unpleasant taste or smell that the birds learned to leave them alone, while others, without the unpleasant taste, were protected by being shaped so like the others that they were mistaken for them. A large number of photographic lantern illustrations were shown. The next lecture will be on Nov. 4 by Rev. W. Tuckwell, the subject, "A Bank Holiday among the Hills." Some unusually good ballad concerts have been arranged for the Thursdays in November at the above hall. On Nov. 6 Mdme. Evans Warwick will give the concert, in which the talented Mdme. Adeline Paget, as well as other popular artistes, will take part.

A FEW days since a little girl, whilst attempting to cross the road in Northgate, Hartlepool, was run down and killed by a steam tramcar. Every effort was made by the driver to warn the child of her danger, but without avail, and her body was dreadfully mutilated. There is no reason on earth why this sort of result should follow such an accident, and if tramway vehicles were properly guarded it would be impossible; and such fatal results would not accrue if due and proper precautions were taken by oramway managers. Of late a number of similar fatal accidents have occurred in different parts of the country, and which would not have proved fatal if proper means had been adopted to prevent those who happen to be on the line from passing under the car. At one time no attempt was made to provide cars with any guard by which any obstruction would either be carried along or pushed off the rails, instead of being run over. Latterly, on some lines guards have been affixed to cars in certain towns, which would in most cases push a person along or off the rails, but these are not yet attached to all. Considering the nature of tramcar traffic, whether horses or steam motors are employed, it should be considered imperative, if only in the interests of tramway companies, that the best means of preventing fatal accidents should be provided. In very few cases, however, has this been done, and it can hardly be looked upon as less than criminal negligence that this should be the case. A guard which would be effective in preventing even a child from passing under a car or tramway engine from the front could be made by almost any mechanic who might be asked to do it, and it is high time that all tramway companies should be called upon to provide all cars and tramway engines with such a guard. There is nothing to prevent the application of a form of cow-catcher to all tramway vehicles, and it should be within the power of the Board of Trade to call upon all tramway owners to adopt such a thing under compulsion.—*Engineer.*

TO CORRESPONDENTS

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

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.

WINE COOKERY.

[1493]—The revelations of Professor M. Williams in your pages are deeply interesting. Will he kindly supplement them by other instructions in elementary analysis of wine?

Some years ago I experimented, according to "Griffin's Wine-testing," upon various kinds as to their alcoholic strength, acidity, and saccharine matter; but that system gives no help in detecting adulterations. So, after reading your articles of the 10th and 24th inst., I made a saturated solution of barium chloride in distilled water, and added a little to test-tubes containing different wines. The effect on choice dry sherry *was* a caution! Madeira showed only a slight turbidity, hock slightly more, and claret hardly any. Is this substance as good a test for these other wines as for sherry? And does it follow that there must also be a precipitate in the process of digestion?

As to the late ex-Emperor, it was said that his favourite wine was champagne rather than dry sherry; and I have heard it stated that one danger of the former is that it may be only rhubarb wine in disguise, because that means oxalic acid; and where much lime (whether in water or in food solids) is taken simultaneously, that means a deposit of oxalate of lime, or calculus, the disease to which Louis Napoleon succumbed. Supposing this to be true—of which I know nothing—it would seem to be prudent in the male sex to avoid rhubarb as a vegetable altogether.

There are, no doubt, many of your readers who, like myself, find they are better with a little (a very little) wine, than without; and Professor Williams would earn our best thanks by telling us how to detect deleterious substances (other than sulphuric acid) in the wines commonly met with. VILE POTABIS.

COCOA *v.* TEA.

[1494]—Supplementary to Mr. Mattieu Williams, my own experience of the relative effects of tea and cocoa may be not without interest. Up till about February of the present year it was my custom to take cocoa daily about 5 p.m., falling asleep at nights within half-an-hour of retiring. For seven months after that period (till a fortnight ago, in point of fact) I substituted tea for the cocoa, with the result, as I now know, of inability to attain somnolency within $1\frac{1}{2}$ to 2 hours after going to bed. The cause was suggested by certain correspondence which of late has appeared in the pages of KNOWLEDGE. It is almost superfluous t add that the cause has been removed; I have reverted to cocoa-drinking, and once again enjoy a respectable quantum of "tired nature's sweet restorer." JOHN BELL.

EUCLID'S THEORY OF PARALLELS.

[1495]—In your "Chats about Geometrical Measurement," p. 337, line 5 from end, you say that Euclid's 12th Axiom is "no axiom," as "the converse is demonstrated in the 17th Proposition." If this were the *logical* "converse" of the axiom, so as to follow immediately from it, there *would* be some absurdity in making the first statement an axiom and the second a theorem. But this is not so. The two statements are of the form "all X is Y," and "all Y is X;" and it is so far from being the case that, if one of these be axiomatic, the other is axiomatic, that it may easily happen that one is axiomatic, while the other is not even true.

Again, at p. 338, col. 1, last line, you say "it is evident that K L = C H." If this were once granted, you would not need the diagram in col. 2, you need only say "join H K. These triangles have all their sides equal. Therefore angle C K H is equal to angle K H L. Therefore the three angles of the triangle H C K are equal to the three angles K C H, H C K, K H L, *i.e.*, to two right-angles. But *any* given right-angled triangle may be treated like this, and any triangle may be divided into two right-angled triangles. Hence the angles of any triangle are equal to two right-angles." This proves Euc. I. 32, after which all is easy.

Again, in col. 2, you claim to have *proved* Simson's axiom that two lines through a point cannot both be parallel to a third line. But you have only proved this for "parallels" as you define them, viz., "lines which have a common perpendicular," and so have not proved *Simson's* axiom at all. This is, I fear, a logical flaw in your argument. C. L. Dodgson.

Ch. Ch., Oxford.

"WHAT LARGE EYES YOU HAVE, GRANDMAMMA!"

[1496]—Whoever walks through a good collection of fossils, arranged according to strata, or turns over many engravings of them, is likely to be struck by one distinction, I think, between the majority of animals prior to a certain date and all those since. Those that now have eyes, or that had them in the Tertiary, the Cretaceous, or the Wealden times, have those organs very small compared to the great eyes prevalent of old both in the vertebrate and lower classes. If our crocodile be descended from the ichthyosaur, for instance, or our shrimp or crayfish from a trilobite, might not these moderns address to their ancestors Ridinghood's exclamation to her sham grandam? Is any reason yet suggested for this seemingly sudden and unique change of fashion between the Oolite and Wealden days? If not, I can propose one; but would like to hear first of any existent theory. E. L. Garbett.

MAY-FLIES.

[1497]—Mr. F. W. Halfpenny's query (1487) will be found answered in Knowledge for Oct. 10, p. 294. May-flies are the only insects that cast the skin after acquiring wings.

E. A. Butler.

THE ECLIPSE OF THE MOON OF OCT. 4.

Morar, Oct. 5, 1884.

[1498]—I have witnessed many total lunar eclipses, but for impressiveness, completeness, and length, none approach that observed last night.

In every sense of the word it was a total eclipse, the moon being almost obliterated from the sky for an hour and a half. To the naked eye, a mere nebulous blotch remained, recognised with difficulty, and a powerful binocular only just revealed the disc.

The totality I have hitherto observed has always been confined to a rusty or smoky veil, through which the lunar surface was distinctly traceable. In the present instance, an inky pall veiled the orb entirely, and its nature was revealed at first contact, for it was at once apparent that the moon was caught in the umbra, the penumbra being barely visible (Fig. 1). During totality, you could dimly discern through the inky pall a still blacker configuration,

Fig. 1.

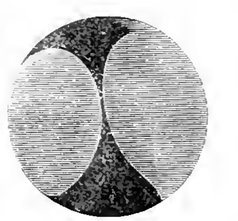


Fig. 2.

as if of two triangular continents connected by a lengthy isthmus (Fig. 2). This eclipse was further characterised by a combination, I fancy, of rare occurrence, and that was an occultation. The behaviour of the star was quite new to me, for it certainly descended (apparently) behind the moon, from its position to her N.E., as regarding the top of the moon as N. I did not witness emergence.

Kindly let me know if you noticed at home the blackness of this eclipse, and what I have advanced regarding the occultation.

R. F. Hutchinson, M.D.

[Dr. Hutchinson's observation, made at a distance of upwards of 4,500 miles from Greenwich, as measured on a great circle, possesses high interest; as showing that the extraordinary obscuration of the moon during the late eclipse, so far from being local, was seen over a very large area of the earth's surface; and lending additional weight to the idea that it must have had its origin in the existence of some semi-opaque material in our own atmosphere which hindered the ordinary refraction of the solar light into the earth's shadow. The markings shown in Dr. H.'s sketch of the totally-eclipsed moon I am unable to explain. Numerous minute stars were occulted in England during the eclipse, but, of course, parallax would carry the moon wide of these as viewed from Gwalior.—Ed.]

TWO-SPEED GEARINGS.

[1499]—C. Webb can have Hirst's two-speed gearing applied to his front-steering tricycle. The increase in the weight of the machine would be about 5 lb. to 6 lb. The change can be made best from speed to power while travelling. The same crank will answer if there is length sufficient to take the lower clutching apparatus. As regarding price, I must refer Mr. Webb to the maker.

John Browning.

A NEW PHOTOMETER.

[1500]—The following is, I believe, an entirely new discovery, and, at all events, sufficiently important to bring before your readers. It is due to Dr. Gorham, of this town. It is a well-known fact that the iris performs the duty of regulating the amount of light which passes into the interior chamber of the eye by enlarging or contracting the diameter of the pupil. But has it ever occurred to any one before that the eye can be used as a photometer? By means of a little instrument of his own invention, Dr. Gorham is able to measure the diameter of his pupil, and has proved, by a series of measurements, the number, of which he reckons by thousands, that, for the same kinds of light, the measurement of his pupil is invariable. The gradual diminution of the size of the pupil as dawn gives way to daylight, and the increase as daylight gives way to evening twilight—the minimum being reached about an hour or an hour and a half after midnight—on each successive day, combined with numerous experiments on candle-light, gaslight, and other lights seems to place it beyond doubt that Dr. Gorham's pupil photometer is an accurate way of comparing the intensities of various sorts of light. Is it not a curious thing that this fact was not discovered years ago? To my mind, this photometer far excels those of Rumford or Bunsen.

Tonbridge. E. A. Tindall.

[That Dr. Gorham's "Pupil Photometer" will ever supersede those of Rumford or Bunsen as a *quantitative* measurer of light, is, I think, very doubtful. Will Dr. Gorham—or Mr. Tindall—favour us with a more detailed description of it, though?—Ed.]

TRADUCING A TALISMAN.

[1501]—The "potent talisman" in letter 1490 is only our old friend the "magic square" thinly disguised.

8	11	14	1
13	2	7	12
3	16	9	6
10	5	4	15

Add 1479 ($= 29 \times 17 \times 3$) to each of the numbers 9 to 16, and you may imagine yourself "to have full command over demons, fairies, and enchanters." But whether this happy result is produced by the magic square arrangement or by the addition of 1479, probably only the Asiatics (whoever they may be) can say.

If "A Lover of Things Occult" wishes to probe the dread secret of his talisman, he may at his leisure verify the statement that there are exactly 72 ways in which, by adding together four of the numbers on it (more or less symmetrically arranged), he may obtain 2,992. I do not understand "things occult," but I should imagine this ought to be done at midnight amidst suitable surroundings—skull, cross-bones, &c. W.

LETTERS RECEIVED AND SHORT ANSWERS.

J. Murray.—You need not be under the slightest apprehension of ever becoming too wise; or that, during your brief span of life, you will, in respect to knowledge, ever be like Alexander, who wept because he had no more worlds to conquer.—Sirius states that last year's phenomenon of a green moon is now recurring, and was seen at Anerley on the 26th ult. If you read through the articles on

"Nights with a 3-inch Telescope," you will find all the leading double stars and nebulæ, which are well within the power of such an instrument, are described and a large proportion of them illustrated.—"F.R.A.S." writes that he is only waiting until the inexplicable haze which has surrounded the sun for so many months disappears, to complete his series of papers with a drawing and description of Mercury.—JOHN SEWELL. In these columns.—H. D. I have never heard of the publication of any work on the arrangement of facts. Why do you not get a shilling memorandum-book, and divide it into sections headed, Philosophy, History, Politics, Theology, Literature, Science, &c.; subdividing the latter into Mathematics, astronomy, physics, natural history, and so on; and enter your facts under their appropriate headings. I regret that your former letter was overlooked, as it very well may have been, among the hundreds received.—WM. J. DAVIES. I cannot understand how brilliance, however intense, could convert the visible portion of the moon's limb into a seemingly parabolic curve. I should rather refer this illusion to the intersection of the two arcs of different curvature, those, I mean, of the moon's limb and of the periphery of the earth's shadow. See KNOWLEDGE, Vol. I., p. 70.—A COUNTRY LAD. I have never even heard of the book you mention, which is assuredly *not* a "standard" one. The second person you mention is a mere ranter, and is not the very slightest authority on any scientific question whatever. — MUSAFIR. See reply to "The Ghost of a Little Boy," on p. 373. The latter half of your letter has been anticipated in a hundred cases, as you will ere this have learned. — JOS. W. ALEXANDER. Very much too long for insertion: a thing to be regretted, inasmuch as you advance something worthy of serious attention, could you only compress it into about a tenth of the space.—ENQUIRER. Probably your "Man-frog" *did* swallow some water with his cake. The performance is quite genuine. Beckwith, of London, Reddish, of Liverpool, and others continue to do the same thing.—W. H. S. MARK. The subject has been sufficiently discussed.—JOHN BELL. They will be re-published in a book-form, upon their completion here.—IGNORANCE. From the most elementary properties of numbers. See any book on the higher arithmetic. The date of the submersion of oak in bogs varies. In Denmark, the fir-tree seems to have flourished in immediate succession to the last Glacial Period. This was succeeded by the oak, which was coëval with the "bronze age" of anthropologists, as that was in turn by the beech. Sir Charles Lyell ("Antiquity of Man," p. 17) says that there is nothing in the growth of peat opposed to the conclusion that the Danish bogs may be 16,000 years old. I know nothing specifically of the Newmarket "Devil's Dyke;" but it is a name applied all over the country to Roman and other fortification lines.—THOMAS WILLCOCKS and R. COUPLAND THOMAS. You will see from the announcement on p. 329, that the "Life after Death" controversy is now closed. Yours are both letters which cause me to regret that they did not reach me sooner. Quires of correspondence on this subject found their way into the waste-paper-basket.—A. G. There is nothing to wonder at when we remember that refraction raises an object really on the horizon nearly 35′ (or more than the diameter of the sun or moon) above it. Had our atmosphere been removed, the eclipsed moon would have set before sunrise.—GEORGE R. SAUNDERS. Visible occultations of planets by the moon are not very common, but are by no means the rare phenomena you imagine. For example, Venus was occulted on Feb. 29th of the present year (see Vol. V. of KNOWLEDGE, p. 131); Mars was occulted on June 3, 1878, &c. For the dates of such occultations I can only recommend a hunt through back volumes of the *Nautical Almanac*.—Z. If by "names of the Stars" you mean their Arabic names, you will find these appended to the maps published in our earlier volumes, and reproduced in "The Stars in their Seasons." It would crowd the projected maps to an extent rendering them scarcely intelligible were the name of each individual star printed against it.—LANCASHIRE. No reward has ever been offered for the trisection of an angle or arc. Besides, if there had been, yours is not a solution. The problem is an *impossible* one, if you are confined to the straight line and the circle. For approximate mechanical methods, see Vol. I. pp. 117 and 166.—G. H. DANN sends me a copy of the *Port Elizabeth Telegraph* (South Africa), with carefully-written local "Astronomical Notes" for October.—DR. GROTH. I have read your pamphlet entirely through. Forgive me for saying it is full of fallacies from beginning to end. (1) Gravitation cannot possibly be identical with electrical action. The latter takes a perfectly measurable time to travel; the action of gravity must be *instantaneous*. If not, you, with your mathematical attainments, must see at once how the motion of the earth in her orbit would be affected. (2) Orbital motion, *per se*, could never cause axial rotation. (3) The idea of the sudden recession of the earth from the sun at the epoch of the flirting off of each successive interior planet is wild in the extreme. The mass of Venus is $\frac{1}{401035}$th, and that of Mercury $\frac{1}{4862133}$th, that of the sun! What sensible or appreciable difference could the abstraction of these infinitesimal fractions of the sun's mass have upon his attractive power at the earth's distance? (4) Your assumption of the sun's *fluidity*, when he was even hotter than he is now, is perfectly unwarranted. See "The Sun a Bubble," in "Science Byways." (5) Your dynamics are not as the dynamics taught at Cambridge in your view of the formation of the planetoids. Your alleged cause is wholly inadequate to produce any such effect. (6) Your "Glacial Period" theory postulates the creation or projection of Mercury from the sun within the human period on the earth! (7) "Phosphorescence" is *not* seen on Venus "near the time of the planet's greatest elongation," but when she is in inferior conjunction. (8)—But need I proceed? *Ex uno disce omnes.*—Some ANONYMOUS CORRESPONDENT sends me "La Petite République Française," with a pretty severe historical retrospect of the martyrdom of Étienne Dolet. Men consigned their theological opponents to material fires in those days. Now, they condemn them to an immaterial conflagration; but the old spirit survives.—A. H. SOMERSCALES forwards a cutting from a Hull paper of the most remarkable tides which have been observed at Hull during the week ending Nov. 1, and what seems in some way to have been referable to the very heavy N.W. gale which blew on October 26. On that day it was high water at 10h. 40m. a.m. and 8h. 40m. p.m. Moreover, after flowing for 1h. 20m. after its theoretic time, it held up for three-quarters of an hour. A similarly anomalous condition of things appears to have prevailed up to October 29. — DR. DAVEY sends me a small volume of his own "On the Nature and Proximate Cause of Insanity," published in 1853, in which reference is made to a paper by the author in the *Lancet* for 1844. Forty years ago we find Dr. Davey insisting on the duality of the brain, and pointing out that the doctrine is as old as Boerhaave, and possibly even as Hippocrates! I intimated on p. 287 that a packet of re-directed letters had somehow gone astray. This was written at the end of September. This morning (Nov. 3) the packet has turned up! having been delayed by carelessness so utterly scandalous as would have ensured the dismissal at once of any one in private employment, but which is simply "regretted" by the Post Office. Luckily, beyond a Post Office-order sent by J. KENNEDY ESDAILE, it contains nothing of great importance. Had Mr. E. only addressed his letter to the *Publishers*, this would have reached them some five weeks sooner.—W. B. writes on "Brain and Mind."—ALBERT WILLAN, THOS. J. HOGG, PROTEA, H. DAVEY, and E. H. TROWER all send solutions of Mr. Sidder's figure puzzle.—AN ANONYMOUS WRITER who wants a book reviewed, is informed that it only does mischief to give wide publicity to rubbish.—N. S. gives an account of a meteor seen in Guernsey on Sept. 18th; and JOHN E. STEWART of another observed at Dundrum on Sept. 22nd. Thanks to Mr. Fawcett's subordinates, these communications are a little out of date now.—PUZZLEHEAD, FRANKLIN J. SONNENSCHEIN, T. B. S., JAS. SMITH, CHAS. G. DEWBERRY, G. WOODCOCK, HENRY PETERS, FRED. D. HENDERSON, F. G. S., J. C., and C. L. DODGSON, one and all point out that the "problem" contained in Letter No. 1490 (p. 372) is nothing but our venerable friend, the Magic Square. No one, however, attempts to show the connection between the figures, and the power they are alleged to possess "over demons, fairies, and enchanters."—EDWARD IRVING. I regret that you should be so severely exercised by the expression "undoubtedly." Be this as it may, there can be very little question that the existing date is wrong. Thanks for the kindly conclusion of your letter.—W. CAVE THOMAS. If it be the fact, as you allege, that you "have killed long since" the theory of three primary colours, I would suggest that you should forthwith communicate with Lord Rayleigh, the Professor of Experimental Physics at Trinity College, Cambridge, in order that he, Mr. Glazebrook, and a few others usually accepted as leading authorities on physical optics, may hold an inquest on the remains of the deceased hypothesis. Have you ever read Nood's "Modern Chromatics," in the "International Scientific Series"?—A. M. D. Thanks for your very friendly letter.—H. N. SMITH. I am wholly ignorant of the extent to which the late Mr. David Urquhart cooked himself in the Turkish bath, or what was the maximum heat he there endured. Chabert, the "Fire King," remained in an oven while meat was cooked, but, of course, he stood upon felt or some other non-conducting material, while the meat lay upon heated metal. A surreptitious test of his oven, though, showed the temperature to be 220° Fahr., and the steak was grilled on concealed charcoal embers.—J. R. SMITH. I accorded you all the space at my disposal on pp. 348 and 349, and can assuredly spare you no more, merely to reiterate, without one fragment or atom of *proof*, that brass was a "primordially formulated metal"—and so on. You entirely ignore the offence (not to say disgust) given to a large mass of readers who really possess some knowledge of the rudiments of science, by the insertion of such utterly wild and foundationless guessing as yours.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

A GOOD GREENHOUSE BOILER.

We are now in full view of those night frosts which occasion such anxiety to all who have choice plants in their conservatories and greenhouses. Such horticulturists as may not be satisfied with their existing warming arrangements will, doubtless, be interested to know that Mr. J. Watson, florist, of St. Albans, Herts, has invented what is known as Watson's Patent Double-Action Suspension Arrangement. It is stated that quite half the usual cost in fuel is saved by using this boiler, which is claimed by the inventor to possess all the good qualities of the single-action patent (of which about 200 have been sold, without a failure), while it has nearly double the heating surface in the same size boiler. The cost of this boiler is economised, it is stated, in fuel, and it is claimed to be far superior to the saddle and wedge for large quantities of piping. It is manufactured, we understand, from the very best ⅜-in. wrought iron, and has the additional advantage of requiring the most simple setting. Orders for these boilers should be sent to Messrs. S. E. Ransome, 10, Essex-street, Strand, who are, we understand, the sole agents for Watson's well-known patent hot-water apparatus.

AN ECONOMISER WATERING-CAN.

Many persons fond of gardening, more particularly invalids having indoor plants, would, we fancy, like to know of a can that does not spill water over the ground or carpet, and which is capable of entire regulation as to flow with perfect ease. Messrs. J. Kaye & Sons, of 93, High Holborn, have invented a watering-pot of this description, for which the following advantages are claimed :—A neat and handy shape, favouring the admission of the pot (without catching) over and between plants closely arranged. Repeated tilting is needless, as the flow is let off by a touch of the valve, and the water can be so controlled (measured practically to the drop) that no overflow occurs nor does the foliage get wetted. The flow can be so regulated that vexatious and unsightly stages from the displacement of soil of newly-potted things may be entirely avoided. There is a total absence of "flushing." Then, again, secondary advantages accrue from the foregoing, as the saving of water and carrying; dry floors, so essential in winter, and desirable, too, in summer, until the watering is finished, in order to keep the feet dry. Among those for whom these improved watering-cans are specially calculated to be really serviceable are ladies and amateurs who wish to avoid the annoyance of escaping water, also those growing plants in carpeted rooms. The professional gardener, too, will find it a handy pot for such things as orchids, ferns, &c., requiring moisture carefully given. Finally, invalids, who so much enjoy the pastime of flower-growing, will find it the very article they need.

AN IMPROVED LAMP-BURNER.

Messrs. Hinks & Son, of Birmingham, and the Holborn Viaduct, London, have invented an interchangeable, lever-action, duplex burner (Joseph Hinks's patent), which supplies a facile means of lighting and trimming a lamp without removing the cone, globe, or chimney. The new burner possesses neither spring, bolt, hinge, nor other complication, so that it cannot readily get out of order, while it will accurately fit any of Hinks's ordinary past or present duplex lamps. A slight turn of the lever-key causes cone, globe, and chimney to smoothly ascend, thus giving free access to the wicks for trimming and lighting. The movement being perpendicular, the danger of over-balancing, breakage of glass, smoking of cone, or straining of mechanism (inseparable from all tilting or hinge arrangements), is obviated. With this arrangement a full light is maintained to the last drop of oil. By removing screws from bottom of slide-rods and of lever-rod, the burner can be taken to pieces. All persons using ordinary lamps will appreciate this invention, and accept it as a long-sought desideratum.

FURNACE SLAG AS A FINE ART MATERIAL.

What is claimed to be a marvel of inventive science has just formed a rather prominent exhibit at the late Brewers' Exhibition, and consists in a utilisation of that waste product, blast-furnace slag, into a material capable of being wrought up into a variety of art works. Slag is a mixture of minerals and silicates fused by the furnace, and so beautifully coloured by metallic oxides as to rival the finest marbles. Its extraordinary hardness, however, defied all tools, and it was only after seven years of experiments that a German chemist invented the means for softening the slag chemically, and while thus plastic, forcing it into steel moulds under hydraulic pressure. The substance then, while taking the finest art forms, retains all its delicate grain and variegated markings which constitute its special beauty. The Artistic Pottery Company, of Churson Works, Western-road, Wood-green, N., have taken up the conversion of slag into a great variety of ornamental and artistic articles, and as these range in price from sixpence to five guineas, it may be inferred that the range of the company's productions is very wide.

THE "CESTUS" BOILER.

At the recent Brewers' Exhibition, among the new inventions exhibited was one known as the "Cestus" boiler, for which the following important advantages are claimed :—Simplicity of construction, facility of access for examination or repairing, and, finally, great evaporative efficiency, and, as a resultant, economical use of fuel. Details may be had of the sole licensee, Mr. H. Fletcher. The only agents in London for these boilers are Messrs. Stevenson & Davies, of 11, Queen Victoria-street, E.C.

A PORTABLE KITCHEN.

Multum in Parvo is undoubtedly a guiding principle with much of the invention of the day, and it is very emphatically the case with the "Patent Compactum Cuisine," the invention of Mr. Alfred Parkes, of Zoar Works, Wolverhampton. This is quite like a conjuror's puzzle, for in a neat case resembling a rather large tin collar-box there are stowed away a saucepan and a kettle, each holding two pints, a basin, a frying-pan, a stand for lamp, tea and sugar caddies, tea-strainer, two cups, two teaspoons, a spirit-flask, two enamel plates, two knives, two forks, a water-pail, a spirit-container, a matchbox, and last, but by no means least, a "Hecla" lamp, with measure. This lamp is a well-constructed article, made of yellow metal; by the peculiar action of the methylated spirits, it produces a gas which is practically unextinguishable by wind or rain. The "Compactum" contains, in point of fact, just 25 articles, all well made and thoroughly fit for use.

LIFE-SAVING APPLIANCES.

That deaths from drowning—one of the most preventible forms of casual mortality—multiply is well known, and this fact has happily stimulated invention to furnish means for minimising water-risks. Cork has hitherto been greatly relied on, but it is not, we think, generally known that that material loses its buoyancy when exposed to damp. Even and granulated cork, so much relied on, loses, soon after immersion, one-fourth of its sustaining power. Mr. Joseph Sexton, of 3 and 4, Great Winchester-street, London, E.C., uses vaselin to treat cork, and by this simple means renders its buoyancy permanent. He encloses the cork, too, in waterproof cylinders, thus doubly protecting it. Experiments with life-belts made upon Mr. Sexton's principle have been tried at several of our sea-ports, and have given the most satisfactory results, the testimony of all who witnessed the tests being emphatically in favour of these belts. Mr. Sexton has also perfected an improved deck-seat on this principle for use in passenger vessels.

AN IMPROVED UMBRELLA.

Greatly as umbrellas have been improved of late years, there is still room for further progress. For one thing, umbrella-sticks are never strong enough to resist a really high wind properly unless when, on quite a clumsy scle, inadmissible in the case of those designed for ladies. Mr. William Temple Stephens, of 115, Wood-street, Cheapside, London, has, however, invented what seems to be a decided improvement in the springs and attachments of the same to the sticks or canes of umbrellas, parasols, or sunshades. The improved spring, of iron, steel, brass, or other metal, may be flat or round, and is secured by simply drilling two holes in the stick. One end is passed through one hole and rivetted in the usual manner. The spring may lie along the stick, for neatness, in a shallow groove, its other end terminating in a hook, shorter than in general to enable it to work in the other hole, which is slightly slanting and pierces the stick only for two-thirds of its diameter. The usual stop-wire is put across to keep the spring in position. The point of this invention is that the improved spring obviates the necessity for cutting the ordinary slit, which so greatly weakens the stick. This invention can be adapted to any size of umbrella, parasol, or sunshade.

Our Chess Column.

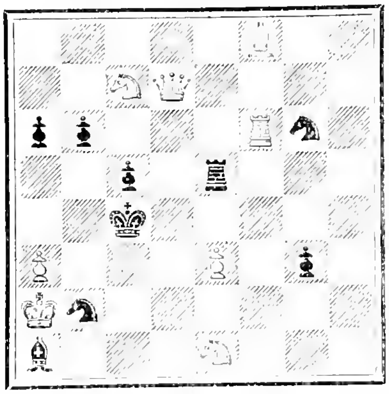
By Mephisto.

PROBLEM No. 135.

By J. Berger.

(From his collection of problems.)

Black.



White.

White to play and mate in three moves.

THE EVANS GAMBIT.

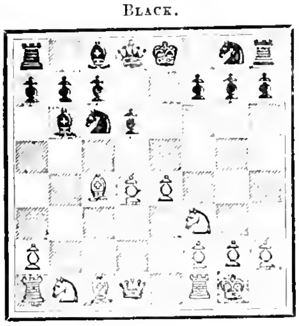
(*Continued from p.* 330.)

1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. B to B4 B to B4. 4. P to QKt4, B × P. 5. P to B3. Black has two moves at his disposal, viz., (*a*) B to B4 and (*b*) B to R4.

(*a*) 5.	B to B4
6. Castles	P to Q3
7. P to Q4	P × P
8. P × P	B to Kt3

This is one of the main positions in this opening, and may also be brought about by a slight transposition of the moves, such as 6. P to Q4, P × P. 7. P × P, B to Kt3. 8. Castles, P to Q3; or, also, if Black plays 5. B to R4.

Black.



White.

White now has a strong centre position and the better development as compensation for the Pawn.

The continuations at White's disposal are, indeed, numerous. We shall content ourselves with giving a few of the principal attacking variations:

9. Kt to B3	B to Kt5

Steinitz played 9. Kt to R4 instead of B to Kt5 against Tschigorin, which, however, resulted in a bad game.

10. B to QKt5 (*a*)	K to B sq.

Should White play 10. Q to R4, then Black must retire his B to Q2 (see *a*). Now follows 11. B × Kt, P × B. 12. P to K5. B × Kt. 13. P × B, P × P. 14. B to R3 (ch), Kt to K2. 15. P × P, Q × Q. 16. R × Q, K to K sq., with a good defence.

(*a*) 10. Q to R4, B to Q2. 11. Q to Kt3, Kt to R4. 12. B × P (ch), K to B sq. 13. Q to B2, K × B. White obtains a very strong attack, but nevertheless the sacrifice of the piece is unsound. White would continue with 14. P to K5, K to B sq. 15. R to K sq., Kt to QB3. 16. B to Kt5, Q to K sq. 17. P to K6, Q to Kt3. 18. Q × Q, P × Q. 19. P × B, Kt to B3. 20. P to Q5, Kt to K4. 21. Kt × Kt, P × Kt, threatening B to Q5 with a good defence, as the White P's on Q5 and 7 are weak.

We have given the above variation at length to show how dangerous are the attacks in this opening. Returning to the position in the diagram, we now proceed with 9. P to Q5, which is the continuation most frequently adopted.

9. P to Q5	Kt to R4
10. B to Kt2	Kt to K2 (best)

Of course if Kt × B, White recovers the piece by Q to R4 (ch). Or, if now White should play 11. B × KtP, Black will obtain a very strong attack by playing 11. R to Kt sq., followed by 12. Kt × B, and on the White Q checking by 13. Q to Q2 threatening the sacrifice of the R by 14. R × P (ch) and 15. Q to R6 (ch), &c.

11. B to Q3	Castles
12. Kt to B3	P to QB3

and although White has a good position, Black ought to be able to defend his Pawn. If on his 9th move White plays

9. R to K sq.	B to Kt5

with a fair defence, for if 10. Q to Kt3, Kt to R4, or if 10. B to QKt5, K to B sq., or B × Kt, &c. White can likewise play

9. B to R3	Kt to R4
10. B to Q3	Kt to K2
11. P to K5	Castles, &c.

Another continuation for White is

9. B to Kt2	Kt to B3
10. P to Q5	Kt to K2

White would not do well to take the KKt and open the Kt's file for the action of the R, therefore 11. Kt to B3, Castles. 12. Kt to K2, Kt to Kt3, &c.

Finally we give a charming little game played by the late Grand Master Anderssen against Lowenthal, the first eight moves being identical with the position in the diagram.

White. Anderssen.	Black. Lowenthal.
9. P to KR3	Kt to B3

(Kt to R4, dislodging the B, is considered best)

10. Kt to B3	Castles
11. B to KKt5	P to KR3
12. B to R4	P to Kt4

One of the tricks worth knowing is to give up the Kt for two Pawns in a similar position, as the pinned Kt on B3 mostly succumbs to the attack brought to bear upon it and the exposed K. But considering that if White plays 13. Kt × KtP, P × Kt. 14. B × P, Black has the apparently good defence of B × QP. Black's move seemed safe enough. If, in spite of this, White sacrificed his piece, it shows what a wonderful power of penetration and deep combination Anderssen did possess.

13. Kt × P	P × Kt
14. B × P	B × QP
15. Kt to Q5 !	

Very fine if now B × R. 16. Q × B first, followed by Kt × Kt (ch), with a strong attack.

	B to K3
16. R to Kt sq.	R to Kt sq.

Black is quite helpless, if B × Kt. 17. P × B, winning a piece.

17. R to Kt3	K to R2
18. B × Kt	B × B
19. Q to R5 (ch)	K to Kt sq.
20. R to Kt3 (ch) and wins	

(*To be continued.*)

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

G. W. Middleton.—You can place eight Queens on the board without attacking each other, as follows:—Q on KR3, KKt5, KB2, K8, Q sq, QB7, QKt4, QR6.

Littlehampton.—If 1. R to QKt sq, B to K sq, 2. Q to K4, B × Kt, and there is no mate.

Clarence.—Many thanks for letter, game, and problem.

Q. T. V. and A. W. Overton.—Solutions correct.

Correct solutions of 134 received from W., W. Furnival, R. Champ. H. W. Sherrard, and Scribbler.

Middlesbrough.—No. 133 is incorrect.

Contents of No. 157.

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Contents of No. 159.

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

XII.

In these times, when many run to and fro, and knowledge is increased, we forget how recent are the tremendous changes wrought by the science that—

> "Reaches forth her arms
> To feel from world to world, and charms
> Her secret from the latest moon."

Dulled by familiarity, we forget how operative these changes are upon opinions which have been—save now and again by voices speedily silenced—unquestioned during centuries. It is, in truth, another world to that in which our forefathers lived. Even in science itself the revolution wrought by discoveries within the last fifty years is enormous. Our old standard authorities, especially in astronomy and geology, are now of value only as historical indices to the progress of those sciences, while in the domain of life itself, the distinctions between plant and animal, assumed under the terms Botany and Zoology, are effaced and made one under the term Biology. Sir James Paget, in a profoundly interesting address on Science and Theology, has pointed out that it was once thought profane to speak of life as in any kind of relation or alliance with chemical affinities manifest in lifeless matter; now, the correlation of all the forces of matter is a doctrine which investigation more and more confirms. It was believed, many believe it still, that an impassable chasm separated the inorganic from the organic, the latter being attained only through operations of a vital force external to matter. That chasm was imaginary. Even the supposed difference between plants and animals in the existence in the latter of a stomach by which to digest and change nutritive substances, vanishes before the experiments on carnivorous plants. And not only do the observations of Mr. Darwin go far to show the existence of a nervons system in plauts, but examination of crystals shows that a "truly elemental pathology must be studied in them after mechanical injuries or other disturbing forces." And is man, "the roof and crown of things," to witness to diversity amidst this unity?

If we hesitate to believe that our metaphysics have been evolved from savage philosophy, that our accepted opinions concerning man's nature and destiny are but the improved and purified speculations of the past, we must remember what long years had elapsed before the spirit of science arose and breathed its air of freedom on the human mind. The Christian religion wrought no change in the attitude of man towards the natural world; it remained as full of mystery and miracle to the pagan after his conversion as before it. When that religion was planted in foreign soil, it had, as the condition of its thriving, to be nourished by the alien juices. It had to take into itself what it found there, and it found very much in common. Although it displaced and degraded the *Dii majores* of other faiths, it had its own elaborated order of principalities and powers; it had as real a belief in demons and goblins as any pagan; and it was, therefore, simply a question of baptising and re-christening the ghost-world of heathendom, substituting angels for swan-maidens and elves, devils for demons, and retaining unchanged the army of evil agencies, who as witches and wraiths swarmed in the night and wrought havoc on soul and body.

The doctrine of continuity admits no exceptions; it has no "favoured nation" clause for man. Its teaching is of order, not confusion; of gradual development, not spasmodic advance; of banishment of all catastrophic theories in the interpretation of the history of man as of nature. In its exposition nothing is "common or unclean;" nothing too trivial for notice in study of the growth of language, of law, of social customs and institutions, of religion, or of aught else comprised in the story of our race. The nursery rhyme and the "wise saw" embodied the serious belief of past times; ceremonial rites and priestly vestments preserve the significance and sacredness gathering round the common when it becomes specialised. And in this belief in spiritual powers and agencies within and without, the line uniting the lower and the higher culture is unbroken. Nor can it be otherwise, if it be conceded that the sources of man's knowledge do not transcend his experience, and that within the limits of this we have to look for the origin of all beliefs, from the crudest animism to the most ennobling conceptious of the Eternal.

> "This world is the nurse of all we know,
> This world is the mother of all we feel."

And yet we find scientists shutting their eyes to the light. The Theistic philosopher, trembling at the bogey of human automatism, creates an Ego, "an entity wherein man's nobility essentially consists, which does not depend for its existence on any play of physical or vital forces, but which makes these forces subservient to its determinations."* The Biologist, shrinking from the application of the theory of evolution to the descent of man, argues that "his animality is distinct in nature from his rationality, though inseparably joined during life in one common personality." His body "was derived from pre-existing materials, and therefore, only derivatively created; that is, by the operation of secondary laws. His soul, on the other hand, was created in quite a different way, not by any pre-existing means external to God himself, but by the direct action of the Almighty symbolised by the term "breathing."† As

* Dr. Carpenter's "Mental Physiology," p. 27.

† St. Geo. Mivart's "Genesis of Species," p. 325. In the 2nd edition of this work, Professor Mivart cites with satisfaction the authority of S. Thomas Aquinas and of Cardinal Newman on the matter.

this compound nature of man is defended in a scientific treatise, and Knowledge is concerned with its scientific side alone, the question that leaps to the lips is, when did the direct action take place—in the embryo, or at birth, or at the first awakenings of the moral sense? Readers of that eccentric book, "The Unseen Universe," published some eight years ago, may remember that the authors built up a spiritual body whose home lay beyond the visible cosmos.* Their argument was to the following effect:—Just as light is held to result from vibrations of the ether set in motion by self-luminous or light-reflecting bodies, so every thought occasions molecular action in the brain, which gives rise to vibrations of the ether. While the effect of a portion of our mental activity is to leave a permanent record on the matter of the brain, and thus constitute an organ of memory, the effect of the remaining portion is to set up thought-waves across the ether, and to construct by these means, in some part of the unseen universe, what may be called our "spiritual body." By this process there is being gradually built up, as the resultant of our present activities, our future selves; and when we die our consciousness is in some mysterious way transferred to the spiritual body, and thus the continuity of identity is secured.

> Eternal form shall still divide
> Th' eternal soul from all beside.

We may well quote the ancient words: "If they do these things in a green tree, what shall be done in the dry?" The physicists, who thus locate the soul in limitless space, and call it vibrations; the mathematician, who said it must be extension; and the musician, who said, like Aristoxenus, that it was harmony; the Cartesian philosopher who locates it in the pineal gland; the Costa Rican, who places it in the liver; the Tongans, who make it co-extensive with the body; and the Swedenborgians, who assume an underlying, inner self pervading the whole frame—these have met together, the lower and the higher culture have kissed each other.

The tripartite division of man by the Rabbis, the Platonists, the Paulinists, the Chinese, the mediæval theories of vegetal, sensitive, and rational souls—what are these but the "other self" of savage philosophy writ large? Plato's number is found among the Sioux: of their three souls one goes to a cold place, another to a warm place, and the third stays to guard the body. Washington Matthews, in his "Ethnology and Philology of the Hidatsa Indians," says:—"It is believed by some of the Hidatsa that every human being has four souls in one. They account for the phenomena of gradual death, when the extremities are apparently dead while consciousness remains, by supposing the four souls to depart, one after another, at different times. When dissolution is complete, they say that all the souls are gone, and have joined together again outside the body. I have heard a Minsutaree quietly discussing this doctrine with an Assinneboine, who believed in only one soul to each body."

Let it not be thought that because science explains the earthborn origin of some of man's loftiest hopes, she makes claim to have spoken the last word, and forbids utterance from any other quarter. The theologian is not less free to assume such miraculous intervention in man's development as marks him nearer to the angel than to the ape, only his assumptions lie beyond the scope of scientific inquiry. And it should be noted that whilst science takes away, she gives with no niggard hand, so that the loss is more seeming than real.

When belief in the earth's central and supreme place in the universe was surrendered at the bidding of astronomy, there was compensation in the revelation of a universe to which thought can fix no limits. And if man is bidden to surrender belief in his difference in kind from other living creatures, he will be given the conception of a collective humanity whose duties and destiny he shares. That conception will not be the destruction, but the enlargement, of the field of the emotions, and, in contrasting the evanescence of the individual with the permanence of the race, he may find a profounder meaning in the familiar words—

> "We are such stuff as dreams are made on,
> And our little life is rounded with a sleep."

* For criticism of this pseudo-scientific theory, see Professor Clifford's brilliant paper in "Lectures and Essays," Vol. I., pp. 228, ff.; and a review of "The Unseen Universe," by the present writer, *Fraser's Magazine*, January, 1876.

PLEASANT HOURS WITH THE MICROSCOPE.

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

A DADDY-LONGLEGS is not an insect treated by ordinary observers with much respect. Children laugh at it, and wonder at its readiness to leave a few legs in their fingers. Older folks find nothing elegant in its appearance, or graceful in its short snatches of flight across the grass. To the gardener and farmer it is an object of dislike on account of the damage its grub does to lawns and grass-land. Curtis, in "Farm Insects," says of it: "This universally-distributed and mischievous gnat, by dropping its eggs in the field, garden, and pasture-land, annually causes serious losses to the cultivator by the destruction of various crops as well as flowers." The ravages committed by it are sometimes enormous, whole fields of mangel-wurzel falling a prey to it, besides the ruin of potatoes, beets, cabbages, &c. There are upwards of thirty British species of *Tipulæ* or Crane-flies, the Daddy-Longlegs being the biggest. Their grubs are tough, hardy things, standing any amount of wet, and called in some country places Leather Jackets. Out of thirty species, Curtis only identified three as positively known to be a serious nuisance.

The profile of these insects shows how they got their name of Crane-flies, from the projection of the mouth organs, which, however, make a snout rather than a neck. The male of *Tipula oleracea*, the Daddy, is easily known from the female by the end of its abdomen being blunt and thick, while that of the female is tapering and pointed. Mr. Curtis says, "The eggs are laid by the females, I apprehend, as they fly, or when they rest amongst the herbage, and are propelled as from a popgun." This may be so when the nature of the ground suits, but the creature is supplied with an ovipositing apparatus consisting of two parts, one adapted, like certain forceps used by surgeons, to enlarge an orifice, and another to guide the eggs into the hole thus made. Fig. 1 represents these organs separated; the shorter one, which conducts the eggs, is opened wide to show its hollow jaws. The female often seems stuffed full of eggs, which, according to Curtis, may amount to three hundred or more at one time. The maggots are footless things, with black heads and good jaws. They change to pupæ from August to September, and are furnished with spiny rings, which enable them to work their way to the surface of the ground, and, when their emerging time comes, he says, thousands of empty cases may be seen sticking half out of the earth amongst the grass. The wings of the perfect insects, though long and fairly broad, do not make them

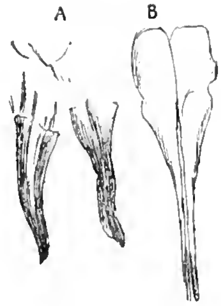


Fig. 1.

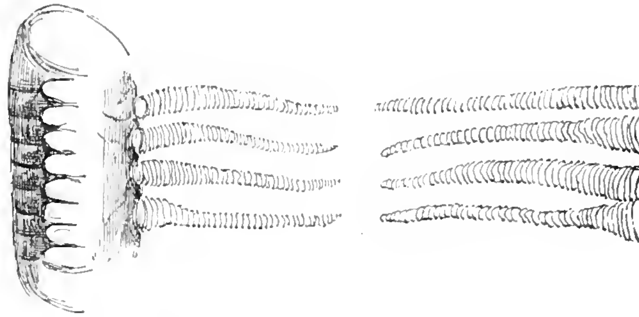


Fig. 3.

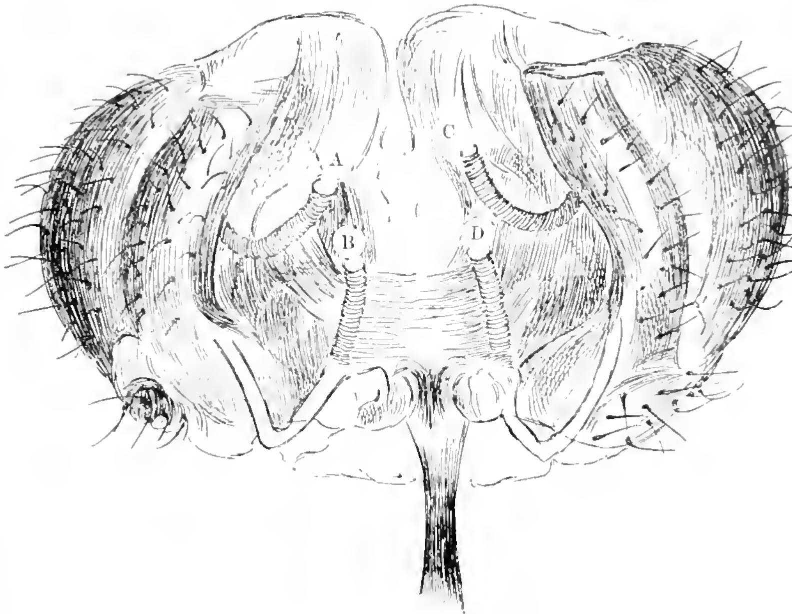


Fig. 2.

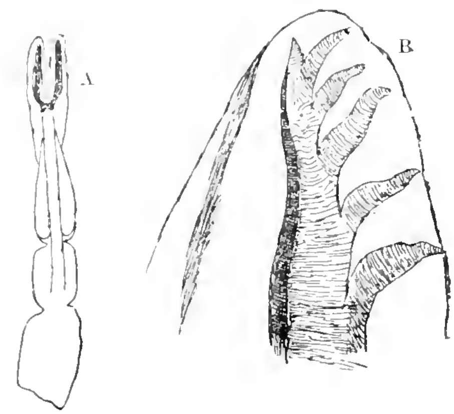


Fig. 4.

Fig. 1. Ovipositing Apparatus of *Tipula oleracea*.—A, ovipositor; B, forceps to move the ground and make room for the eggs ($\times 10$). Fig. 2. Tongue of ditto ($\times 60$).—Opening it to show structure, broke the large pseudo-tracheæ; A, B and C, D formed two curved vessels in their natural state. Fig. 3. Some pseudo-tracheæ in centre of the organ, the small ones springing from the larger; the large one omitted on right ($\times 600$). Fig. 4. A, Proboscis of *Rhingias rostrata* ($\times 10$); B, Portion of tip ($\times 320$).—The hairs and ornamental leopard spots are omitted. The lateral tracheæ are twenty-six on each lobe.

good flyers. Their outer margins are set with thick spines, the inner with larger and finer ones, and the intercostal spaces covered with minute hairs. The poisers are very conspicuous, and look like long-handled battledores. They are well worth mounting in Canada balsam, and are more winglike in aspect than those of most other flies.

The antennæ are long; composed, according to Westwood, of from thirteen to sixteen joints. Those of a female now before the writer has the former number. Mounted in balsam, they show each joint to commence with a slight bulge from which spring four bristles. All the joints are covered with numerous fine hairs springing from transparent spots, which have a pretty effect in a good light or with dark ground illumination. The snouty projection is in front of the antennæ, and carries at its tip two four-jointed palpi and the remarkable tongue. The last joint of the palp is beautifully ringed.

The tongue is the most marvellous specimen of the blow-fly pseudo-tracheal sort the writer has met with. It is short and broad. On each side is a thick, fleshy cushion, covered with bristles on its outer surface; inside are very numerous groups of pseudo-tracheæ, and in the centre a thinner portion also abounding in them. The Blow-fly, or the Drone-fly proboscis opens and shuts its two lobes, much like the opening and shutting of a book. The tipula tongue is more like the form obtained by the curve of two human hands holding a big apple within their grasp. The general shape is shown in Fig. 2, sketched from a specimen mounted, without squeezing, in a shallow cell of Canada balsam. It is slightly altered in appearance by being forced open, which has broken the large pseudo-tracheæ in the central portion, and put the two halves a little way apart. Fig. 3 shows a few of the pseudo-tracheæ in the centre of this organ, as seen with an oil immersion $\frac{1}{12}$th and "A" eye-piece.

It is difficult to count all their pseudo-tracheæ, as, when the tongue is whole and in its natural state, many are not visible from the superposition of parts, and taking it to pieces accurately requires much patience and skill—more than the writer can boast of. The number, however, seems about 300, and for our present purpose a few more or less do not matter. There is an enormous advance in the complexity of this organ, not only from such a simple form as that of *Rhingias rostrata*, but also from that of the Blow-fly or the Drone-fly. Of what advantage is it to the Daddy-Longlegs to possess such an elaborate and complicated feeding machine? Does anybody know? The writer confesses complete ignorance, and will not venture a guess. Books are so generally mere compilations, one from another, that it is little wonder that those ordinarily accessible contain no account of this organ; but it is curious that its complex structure seems to have escaped Westwood at the date (1840) of his excellent "Classification of Insects." From his sketch it is evident he had only seen the tongue with a very low power. Figuier, in his "Insect World," says of the *Tipulæ*:—"The perfect insects, at first sight, resemble gnats; but are without a trunk, or rather their trunk is extremely short, terminating in two large lips. The sucker is composed of two fibres only." Where did he get this notion? If any reader has met with a good description of this tongue I should be glad to know of it.

A curious question arises with respect to an organ of this character in reference to the theory of development: What did the ancestors of the present creatures do while the thing was developing? A comparison of the mouth-organs of various dipters may throw light upon the Daddy-Longlegs case. The *Tabani* (breeze-flies) and others have, besides the proboscis, piercing and cutting tools and a pump. If in any insect the latter became gradually obsolete or imperfect while the former was growing, no inconvenience would arise. The gnats are piercers and pumpers; and perhaps remote progenitors of Daddy-Longlegs had as good lancets, saws, and pumps, while the proboscis passed from simple stages to the marvellous development of the *Tipula*. Fig. 4 shows the tongue of *Rhingias rostrata*, like dentist's forceps, with few and very short lateral tracheæ, and if we could find an early ancestor of the Daddy, his proboscis might afford still simpler exhibition of this kind of organ.

With regard to my paper on the Drone-flies, let me thank Mr. John Moore for his kind offer, and his remark that their food is not exclusively liquid, as he finds pollen in their stomachs. I have no doubt he is right, but their regular diet is, I think, obtained by sucking the nectar of florets, and I have examined many which had not swallowed pollen or other solid matter.

NOTES ON COAL.

By Richard A. Proctor.

(*Continued from p.* 334.)

In all such progressions as we are here dealing with, statistics indicate a *wave-like* alteration. Just as in the shape of a wave's front, we see a gentle slope, then a more rapid slope, and then, up to the wave's summit, a gradually diminishing slope, so, in statistical progressions, we recognise a gradual increase at first, then a more rapid increase, then a diminishing increase, until the absolute maximum is reached, after which comes a gradual decrease. But the rear of such a statistical wave may be altogether unlike the front—in other words, the rate and manner and variations of decrease may be quite unlike the rate and manner and variation of increase. It is so with the progress of epidemics, with changes of population in the complete history of a nation from its rise to its decadence, with the growth of a trade, with every known subject to which statistical research has been applied. There may be alternate wave-like rise and fall, there may be so slow a rate of increase or decrease that the crest or valley of the wave seems long in passing, and the decrease after increase, or *vice versâ*, may so far differ from the preceding phase as to be almost imperceptible; but in every case there is to be recognised, either once or more than once, the wave form of rise or of fall.*

Now, the consumption of coal is at present, and for very obvious reasons, passing through the more rapidly-ascending portion of its wave of increase. For many years after the first recognition of the value of coal as fuel, the mineral crept slowly into use. With its employment, fresh uses for it were found, the very usefulness of the mineral suggesting new wants. Chief among the results which sprang directly from the use of coal as fuel, was the application of the steam-engine to a number of purposes which had before been either unthought of or unattainable for want of proper fuel. The spread of manufacture, of trade, of travel, and general intercommunication, followed in due course, at once directly and indirectly necessitating a continued increase in the quantity of coal employed throughout the Kingdom. These causes are still in full operation; and it is to be expected that, while this is the case, there will not merely be a steady annual increase in the use of coal (for such an increase would follow from the mere expansion of the uses already discovered for the mineral), but an increase of that increase, on account chiefly of the progress of invention and discovery.

That this state of things will continue for several years to come may fairly be anticipated; that for many years to come the average rate of increase in the coal-consumption will be fully equal to that at present observed may also be expected; but that, before many years are passed, the rate of increase (then higher than now) will be beginning to diminish, thenceforward returning towards its present rate, and passing eventually below its present rate, is to be looked forward to as the natural order of events in the future. Let it be remembered that such a result would by no means imply a falling-off in the commercial and manufacturing activity of the country. The extension of the employment of coal for known uses has, in several instances, already nearly approached a limit. In other cases, such extension, though still proceeding, is not proceeding at an increasing but at a decreasing rate. This must happen in turn with all the known applications of coal, the extension of its use perhaps attaining a rate corresponding nearly to that of the actual growth of our population.† Such a change would imply a continual increase of national commercial prosperity, not (as at first view might seem to be the case) a gradual decadence. It is as though a merchant, whose gains, already large, had been increasing year by year, say by £1,000, should find them still increase year after year by £900, £800, £700 (the change occupying many years), until, at length, the

* Let any one try such an experiment as the following, and he will readily understand what is here meant by wave-like progression, and obtain also very convincing evidence of the fact in question. Along a horizontal line let equal spaces be measured, and let a set of vertical lines be pencilled through the divisions on the horizontal line. Now, from the weekly records of health let the number of deaths due to any disease, or form of disease—as, for instance, diarrhœa, or the class of diseases included under the head zymotic—be noted from the commencement to the end of some period in which such diseases may have been particularly active, and let the number of deaths in successive weeks be represented on any convenient scale on the successive vertical lines, measuring upwards from the horizontal line. [For example, say that fifty deaths shall be represented by one inch, and other numbers proportionately.] Then through the summits of the lines thus drawn let a curve be swept. It will be found that this curve has the wave-figure spoken of above.

† The population is increasing at an increasing rate at present; but as this rate is much lower than that at which the consumption of coal is increasing, this consumption, in changing to the rate at which population is increasing, must diminish its rate of increase. Moreover, the increase of the rate at which the population of this country is increasing, grows less, decade by decade.

annual increase settled down to some constant or nearly constant sum, such as (say) £200. The prosperity of such a merchant could hardly be regarded as failing; for his gains, large at first, would have grown larger and larger throughout, and in the final stage they would still be growing larger and larger from year to year. So it would be in the case of those uses of coal which are already known. Already large, they would grow larger and larger (on our supposition, which we believe to be in accordance with all experience); they would not throughout the change fail to increase; and, at the last, they would settle down to a nearly constant rate, *not* of consumption, but of increase of consumption.

So soon as such processes begin to operate freely (and, as we have said, they are already operating to some extent) they will reduce the rate at which the whole consumption is increasing. Operating against them would be the progress of invention, by which fresh uses for coal are continually springing up. Yet this cause would not act *solely* to increase the consumption; for many of the inventions which require directly or indirectly the employment of coal, operate to remove or to reduce some other cause also requiring the consumption of coal. Nor is it at all unlikely that before long inventions will be so directed as to reduce in a very marked manner the consumption of coal in certain departments of trade and commerce.

Now, if this view of the future is just, we can no longer apply a percentage of increase after Mr. Jevons's method, except for so moderate a number of years that the monstrous annual consumption indicated for 1950 (for example) is no longer in question. For the next ten, twenty, or even thirty years, it is not vitally important whether we take Mr. Jevons's method or Mr. Hull's. There would, indeed, be a considerable difference in the annual consumption at the end of the ten, twenty, or thirty years; but still the main difference would be that a certain consumption would be reached so many years sooner in one case than in the other.*

Thus, taking 120 millions of tons as the annual consumption in 1872, and 3·26 as the rate of increase per cent. per annum, the annual consumption in 1882 would have been estimated at 159 millions of tons if the actual increase remained constant, and 165 millions of tons if the percentage of increase remained constant; at the end of twenty years from 1872 the numbers would be respectively 185 millions and 227½ millions; at the end of thirty years from 1872 they would be 218 millions and 314 millions. The difference in the last two cases is no doubt considerable; yet it is seen that the consumption in 1892, on Mr. Jevons's hypothesis is the same as the consumption in 1905 on the other; and it can readily be calculated that the consumption in 1902, on Mr. Jevons's hypothesis, is the same as the consumption in 1922 on the other. The advance to that rate twenty years earlier or later is a matter of very little importance compared with the question whether Mr. Jevons's view will be justified during after years.

If, on the contrary, as I believe, the present increasing rate of increase will be changed long before even thirty years have passed into a decreasing rate of increase—if such a consumption as 250 millions of tons is not reached until long after the time when even the present rate of change, continued uniformly, would have brought it—we need not fear that the exhaustion of our coalfields is so near at hand as either Mr. Jevons or Mr. Hull has supposed. And we may recognise this further cause of hope in such a view, that, whereas the prospect of the exhaustion of our coal within 150 or 200 or even 300 years would imply little less than the prospect of approaching national bankruptcy, the continuance of our supply for 800 or 1,000 years would suffice to put us on a secure and stable footing. During all these years the power and wealth of the nation would be increasing, so far as the cause in question is concerned (since our assumptions imply a continual increase in the consumption of coal); inventions and discoveries would have multiplied on all sides; means might even have been devised for accomplishing, without coal, the greater part of the work which coal now does for us; and at the worst we should be in a position to obtain abundant supplies of coal from other countries. It is not, however, too much to say that, even if these hopes were not justified, 1,000 years of prosperity is a future which this nation might contemplate with satisfaction. Whatever our pride in our country—in her past history, her present condition, or her future prospects—we are to remember that it is not given to any nation to endure for ever. As the most powerful nations of antiquity passed into decadence, so one day must it happen with this country, though we, her children, may well believe that that day is far off, and that the might and prosperity of this nation will rather undergo a change of form than a complete destruction—not perishing, but being merged in the might and the prosperity of one or other of the nations which have sprung from ours.

* In my original paper, which appeared in 1872, and has, of course, been modified above, I wrote as follows:—"It will be very soon in our power to decide whether one or other hypothesis be correct; nor will it be long before it will be possible to decide whether the hypothesis advocated by myself is not sounder than either. I venture to predict that before the year 1890 the percentage of increase will be markedly below Mr. Jevons's estimate; and that before the year 1900 the actual increase will be below its present value (3,500,000 tons)." The consumption appears now (in 1884, and judging from the records for 1883) to be about 164 millions of tons, which is considerably below Mr. Jevons's estimate, and shows that the first part of my prediction was sound; whether the latter part will be confirmed remains to be seen. As the average increase in the 11 years, from 1872 to 1883, has been nearly 4,000,000 tons, it is evident that when due account is taken of the reserved diminution of the rate (not the *amount*) of increase, the tendency of events is towards the fulfilment of this part, too, of my anticipations.

A lecture was delivered on Tuesday at the Royal Victoria Hall, by the Rev. W. Tuckwell, Rector of Stockton Rugby; the subject being a Bank Holiday on the Hills. The lecturer supposed his hearers to accompany him to some hill within reach of London by excursion train, and to spend the holiday upon it. He led them through roads and fields fringed and carpeted with summer flowers to the hillside, resting for a while beside a rustic home to look at the cottager's bees, and hear from him a delightful history of their culture. Past bogs blue with forget-me-not, yellow with asphodel, gleaming with sun-dew; through a wood where the squirrel and the wood-pigeon sat aloft, the golden-rod and foxglove waved below; along the hillside with its bracken, its whortle-berries, its heather, and its staghorn moss; the party climbed to the top, sat down to enjoy the sights and sounds, measured the height ascended by means of an aneroid barometer, discussed the geological formation of the hill itself, read chapters of English history in the view from its summit. In the walk which followed the flowers all around, pimpernel and St. Johnswort, and Lady's Bedstraw and club-moss, were made to yield their legends and associations; the viper, the burying beetle, the gossamer, the wasp's nest, suggested curious talk; a pond revealed mysteries of the stickleback's nest, and the dragon-fly's transformations, and the transparent water-flea, and the house-building Milicerta; a stone quarry exhibited Ammonites and Saurian remains and Coprolites of a million years ago, while flint implements from a gravel-pit told their tale of earliest man. Finally, a farmhouse gathered the excursionists to tea and country fare, and the happy day found its end, with certainty that its thoughts and feelings would penetrate the dust and heat of town life like a refreshing breeze from the hills themselves, a reminder of pleasures past, a provocative to renew them on many a future holiday.

"CRACKLE" GLASS.

This variety of glass, which has become so fashionable on account of its effective and crackled appearance, is, according to the *Glassware Reporter*, very easily made.

It is produced by covering one side of a piece of plate-glass with a thick stratum of a flux or readily fusible glass, mixed with coarse fragments of glass. In this condition it is placed in a muffle, or an open furnace, where it is strongly heated. As soon as the flux is melted and the glass itself has become red-hot, it is removed from the furnace and rapidly cooled. The flux (or fusible glass), under this treatment, cracks and splits, leaving innumerable fine lines of fracture over its surface, having much the appearance of scales or irregular crystals, which cross and intersect each other in every direction, producing very striking and beautiful effects when the light falls upon its surface.

The rapid cooling of the fusible coating is effected either by exposing the heated mass to the action of a current of cold air, or by cautious sprinkling with cold water.

By protecting certain portions of the glass surface from the action of the flux, these portions retain their original smoothness and polish, and form a striking contrast to the crackled portions of the surface. By this means inscriptions or decorative designs of every description are produced upon a colourless or coloured ground.

A modification of this method of producing crackle glass is the following: A coarsely granular flux is strewn upon the surface of a glass cylinder, while the latter is red hot, until the flux melts. It is then removed and rapidly cooled either by the use of water or by waving it about in the air. The stratum of melted flux is then caused to crack as above described. The cylinder is then cut, flattened, and brought to a level surface in the usual manner.

DICKENS'S STORY LEFT HALF TOLD.

A QUASI-SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Concluded.*)

I have purposely kept to the last what I take to be the most striking proof of all that Edwin Drood was not really slain and that he communicated at once with Grewgious—a proof plain and striking, yet somehow entirely overlooked by all who have examined the story (except Mr. Proctor and myself, who take the same view of the plot).

When Mr. Grewgious had given the ring to Edwin which had been removed from the unconscious hand of Rosa's mother, he was sad and out of spirits. "I hope I have done right," he says: "*it was hard to lose the ring*, and yet it must have gone from me very soon." "He closed the empty drawer with a sigh, shut and locked the escritoire, and came back to the solitary fireside. 'The ring,' he went on, 'will it come back to me? My mind hangs about her ring very uneasily to-night. But that is explainable. I have had it so long and prized it so much.'"

This much-prized memento of his dead love was, he knows, in Edwin's possession when he disappeared. The watch, chain, and breast-pin which were also in Edwin's possession are found in Cloisterham Weir. Is it conceivable that Grewgious would have made no inquiry whatever about the ring he valued so much if he had supposed—as so many readers imagine he did—that Drood had been made away with? Is it conceivable that when feeling and duty alike (and with almost equal strength, we may say, when we consider that duty was a passion with him) urged Grewgious to seek for the ring, he would have overlooked his duty and set his feelings on one side, as he actually did, if he knew no more than the ordinary reader supposes? I answer unhesitatingly that this is not conceivable. It is absolutely certain that Mr. Grewgious had the ring again in his possession many hours before the watch, chain, and pin were found in the weir?

But we are told that in resolving to restore this very ring to his breast, Edwin was unconsciously preparing "a chain, riveted to the foundations of heaven and earth, and gifted with invincible force to hold and drag." The idea is suggested that the ring was to be found in the tomb when Edwin himself and his very clothes had disappeared through the action of the quicklime. But this idea a score of reasons have compelled us to abandon. How are we to reconcile what was said about the ring and our knowledge that Jasper is to be condemned to death for murder, with what we know to have happened to Edwin and with what we know to have been planned against Jasper.

Very easily, if we consider the course which Edwin's plans would naturally take after he had discovered what the old opium-eater knew or might learn. Among the revelations he was awaiting must inevitably have come the discovery that Jasper's main idea in removing the watch, chain, and pin was that they might afford no evidence against him in the tomb. So soon as Edwin and Grewgious had learned this, their power to inflict a very terrible punishment on Jasper would at once be manifest. They would see that the use of the watch, chain, and pin, to bring suspicion on Neville, was only an afterthought. They would feel that Jasper had planned to remove all trace of his guilt from the tomb into which he had flung his victim; and they would force on him the completion of his purpose. Edwin had himself removed from the tomb the only object which could have resisted the action of the quicklime. But of that ring Jasper had known nothing. What horror fell upon his guilty mind when he learned that he had unwittingly left a fatal witness of his crime, within the very tomb of his victim! His sense of security is at once utterly shaken. He broods over his danger, while he shudders at the thought of the only possible way of removing it. But, struggle as he may to resist, he is compelled at last to take this dreadful yet only available course. He is forced to the tomb itself, nay to the very dust of his victim, that he may there grope in darkness and horror for the evidence of his crime.

We may feel sure that a part of Jasper's penalty was to have been this,—to be driven by terror for his life to face the ghastly terror of his victim's tomb. Further, I have myself no doubt that the course of his fate was to have been so guided that his visit to the tomb was made on the same day of the year on which his attack had been made, and at the self-same hour of the night.

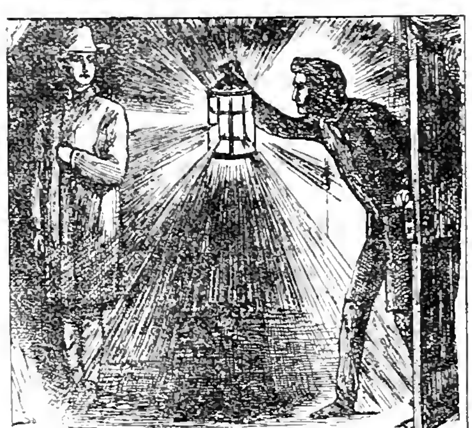
Creeping down the crypt steps, oppressed by growing horror and by terror of coming judgment, sickening under fears engendered by the darkness of night and the charnel-house air he breathed, Jasper opens the door of the tomb and holds up his lantern, shuddering at the thought of what it may reveal to him.

And what sees he? Is it the spirit of his victim that stands there, "in his habit as he lived," his hand clasped on his breast, where the ring had been when he was murdered? What else can Jasper deem it? There, clearly visible in the gloom at the back of the tomb, stands Edwin Drood, with stern look fixed on him,—pale, silent, relentless!

With a shriek of horror (the ghost of that awful cry had been heard before by Durdles*), Jasper casts down the lantern and flies from the tomb. But even as he rushes forth he is faced by two men, from whom he turns (utterly unnerved by the horror of the tomb) to seek the only path of escape—the winding staircase of the Tower. They follow him closely, Neville first, Tartar close by him, Drood himself but a few steps behind Tartar, and Crisparkle following. Seized by Neville at the top of the staircase, Jasper turns and struggles fiercely with the man he hates. Neville receives his death-wound (but lives long enough to know that his name has been cleared), Tartar, Drood, and Crisparkle capture Jasper, and the villain is cast into prison, but not till he has been confronted by his supposed victim and by Grewgious and made to feel how, while he supposed himself safe, every movement of his had been known to them and watched by them. In the knowledge that Tartar loves Rosa and is loved by her, Jasper's punishment is complete.

Very little of this suggested close of Dickens's Half-Told Story is invented. Dickens himself told very nearly all of it, in what the story itself discloses unmistakably,† in what he said to Forster and to Miss Hogarth, and finally in the instructions to Mr. Fildes respecting the illustrations.

With regard to these illustrations, we know that a picture showing Jasper in Rochester gaol was to have appeared towards the close of the book. But there were earlier indications in Mr. Fildes' work under Dickens's instructions (and not explained to Mr. Fildes, of course, so far as their bearing on the story was concerned) which are full of meaning. Yet, strangely enough, they seem to have been quite overlooked by most readers. Or perhaps most of these read from the cheaper editions, in which the old illustrations of the paper covers to the monthly parts were not reproduced. I venture to give two of the small pictures from the love side of the cover, two from the murder side, and the central picture below, which presents the central horror of the story—the end and aim of the "Datchery assumption" and of Mr. Grewgious's plans—showing Jasper driven to seek for the proofs of his crime amid the dust to which, as he thought, the flesh and bones, and the very clothes of his victim, had been reduced.‡



Nothing more sensational had ever been invented in fiction than the terrible punishment devised for Jasper. Yet amidst the gloom and horror even of that part of the story there would have been found room for touches of humour and pathos after Dickens's best manner. When we consider the course of the other events which were to have led to the dénouement, we feel still more what a loss the missing half of this fine story has been to literature. The relations between Tartar and Neville would in particular have been full of interest. In the earlier part of the story we see Neville roused to fiery wrath with Drood,—but not because of rivalry. We feel that Neville, though proud and fiery, will not be moved to wrath by Tartar's love for Rosa; nay, that his own love for her will cause him to sympathise with the earnest love of the brave and honest sailor. The relations of Helen and Tartar would also have been a fine subject for such a pen as Dickens's. She would quickly feel that Tartar was worthy of Rosa, and both she herself and her brother, in their love and esteem for Crisparkle, would be naturally drawn towards the man who had saved Crisparkle so gallantly in early boyhood.

But most difficult to deal with, and therefore worthiest of Dickens's pen, would have been the relations of Edwin, after his identity had been revealed, with Landless and Tartar. Neville would have been more in sympathy with Edwin Drood — earnestly loving Rosa, loving her like himself without hope—than even with Tartar; and Edwin would now thoroughly sympathise with the feelings which had driven Neville to an outbreak of wrath against himself. Purified by trial, strengthened though saddened by his love for Rosa, Edwin would have been one of those characters Dickens loved to draw—a character entirely changed from a once careless almost trivial self, to depth and earnestness. Neville was to have died, but we may be sure not before he had learned to understand the change which Edwin's character had undergone. Between Tartar and Drood, though rivals awhile for Rosa's love, a warm friendship was to grow, in which Rosa, Helena, and Crisparkle were to share—while all were to join in changing the ways of dear old Grewgious from the sadness and loneliness of the earlier scenes to the warmth and light of that kindly domestic life for which, angular though he thought himself, his true and genial nature fitted him so thoroughly.

* A dog was certainly to have been introduced into the story—probably it was to have been Neville's (Crisparkle would advise Neville to get a dog-friend): and the "howl of a dog" was doubtless heard by Durdles after Neville's death, a few minutes after Jasper's shriek of horror.

† I include among these indications such remarks as Neville Landless's, that "He hoped he might live" to see himself cleared. Any one who understands Dickens knows as certainly from this that Landless will live so long and no longer, as if Dickens had said as much. In a similar way (to cite one from hundreds of cases when we are told in his "Wreck of the Golden Mary," that Mr. Rarx "*kept* his secret,") we know certainly that Mr. Rarx is marked down for death, early though the remark comes in the story.

‡ Above are shown Durdles's spade and bundle, and the great key of the tomb, from which we learn that near Durdles and the tomb the central meaning of the mystery is to be sought.

RAMBLES WITH A HAMMER.

GEOLOGY OF CRICCIETH AND PWLLHELI (*continued*).

By W. Jerome Harrison, F.G.S.

II.

PRE-CAMBRIAN ROCKS.—Of these rocks, of which it is in some degree doubtful whether they are (*a*) older than the Silurian strata which now surround them, or (*b*) of *later* date than such beds, being, in fact, intrusive in them, there are several examples near each of the towns to which this article refers. The picturesque old castle at Criccieth is built on a mass of columnar felspar—porphyry. It is a compact pinkish rock, in which distinct felspar crystals are here and there visible. About four miles west of Criccieth, the headland of Pen-y-chain gives a most interesting section. Approaching it by the shore from the Afonwen side, we meet with (1) a compact felsitic rock resembling that of Criccieth; (2) a dark-coloured rock, such as the older geologists called "greenstone"; (3) a remarkably laminated bed, the laminæ (about the tenth of an inch in thickness) being alternately green and white in colour (this may be a schistose gneissic rock or a laminated volcanic ash; it requires microscopic examination); (4) another bed of "greenstone;" (5) a beautiful breccia — either a volcanic agglomerate or a shore conglomerate little rolled, consisting of masses of a pale felsitic rock like (1) embedded in a dark matrix like (2). The included fragments increase in size as we cross the strike of the bed from the size of a marble until they are a foot in diameter, and the larger the fragments are the less of the dark matrix is seen between them, until at last they are almost in contact with one another. Continuing in a westward direction we cross (6) a platy felspathic rock, and then in a little cove we find a very remarkable mass of (7) chalcedonic nodules, the sizes varying from a fraction of an inch to several inches in diameter. (Similar nodules occur in the little promontory of Careg-y-defaid, two miles south-west of Pwllheli.) Beyond this comes more of (8) the platy felspathic rock, and finally (9) more of the compact felsite, forming precipitous cliffs from which sea-fishing with the rod may be carried on.

All the nine varieties of rocks which we have described are lumped together by the Geological Survey in their map and memoir as "felspar porphyry" intrusive in Silurian strata. My own opinion is that they are in part, at all events, of immensely greater antiquity, and very probably of Pre-Cambrian age. The fragments in the breccia bed (5) must have been in their consolidated and hardened state when they were broken up to form the layer in which they now lie. This breccia bed is, therefore, of *later* date than the felsites from which its materials were derived. All these beds appear to be of volcanic origin, and of contemporaneous volcanic action of this kind the Bala beds (as those Silurian rocks are called which rest upon the flanks of Pen-y-chain) of Lleyn offer few or no traces.

Walking on four miles more—still westward—to Pwllheli, a remarkable section is exposed in the deep cutting through which the road passes to the little villages of Llanor and Denio. Here shivery slates of Bala age are broken through, and cast into wonderful contortions by a felspathic rock which forms a bold ridge several miles in length. Here it might appear that we have clear evidence of a mass of molten rock (for the felspathic rock is clearly of an igneous character) having burst through the Silurian slates, and I cannot say (in the absence of fuller investigation than time permitted me to give) that such is certainly not the case. But what puzzled me was the slight evidence of alteration afforded by the slaty strata. They did not appear to be more indurated near the junction, and fossils could be found in them quite close to the felspathic rock. It is, then, possible that the disturbed junction between the two rocks may be a line of fault, and that the felspathic rock, already in a hardened state, was forced, like a wedge, through the newer overlying slates. The occurrence in this cutting of a brecciated bed, in which fragments of a pale rock were embedded in an ashy matrix, a bed which apparently belonged to the felspathic rock, strengthened this belief. In this case it is probable that all this ridge of hard rock is of the Pre-Cambrian age. At the south-west end of Pwllheli, near the old turnpike gate, there is an exposure of a volcanic ash or breccia, which may be a continuation of the breccia-bed just named. Prof. Ramsay writes that it is "the only rock in Lleyn of an ashy or brecciated character;" but in view of the magnificent breccias at Pen-y-chain and Porth-dinlleyn this is certainly an error. The other masses of igneous rock north and west of Pwllheli and Criccieth—coloured red on the Survey Maps, and considered by the professional geologists who made those maps as intrusive masses in the Silurian strata—all, or nearly all, are claimed by Dr. Hicks as belonging to his immensely old Pre-Cambrian rocks. But if these hills —for the hard, igneous masses all stand up boldly above the softer Silurian slates — are Pre-Cambrian, where are the *Cambrian* strata, which ought to lie *between* the Pre-Cambrian beds and the Silurian strata? Dr. Hicks accounts for the absence of Cambrian strata round Mynydd-y-cennin, Yr Eifl, the Nevin, and Boduan Mountains, &c., by calling in the aid of *faults*, by which, he says, the Pre-Cambrians have been thrust upwards while the Cambrians are left below. This may be, and no doubt very frequently is, the case. A further explanation may be found in the *overlap* of the Silurian beds which has sometimes covered over and hidden from view the junction of the Cambrian and Pre-Cambrian strata (Fig. 1). Our knowledge of the Pre-Cambrian beds of Lleyn is, however, as yet extremely small, and much work must be done before their true nature, extent, and relations are made clear.

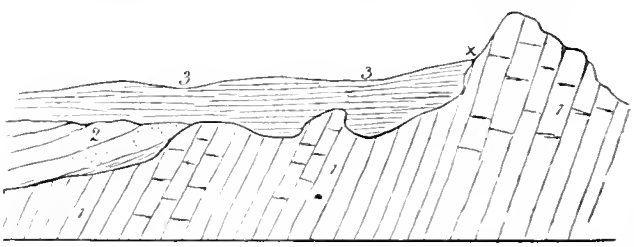


Fig. 1.—Overlap of Silurian strata (3, 3) by which they abut upon the Pre-Cambrian rocks (1) at ×, thereby entirely hiding from view the Cambrian beds (2).

The land-locked harbour of Pwllheli owes its existence to the great boss called the "Gimlet Rock" (Welsh, *Carreg-y-rimbill*), which lies at the entrance to the harbour, and serves the purpose of a pier or breakwater. It is a very handsome rock, a diabase, composed of the minerals felspar (white) and augite (black). Beautiful crystals of quartz occur in the fissures by which the rock is traversed. There are large quarries here whence excellent paving-setts are obtained, and similar quarries may be seen at many points round the coast, as at Llanbedrog, Nevin, and Porth-y-nant. The stone is largely shipped to Liverpool, but at present the demand for it is but small, and several of the quarries have ceased working.

(*To be continued.*)

THE WORKSHOP AT HOME.

By a Working Man.

(*Continued from p 356.*)

When I was explaining the way of making a simple picture-frame on p. 356, I recommended the amateur to clamp it up by strips of wood nailed down on to a plank; and this method will serve very well if he is only going to make one or two. Should he, however, take a fancy to this kind of work, he had better construct the simple kind of clamp which I am going to describe, and which is shown in Fig. 24. He will find it very handy for

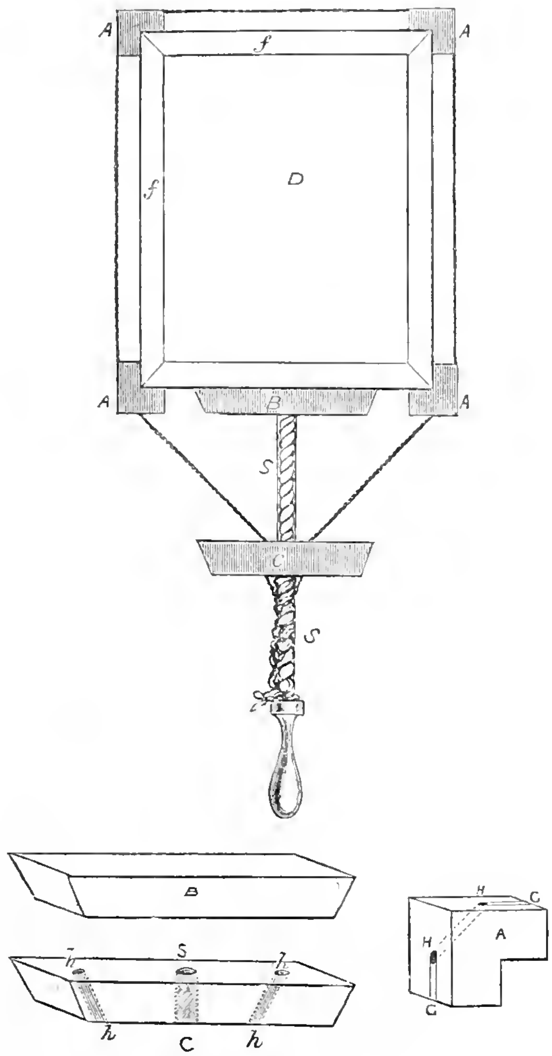


Fig. 24.

shallow trays with mitred corners, and similar things beside. I always use it myself. First and foremost we cut out four pieces of beech-wood into the shape shown at A; in the clamp now before me, the four longer sides of these measure 2 inches. Through these we bore diagonally from h to h, and cut the grooves $h\,g$, $h\,g$, from the holes $h\,h$ to the ends of the blocks. Now cut two pieces alike, as shown at B and C. Drill a hole in the bottom of B a quarter to half-way through it. This is to take the end of the screw immediately to be referred to. It is a wooden one cut in a "box," and if the amateur does not possess such a box, he can buy a screw like S (in D, above) for a few pence. C must be tapped to take this screw, as shown at S; the diagonal holes $h\,h$, too, must be bored through it. It only remains to thread a sufficiently stout piece of cord through the four pieces A and C, and our clamp is complete. It is shown in action in D. The frame $f\,f$ having been glued up, the four pieces A are placed one at each corner, and B against one edge. Then the two ends of the string are firmly attached to the handle of the screw previously passed through C, as are the strings too, and the end of the screw is inserted in the hole at the bottom of B. A glance at the figure will show how, by turning the screw, the string is tightened, A A A A caused to approximate, and the included frame $f\,f$ tightly clamped up.

While we are talking about picture-frames, though, by far the prettiest and most effective frame that the amateur can make is what is known as the "Oxford" one; in which instead of the corners being mitred and square, the sides and ends cross each other and project, as shown in Fig. 25. It will be noticed, too, in the sketch, that the

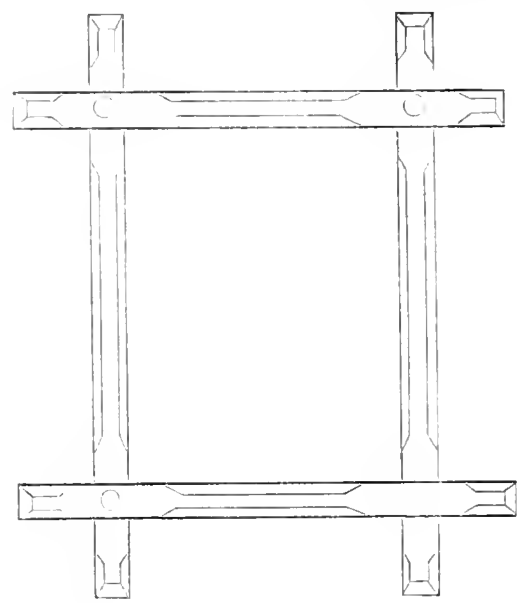


Fig. 25.

edges of the piece of wood are what is called "stop-chamfered"; that is to say bevelled at an angle of 45°, in (if I may so speak) lengths, the bevel stopping at intervals and not extending all along the work. Let us suppose now that we are going to make an Oxford frame to take a "Cabinet sized" photograph, the mount of which will measure about $6\frac{1}{2}$ in. by $4\frac{1}{2}$ in. Oak is very commonly used for these frames, but I have myself made a great many from walnut wood, which is very pretty and effective, and, with

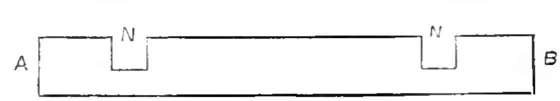
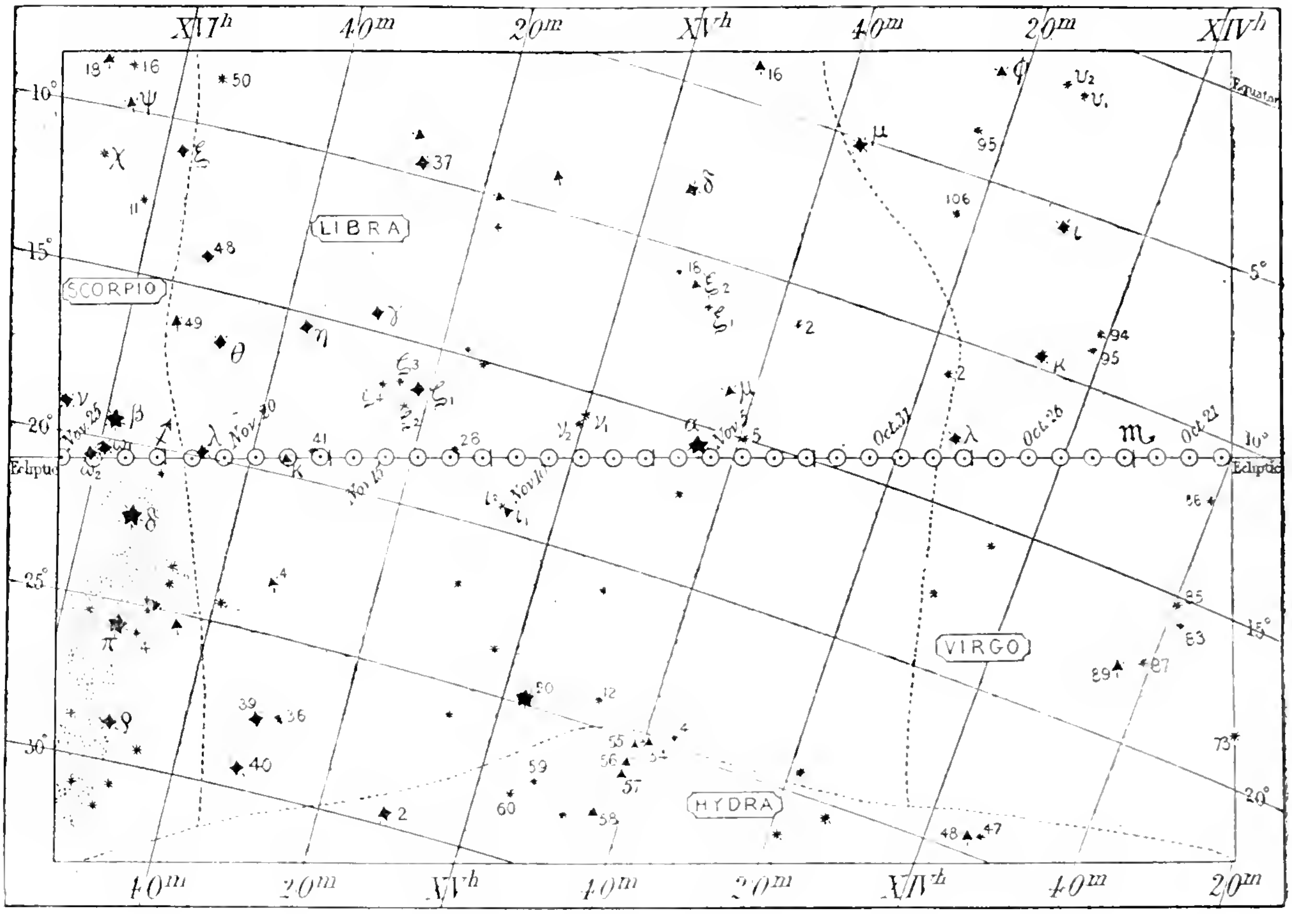


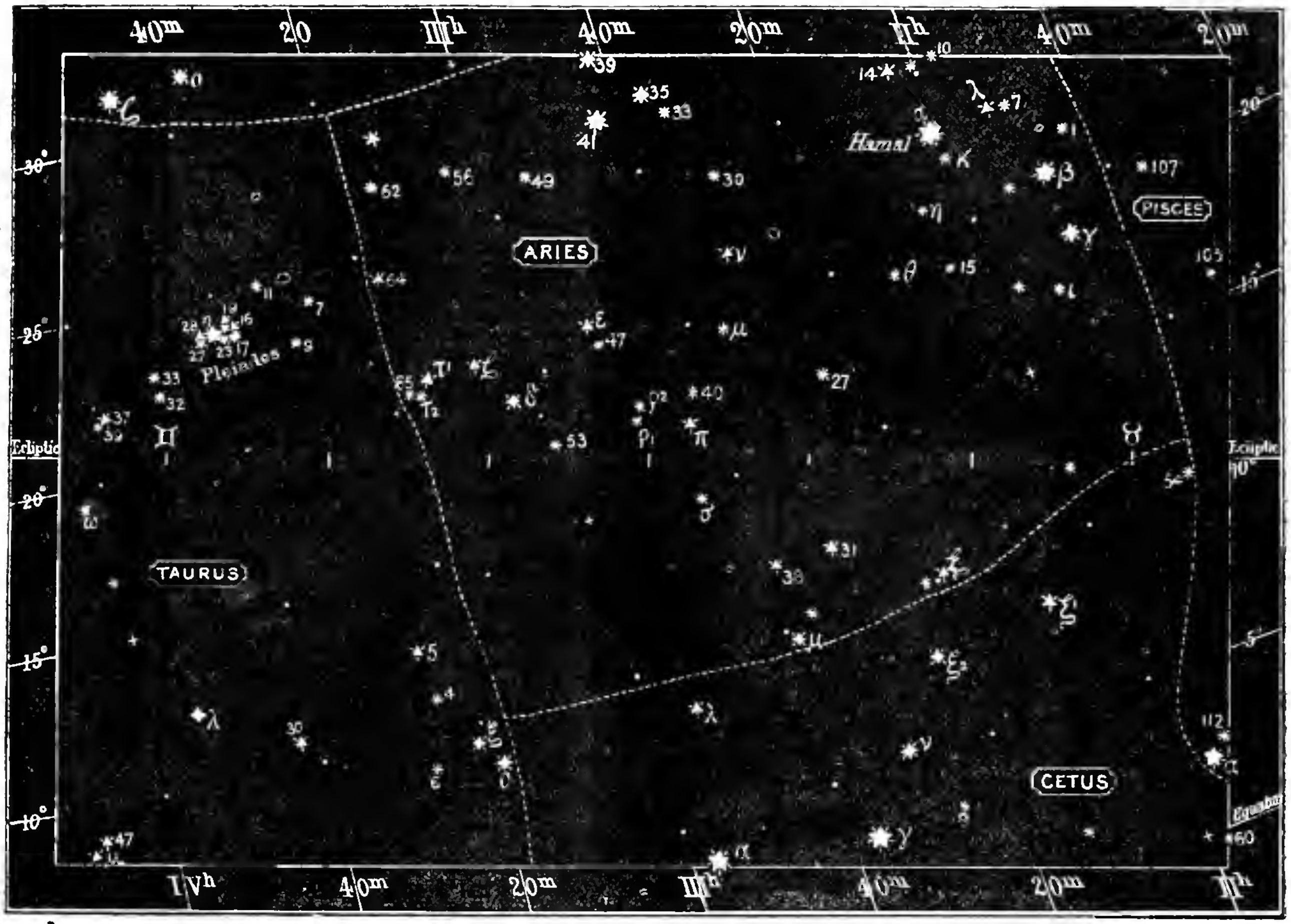
Fig. 26.

moderate care, easy to work. First we must square up four bits of wood $\frac{5}{8}$ in. wide and $\frac{3}{4}$ in. deep, two of them $9\frac{1}{2}$ in. long, the other two $7\frac{1}{2}$ in. long. These are to be (what workmen call) "halfened" together. Fig. 26 explains this. Here A B represents one of our pieces of wood in which the notches N N are cut $\frac{5}{8}$ in. wide (the width of the wood) corre-



Day Sign for the Month.

sponding pieces being cut out of the others. A very little study of the sketch will show that if these are truly cut, when the top and bottom of the frame are laid notches downwards, and in the notches of the sides, the whole frame will fit flush together, like one solid piece of wood. If the inside edges of the notches are 6 in. apart on our longer pieces, or sides, and 4 in. apart on our shorter pieces, or top and bottom, we shall have a solid frame measuring 6 in. by 4 in. inside. We will look it over and see which face looks the best, and that shall be the front of our frame. Now our photograph is $6\frac{1}{2}$ by $4\frac{1}{2}$ in., so by aid of the marking-gauge (Fig. 8, p. 154), we must mark a "rabbet" or rebate on the inside of the frame, $\frac{1}{4}$ in. wide, and $\frac{3}{8}$ in. deep. First marking our fitted strips with pencil, in order that we may restore them in their order, we take the frame to pieces, and, with a knife or chisel, cut the rebate out. If we now replace the pieces we shall, of course, have a depression at the back of the frame, $\frac{1}{4}$-inch larger each way than the *front* inside measurement, and $\frac{3}{8}$-inch deep. Into this subsequently will drop the glass, the picture, and the thin bit of "scale-board," which will keep it in its place. And, as far as merely holding the picture is concerned, we may regard our frame as finished; but we want to have it ornamental as well as useful, so we must proceed to the more decorative part of the work. So far it has all been pretty plain sailing; but I am rather afraid that at this stage the incipient mechanic will find that, in the words of a vulgar proverb, he is "like a young bear, with all his troubles before him." For he has now got to do the chamfering, which is far from an easy job; in fact, he may very possibly spoil his first frame altogether at this stage of its manufacture. He must begin by marking the edges of the chamfer on the front and sides of his pieces of wood; and then it is not a bad plan to saw nearly down to the lines at short intervals. This enables the initial part of the work to be done more cleanly. If, having marked out your chamfers and determined their length you go straight at them with a chisel, the chances are that after taking off the first few thread-like cuts from the sharp angle of the wood, the chisel will, as joiners say, "find its own way" into the wood far below the proper level of the bevel, and so ruin the whole affair. The secrets of bevelling are to find the right way of the grain of the wood, to use a very sharp, thin chisel, and to turn it bevel-side next the wood. It is much less likely to dig in then. When the bevel in the wood is long enough, one of the little American "bull-nose" planes, which only cost a shilling or eighteen-pence, may be used with advantage to make the central part of it. There is also what is called a "chamfer shave," which may be similarly used. The "stopped" ends, though, must be carefully finished with the chisel. Fig. 25 will serve as a pattern for the learner. Four little knobs or pins will be seen at the points of junction of the ends and sides of the frame. These are simply for ornament. I turn them myself out of old tooth-brush- or knife-handles, &c., when I am using dark-coloured wood, and out of ebony when the wood is of a light colour. I have endeavoured to make this description as intelligible as possible; but no amount of pictorial illustration can ever



Night Sign for the Month.

supersede, or be a substitute for, an examination of the thing itself. I strongly recommend the amateur, then, to obtain an old Oxford frame, take it to pieces, and to re-read this article with it in his hand. He ought not to have much difficulty in making another then.

(*To be continued.*)

ZODIACAL MAPS.

By Richard A. Proctor.

We give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

II.—THE FRAMEWORK OF THE DWELLING-HOUSE.

GENERAL PRINCIPLES OF CONSTRUCTION.

During the past few weeks we have instituted a series of inquiries regarding the present state of knowledge amongst builders and others who are concerned in the establishment of dwellings in the vicinity of London, and we have been led to discover a few items of interest which may prove of value to some of our subscribers.

The vast majority of villa residences and superior semi detached houses are the outcome of plans submitted to capitalists by competent architects; they usually include most of the conveniences of a healthy dwelling, with the exception of certain details which are very apt to be overlooked as trivial or unimportant, but, which we shall show hereafter, are of considerable practical value. Altogether, however, there is but slight ground for fault-finding amongst this class of buildings, the reason being that they are the work of competent and well-trained professional men.

But let us turn for an instant to those other abodes which represent the major portion of our homes. They are tenanted by the middle, poorer, and labouring classes, and realise rents of from £15 to £40 per annum. They are generally erected under the following circumstances:—A capitalist, usually a working man "who has ris," invests a few hundreds through the agency of a practical friend, or other intelligent workman, whom he styles his foreman. It may happen that the foreman in question has had a good builder's education, and is fully aware of the advances that have been recently made; but it is more often the case that he is a man who can turn his hand to anything, from the nailing on of garden palings to the fixing of a "Long Hopper" basin. His architectural acquirements are based upon the practical information he has derived during his apprenticeship and journeymanship in the work connected with larger and well-constructed houses, but he falls short when he comes to apply his knowledge as a supervisor, inasmuch as his training is devoid of those thoroughly sound and general principles, brought up to the requirements of the times, which characterise the labours of the cultured architect. The planting of D-traps, the dissociation of the household from the closet-cistern, the knowledge that a damp-proof course is useful; these are the utmost that we have found attended to in the most advanced types of the dwellings now under consideration.

By way of an example we propose to consider an averagely well-constructed house of moderate proportions; such a one as would realise an inclusive rent of about £30 a year. The capitalist endeavours to expend his funds to the best advantage, to erect a house which shall last for the period of his tenure of the land and no longer; and yet, through the excessive competition of his rivals, he is forced to make out that his commodity, if we may be here allowed to substitute such an expression, is all that could be desired. The would-be tenant, who is not only wholly ignorant of the geological structure of the chosen district, but also quite uninformed as to the suitable construction of a healthy house, is made to appreciate sundry innovations which are carefully pointed out to him, and he thereafter lives, happy and contented, in the midst of a disease-producing or aggravating neighbourhood, until its pernicious influences have done their deadly work. And yet all these evils are in vogue when only a slight excess of outlay could wholly obviate their existence.

The small capitalist, with his foreman to guide and direct him, invests in bricks of the commonest quality; fortunately cheap bricks are nevertheless reliable—at least, for the kind of work we are at present considering. He buys ingredients for mortars and cements; and once again the expenditure is a primary motive power. He is quite regardless of the nature of the sand used; it is probably sea-sand, thoroughly impregnated with the hygrometric chlorides which abound in salt water, and which, when mixed with mortars, is a perpetual cause of damp walls. The walls themselves are but a brick and a-half thick; they have scarcely time to dry, and aggravated by the employment of inexpensive and inefficient materials, result in a humid and cold suite of apartments, instead of a healthy and comfortable set of rooms.

Every house has a foundation, that could not very well be avoided. Every house, however, does not possess a suitably-constructed area of ground underneath it. It has long been known that swampy lands are unsuitable for building purposes; the consumption death-rate on clayey soil is far greater than that on dry pervious strata, and it can only be lowered by careful drainage. The causes of pulmonary and other deadly diseases have only recently been discovered; the researches of Pasteur, Koch, Lister, Ewart, Watson Cheyne, and others, in the domain of microscopical biology, have shown that those diseases are attributable to the growth and multiplication in the tissues of the lungs and other organs, of minute schizomycetous plants—*Bacillus tuberculosus* and its allies. These plants only thrive under suitable conditions of temperature and *moisture*, and it therefore stands to reason that houses built on swampy or badly-drained lands are susceptible to the invasion of the germs which cause zymotic diseases.

Now, although the unsuitable geological aspect of a tract of land, which is conveniently situated for building purposes, can be successfully modified by drainage so as to become adapted to the erection of homesteads, there is another thing which ought to be borne in mind by every builder:—His house, to be freed from the possibility of damp arising through the basement floor, ought to be built upon an impervious layer of cement, concrete, or asphalte. A substratum of this nature affords immunity from three dangerous or undesirable things, viz., when the joists of the floor rest upon a consolidated area—(α), damp is avoided; (β), suitable ventilation becomes easily and perfectly possible, and dry rot is thus prevented; (γ), vermin, such as rats, mice, &c., are effectually excluded. Amongst the numerous houses which we have lately examined, whether completed or in progress, we have not found a single good example; yet, the greater number of houses near London are built upon clayey soil, but imperfectly drained, as is clearly attested to by the pools of water which remain in the roads for several days together after a shower of rain.

In ancient times, when our ancestors built walls several feet in thickness, they thereby diminished the possibility of damp houses; but in the present day, when economy regulates the thickness of a wall, something else must be done. Apart from hygrometric mortar, damp is very liable to rise in the walls of a building, and make it unhealthy, for reasons which we have already indicated. It is necessary to extend the impervious layer beneath the basement floor, through the walls. Such an extension, or damp-proof course, as it is technically termed by modern builders, ought to be specially well constructed. When architects first became aware of the value of the damp-proof course, their attempts, although valuable, were capable of vast improvement; the counteracting influence of expenditure again became manifest in the introduction of a thin layer of tarred felt as a preventive to the rise of damp in walls. Many houses which we have inspected have no damp-proof course at all; the more enlightened of the aforesaid foremen use the tarred felt, but we are sorry to state that we have not yet discovered a single abode in which an efficient protection from damp is secured. The damp-proof course ought, if anything, to be more rigorously looked after than the impervious sub-basement; it ought to be perfect, especially at the exposed corners of houses, where damp is most liable to rise.

The circulation of fresh air without draughts underneath the basement, is only second in importance to its introduction, under analagous conditions, into the inhabited apartments. In small and moderate-sized rooms, such as those which constitute the class of houses we are at present discussing, an efficient fireplace and suitably-constructed windows are amply sufficient. The frames of the upper and lower sashes of each window ought to be very accurately fitted; the meeting rails, especially those at the middle, should be broader than the accepted inch or inch and a half; and the bead on the window-sill ought to be deep instead of narrow. The value of a deep bead may be said to be two-fold, (i), when the lower sash is raised, the inrush of air is directed upwards instead of directly to the door or fireplace, thereby acting as a ventilator instead of a draught-producer. This simple form of ventilator becomes all the more efficient when the upper edge of the deep bead is cut at an angle of 45°, or somewhat less; (β), when the lower sash is raised during a shower of rain, the fresh air can gain access to the apartment to the exclusion of the wet; this is particularly desirable in a bedroom.

We shall continue the subject of ventilation in our next communication, and follow our remarks by a notice of some of the most reliable contrivances that have hitherto been brought forward, in practical illustration of our foregoing observations. In this way we hope to point out what is desirable in the framework of a modern dwelling-house, and show our readers how those desiderata may become available.

THE paragraphs on "The Moon Eclipse" and on "The Action of Moonbeams," which appeared as quasi-editorial ones among our "Miscellanea" on pp. 369 and 370, were received from our esteemed contributor, Mr. H. J. Slack, F.G.S., &c., and should have borne his signature.

OUR SCIENTIFIC INDUSTRIES.

By W. Slingo.

GAS AND ITS USES.

I.—Manufacture.

THIS series of papers will obviously take a wide range of subjects—subjects, too, in which our readers must be more or less directly interested. The object in view is to present in as readable form as possible some of the very many commercial pursuits which are largely based on scientific principles. At first thought it might appear that no industry would be outside this category; but a little consideration will render apparent the fact that very many of our industries are not only weak in scientific bases, but that they are frequently more opposed than conformable to science. The end and aim of Knowledge, however, is not only to disseminate scientific information, but also to indicate new paths for scientists to tread. Consequently, reference to unscientific industries will occasionally be necessary, if only to point out the way in which the teachings of science may be advantageously applied.

The gas industry has been chosen as the first upon which to expatiate, not because of its paramount importance, but rather because it is one which appeals directly to everybody and which is of considerable interest in many directions.

Notwithstanding all that has been said and done in the way of promoting the electric light since the inauguration of the Paris Exhibition of 1878, it is manifest that the extent to which the new illuminant has beeu adopted is but a shadow—and that only a faint one—of what was so fondly hoped for by the crowd of too-enthusiastic promoters. Several hundred thousand pounds have been risked and lost in the venture, and doubtless many more will, ere long, share the same fate. Nor is this much more than might have been expected, even had attention only been directed to the fortunes and misfortunes which have attended the introduction of any novelty in previous times. George Stephenson had much more trouble in all directions than have waited upon electricians before he was able to demonstrate the real worth that lay hidden in his ideas. Amongst the many adversaries contending with him and many other progressive luminaries, ignorance, prejudice, and scepticism were not the least hurtful, but the day when such enemies may testify their potency has gone, and surely the electric light has suffered but little from either. All that electricians have to do is to prove that their apparatus can do what they claim it to be capable of doing, and that it shall do it at a price somewhere near what we are now paying for similar benefits derived, may-be less pleasantly, from other sources. There are many points about which electricians have been less careful than they should have been. They seem to have run away with the idea that, being able to demonstrate that light could be produced by the agency of electricity, they had done their share in introducing the new system. The troubles and reverses suffered by them during the past six years, however, have been sufficient to impress them with the necessity for making their system a practicable one. Nor can there be any doubt that, the position having been realised, they have stirred themselves in earnest to do that which hitherto they neglected. The past summer has shown us, in a great measure, what the electric light is capable of doing, and how great are the facilities for adopting it at the shortest notice. We have only to turn back, in our mind's eye, to the display made at the recently closed Health Exhibition for ample evidence on this score.

Great, however, as are the capabilities of electricity for illuminating purposes, it will doubtless be many a long day before a sufficient amount of confidence is placed in it to warrant its general adoption. In the mean time, coal-gas will continue to fill with ever-increasing efficiency that sphere which it has so ably occupied for the greater part of the present century. Coal-gas is not only an illuminant, but it is also a proved source of energy; it is capable of driving powerful engines, of heating stoves and conservatories, and of being applied in a great number of other ways—ways in which electricity, notwithstanding all that certain learned professors may say to the contrary, has not yet been proved practicable. Electricity as a motive power still requires the feeding-bottle, nor are storage batteries far out of the cradle. Visions of their maturity loom before us, but they appear only in the dim, dim distance. The sooner their development is brought about the better. We should all benefit by the change, and even holders of gas shares might, by exhibiting becoming discretion, profit by it. For cooking purposes the application of electricity has scarcely been suggested, and there is every indication that, for this purpose alone, the consumption of gas will continue to increase with gigantic and constantly-augmented strides. The possibilities of the distant futnre, however, should not deter us from studying matters as they are, but should rather prompt us to become better acquainted with the present order of things, that we might be duly prepared to receive and welcome the change.

It is, then, with the conviction that gas is an old and faithful servant, but that the time will come when as an illuminant it will be superseded, that I venture to describe, first, the general principles involved in the manufacture of gas, and then one by one the many ways in which it is applied to satisfy our daily wants.

To commence with, a few historical remarks may not be out of place. The word "gas" is believed to have been derived from the Flemish "geest," a spirit (the term then generally applied to all thiugs invisible). It was introduced by Van Helmont, a native of Brussels, born in 1577, who, in one of his experiments, burnt seventy-one pounds of charcoal, which yielded but one pound of ashes, and he concluded that the other seventy pounds served to form a "spirit," which he found to differ entirely from atmospheric air.

Very little, however, was derived from this, so far as the discovery of coal-gas and its properties are concerned. "Burning fountains, arising from inflammable gas issuing from the earth, have existed from remote ages, and, being attributed to supernatural agency, they were worshipped as emblems of the Deity." Records are also left of springs of "boyling water" that "did burn like oyle;" but perhaps the most interesting is the account of the discoveries and experiments of the Rev. Dr. John Clayton, who, towards, the close of the seventeenth century, had his attention drawn to one of these burning springs. It is stated that, "having caused a hole to be dug, on a candle being put down into the hole, the air catched fire, and continued burning." Dr. Clayton's interest was evidently excited, for he says, "I got some coal and distilled it in a retort in an open fire. At first there came over only phlegm" (steam), "afterwards a black oil, and then likewise a spirit" (gas) "arose, which I could in no ways condense, but it forced my lute, and on coming close thereto to repair it I observed that the spirit which issued out caught fire at the flame of the candle, and continued burning with violence as it issued out in a stream, which I blew out and lighted alternately several times. I then filled a good many bladders therewith, and might have filled an inconceivable number more, for the spirit continued to rise for several hours and filled the bladders almost as fast as a man could have blown them with his mouth, and yet the quantity of coals was inconsiderable. I kept this spirit in the bladders a considerable time, and endeavoured several ways to condense it, but in vain, and, when I had a mind to divert strangers or friends, I have frequently taken one of the bladders and pricked a hole therein with a pin, and, compressing gently the bladder near the flame of a candle till it once took fire, it would then continue flaming till all the spirit was compressed out of the bladder, which was the more surprising because no one could discern any difference between those bladders and those that are filled with common air." In 1733 an interesting communication was made to the Royal Society by Sir James Lowther on the inflammable air issuing from the shaft of a coal-mine near Whitehaven. "The workmen were surprised, on sinking to a depth of forty-two fathoms, to find a rush of air taking place, which caught fire from the flame of a candle, and burnt with great intensity, making a blaze about 3 feet in diameter and 6 feet high. . . . . At length the heat communicated by the flame was found to be very inconvenient, as it warmed the pit to a high degree, and it was necessary to have recourse to water in order to extinguish it. . . . . The part of the pit at which the gas escaped was afterwards securely walled off, and a tube about 2 inches in diameter extended up the shaft to a height of 12 feet above the surface of the ground. Through this tube the gas was allowed to escape into the open air, which it continued to do in undiminished quantity for several years. Many observations and experiments were made on the gas which was thus discharged from the extremity of the tube." One of the fathers of modern chemistry, Dr. Priestley published in 1790 his "Experiments and Observations of different Kinds of Air," in which he says, "There are different kinds of inflammable air, as has been observed by most persons who have made experiments with air. That which is commonly observed is, that some of them burn with a flame which may be called a 'lambent flame,' sometimes blue, sometimes yellow, and sometimes white, like the flame from wood or coal, or a common fire. . . . . It is observable that when wood is heated in an earthen retort the first portion" (of inflammable air) "burns with a lambent white flame, like that from burning wood in an open fire." This brings us very near to the introduction of gas for illuminating purposes, for it is recorded that Mr. William Murdoch, an engineer of Redruth, in 1792 actually lighted his own house and office with gas derived from coal distilled in iron retorts, the gas being conveyed through tinned iron and copper tubes to a distance of seventy feet.

(*To be continued.*)

Some idea of the amount of engineering employment afforded by brewing trades may be gathered from the following statistics:—England is at the head of all beer-producing countries with 27,000 breweries, and a product of 990,000,000 gallons annually; while Germany, with 25,000 breweries, makes 900,000,000 gallons yearly. The United States, with only 3,000 breweries, makes about 600,000,000 gallons per annum. Then comes France, with 3,000 breweries, and a production of 157,500,000 gallons; and Austria and Hungary, with 2,093 breweries, but a production of 280,000,000 gallons. Belgium has 1,250 breweries, which produced last year 210,250,000 gallons; Holland, 500 breweries, producing 34,000,000 gallons; Russia, 480 breweries, producing 8,000,000 gallons; Switzerland, 423 breweries, producing 13,500,000 gallons; Denmark, 250 breweries, producing 28,000,000 gallons; Sweden, 220 breweries, producing 21,000,000 gallons; and Italy, 150 breweries, producing only 4,000,000 gallons. Nearly 80,000 persons are engaged in brewing lager beer in the United States.

In Passu.

There is every prospect of next year's Exhibition being a great success. It is stated that the number of applications already sent in represent more than twice the available space.

There are rumours that the net proceeds of the Health Exhibition amount to something like £40,000.

For those who find pleasure in pomp and pageantry, the passage of the London Government Bill would be neither more nor less than a gigantic calamity; and, judging from the immense crowds of people who thronged to witness the Lord Mayor's Show on Monday, such people are wonderfully numerous.

The fine weather helped materially to swell the enormous multitude, which is conceded on all sides to have been the largest ever brought together in London. The general bearing of the sightseers was exceptionally good, and betokened considerable respect for the outgoing and incoming magnates. Of course, there was the usual exhibition of horseplay by such gentlemen as sweeps in uniform and coal-heavers in full canonicals.

The Lord Mayor succeeded in introducing an instructive element into the display, which made it more acceptable than one could have deemed possible. He has the satisfaction of knowing, too, that his efforts were highly appreciated. It is to be hoped that he will experience at least as peaceful and prosperous a term of office as was enjoyed by his predecessor.

From a paragraph which appears in another part of this page, it will be seen that Englishmen maintain the position of "the greatest beer-drinkers in the world," but, after all, they are probably wiser than other nations, if we may judge from the remarkable revelations made by Mr. W. Mattieu Williams in his articles on "Wine Cookery."

Reviews.

SOME BOOKS ON OUR TABLE.

Hygiene; a Manual of Personal and Public Health. By Arthur Newsholme, M.D. (London: Geo. Gill & Sons. 1884.)—This is a succinct Encyclopædia of Hygiene, from which details as to sanitary diet, clothing, and employment; the construction, drainage, and ventilation of houses; water supply; the prevention and cure of diseases; accidents and their treatment, &c., &c., may be found in abundance, and studied with profit by all who wish to be healthy and wise.

A New Method of Recording the Motions of the Soft Palate. By Harrison Allen, M.D. (Philadelphia: P. Blakiston & Co., 1884.)—By the aid of a copper wire rod passed up the nostril, so as to touch its anterior border, the free end of such rod impinging on a carbon-covered rotating cylinder, Dr. Allen has succeeded in graphically registering the movements of the soft palate, during the acts of swallowing, sneezing, coughing, the pronunciation of various vowels and consonants, and even sentences. The interest and importance of this, alike to the physiologist and the student of acoustics, cannot fail to be apparent.

Nerves and Nerve-Troubles. By J. Mortimer Granville, M.D. (London: W. H. Allen & Co. 1884).—Dr. Mortimer Granville has written a little book which should be procured forthwith by everyone who has arrived at the years of discretion. In language as simple and perspicuous as it can be, he points out the nature and origin of so-called "nervous" disorders, and gives the soundest advice as to their treatment, and especially as to their prevention. The chapter on "What is 'a cold?'" will convey some novel information to the mass of those who read it.

The History and Mystery of Sacrifice. By St. George St. Clair, F.G.S. (Birmingham: Cornish Brothers.)—With a considerable portion of Mr. St. Clair's pamphlet, we are precluded from dealing here; referring as it does to a fundamental dogma of the Christian faith. We may, however, say that the part in which he deals with the origin of sacrifice possesses a considerable amount of interest from an Anthropological point of view, and may be read, not without profit, by many who will wholly refuse to follow the author in his inferences from it.

In the Watches of the Night. By Mrs. Horace Dobell. Vol. IV. (London: Remington & Co. 1884.)—As we have spoken somewhat disparagingly of Mrs. Dobell's previous volumes, we may in fairness say that the poetical element is more conspicuous in her fourth one than in its predecessors. But why will she be so utterly depressing? The book before us is one long-drawn sob from beginning to end.

A Short Handbook of Natural History. (Charles G. R. Griffith.)—This is really the expansion of a programme originally issued by the Chester Society of Natural Science giving details of the Classification of the Animal and Vegetable (with a glance at the Mineral) Kingdoms. It will be found handy by any one wishing to possess such a classification in a compendious and portable form.

A Manual of Bee-keeping. By John Hunter. Fourth Edition. (London: W. H. Allen & Co. 1884.)—It seems but as yesterday that the barbarous fashion of ruthlessly suffocating the busy little inhabitants of our hives, for the purpose of obtaining their honey, prevailed throughout the length and breadth of the land; yet now, the ancient straw "skep" only lingers among a very few old-world, benighted cottagers. How pleasant, profitable, and instructive bee-keeping on the modern system is, let all who practise it testify; and assuredly no better guide to its mysteries could be found than the ex-Honorary Secretary of the British Bee-keepers' Association. Mr. Hunter's is a book to make an Apiarian of the veriest urban dweller; and if bees could be kept in back-yards, no doubt its perusal would have the effect of adding wooden hives to other less pleasing objects which form the landscape visible from the windows in rear of London houses.

A Few Remarks on Railway Permanent Way. By Clement E. Stretton, C.E. (Leicester: The Author.)—Mr. Stretton points out the defective condition of a good deal of our permanent way, and makes very practical suggestions for its improvement. Among other illustrations appears one (from a photograph) of the awful accident which occurred at Huystetten, on Sept. 3, 1882, through the failure of the permanent way and the "spreading" of the rails.

The Queen and her Relations. (London: H. G. Davies.)—Those loyal subjects who may feel an interest in tracing the descent of her Majesty from Alfred the Great and William the Conqueror, or who are desirous of possessing a list of all the descendants of poor old mad George III., can do so by reference to the compendious little chart whose title heads this notice.

Competitive Examination Papers in Arithmetic. By N. C. Potter. (London: Moffatt & Paige.)—Mr. Potter's series of questions seem well-selected and carefully graduated, involving tests of gradually increasing difficulty. Any student who can work all his examples through, may go with a light heart into the presence of an examiner.

The Social Emancipation of the Gipsies, by James Simson. (London: Baillière, Tyndall, & Cox. 1884.)—We have tried very hard to understand this queer little pamphlet; we fear, however, with but scant success. Its author seems to rank among the great unappreciated, and is irate seemingly with the English press for its failure to estimate the value of his conclusions that John Bunyan was a gipsy, and that Mrs. Carlyle had gipsy blood in her. Really, though, Bunyan is mixed up in such a way with snakes swallowing their young alive for protection, &c., that we speak with some diffidence.

Slyboots. By Beata Francis. (London: Hodder & Stoughton. 1884.)—All little people who make pets of domestic animals will be delighted with Miss Francis's "Slyboots." The wily artifices of Slyboots to secure a supper for his wife and family form the groundwork of the introductory chapter, the succeeding ones being devoted to the history and mystery, manners and customs, excellencies and failings of the whole of the livestock of Mrs. Jerkins's farm. The moral of these various stories, without being obtruded, is rendered obvious enough. The repentance of Miss Rosytoes for the troubles which her vanity brought upon her lover, and the tragic ending of the close friendship between Sandy the cat and Johnny the pigeon will be among the most attractive parts of the story for the young folks.

The Adventures of Oliver Twist, by Charles Dickens. (London: W. Kent & Co.)—A cheap and daintily-printed edition of our great English novelist's terrible and powerful story. The very thing to take on a journey, as it may be carried easily in the pocket.

Aunt Judy's Annual Volume. Edited by H. K. F. Gatty. (London: Bemrose & Sons. 1884.)—Biography and botany, songs, poetry, tales, essays, and sketches, as bright and fresh as ever, will cause dear "Aunt Judy" to be as heartily welcomed as of yore in the nursery and playroom. Here is a perfectly delightful present for a good boy or girl.

We have also on our table, from Messrs. Cassell & Co., *European Butterflies and Moths*, *History of the Franco-German War*, *The Library of English Literature*, *The Countries of the World*, *Cassell's Household Guide*, *Cassell's Popular Gardening*, *The Book of Health*, *Old and New Edinburgh* (very interesting, and modelled on their well-known *Old and New London*), *Cassell's Illustrated Almanack for* 1885, and *Recent British Battles.* Also *The American Naturalist*, *Science*, *Ciel et Terre*, *The Journal of Botany*, *Mottoes and Motives*, *On the Manufacture of Gas from Oil*, *The Medical Press and Circular*, *The Practical Confectioner*, *The English Household Magazine*, *The Kansas City Review of Science and Industry*, *Our Monthly*, *The Life-Boat*, *The Hindu Excelsior Magazine*, *Bradstreet's*, *Society*, *The Tricyclist*, and *The Gazette of the Travelling Tax Abolition Committee.*

Errata.—In "Graphical Projection of an Eclipse of the Moon," on p. 383, col. 2, line 3, for "5° 9′ 17″ ·1" read "59′ 17″ ·1." In the same column, lines 19 and 15 from the bottom, a comma should have been inserted between the letters "E" and "K." In line ten from bottom, for "R T" read "R I." In line 4 from bottom a comma should have been placed between "S" and "T." In letter 1500, line 15, "midnight" should be "midday." In p. 382, col. 2, second line from bottom, for "less" read "greater." In reply to W. Cave Thomas, p. 392, col. 2, "Nood" should be "Rood."

Miscellanea.

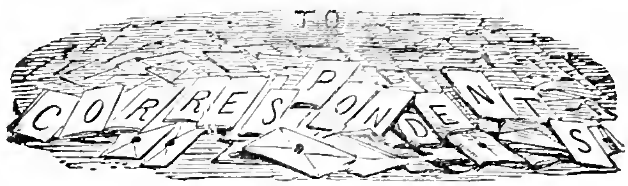
As a contribution towards the question of post-mortem attitudes, a correspondent sends us the following extract from the evidence given at the inquest on the body of Mrs. Ridley, who cut the throats of herself and her children at Newcastle, on Oct. 31:—"The mother was in a half-standing position, and leaning partly against a cupboard and the wall. Her feet were towards the parlour, and her hands were held up before her face, as if, after she had cut her throat, death had intervened so quickly that she had immediately become rigid."

M. Ch. Mano brought before the Académie des Sciences at the séance of September 29, the results of a careful survey of the section of the Cordilleras traversing the Isthmus of Panama. He is satisfied that the northern continuation of the Andes system belongs to a more recent geological epoch than that of the Syenites and serpentines of Choco and Antioquia, whence it appears to branch off. It is also later than the porphyries of the Costa Rica coast range, which belong to the system of the Rocky Mountains, stretching thence northwards to the Polar Sea.

The *Athenæum*, from which we copied last week a note with reference to Dickens's connection with the *Daily News*, says:—"The volume in the possession of the proprietors of the *Daily News* containing entries made whilst Dickens was editor of that journal, is, we understand, of rather too technical a character to have much interest for the general public, excepting a few passages. We were in error last week in supposing the existence of such a volume to be known to the editors of Dickens's correspondence. We may further add that Mr. Dudley Costello, who made the entries in the volume in question, was foreign editor, Mr. Wills being sub-editor."

According to a foreign paper the international steel railmakers' combination is arranged upon the following understanding, viz.:—That English makers shall receive 65 per cent. by weight of all rail orders, Germany 27 per cent., and Belgium 8 per cent. Indian orders are specially reserved for the English makers. A contract for 11,000 tons for Italy has been recently allotted to the Bochum and Phœnix companies, near Dusseldorf. Consumers of rails may, observes the *Engineer* (and we are at one with our contemporary on this point), flatter themselves that they determine where their orders are placed. If so they are simply deluding themselves. It is all arranged for them by the railmakers themselves, and they must submit to their fates unless they are prepared to accept other than the lowest tender. It will be interesting to observe how long this artificial state of things will last.

The Polytechnic Institute.—A series of Winter Saturday Evening Concerts has been arranged in connection with the above-named Institute, which, judging from the large and appreciative audience in attendance on Saturday last, bids fair to prove extremely successful. These concerts are given in development of Mr. Quintin Hogg's scheme of making instruction attractive by running it hand-in-hand with pleasure; and much of their success is no doubt due to the thoroughly liberal spirit of that gentleman (who, by the way, is also Liberal in politics, and will stand as a Parliamentary candidate for Westminster at the first opportunity). Mr. Hogg readily perceived that to make the Institute successful as a medium of education, he must first of all ensure its *popularity*, and towards that end no expense or trouble has been spared. Not the least interesting feature of these concerts is the manifest feeling of good-fellowship evinced by all who "assist" at them. Most people have at one time or another been present at one of those so-called "grand," but depressing, evening concerts which are generally promoted by local busybodies, ostensibly for some good purpose, but really to display their own importance; and doubtless they retain painful recollections of the barely-furnished building, the stony stare of superiority bestowed by the five-shilling "exclusives" on the less-fortunate one-shilling visitors, the "wooden" manner in which the *artistes* engaged went through their performances, and the self-complacent air of having performed a duty which seemed to pervade the audience when the programme had dragged itself to a close. No greater contrast to this sort of thing could be found than is afforded by the concerts at the "Poly." The members seem to vie with each other in their endeavours to promote the comfort of their visitors; and this desire cannot but be conducive to the success of the entertainments, which, however, should command extensive support on their artistic merits alone. Last Saturday's programme was extremely well chosen, and its items rendered by the performers (who are all either members of the Institute or their friends) in a very creditable manner; special praise, perhaps, being due to the military band of the Institute, which, under the direction of Mr. T. Scamell, played several selections during the evening.



"Let Knowledge grow from more to more."—Alfred Tennyson.

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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No communications are answered by post, even though stamped and directed envelope be enclosed.

DUALITY OF THE BRAIN.

[1502]—The duality of the brain is a familiar theory. I have never before heard that the left brain was supposed to be the chief seat of intellect. But I have always felt sure that it was so in my own case. My left side is more than usually inferior, both in power and in prompt response to the semi-conscious impulses of the mind. For thirty years I was subject to frequent and severe neuralgic headaches, nineteen in twenty of which originated in, or were generally confined to, the left half of the head. But more than this. When sleepless or fevered by intellectual labour, I *feel* the whole brain, feel conscious of its existence, and in some sense its working. In a lesser degree I am almost always conscious of the left brain, but not of the right; conscious not exactly of its working, but of its presence, as a sort of light weight inside the head. Indeed, in quiet fancy or reverie I might well suppose that the right half of the head was empty, and the left filled. And this difference almost always increases with prolonged brain work, till it reaches the stage at which the whole brain is consciously oppressed and uncomfortable.

Of the dual action of the mind, I have also had at times very curious experience. A keen and eager partisan, strongly convinced of the truth of the doctrines I advocate, there is frequently a sort of contradictory intelligence with me, saying to me: "You know that thought is exaggerated; the other cannot be true; so many of the wisest men, you know, differ from you about this third point." Yet my conviction of their truth remains. I should say that the left brain, the working one, was derived from one parent the other—the critical, inactive, correcting brain—from the other. I can well understand the demon of Socrates. It would need but a little exaggeration of my own consciousness to make the correcting intelligence a separate, external personality.

Still more curious is the fact that occasionally for a moment, in waking from sleep—rather, perhaps, before waking—I feel myself two persons—never more; which coalesce, as by a flash of lightning, before I become even half-conscious. This experience has not been frequent; but has occurred often enough to impress itself as a fact upon my memory.

Finally, since a severe illness, which slightly affected the brain, I have been far less conscious of any of these abnormal phenomena; but the only power that has deserted me, and that gradually, is that of writing poetry. Verse I can still manufacture after a fashion, but can never sustain the intellectual strain and absorption necessary to earnest poetry for more than a couple of stanzas at a time. It would seem as if that illness had equalised more or less the power and activity of the two brains. Q. X. V.

[1503]—I have read with great interest your series of papers on "Our Two Brains." Possibly the following experience may be of some interest to you, and you might also be able to offer an explanation of them. When being shown into a strange room, which I am positively certain I never entered before, it often seems strangely familiar to me, and I am dimly conscious of having been there on some former occasion. Often in society I seem to have a vague consciousness that I have listened to the same conversation before. This sensation sometimes haunts me, even in the most ordinary affairs of life, but it is only when my attention is roused by something uncommon happening that I feel it most strongly. Somehow or other I cannot suppose that I have fore-knowledge of what was going to happen, as I seem invariably to forget it, and it is only with the occurrence of the event that the impression returns. Mr. Rudd, in letter 1181, in KNOWLEDGE of April 11, suggests that one hemisphere is asleep while the other is awake. Admitting this, we have a very plausible explanation. The faint impression passing through the single brain, and immediately afterwards the vivid impression being received by the two hemispheres, might cause the effect in question. But of this you are more able to judge than I.—I am, &c.,

W. S.

[The experience of "W. S." must be a familiar one to almost everybody. So strong, on occasion, has been my own impression that I was witnessing the repetition of a scene, or of a conversation which had previously occurred at a remote date, that I have seemed to know what was coming next.—ED.]

[1504]—I have been much interested in your articles on "Our Two Brains." While reading I thought of what occurred under my own eye a short time since. A young girl, about 13, had an attack of hysteria, which lasted, more or less, for three weeks. At times she would be for twenty-four hours in a state so far unconscious as not to recognise her friends. While in these conditions she would talk to any one of us quite reasonably, but persisted in calling us by wrong names. I was called in anything but glowing terms, and was always looked upon as a person representing her schoolmistress. Whenever I went in and saw her in this state, which was frequent, I was without exception called by the same name. I was frequently there when she was roused from her unconsciousness when I was at once addressed as Mr. T——. This appears to be a satisfactory answer to the question, have we two brains? When in a state of perfect consciousness, she would be wholly ignorant of what she had been saying during her former state; but when returning she would answer any question put to her when in a previous state without fail.

While writing the above, I will relate what occurred to myself to-night. After tea I fell asleep, and while in that state I felt an inclination to awaken myself—a feeling somewhat akin to the nightmare. I succeeded, and experienced a violent palpitation of the heart for about fifteen minutes afterwards. Could any of our readers kindly explain? J. W. T.

FEMALE BRAIN-POWER.

[1505]—In 1444 Mr. W. H. Jones suggests that women are inferior because they have been long uncultured, and that now that things are different they may improve up to male level. This is surely a fallacy; it is treating women as if they were a separate race, like negroes, &c. Every woman must have a father; what reason can be given for her inheriting less of his natural and acquired capacity than her brothers? What is true is, that the cultivation of women will probably raise the level of all their children. But then, the boys improving *pari passu* with the girls, and having already a great start (*ex-hyp.*), the girls will never get up with them. HALLYARDS.

ECONOMY.

[1506]—One of the wonders of the present age is "How do most people manage to live?" We do not refer to the large percentage of those who, without any ostensible means of obtaining an independent livelihood, are thrown for support upon the kindness of their friends or relations, and who continue through life to draw from that source what may be necessary to make up the deficiency in their own incomes.

These are *dependent*, but their friends are satisfied that it should be so, and cheerfully contribute to their support, so that they are somehow always enabled to make both ends meet.

The class to which we allude as the majority is that comprised of people who may be considered to have done as well as they and their friends could naturally have expected, and who have certainly reached as high a social status as they are ever likely to attain to. These are in receipt of a settled income, uncertain, perhaps, but, for the moment tangible, and it is at first sight surprising that such apparently ample means should fall to the lot of so many, and still more so that they should prove insufficient to meet the demands which are made upon them by the usages of modern society. As a rule, the expenditure appears to be quite up to, if not in excess of, the income, instead of being—were the dictates of common sense only followed—somewhat or even considerably under it, in order that provision might be made for the proverbial rainy day or the age of the "sere and yellow."

Many a man at the end of the year is surprised at the amount he has got through, and the little he has to show for it. Even taking those who carefully avoid extravagance or the indulgence of frivolous or expensive tastes or habits, it is the actual *necessary* expenditure every day that runs away with the money, and it is necessary because we are all obliged to conform to certain rules and regulations which our position in society exacts, and which it is high time some stand were made against, were it only to avoid a state of universal bankruptcy.

We are convinced that the greater number of civilised beings, no matter what their position, live quite up to, if not beyond, their means. They are brought up with tastes and ideas frequently quite unwarranted by their expectations.

Parents wish their children to have more than they had themselves, instead of instilling into them, when young, the principles of self-denial and prudence. When they grow up they are accustomed to regard as necessaries what their fathers looked upon as luxuries, and the means which ought in their position to prove ample, are not sufficient to cover their increased expenditure.

Society is hard upon those even in the middle class who are not well dressed, whose table is homely, and who take no part in the amusements which, though innocent enough in themselves, are either expensive or occupy time which might be much more profitably employed in some remunerative occupation, or, what in the end amounts to the same thing, the acquisition of knowledge.

Against the growing evil of impecuniosity, with which there is no doubt we are all afflicted (excepting those who are born with silver spoons in their mouths), we know of only one remedy, but it is one that is open to all, and has been proved to be effective by many. "Time is money."

We want money—very badly some of us—and yet we waste and spend it in the shape of time, throwing away the precious hours which, if well employed, would ere this have afforded us a mine of wealth.

No one can afford or has any right to be idle, and were this generally acknowledged and acted upon, a certain stigma would attach to those who "lost their time" in doing nothing. Moderate recreation and the duties of home are in themselves healthy and necessary employments, and we refer only to those who are needlessly and absolutely *idle*.

Each one can tell the amount of *idle* time he has at his disposal. Let him employ this as we have already suggested, in *working* or *learning* or *teaching*, and he will find that even if his income does not perceptibly increase, his expenditure will certainly diminish, and he will ere long learn to value at its full the advantage and comfort of true economy. N.

[I print this letter (which reaches me all the way from South America) as a contribution to a somewhat important problem in sociology.—ED.]

FIGURE PUZZLE.

[1507]—After the trouble caused you by the appearance of Puzzle 1398, I hesitate again to refer to it; but I may be allowed to point out that the peculiarity shown was due to the position of the number 7 in the decimal system. The same peculiarity exists in regard to the fraction $\frac{1}{13}$, as shown below, in what may be termed the converse of Puzzle 1,398, thus:—

076923 = $\frac{1}{13}$ in decimal form.
769230 = 10 times the above.
692307 = 9 ,, ,,
923076 = 12 ,, ,,
230769 = 3 ,, ,,
307692 = 4 ,, ,,

J. C.

THE MOUTH ORGANS OF THE DIPTERA.

[1508]—A friend has recently brought to my notice a copy of KNOWLEDGE containing a paper by Mr. H. J. Slack, on pages 312–13 of the present volume, on the "Mouth Organs of the Diptera," which, among other matter connected with the subject, treats in a general way of the teeth of the blow-fly.

Having paid considerable attention to these particular organs in the Diptera, perhaps you will permit me to fully confirm what Mr. Slack has stated with regard to the dentition of the blow-fly, and to add that, in addition to the genus Musca, these organs are to be found in many widely divergent species of the Diptera. These organs are not always of the simple type exhibited in *Musca lardaria*, but that by gradations they can be traced to most divergent forms.

I am at present engaged in contributing a series of short articles, accompanied with illustrations, on this subject to the pages of *Science Gossip*, which will, I think, show pretty conclusively there is a wide field for research in this direction, and that the knowledge thus obtained will shed a new light upon a subject which has as yet been comparatively unworked.

The number of teeth, their form, and manner of grouping, point in a very remarkable manner to the truthfulness of development; and perhaps, if agreeable to you, sir, I may, when my experience is further extended, offer the readers of KNOWLEDGE a few remarks on this very interesting subject.—I am, sir, yours faithfully,

W. H. HARRIS.

SUPERSTITIONS.

[1509]—Many years ago, when a very young girl, I was taken to the bedside of an old lady, a connection by marriage of my family, who had shortly before been seized with a slight attack of paralysis. She was propped up in bed, and in a kind of semi-conscious condition—that is to say, I remember doubting at the time whether she completely recognised me, though she had known me from my earliest childhood. Her bed faced the window, before which was the usual toilet-table and mirror. To my astonishment, the latter piece of furniture was covered with a large white cloth. On my inquiring the reason of this I was told by the attendant that it should always be done in the case of a sick or dying person; it was unlucky for them to see themselves in a looking-glass. The invalid's sister seemed also to see it in this light. Is this idea an universal one with the lower orders in England, or is it peculiar to the Midland counties, where this occurred? COSMOPOLITAN.

PRIMARY COLOURS AND PRIMITIVE COLOURS.

[1510]—After reading the articles Nos. 1326, 1388, and 1433 in KNOWLEDGE, it struck me that we are apt to confound the word *primary* with *primitive*, when speaking of colours, and that the former should be used to denote the tints which the atmosphere produces in a ray of solar light in its passage to us; as for example, under certain conditions when the rays of the sun strike upon a waterfall we see a most brilliant rainbow between ourselves and the cascade, if we move to one side or the other, the different colours seem to us to change their places as we change our position with regard to the ray of light.

The word *primitive* as applied to colours, does not in this case appear to be appropriate, this expression seems as if it should rather be used when speaking of the three principal colours used in painting, viz., red, blue, and yellow, whereof other colours can be composed.

Being at the time absent from home, I had no works of reference with me, and the matter had almost faded from my mind, when an accidental conversation recalled it. At the first opportunity I consulted Brande's "Dictionary of Science, Literature, and Art," to ascertain his opinion on the subject. He seems to have come to a similar conclusion as myself, though couched in scientific language.

Red, blue, and yellow may be called *primitive* colours in another sense also, for they are those which are not only preferred, but we may say exclusively adopted, by *primitive* peoples—that is to say, by certain races in Asia and in Europe, who, living in remote and almost inaccessible districts, have remained very conservative in their manners and customs. The following instances have come under my own observation:—

In the Spiti Valley, in the Himalayas, and in Ladakh, or Western Tibet (both of these from their position and climatic conditions shut off from the outer world during nearly half the year), the women use these three colours in their dress and ornaments. The upper garment of those of the former place is of dark blue cloth; red and yellow are introduced in the trimming, the latter very sparingly. The ornaments of both these peoples are composed of red cornelian, coral, rough turquoises, and amber, but some of the richer women in Ladakh introduce small squares of green cloth alternately with red; on the inner side of the square of sheepskin with which they cover their shoulders both in summer and winter; and when in gala-dress, they not unfrequently stick the small gold-coloured seeds of some plant on their faces, at distances about half-an-inch apart, which gives a singular effect to their countenances.

When in India I observed that though the natives seem to have an instinctive feeling for harmony of colour, as we see by the carpets they produce, yet many appear to be unable to distinguish between light and dark shades of the same colour. I have often been assured by them that two pieces of brown woollen material were identical when there was really many shades of difference between them.

To turn to Europe. The women of some parts of Albania execute embroidery in geometric patterns on white linen for the adornment of their own under-garments. Even tiny girls of four or five are adepts at this work. As far as I saw, they used cotton thread of these three colours only. They have no pattern traced on the material; it is all done out of their own inner consciousness. So also in northern lands. Races whom the position of their country has shut off from communication with other peoples use them likewise. In the museum at Bergen, in Norway, are some specimens of embroidery, perhaps a century or two old, which resemble, both in character and colouring, the handiwork of the Albanian peasant girls. COSMOPOLITAN.

[There can be no objection to "Cosmopolitan" using the word "primitive" in the sense in which it is employed above—that red, blue, and yellow are primary colours, though, it is a grave error to suppose. Crimson-lake, gamboge, and Prussian blue (as Rood points out) suffice approximately to represent all colours *in painting*, though blue light and yellow light do not produce green light, but white, and the mixture of red and green light produces yellow. In the present state of our knowledge all evidence points to the fact that the real primary colours are red, green, and violet. —ED.]

LETTERS RECEIVED AND SHORT ANSWERS.

HENRY PALMER. Thanks. You will see that it has been utilised —E. L. G., WM. ASTON, J. H., ALFRED BUSS, J. T. WOOD, J. GREEVEZ FISHER, H. ASKEY, M.A., W. TOWLER, J. E. GORE, and W. E. SADE write to say that the "Figure Puzzle" in letter 1490 is nothing but a magic square. Mr. Towler adds a long extract from some article or essay detailing how the Egyptians and Pythagoreans held the magic square in great veneration, dedicating it to the then known seven planets, and engraving it on a plate of metal "in sympathy with the planet." (I wonder how they managed this with Mercury?) The square thus dedicated was enclosed in a regular polygon inscribed in a circle, divided into as many equal parts as there were units in the sides of the square, with the names of the angles of the planet (?) and the signs of the zodiac written on the void spaces between the polygon and the circumference. No single correspondent, however, attempts to show the connection between the figures in the (quite obvious) "Magic Square," and the tremendous magical power attributed to them, which I understood to be the specific subject of the question of "Lover of Things Occult."—H. W. WILSON (The Lyceum, Cornholme, Todmorden). For the *n*th time Mr. Proctor has entirely ceased to lecture. See p. 62 of the current volume of KNOWLEDGE, and the paragraph (in capital letters) which concludes the heading to the correspondence column.—SAMUEL KINNS. Forwarded to the conductor of this Journal.—W. S. B. wants to know how, in the "Game of Fifteen," to obtain the consecutive order when, after arranging three rows, the last row reads 13, 14, 15?—JAS. FRASER. Your object-glass is certainly not achromatic; and hence not worth spending any more money upon. Even, however, assuming that it did transmit a colourless image, the eye-tube of an ordinary terrestrial eye-piece would give far too low a power for the observation of Saturn's rings. These might be seen—or rather perceived—as a single ring with a first-class two-inch objective and a power of 80. You have been trying to view them with a very indifferent one on a magnification of perhaps 8 or 10!—NEO. No. The day can *not* by any possibility have been lengthened since Neolithic times to an extent which would have caused a difference of 6° in the point of sunrise; in fact it is a moot question whether it has ever lengthened at all. Moreover, the length of the day has nothing to do with the point of sunrise, the only operative factor in changing which is the alteration in the obliquity of the eclipse. Under any circumstances, however, this could merely shift such point a little over 2° in 9,000 years, and this, I fear, will not help you much. You must address any order for KNOWLEDGE to the *publishers*, and not to me. You state that you "enclose stamps," which you do not. —F. W. RUDLER. Received with thanks.—HALLYARDS. Never mind the phrase. *Ars probat artificem*, and your fellow readers will judge you by what appears in print from your pen. You are too flattering. In connection with your American friend, I may quote a dictum of a fellow-countryman of his, apropos of a man who had made a certain statement in his presence, "I don't say he's a liar, but if I met him walking down the Broadway of my naytyve city of New York between Ananias and Sapphira I should say that they were an uncommon nice family party!"—A. K., ALFRED BUSS, and W. MATHIAS further add to the noble army of solvers of the "Magic Square" in letter 1,490; Mr. Mathias pointing out in addition that the numbers, 1, 3, 5, 7, 9, 11, and 17, which occur frequently, are (in connection with days) "turning points in all, or most, human diseases;" whence the superstition of this occult power may have had its origin. He also suggests the following problem. Arrange the numbers from 1 to 16 in a square, "so that the sum of any row, column, or square of four numbers may be 34."—JOHN G. RICHARDSON forwards his subscription for one year to the *Editor*, who has had in turn to send it back to the Publishers. thereby causing wholly needless delay. I am almost tired of reiterating that I have nothing, proximately or remotely, to do with the business management of KNOWLEDGE, and that it is not I, but the Messrs. Wyman, who sell it. The other matter in your letter shall have immediate attention.—GEO. LUFF. Stamps sent on to Publishers, to whom you ought to have addressed them, and not to me.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

THE "IDEAL" LAMP.

Although gas is now so general, and although gas is threatened by the electric light, the lamp still holds its ground, and remains the object of much inventive ingenuity. One of the leading inventors in this line is Mr. C. F. A. Hinrich, of New York; and at the offices of Messrs. Zimmerman & Co., of 57, Farringdon-street, London, may now be seen several remarkable inventions in the form of new lamps. One of these is known as the "Ideal," and is constructed wholly of nickel-plated brass, and any quality of kerosine may be used without the slightest danger of an explosion; the oil also is kept constantly cool by the draught of cold air which is continually circulating around the well. No shade or chimney is required, but for the protection of the eyes while reading a shade such as used on gas can be utilised. Whether the lamp is turned at its full height or very low it will burn without smoke or odour. In fact, it replaces gas at a low cost. The combustion is created by a fan attached to a clock in the body of the lamp, made of the best steel with hard brass mountings, perfectly noiseless, and wound by turning a rosette on the side to a full stop, when they will run until the oil in the lamp is consumed, or about ten hours. The clockwork is made very heavy and open so that anyone can clean it without taking it apart. The light is clear and steady, without the flickering or tremulous shadow of gas; it is bleached almost white by the constant supply of air, without having any injurious qualities.

THE NEW PATENT "CARRAGO" STEEL NOSE-BAND.

What is claimed to be a perfect cure for restive horses has at last been found. Mr. Richard Winder, of Farningham, Kent, has invented what is called the New Patent "Carrago" Steel Nose-Band, which supersedes the bit, and is said to be greatly superior thereto. It is fixed about two inches below the place where the nose-bone separates from the skull proper, and, as a further check, the "Carrago" should show just above the mouth. The secret of the power which can be exercised over the horse by the "Carrago" lies in the fact that the nose and cheek-bones are very sensitive to pressure. This pressure is not exerted when the animal is going quietly, and only slightly to guide him. An india-rubber pad inside the curved part protects the nose from chafing. One of the advantages of this appliance is that its use entirely supersedes that of the bit, or a mouthful of bits, and these alone are a great and prolific source of irritation to all horses. Another advantage claimed by the inventor is that the "Carrago" simply lies upon the nose-bone, and weighs only some eight ounces; as long as the horse is driven by a light hand, it is practically unfelt, and only becomes severe when the horse needs correction or coercion. The guiding is performed by the thumb and finger only, so sensitive is any horse to the side pressure. It is believed that the use of this invention would prevent many accidents which the ordinary bit and reins are powerless to avert.

THE PREVENTION OF "BLOCKING" IN PIANOFORTE ACTIONS.

Nearly every advanced instrumentalist on the piano must at times have suffered extreme annoyance from what is technically known as "blocking"—*i.e.*, the failure of the hammer to return consequent on the repeating action being in some way defective. Musicians who suffer from this cause will be interested to know that Mr. James Semple, of North-park-terrace, Hillhead, Glasgow, claims, by the improvements he has effected in pianoforte actions, to effectually and completely obviate this source of annoyance by securing a perfect repeating action, combined with a complete check action which prevents any vibration or "blocking" of the hammer.

TOY FOOTBALL.

The inventor of a new game, or even a good modification of an old one, well merits the gratitude of all his fellow-creatures in these high-pressure, overwrought days. What appears likely to prove a highly popular game for long winter evenings has been just invented by Messrs. Pomfret & Fox, of 54, Church-street, Preston. The game in question is an ingenious application of football for indoor recreation. Football pure and simple is a very manly and hardy sport to which many object, but "parlour" football, as will be seen, is free from fault of any kind, and deserves the widest encouragement by reason of its ingenuity and ever-varying interest. The game is arranged to be played by two persons on a board divided into 208 squares. Each player has 11 toy men, consisting of 5 forwards, 3 half-backs, 2 backs, and a goal-keeper. The mimic men can be moved forwards, backwards, or sideway, either in a square or diagonally, under certain rules; for instance, the goal-keeper is allowed to move any number and to any square between his goal-posts, and can kick out from one to six squares, but can only retreat one square at a move, except in a "goal-kick," when he must kick 6 squares in any direction, and must return at once to his goal. The ball is pushed or "kicked" from square to square by the toy men according to the rules, and is put in motion at the commencement by the centre forward. The object is to work the ball from the centre and get it between the opposite goal-posts. There are "corner-kicks," "throws-in," "free kicks," and "goal-kick," but that bone of contention—the off-side rule—is not recognised. The duration of the game is thirty minutes each way, but this time can be shortened or lengthened as convenience demands; when "half-time" is called, no matter where the ball is, ends must be changed, and the "kick-off" again taken from the centre.

A NEW BLIND-PULLEY.

Pulling down the blind often tries the temper, and is an operation that should be performed by automatic means on touching some simple contrivance for the purpose. Messrs. George Salter & Co., of West Bromwich, have improved a blind-pulley of theirs, which is now practically perfected. This arrangement is self-acting; the movement being regulated by a steel spring enclosed in the barrel, which adapts itself to the cord as it lengthens or shortens with the changes of the weather. The strain on the cord and the roller is thus very much reduced, and the risk of a falling blind is almost entirely obviated. In construction, the article is very strong and durable, and it has an elegant appearance, thus rendering it suitable for any class of room. This pulley is also made in iron, and in larger sizes for out-door use, such as for greenhouse blinds, &c.

A NEW SHOE-TIE.

Englishwomen have not been remarkable for care and taste in foot gear, but of late an improvement has been evident in that respect, and ugly shoes and clumsy boots are now disappearing rapidly in favour of more artistic patterns. Following out this phase of fashion, Messrs. G. Hoby & Co., of 4, Great Queen-street, Lincoln's-Inn Fields, have introduced an ingenious French invention for fastening shoe ties. The principle of the invention is a kind of spring clutch, the lower jaw of which is laid under the bow of the tie when the knot is made; the upper jaw then closes upon the bow, and the roughened edges of the clutch keep the lace from slipping or becoming untied. The appearance is highly ornamental, and its use would entirely remove the ugly look of many ordinary walking-shoes, without becoming in any way an obtrusive ornament.

A PATENT GREASE-TRAP.

Every householder who does not entirely ignore the kitchen and its many vital details, knows the troubles and sanitary evils that arise out of the construction of most sinks and their drains. Messrs. J. and M. Craig, of the Hillhead and Perceton Fireclay Works, Hillhead and Long Park Sanitary Pottery, Kilmarnock, are now introducing a new patent grease-trap, which is in use at Balmoral Castle, and when fixed between the waste-pipe from a kitchen sink and the drain, entirely prevents the accumulation of grease in the drain and the consequent choking of the pipes. This result is obtained by the use of a large central chamber or reservoir, in which the grease collects, and from which it may be removed as often as necessary without trouble. The same firm also manufacture enamelled sinks, which possess obvious merits of a sanitary character, besides their comfort and convenience.

IMPROVED FIRE-GRATES.

Grates and stoves have been, and are, the subject of a bewildering list of patents, good, bad, and indifferent. An invention, however, of Mr. John Bate, of Holborn-viaduct, E.C., machinery merchant, seems ingenious, and should certainly conduce to great convenience and economy of fuel. According to this invention, the fire-grate is divided by a grating or grated partition, so arranged as to cut off a hopper, or similar space or receptacle, preferably at the back or sides of the fire; and into this small coal, dust, cinders, or the like, are placed, whilst the main body of fuel is placed outside such partition or receptacle. This hopper-like space may occupy any portion of the whole, and may be open at bottom in some cases. The grate, moreover, may either be cast with such partition, or it may have guides to receive a loose partition.

Our Chess Column.

By Mephisto.

Game played Saturday, the 8th inst., in the match of Lancashire v. Yorkshire, at the Athenæum, Manchester.

French Defence.

White. Mr. R. K. Leather. (Liverpool.)	Black. Mr. R. M. Macmaster. (Bradford.)
1. P to K4	P to K3
2. P to Q4	P to Q4
3. Kt to QB3	Kt to KB3
4. P to K5 (a)	KKt to Q2
5. QKt to K2 (b)	P to QB4
6. P to B3	Kt to QB3
7. P to KB4	B to K2
8. Kt to B3	P to QKt4
9. B to K3	P to B5
10. Kt to Kt3	P to B4 (c)
11. P × P (en pas)	Kt × P
12. Kt to K5	Q to Kt3
13. B to K2	Castles
14. Castles	P to Kt5
15. Q to Q2	R to Kt sq.
16. B to B3	P to Kt3
17. K to R sq.	P to QR4
18. QR to Kt sq. (d)	Kt to Q2
19. KR to K sq. (e)	Kt (Q2) × Kt
20. BP × Kt	P × P
21. P × P	Q × R (f)
22. R × Q	R × R (ch)
23. B to Kt sq.	B to Q2
24. Q to QB2 (g)	KR to Kt sq.
25. Q to R4 (h)	Kt × KP
26. Q × RP	Kt to Q6
27. P to KR3	B to Q3 (i)

And Black won.

NOTES.

(a) The usual continuation is B to KKt5; the move of P to K5 at this stage deserves attention.

(b) Preparing to support his QP against P to QB4.

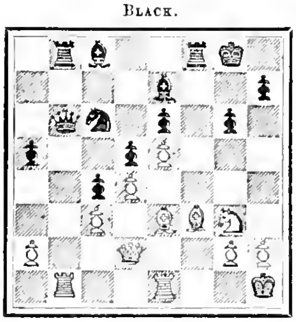
(c) Black ought to have further proceeded on the Q's side; this move injures Black's position by enabling White to occupy K5, and the KP is likewise weak.

(d) Kt × QBP would not have won the P, for after P × Kt, P to Q5 and P × Kt, the White P could not be defended for long. QR to B sq. would have been a better move, as it would have provided against any further proceedings on the Q side, and left White free to act against the weakened Black K.

(e) Here 19. P to B5 seemed a better move, for if KtP × P 20. B to R6, but now Black could give up the exchange and have two good Pawns, or he may likewise reply with QKtP × P.

(f) It is very difficult to judge when the exchange of the Q for the two Rooks is good or not. It is certain, however, that had Black retired his Q, White would soon have obtained the better game.

Black.



White.

(g) This is worse than useless, as it is clearly Black's intention to double his Rooks. It would have been better to play P to KR3 and K to R2 at once, or play Q to K3.

(h) A grave mistake, and at best an error of judgment, for instead of trying to win a P, White should have endeavoured to disengage his pieces.

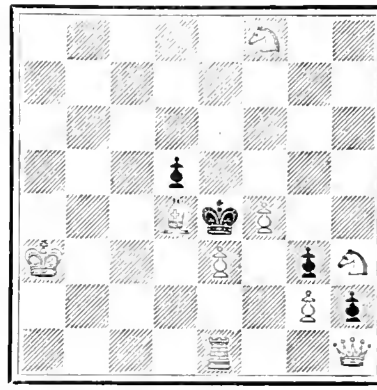
(i) Black has conducted this game with a sound judgment combined with a vigorous attack. The record is, unfortunately, incomplete. If now 28. K to R2, P to R4. 29. P to KR4, P to Kt4, and Black must win.

A highly interesting Chess match was played on the 8th inst. at Manchester, the contestants being 80 players of Lancashire v. 80 of Yorkshire. The Manchester and Liverpool Chess clubs contributed the majority of Lancashire players. Both these clubs are very strong, indeed, probably the two strongest provincial clubs in the kingdom. The best Liverpool players were Mr. A. Burn, Rev. J. Owen, Mr. S. Wellington, Mr. R. K. Leather, Mr. W. W. Rutherford Mr. A. Hoistendahl. The foremost amongst Manchester players were Messrs. H. Jones, J. Baddeley, A. Steinkuhler, T. von Zobern. These players were opposed respectively by Messrs. J. W. Young, J. Butler (Wakefield), C. G. Bennett, James Rayner, T. Y. Stokoe, E. R. Hussey (Leeds), F. F. Ayre, E. Freeborough (Hull), Rev. H. J. Huntsman (Sheffield), R. M. Macmaster (Bradford). There were 132 games played, the result being a victory for Lancashire by 74 games to 31, with 27 draws.

PROBLEM No. 135.

By H. F. L. Meyer.

Black.



White.

White to play and mate in three moves.

"Clarence" writes:—"I send you a problem composed by Herr Meyer, admittedly embodying two ideas, each separately claimed *as original* by Shinkman and Lloyd; the former anticipating Healy's idea, the latter elaborating the Pawn mate. Perhaps you will agree with me that Mr. Meyer has treated the two ideas most skilfully." [We do. Of the two, we consider this the finer problem.—Mephisto.]

SOLUTION.

Problem 134, by F. Healey, p. 374.

1. R to R sq.	B to K sq.
2. Q to Kt sq.	B to Kt4
3. Q to Kt sq. mate	
2.	if B × Kt
3. Q to Kt4 mate.	

Correct Solutions received:—No. 134: E. G. M. (rather vague), J. J. Cridlon (problem construction since then has advanced very much), A. E. Rayment, G. W. Middleton. No. 135: W., W Furnival, Littlehampton, R. Champs (solution incorrect).

Contents of No. 158.

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CONTENTS OF No. 160.

STATISTICS OF BARATARIA.

II.

By Grant Allen.

IF we look away from our imaginary instance of Barataria, and apply the curious statistical facts we there arrived at to actual cases of mixed population in the real world, we shall see how very misleading is that kind of ethnology which bases itself entirely on historical or quasi-historical data. Let us take, for example, the case of England.

People often talk as though the ethnical elements in the population of England must be the same at the present day as they were shortly after the Norman Conquest. It is common to hear thinkers of the purely historical school take it for granted that the proportions which then obtained must still obtain throughout the nation. I believe this to be very far from the real truth. It seems infinitely more probable, in the light of the statistics given by Mr. Galton, that every race is always in a state of perpetual flux; that large numbers of families are always dying out; and that other families are always increasing and spreading at an extremely rapid rate. If we could take a glance at the England of the twelfth century, and enumerate all the families it contained, it appears likely that we should find ever so many of those families had died out utterly meanwhile, whereas the remainder had increased so greatly as to form the bulk of the existing English people in our own day.

Now, I don't want to press this argument here so as to favour any one particular ethnological theory as to the composition of the modern British nation. I don't believe the time has yet arrived when it would be possible to do this with even the slightest approach to rough accuracy. In order to apply the idea here set forth to concrete ethnology, it would be necessary to make prolonged and systematic research among church registers and other genealogical documents in all parts of the kingdom. But what I want to point out at present is the fact that this particular factor—the relative fertility of special families and special races—is really all-important to the proper study of ethnography. Let us suppose, for example, that at any given period the population of Britain consisted one-half of Teutonic Saxons and one-half of indigenous Celts; then, if the Saxon women marry on the average at seventeen, and have on the average nine children each, they must have been rapidly increasing ever since; while if, conversely, the Celtic women marry on the average at thirty-two, and have on the average some four children apiece, they must have been steadily decreasing in number ever since. But if, on the contrary (as is more truly the case), the Saxons marry later and the Celts earlier, then the Celts must have been gaining continuously upon the Saxons, and must, in the long run, be gradually supplanting them.

As a matter of fact, however, in every country where we get varieties of race inhabiting contiguous districts, intermixture continuously goes on; and this intermixture still further increases the difficulty of arriving, by historical research, at any definite result. Still, there is one way in which some approximation may hereafter be obtained, as regards the total of the several proportions, and that is by observation and enumeration of surnames, so far as they can be shown to indicate race. For though a daughter who marries loses her father's surname, and so in mixed marriages merges the marks of her own ancestry in her husband's, yet, since as many mixed marriages are likely in most cases to take place one way as the other (for example, as many Celtic men will marry Teutonic women as Teutonic men will marry Celtic women), the women on both sides may be considered to cancel out, and we shall get approximately correct results by reckoning the father's side alone. In short, though a great many Smiths and Browns may be very largely Celtic, yet an equal number of Macphersons, Evanses, and O'Briens are no doubt very largely Teutonic.

There are, however, a few cases where intermarriage has long taken place on one side only. Take, for example, the Turks in Europe. It is usual to talk of the Turks as Tartars. So far as language and manners are concerned, this may be true enough; but, ethnologically, it is quite untenable. For years Turks have habitually had in their harems Circassian, Greek, and Slavonic women. Any so-called Turk whose mother was Circassian is only half Tartar; if his father's mother was also Circassian, then he is only one-fourth Tartar; if his paternal grandfather's mother was also Circassian, then one-eighth; and so on in a rapidly-vanishing proportion of Tartar blood. I say this without political prejudice for or against Turks; for, so far as I have read, Tartar, Turk, and Circassian are pretty much six of one and half-a-dozen each of the two others.

It must be remembered, too, that in all times and at all places town population tends relatively to die out rapidly, while rural population tends to roll in upon the towns, and swamp their original ethnical peculiarities. For example, most of the great towns of Britain are situated in what was (during earlier ages at least) the most Teutonic part of the kingdom. But they are nevertheless saturated through and through with Celtic immigration. Glasgow is full of Highland Scots and Irishmen; Liverpool and Bristol of Irish and Welsh; London of all three put together, besides a strong contingent of Cornishmen and half-Celtic Devonians. The rural districts of the Highlands, of Wales, of the west country, of Ireland, are the great breeding places for the modern British races. The people there marry early and rear large families; part of their surplus population finds an outlet in emigration, and helps to people America, Australia, and the colonies generally; the remainder rolls back upon the towns, where it intermarries with the natives, and soon merges in the mass of inhabitants, while still retaining all its original ethnical peculiarities.

In short, the relative numbers at starting of any two races which occupy the same country are comparatively unimportant, ethnologically speaking; what it really imports us to know is how fast or how slowly each of the two elements tends to increase. A constant supplanting of families by families is always going on—an absorption of one family by the other; and this often in a way that completely misleads us as to the true result. For, suppose a stock with a Normau name—call it De Montmorency—to settle down among a Saxon population, and, from generation to generation, to have one son only, who always marries a Saxon woman. At the fifth generation, there will still apparently be a De Montmorency, who will pass current with all of us for a genuine unadulterated Norman. But, in reality, though he traces in the direct line by heir male back to the original De Montmorency, he will have only $\frac{1}{32}$ of Norman blood, and $\frac{31}{32}$ of Saxon. Put a negro for the ancestor, and this truth will be immediately apparent. For the first generation will be a mulatto, the second will be a quadroon, the third an octaroon, and the fourth will so entirely have lost the traces of African descent as to be (in the old slave phrase) "white by law." Nobody on earth could possibly detect in the fifth remove the very slightest tinge of negro ancestry.

And this last example leads us up to the final point, to prove which I have ventured to adduce the imaginary case of Barataria. It seems to me that while historical data are in the very highest degree misleading (because we can never really ascertain for distant times the relative rates of increase), the one certainty upon which the ethnologist can repose is physical peculiarities. These, it has abundantly been shown, do really repeat themselves with great persistency, being truly characteristic of races and of their intermixture, even down to the very fractions of each involved. Nobody has any practical difficulty in distinguishing a mulatto from a negro or a white man; a quadroon from a mulatto; or an octaroon from a quadroon. One can say at once, "This man is a pure-blooded Chinaman; this one is half-Chinese and half-Malay; this one is Malay with a slight Chinese intermixture," and so forth. The physical peculiarities of both races persist in the hybrids; and when we find a remote hybrid (like our person of negro descent in the fifth degree) in whom one stock has completely overborne the other, it is because the remaining fraction of the weakest blood has been practically bred out. Such a person is, in fact, essentially a white man. In British ethnology (to take a home case) the differences of race are, of course, far less marked, but they are equally persistent; and the best way, therefore, to arrive at a just conception of what blood preponderates in our modern British people is not to follow the procedure of Professor Freeman and the historical school, but to follow that of Professor Huxley, Dr. Beddoes, and the scientific anthropologists. Look not at the ethnical composition of Britain in the ninth century, but at the skull and bones of the modern Englishman, compared with those of the purest discoverable old Celts and the purest discoverable old Teutons.

Her Majesty the Queen has accepted a copy of Mr. Fayle's new work entitled "The Spitalfields Genius; a Memoir of William Allen," who was the confidential friend, the trustee, and the executor of her Majesty's father.

Messrs. Hachette & Co., of Paris, will publish very shortly a popular illustrated French editions of Dickens's works. The majority of the illustrations are those by Barnard, but every volume will contain a certain number of original designs by various English and foreign artists residing in England. M. Joseph Tonneau will supply the greater number of these.—*Athenæum.*

CHATS ABOUT GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

(*Continued from p. 383.*)

A. But can we always get a neat set of chords, like A C, C D, D E, &c., in Fig. 3, or of tangent-lines like A H, H K, K L, &c., in the same figure, and so determine the length of our arc?

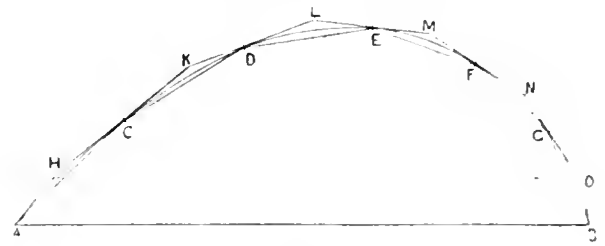


Fig. 3.

M. Unfortunately we cannot. We usually have to be content with another device, the consideration of which is of some importance, since it brings before us the true idea of tangent-lines. Indeed, I am not sure but that the measurement of direction at different points of a curve ought not to have been the first point to be considered. However, as we have been naturally brought to it along the line we have followed, we may take it now as well as earlier.

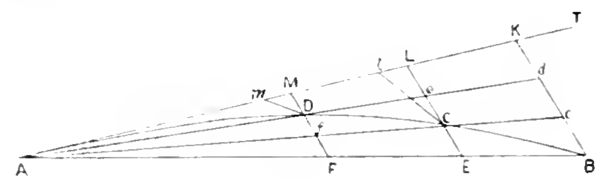


Fig. 6.

A. I am all attention.

M. 'Tis well. Let A D C B (Fig. 6), be a small part of some arc, A T the tangent at T. Join A B, A C, A D. Then it is clear that these lines lie nearer and nearer in direction to the tangent line A T. Moreover, since the curve has the direction A T at the point A, and changes *continuously* in direction from A to D, C, B, &c., it is evident that by taking points as C, D, and thence, along the curve, successively nearer and nearer to A, we get chords as A B, A C, A D, &c., drawing nearer and nearer in direction to the tangent A T, until they differ from it in direction by an angle less than any angle, however small, that can be indicated. The angle like B A T made between one of these chords and A T grows less and less up to nothing as the other end draws nearer and nearer to A, passing continuously through all values between the angle B A T with which it may be supposed to have begun, and the evanescent angle when the moving point merges into A.

A. All this is clear; but what this has to do with the measurement of the length of an arc I fail utterly to see.

M. Nay, did I say you *could* see the connection? But I think you will as I proceed.

A. Again, I am all attention.

M. Suppose now that from B, C, D a series of parallel lines are drawn making some finite angle B K T, C L T, D M T with A T; and produce the various lines as shown in Fig. 6. Then it is obvious that the ratios A B to A K, A C to A L, A D to A M draw nearer and nearer to equality as we take points B, C, D nearer and nearer to A.

They may not do so at the beginning of our approach, but they must do so to the end. For by similar figures these ratios are the same respectively as A B to A K, A c to A K, A d to A K; and eventually we get a line as A d but inclined to A T at an indefinitely small angle. Such a line would be actually equal to A K, so long as the angle B K T is finite. Hence such a ratio A B to A K becomes eventually one of equality when the point B is about to merge into A. Nor does it matter if the lines drawn from C and D, or have such positions as C l, D m,—that is make varying angles with A T,—so long as the angles B K T, C l L, D m M remain finite, no matter how small they may become, the ratio of the chord like A D to the part like A m cut off the tangent must eventually be one of equality. For a finite angle, however small, is infinitely greater than an evanescent angle. Thus from B, Fig. 7 on the line A B, let a line B K L be drawn making a very small but still a finite angle L B A with A B; then it is manifest that if an

Fig. 7.

indefinite line A T be turned round the point A B (in the plane of the figure) till it coincides with A B, the point of intersection K will move up to and eventually coincide with B, no matter how small the angle L K B: that is A K, and A B will eventually be equal,—just as A T, in its motion around A, is merging into A B.

A. Now tell me how this helps us.

M. Why, instead of the chord A B in Fig. 6, we may take A K, a part of the tangent cut off by any line such as B K making a finite angle (*let it be what it may*) with the tangent A T.

A. Can you illustrate the advantage of this?

M. In other words, can I show how the length of a curved arc may be obtained, in some given instance, by this method? I can; and much more readily than by taking chords or tangents fitting round the curve as in Fig. 3.

A. Will you begin with the arc of an ellipse?

M. Not quite.

A. And why not?

M. Simply because the case is too difficult. I will begin with the arc of a cycloid.

A. I thought the cycloid was a curve of higher order than the ellipse.

M. So it is. In fact, it is of infinitely higher order, since, if expressed in the form of an equation between x and y, the powers of these variables would be infinite. But that need not concern us. It happens that the arc can be easily obtained by a geometrical method.

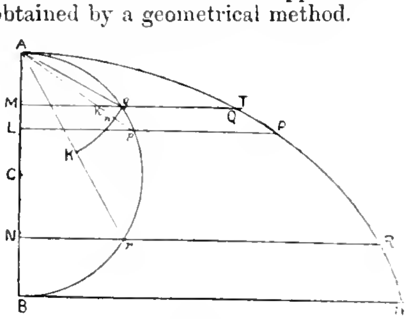


Fig. 8.

A. To the charge, then!

M. Please observe that I am not going to do more, in this or any other case, than give such sufficient outline of the proof as may enable you to satisfy yourself that the relation dealt with is really demonstrable on the lines followed. You must fill in details for yourself.

A. I will endeavour so to do.

M. Let A P D be a half cycloid, A B its axis, A q p B half the generating circle. Through P, Q, two neighbouring points on the cycloid, draw P p L, T Q q k M. Join A q; draw A k n p; the tangent P T; and the arc q n round A as centre. Then, by a known property of the cycloid, T P is parallel and equal to k p: q n is eventually perp. to A p, when Q comes close up to P; and triangle q p k is eventually isosceles ($\angle q k p = \angle k p$ L$= \angle q p k$, standing eventually on equal arc); hence $k n = n p$; or $k p$, *i.e.* P T$=2np$. But P T is eventually equal to chord or to arc P Q since Q T is inclined at a finite angle to the tangent P T; and n p is the excess of chord A p over chord A q. Thus if we suppose the arc of the cycloid measured from A, while as we take successively small increments of the arc (as we have just taken Q P) we keep on taking the chord of AqpB farther and farther towards B, (as we have just passed from the chord A q to the chord A p) the growth of the arc of the cycloid will always be double the growth of the chord from A, to advancing points along the semicircle A q p B. Since they start together from naught, then, the cycloidal arc must always be just double the corresponding chord. Thus,

Arc A Q P$=2$ chord A p;
Arc A P D$=2$ diameter A B;

And any arc Q P R$=2$ K r, obtained by describing the circular arc q n K round A, to meet chord A r.

A. That is strange,—a curved arc like Q R equal to twice a straight line like K r, and that, too, in the case of such a curve as the cycloid!

M. Do you see any flaw in the proof?

A. No; except that when P is very near A it can hardly be said that the angle between P T and Q T is finite.

M. You are right. But consider how much or how little this affects our result. It amounts merely to this, that for an indefinitely small part of the arc A P D, near A, our proof fails; that is, for a portion of this arc near A, which may be made less than any distance which can be assigned, the proof fails,—which is as much as to say that it does not fail at all.

(To be continued.)

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XLVII.—THE COLOURING OF WINE.

SOME years ago, while resident in Birmingham, an enterprising manufacturing druggist consulted me on a practical difficulty which he was unable to solve. He had succeeded in producing a very fine claret (Château Digbeth, let us call it) by duly fortifying with silent spirit a solution of cream of tartar, and flavouring this with a small quantity of orris root. Tasted in the dark it was all that could be desired for introducing a new industry to Birmingham; but the wine was white, and every colouring material that he had tried producing the required tint marred the flavour and bouquet of the pure Château Digbeth. He might have used one of the magenta dyes, but as these were prepared by boiling aniline over dry arsenic acid, and my Birmingham friend was burdened with a conscience, he refrained from thus applying one of the recent triumphs of chemical science.

This was previous to the invasion of France by the phylloxera. During the early period of that visitation, French enterprise being more powerfully stimulated and less scrupulous than that of Birmingham, made use of the aniline dyes for colouring spurious claret to such an extent that the French Government interfered, and a special test paper named Œnokrine was invented by MM. Lainville and Roy, and sold in Paris for the purpose of detecting falsely-coloured wines. The mode of using the Œnokrine was as follows:—"A slip of the paper is steeped in pure wine for about five seconds, briskly shaken, in order to remove excess of liquid, and then placed on a sheet of white paper to serve as a standard. A second slip of the test-paper is then steeped in the suspected wine in the same manner, and laid beside the former. It is asserted that 1-100,000 of magenta is sufficient to give the paper a violet shade, whilst a larger quantity produces a carmine red." With genuine red wine the colour produced is a greyish blue, which becomes lead-coloured on drying. I copy the above from the *Quarterly Journal of Science* of April, 1877. The editor adds that the inventors of this paper have discovered a method of removing the magenta from wines without injuring their quality, "a fact of some importance, if it be true that several hundred thousand hectolitres of wine sophisticated with magenta are in the hands of the wine-merchants" (a hectolitre is=22 gallons).

Another simple test that was recommended at the time was to immerse a small wisp of raw silk in the suspected wine, keeping it there at a boiling heat for a few minutes. Aniline colours dye the silk permanently; the natural colour of the grape is easily washed out. I find on referring to the *Chemical News*, the *Journal of the Chemical Society*, the *Comptes Rendus*, and other scientific periodicals of the period of the phylloxera plague, such a multitude of methods for testing false colouring materials that I give up in despair my original intention of describing them in this paper. It would demand far more space than the subject deserves. I will, however, just name a few of the more harmless colouring adulterants that are stated to have been used, and for which special tests have been devised by French and German chemists:—

Beet-root, peach-wood, elderberries, mulberries, logwood, privet-berries, litmus, ammoniacal cochineal, Fernambucca-wood, phytolacca, burnt sugar, extract of rhatany, bilberries; "jerupiga" or "geropiga," a "compound of elder juice, brown sugar, grape juice, and crude Portuguese brandy" (for choice tawny port); "tincture of saffron, turmeric, or safflower" (for golden sherry); red poppies, mallow flowers, &c.

Those of my readers who have done anything in practical chemistry are well acquainted with blue and red litmus, and the general fact that such vegetable colours change from blue to red when exposed to an acid, and return to blue when the acid is overcome by an alkali. The colouring matter of the grape is one of these. Mulder and Maumené have given it the name of *œnocyan* or *wine blue*, as its colour, when neutral, is blue; the red colour of genuine wines is due to the presence of tartaric and acetic acid acting upon the wine blue. There are a few purple wines, their colour being due to unusual absence of acid. The original vintage which gave celebrity to port wine is an example of this.

The bouquet of wine is usually described as due to the presence of ether, *œnanthic* ether, which is naturally formed during the fermentation of grape juice, and is itself a variable mixture of other ethers, such as caprilic, caproic, &c. The oil of the seed of the grape contributes to the bouquet. The fancy values of fancy wines are largely due, or more properly speaking *were* largely due, to peculiarities of bouquet. These peculiar wines became costly because their supply was limited, only a certain vineyard, in some cases of very small area, producing the whole crop of the fancy article. The high price once established, and the demand far exceeding the possibilities of supply from the original source, other and resembling wines are sold under the name of the celebrated locality with the bouquet or *a* bouquet artificially introduced. It has thus come about in the ordinary course of business that the dearest wines of the choicest brands are those which are the most likely to be sophisticated. The flavouring of wine, the imparting of delicate bouquet, is a high art, and is costly. It is only upon high-priced wines that such costly operations can be practised. Simple ordinary grape-juice—as I have already stated—is so cheap when and where its quality is the highest, *i.e.*, in good seasons and suitable climates, that adulteration with anything but water renders the adulterated product more costly than the genuine. When there is a good vintage it does not pay even to add sugar and water to the marc or residue, and press this a second time. It is more profitable to use it for making inferior brandy, or wine oil, *huile de marc*, or even for fodder or manure.

This, however, only applies where the demand is for simple genuine wine, a demand almost unknown in England, where connoisseurs abound who pass their glasses horizontally under their noses, hold them up to the light to look for beeswings and absurd transparency, knowingly examine the brand on the cork, and otherwise offer themselves as willing dupes to be pecuniarily immolated on the great high altar of the holy shrine of costly humbug.

Some years ago I was at Frankfort, on my way to the Tyrol and Venice, and there saw, at a few paces before me, an unquestionable Englishman, with an ill-slung knapsack. I spoke to him, earned his gratitude at once by showing him how to dispense with that knapsack abomination, the breast strap. We chummed, and put up at a genuine German hostelry of my selection, the Gasthaus zum Schwanen. Here we supped with a multitude of natives, to the great amusement of my new friend, who had hitherto halted at hotels devised for Englishmen. The handmaiden served us with wine in tumblers, and we both pronounced it excellent. My new friend was enthusiastic; the bouquet was superior to anything he had ever met with before, and if it could only be fined—it was not by any means bright—it would be invaluable. He then took me into his confidence. He was in the wine trade, assisting in his father's business; the "governor" had told him to look out in the course of his travels, as there were obscure vineyards here and there producing very choice wines that might be contracted for at very low prices. This was one of them; here was good business. If I would help him to learn all about it, presentation cases of wine should be poured upon me for ever after.

I accordingly asked the handmaiden, "Was für Wein?" &c. Her answer was, "Apfel Wein." She was frightened at my burst of laughter, and the young wine-merchant also imagined that he had made acquaintance with a lunatic, until I translated the answer, and told him that we had been drinking cider. We called for more, and recognised the "curious" bouquet at once.

The manufacture of bouquets has made great progress of late, and they are much cheaper than formerly. Their chief source is coal-tar, the refuse from gas-works. That most easily produced is the essence of bitter almonds, which supplies a "nutty" flavour and bouquet. Anybody may make it by simply adding benzol (the most volatile portion of the coal-tar), in small portions at a time, to warm, fuming nitric acid. On cooling and diluting the mixture, a yellow oil, which solidifies at a little above the freezing-point of water, is formed. It may be purified by washing first with water, and then with a weak solution of carbonate of soda to remove the excess of acid. It is now largely used in flavouring as essence of bitter almonds. Its old perfumery name was Essence of Mirbane.

By more elaborate operations on the coal-tar product, a number of other essences and bouquets of curiously imitative character are produced; one of the most familiar of these is the essence of jargonelle pears, which flavours the "pear drops" of the confectioner so cunningly; another is raspberry flavour, by the aid of which a mixture of fig-seeds and apple-pulp, duly coloured, may be converted into a raspberry jam that would deceive our Prime Minister. I do not say that it now is so used, though I believe it has been, for the simple reason that wholesale jam-makers now grow their own fruit so cheaply that the genuine article costs no more than the sham. Raspberries can be grown and gathered at a cost of about twopence per pound.

With wine at 60s. to 100s. per dozen the case is different. This price leaves an ample margin for the conversion of "Italian reds," Catalans, and other sound, ordinary wines into any fancy brands that may happen to be in fashion. Such being the case, the mere fact that certain emperors or potentates have bought up the whole produce of the château that is named on the labels does not interfere with the market supply, which is strictly regulated by the demand.

Visiting a friend in the trade, he offered me a glass of the wine that he drank himself when at home, and supplied to his own family. He asked my opinion of it. I told him that I thought it was genuine grape juice, resembling that which I had been accustomed to drink at country inns in the Coté d'Or (Burgundy) and in Italy. He told me that he imported it directly from a district near to that I first named, and could supply it at 12s. per dozen with a fair profit. Afterwards, when calling at his place of business in the West-end, he told me that one of his best customers had just been tasting the various dinner wines then remaining on the table, some of them expensive, and that he had chosen the same as I had, but what was my friend to do? Had he quoted 12s. per dozen, he would have lost one of his best customers, and sacrificed his reputation as a high-class wine-merchant; therefore he quoted 54s., and both buyer and seller were perfectly satisfied: the wine-merchant made a large profit, and the customer obtained what he demanded—a good wine at a "respectable price." He could not insult his friends by putting cheap 12s. trash on *his* table.

Here arises an ethical question. Was the wine-merchant justified in making this charge under the circumstances; or, otherwise stated, who was to blame for the crookedness of the transaction? I say the customer; my verdict is, "Sarve him right!"

In reference to wines, and still more to cigars, and some other useless luxuries, the typical Englishman is a victim to a prevalent commercial superstition. He blindly assumes that price must necessarily represent quality, and therefore shuts his eyes and opens his mouth to swallow anything with complete satisfaction, provided that he pays a good price for it at a respectable establishment, *i.e.*, one where only high-priced articles are sold.

If any reader thinks I speak too strongly, let him ascertain the market price per lb. of the best Havanna tobacco-leaves where they are grown, also the cost of twisting them into cigar shape (a skilful workwoman can make a thousand in a day), then add to the sum of these the cost of packing, carriage, and duty. He will be rather astonished at the result of this arithmetical problem.

If these things were necessaries of life, or contributed in any degree or manner to human welfare, I should protest indignantly: but seeing what they are and what they do, I rather rejoice at the limitation of consumption effected by their fancy prices.

THE EXPLOSIVENESS OF COAL-DUST.

It is the special merit of Mr. William Galloway, formerly Government Inspector of Mines, now director of the Dinas Colliery, near Cardiff, in South Wales, that he drew the attention of mining engineers to the great danger of dry coal-dust in fiery coal-mines, owing to its explosiveness, in a paper, "Influence of Coal-dust in Colliery Explosions," read before the Royal Society of London in 1879. Although its influence was already presumed by Faraday and Lyell in 1844, after an explosion in the Haswell Colliery, and also proved to have existed at explosions in mines near Firminy and Villars in 1855 and 1867, by M. du Souich in France, it is to Mr. Galloway the credit is due of having first demonstrated its action experimentally. These experiments were later on repeated by the British Commission on Colliery Explosions, the results corroborating Mr. Galloway's views. As the opinions of some French mining engineers and of the French "Commission sur les Explosions du Grison" did not seem to tally with the English experiments, the Prussian Government Commission on Colliery Explosions deemed it desirable to have these experiments repeated on a large scale and under conditions which would be identical with those existing in fiery coal-mines.

Thus, at the instance of one of its members, Director Hilt, of Aachen, the scientific technical committee of the Government Commission decided upon erecting an experimental arrangement for this purpose at the Government colliery "Kœnig" at Neunkirchen, near Saarbrucken, where natural fire-damp could be drawn in any quantity from a "blower," by which the explosive gas escapes in the mine from a bed of conglomerate.

At this mine, in an old burrow of stones, an adit level was constructed under the special superintendence of Mine-inspector Margraf. From its mouth to the head it has a length of 167 ft., and it is timbered with elliptical rings of double T iron and lined inside with a layer of 2-in. pine planks, which are tightly jointed. On one side this structure is entirely buried up to the top in the old burrow, while on the other its upper quarter is visible, and is provided with thirty small windows of thick glass well fixed in cast-iron frames. The head of this adit level is formed by a heavy block of masonry, 12 ft. 4 in. long and 9 ft. 10 in. wide, forming there a niche or recess 3 ft. 10 in. deep. In this masonry seven small cast-iron mortar guns, whose bores represent ordinary blast-holes, are well fixed in such a manner that two are close under the roof, three in the middle of the head, and two somewhat above the floor. The direction of their respective axes is such, that the upper guns converge so as to cut the floor 10 mètres from the head, while the axes of the lower guns cut the roof at the same distance; the three middle guns, however, converge so that their axes hit the middle of the floor at 5 mètres from the head. The inner end of the adit level is provided with stout wooden frames, between which sailcloth can be fastened, so as to form a series of chambers, of which the innermost has a cubic space of about 20 cubic mètres (706·3 cubic feet). The firing of the guns is effected by electricity, in order to produce an explosion of either firedamp or coal-dust, or of both, and during the last couple of months over 200 of such artificial mine explosions have taken place.

On October 3 the trials were made with powder charges of 8 oz., these charges being 12 in. in length, and being covered with a 19½ in. tamping of clay or small coal. A gun fired with clay tamping gave a length of flame of 10 ft., with small coal tamping of 26 ft., as could be observed through the windows. Then the floor was covered for 131 ft. with a layer of coal-dust 1⅛ in. thick, derived from poor coal from the Union mines of Horsbach, near Aachen. When the guns were fired under these conditions with clay tamping, the flames became 18 ft., and with small coal tamping 31 ft. in length. After this bituminous coal-dust from Pluto mine in Westphalia was placed in a like manner upon the floor and fired at, when a heavy explosion occurred, the flame rushing forth 23 ft. from the mouth of the adit level and thus reaching a total length of 190 ft. from the head, and that without presence of any firedamp. A repetition of this trial gave a like result.

The experiments with fire-damp followed next. The carburetted hydrogen gas was taken from a blower in the mine, 394 ft. below the surface above the Grolmann seam from a coarse conglomerate, and conveyed in a pipe 3,608 ft. long to a gasholder on the surface, whence it could be forced at will into the experimenting chambers of the adit level. A mixture of air with 5 per cent. gas fired at in the 20 cubic mètre chamber with clay tamping, showed a length of flame of 36 ft. The same mixture, with a layer of coal-dust of only 65½ ft. length, gave with clay tamping a very heavy explosion with a flame of 171 ft. long, and much heavy after-damp. The violence of these explosions may be gathered from the fact, that when coal-dust from the Pluto mine, without any trace of fire-damp in the adit, was fired at an iron tub or coal-wagon, weighing nearly 6 cwt., and standing outside before the adit mouth upon a pair of rails rising 4 degs., was pushed on for 24 ft., and when fired with fire-damp as above it was lifted from the rails and thrown a distance of 39 ft. In a siding level a solid brattice work, 2 in. in thickness, was entirely broken by the shock of the Pluto dust explosion alone, and when rebuilt and fired at with dust and fire-damp it was not only broken, but thrown a distance of 98 ft.

It is to be hoped that these interesting trials, conducted under conditions which enable experiments to be made without danger, may be continued with all possible variations, and that they may yield results, from which all concerned in coal-mining may derive benefit and complete immunity from such explosions as are under investigation. —*Engineering.*

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER V.—THE EARTH'S ROTATION.

(*Continued from page 360.*)

The general principles on which the properties of the gyroscope depend are sufficiently simple, though the theory of rotating bodies is one of the most difficult subjects in the whole range of mathematical inquiry. Newton himself shrank from attacking it, where, in dealing with the phenomena of precession and nutation, he found it directly involved. He preferred to regard the protuberant mass of the earth's equatorial regions as a collection of bodies travelling around the earth, and to consider the influence of external attraction on the orbital motions of those bodies; and then having found that such and such changes would be produced, he showed how far those changes would be modified when the bodies, being rigidly attached to the earth, had to force her, so far as they could, to participate in their peculiarities of motion. And even modern mathematics, despite the wonderful power which it gives us over the problems we have to deal with in discussing the motions of the planets, yet leaves the problem of rotating bodies one of enormous intricacy and difficulty.

However, for our present purpose, all that is necessary is that we should understand the general principles on which the theory of the gyroscope depends.

First of all we must remember that the figure of the rotating disc has nothing to do with the observed phenomena. A rotating sphere would exhibit them quite as well, although there are reasons of convenience which render the disc preferable.

Secondly, we must dismiss the notion that gravitation is primarily involved in the observed phenomena. Gravity is a force conveniently applicable to exhibit the peculiarities of the gyroscope, but any other force will serve equally well.

The fundamental property on which all the phenomena exhibited by the gyroscope depend is simply this—that when a body is rotating upon an axis, that axis tends to maintain itself unchanged in *direction*, though free to take up a new position *parallel* to itself. Upon the speed of rotation, and the mass of the rotating body, depend the force with which the axis tends to maintain its direction unchanged; but let the body be ever so small and its rotation ever so slow, *some* force is always required to change the direction of the axis of rotation.*

Now, it is not difficult to show that this peculiarity is merely an expression of the fact that when a body is moving in a given direction, it cannot be made to move in a different direction without an expenditure of force proportioned to the mass of the body and the velocity of its motion.

Let me explain clearly how I mean this to be taken.

If a body moves in the direction A B (Fig. 1), and we wish it to move in the direction A C, we may effect this by giving it an impulse in direction A D, such that it would move from A to D under that impulse in the same time as it would take in moving from A to B if untouched. If it was moving very fast at first, it would of course traverse A B in a very short time, and we must give a very sharp impulse, because we are to force on this body a proportionately rapid motion in the direction A D. Had the body been moving slowly towards B, a slighter impulse would effect our purpose; but even then, some impulse would of course be required.

Fig. 1.

Now, if we consider how the different points in a rotating mass are severally moving, we shall see why it is that we find it so difficult to shift the axis of a gyroscope, when the disc is in rapid rotation.

Let A B C D (Fig. 2) be the circle described by any particle of the rotating disc, about the axis E E′; and suppose we want to shift the axis to the position *e e′*. This is equivalent to making the particle travel in the circle *a* B *c* D. Now at *a* and *c*, the particle would be travelling in the same direction as before the change, so that no difficulty arises here. But at the common points B and D of the two circles, a distinct change of direction has to be

* Foucault's pendulum experiments are in reality merely a case of this great property, since a pendulum in swing is rotating about a definite axis; and if the whole change of position in the supporting frame could be effected at the very instant when the pendulum is at the limit of a swing, undoubtedly the pendulum would partake in the change of place.

effected. The particle, which, starting from B, would have gone in direction B T, must be solicited to travel in direction B t. Now, if we could impart to the particle at the very moment it reached B, a certain force, in the direction towards the plane of the paper (that is, from the observer), it would (neglecting all consideration of its attachment to the rest of the disc) proceed to move in the direction B t.

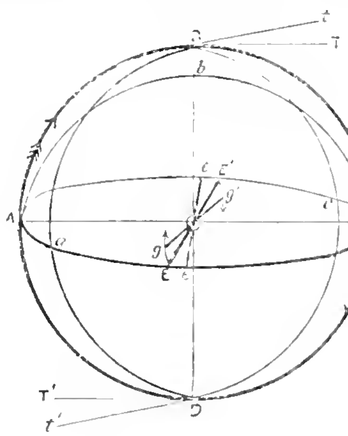


Fig. 2.

At D the particle would require an exactly opposite treatment, in order to be made to move in the direction D t'. As a matter of fact, however, the particle being rigidly attached to the rest of the disc, we have to consider what forces must be applied in order to change the position of the plane of motion A B C D to the position a B c D.

The natural idea would be to try to move the disc bodily round the axis B D so as to shift the point A to a, the point C to c, and therewith the axis E E′ to the position $e\,e'$. But so soon as this is attempted a resistance is experienced, and a movement in a direction not desired results, as though the disc A B C D had been shifted round the axis, A C E being carried *down* and E′ *up*. A little consideration shows why this is. We have not applied forces of the right sort to the particles of the rotating disc. We have tried to shift the direction of motion at A and C, where no change is required, while we have applied no force at all at B and D, where the change in the direction of motion is to be greatest. While the part near E goes down and the part near E′ up, is also clear. Since we try to move A towards E, while its motion of rotation is carrying it towards B; it naturally takes a direction of rotation towards some point on the arc B E, in other words the plane of motion A B C tends to assume such a position as A b C.

Let us, then, instead of following the seemingly natural course in this matter, inquire what we really want, and so let reason guide us to the right course of action.*

We want the point B to change its direction from B T to B t: manifestly, then, B must be thrust *from* us (as we look at Fig. 2). Clearly any other points as F and f on the semicircle A B C must also receive an impulse in the same direction, but with less energy the nearer they lie to A or C. Obviously, then, we shall be giving the right sort of impulse to all the particles along the arc A B C if we try to turn the ring of particles A B C D round the axis A C, thrusting the part A B C from us (as we look at the figure) around A C. It is equally obvious that the same action—by which we bring the part A D C towards us—will give the required directions and degrees of impulse to the particles along the semicircle A D C. This, then, manifestly is what we have to do:—

To make the disc A B c D, rotating in the direction A B C D round the axis E E′, assume the position a B c D, rotating round the axis $e\,e'$, we must act on it as if trying to turn it around the axis A C, to bring the axis E E′ to such a position as $g\,g'$.

If we consider a little, we shall see why the effect which, were the rotating ring at rest, would be produced at B and D—B moving from, and D towards, the eye—is not produced when the ring of particles is rotating. B is moving towards T with greater or less rapidity, according to the rate of rotation, but always with *some* velocity while the rotation lasts. Now this being the case, nothing short of an infinite impulse applied to B at right angles to B T, would make it move off at right angles to B T; for the motion in direction B T must always produce *some* effect. As a matter of fact, while the velocity of rotation is very rapid, the impulse actually applied to a particle momentarily at B, to make it move in direction square to B T, is quite small compared with that which would be required to make the particle move as fast in *that* direction as it is actually moving in direction B T. Hence the tendency to motion at B in the direction of this impulse is slight compared with the motion already existing in the direction B T.

(To be continued.)

* So far as I know, this way of viewing the problem of the gyroscope has not been hitherto adopted. It seems to me far the best for making as clear as possible this not very difficult but still not altogether obvious subject.

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

ABOVE THE SURFACE—*(continued)*.

THE *Perlidæ* are four-winged creatures of a brownish or yellowish tint; the wings are a good deal longer than the body, and when folded, lie flat along the back, overlapping one another, and, of course, extending some distance beyond the extremity of the abdomen. They are interesting from a developmental point of view, since they manifest more clearly than any other insects we have yet had to do with, the composite character of the thorax. In all insects, the thorax, in reality, consists of three segments succeeding one another in longitudinal row, and called, respectively, in order of position, prothorax, mesothorax, and metathorax, the prefixes signifying front, middle, and hinder. It is is always the prothorax that carries the first pair of legs, the mesothorax the second pair of legs and the first pair of wings, and the metathorax the third pair of legs and the second pair of wings. In most cases, one or other of these segments is developed, at least on the upper side, to a far greater extent than the rest, and so occupies a large proportion of the thoracic region; but it is not always the same part that is thus enlarged at the expense of the rest. In beetles and bugs, what is commonly called the thorax really consists simply of the first thoracic segment, though a portion of the second is visible behind this as the triangular piece called "scutellum," which in some bugs is developed to so enormous an extent as to cover the whole abdomen; in the two-winged flies the middle region preponderates, as being that which carries the only pair of wings; in bees, ichneumon flies, butterflies and moths, or, in other words, in the Hymenoptera and Lepidoptera, the meso- and metathorax occupy most of the space, the prothorax being reduced to very minute dimensions. The caddis flies show all three parts, though still the prothorax is small when compared with the other segments, but in the *Perlidæ* (and this is a point which will help to distinguish them from caddis flies) all three segments are very plainly visible, the prothorax being quite as large as the other parts; and, in fact, when compared with most other insects, a stone fly seems as though it had three distinct thoraxes. This separateness of the thoracic segments, taken together with the rudimentary condition of the mouth organs, and the fact that no quiescent pupa stage intervenes between the larva and perfect insect, indicates lowness of type.

The fore-wings are long and narrow, but the hind pair broader and more nearly triangular. In most insects the points of attachment of both pairs of wings to the thorax are, in consequence of the fusion of the thoracic segments, closely approximated; but in the *Perlidæ* this is naturally not the case, and the wings at their bases not only do not overlap, but are separated by a considerable interval, an arrangement that suggests the idea of parts of two different insects having been joined to make the complete creature.

In their larval form, most of the *Perlidæ* prefer swiftly-running streams, at the bottom of which they conceal themselves under stones, &c. Like the caddis flies, the female carries her eggs for a time at the end of the abdomen, as a little black globular bundle. The larvæ are very similar in shape to the adult insects, minus wings, and, unlike the caddis worms, do not construct cases for defence. They are carnivorous, preying upon the larvæ of may-flies and other aquatic insects, but, notwithstanding this, they are neither particularly active, nor endowed with remarkably good offensive weapons. They therefore secure their prey by the expedient of ambuscade, lurking behind stones or pond-weeds in order to surprise their victims, and even sometimes throwing a little mud over themselves, in order to render their concealment the more effectual. This latter habit is practised principally by those whose bright colour would otherwise render them too conspicuous on the dingy muddy bottom which forms their hunting-ground. The pupa resembles the larva, except that it shows traces of wings When the time comes for its final change, it leaves the water and wanders about in the neighbourhood till it finds a place suitable for its disrobement; such a spot will be the surface of a rock, or any other material that, by its roughness, affords a good foothold, without which it would be unable to extract its limbs from their encasing skin. Having chosen the site, it takes a good grip of the irregularities of the surface, by means of its tiny claws, and then, as with so many other insects, the skin splits along the back of the neck, and the fully-formed being, which has already become loosened from its skin by the passage of air under the latter, gradually extricates itself from its investing pellicle.

The flight of a stone-fly is heavy and direct, the weakness of its wings preventing it from being able to "cut

Fig. 1.—Nemoura variegata.

capers" in the air. The slightest touch is sufficient to arrest its flight and precipitate it to the ground. But this is no great disadvantage, for its winged life is of short duration, lasting only a few days, the rudimentary character of the mouth organs rendering the taking of nourishment impossible. Fig. 1 represents one of the commonest of our British stone-flies, and one, too, which inhabits stagnant water as well as running streams. It is sometimes called the willow-fly.

The Alder-fly or Orl-fly is called *Sialis lutaria*. It belongs to quite a different group from the preceding insect, viz., the Neuroptera Planipennia, a section containing about fifty British species. It is a lazy, blackish creature, with a large number of extremely thick and dark nervures on its smoky wings, whereby it may at once be recognised. There are plenty of insects with as many and even more nervures, but none with them so thick and conspicuous. In May the flies are often to be seen in prodigious numbers, sitting about on palings, stones, &c., near a pond. The female deposits an enormous number of eggs, which she is said to lay one by one on rushes or other aquatic plants; they are attached side by side with great regularity, and may be recognised by being terminated at the top by a little pointed projection. They are generally deposited in the immediate vicinity of water, but occasionally at a distance therefrom that must necessitate a considerable terrestrial journey on the part of the newly-hatched larva before it can become properly domiciled. The larva has its respiratory appendages reduced to slender filaments; seven or eight pairs are attached to the sides of the abdomen, and by their rowing motion the creature propels itself. At the close of its preliminary stages, it quits the water, and, unlike the stone-flies, burrows in the neighbouring bank, and forms a cell in which to pupate. The pupa, though incapable of transporting itself from place to place, yet has considerable powers of movement, and vigorously twists its tail about when disturbed.

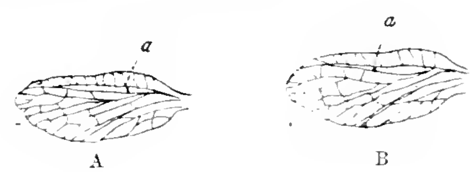


Fig. 2.—Fore-wing of Sialis lutaria (A) and S. fuliginosa (B).

There are but two British species in the genus Sialis. They are very much alike, and would be undistinguishable to any but the expert, who knows just what differences to look for. Mr. McLachlan has pointed out that there is one little nervure in the fore-wings (Fig. 2 *a*), the position of which, relatively to the surrounding ones, varies in the two species; but is so constant in each as to afford the easiest way of distinguishing them. Of course, this is not the only difference, or it could scarcely justify the separation of the species, but the others are less easy of recognition.

(To be continued.)

AUTOMATIC VENTILATION, SO-CALLED.

NOW that the question of the public health, and all matters appertaining thereto, are being brought into such great prominence, it may, perhaps, not be uninteresting to our readers if we attempt to dispel the "magic halo" with which would-be sanitary experts endeavour to obscure the actions of some of the chief agents concerned in automatic ventilation. In so doing, and even if we have occasion to allude to the various physical laws which regulate the results obtained from systems of automatic ventilation, we shall endeavour to keep always before us our watchword, "Science plainly worded, exactly described."

The three chief agents to which we wish to call attention are :—I. The wind. II. The law of "diffusion of gases." III. The movements of the atmosphere caused by columns of air of unequal weights.

I. *The Wind.*—Perhaps the agent which may, *par excellence*, be said to regulate all our endeavours to ventilate our houses, public buildings, house-drains, *et hoc genus omne*, is that very uncertain customer, the wind ; and since the movements in the atmosphere which are due to the force of the wind cannot be perceived directly, it will be best to fall back on some simile in order to establish a basis on which to found our subsequent remarks.

Doubtless, each of our readers has, at one time or another, been standing on the platform of a station when an express train has rushed by, and will probably have noticed how every light particle in the vicinity was sucked in towards the path of the rapidly-moving train. Now, the *raison d'être* of this suction is simply this : Before the approach of the train, a given body of air was occupying a certain place, the train rushes on, and (pushing before it that body of air) occupies (temporarily) its place. After the passage of the train more air rushes in, dragging with it all light particles near, to fill the place vacated, else there would be a vacuum or, in other words, a space containing nothing.

The wind acts very much in the same way. A moving body of air sets in motion all the air in its immediate vicinity ; it drives air before it, and at the same time causes a partial vacuum on either side of its path, towards which all air in the vicinity flows at (or nearly at) right angles. Here is the advantage to be reaped from the wind as a ventilating agent, but, as we shall see presently, this uncertain ally has also evil propensities, which must be guarded against.

The wind, then, blowing over the roofs of our houses, causes a current up our chimneys and ventilating shafts at right angles to the direction in which it blows. Thus we are able to form a very useful alliance with this natural force, if we, at the same time, can only manage to keep the upper hand!

Sometimes the wind, however, may impede ventilation by obstructing the exit of the "induced current" from any particular opening, or by blowing down any chimney or ventilating shaft. This is, indeed, one reason of our failing so often in obtaining an efficient system of ventilation—all may go well in a still atmosphere, but the pressure of the wind has not been taken into account.* We are, in a measure, indebted to Mr. Sampson Low, B.A., F.R. Met. Soc., for showing the plan to be adopted in order to make the utmost use of the wind as a ventilating agent, and at the same time guarding against its ill effects. Mr. Low has constructed a "ventilator" or ventilating head, which, while affording the wind a free passage over the orifice from which it is intended to extract the air, prevents any downward wind-pressure on that orifice. The accompanying diagram of this instrument may enable our readers to more readily understand the following brief description. The ventilator consists of three essential parts—the "shaft," to which is fixed the dome-shaped "wind-chest," and the "cap," which surmounts the whole structure.

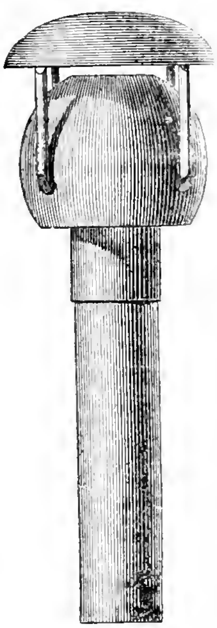
Now the "dome" and the cap are fixed on to one another in such relative positions that at whatever angle the wind strikes the dome, its upward curves direct the current straight across the "extracting orifice," situated in the dome of the ventilator.

Perhaps the most remarkable feature of this instrument is the fact that if the wind strikes down vertically on the cap, an exhaust current within the shaft is in the same way set up. Though we say that this is "remarkable," yet we think our readers will see at once the simplicity of the principle involved, if they will but bear in mind our simile of the "railway train"

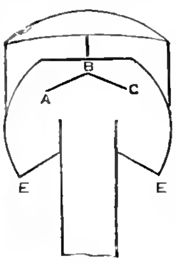
The apparatus may be examined at Messrs. Sharp & Co.'s establishment, 11, Holborn-circus, London.

Passing from our discussion of the wind and Mr. Low's ventilator, we come to other factors in this scheme of ventilation, without due attention to which, we venture to say, not even Mr. Low's patent nor the vendors' *exploitation* thereof will be found a very great success.

Concerning the diffusion of gases, it may be stated that every gas diffuses (that is to say, tends to become intimately mixed with another) at a certain specified rate—viz., at a rate "inversely proportional to the square root of its density," or, to translate that somewhat high-sounding phrase into plain English, we may state this stupendous fact thus : "Four volumes of the gas hydrogen will diffuse through a porous partition in the same time that it takes one volume of the gas oxygen to do so, oxygen being sixteen times heavier than hydrogen."



Elevation.



Section.

From this it will be seen that there is a constant escape of any foreign gas into the surrounding atmosphere. "This diffusing tendency is so great as to obtain even through brick and stone in every room that is not air-tight" (Pettenkofer). The amount of purification thus obtained is, however, for all practical purposes *nil* ; and, moreover, organic substances are not affected by it. It is, therefore, only to be regarded as a subordinate factor in ventilation.

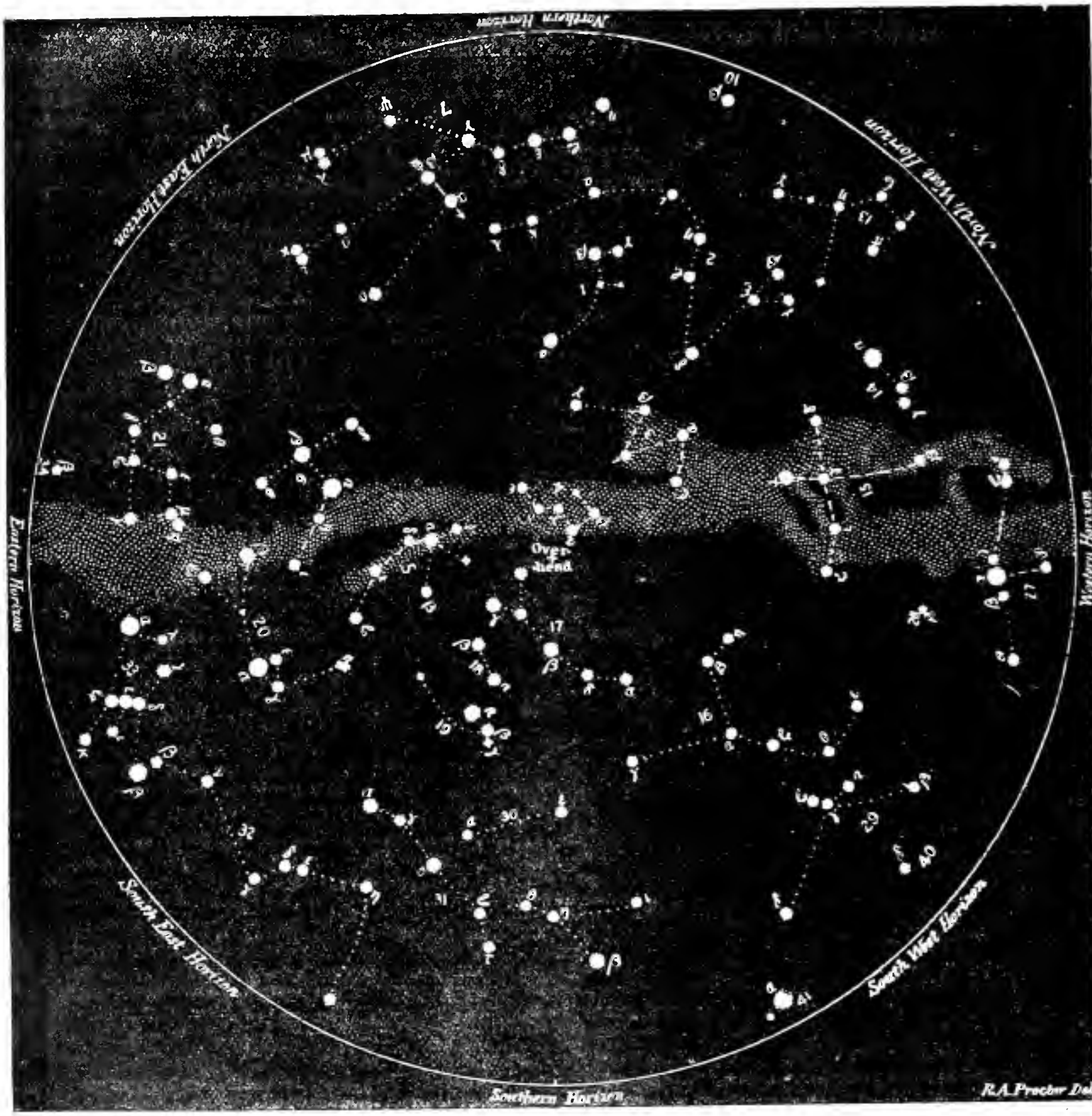
With reference to movements produced by columns of air of unequal weights, it may be said that we have a very important agent to assist us if we will (and to hinder us if we "won't"!), in devising an efficient scheme of ventilation. If the air in a room is heated by the presence of a fire or animal life, or if it be impregnated with moisture, such air will expand ; and, if there be any outlet, a portion of it will escape, and that which remains behind will be lighter than an equal volume of the air external to the compartment. This external air will then rush in through every orifice until "equilibrium" is re-established. But, as the fresh air which comes in gets heated, it likewise expands and escapes, and there is, therefore, a constant stream of air coursing through the compartment.

From the above considerations, we think it will be apparent to our readers (we are, be it understood, treating merely of cases where the external air is colder than the air in the room) that there are, so to speak, two chief forces concerned in the removal of vitiated air from our rooms or buildings. They are the *vis a fronte*, or the suction-power which the wind exerts by passing over our chimneys or ventilating-shafts, and the *vis a tergo*, or the expansion and consequent ascension of the gases within the room, aided, to some extent, by that property of "diffusion" on which we have touched. There is one other agent which we have not as yet alluded to, but it is one to which Messrs. Sharp

* This pressure has been known to vary from one ounce to one pound, as the rate of the wind varies from three and a half miles to fourteen miles per hour.

NIGHT SKY FOR NOVEMBER AND DECEMBER.

FIRST MAP OF PAIR.



Showing the heavens as they appear at the following hours:

November 7 at 10 o'clock.	November 18 at 9¼ o'clock.	November 30 at 8½ o'clock.
November 10 at 9¾ o'clock.	November 22 at 9 o'clock.	December 4 at 8¼ o'clock.
November 14 at 9½ o'clock.	November 26 at 8¾ o'clock.	December 7 at 8 o'clock.

& Co. give great prominence in their system. Briefly it is known as the "Syphon Theory," which consists in the following: where a compartment has to be ventilated entirely from above (*e.g.*, on ship-board), the fresh air will descend the shorter shaft and the foul air will ascend the longer, but, from experiments which have from time to time been conducted, we should say this is modified by a variety of causes, and is true in extreme cases only. However, the importance of extracting the foul air from the highest available point in the room or building cannot be too much insisted on. In conclusion, we would earnestly ommend to the careful consideration of our readers the subject of ventilation, whether of houses or ships, not forgetting, however, those necessary evils, house-drains and it is to be hoped that the few remarks which we have here offered may enable them to understand the *modus operandi* of the "Natural Ventilation" schemes at present before us.

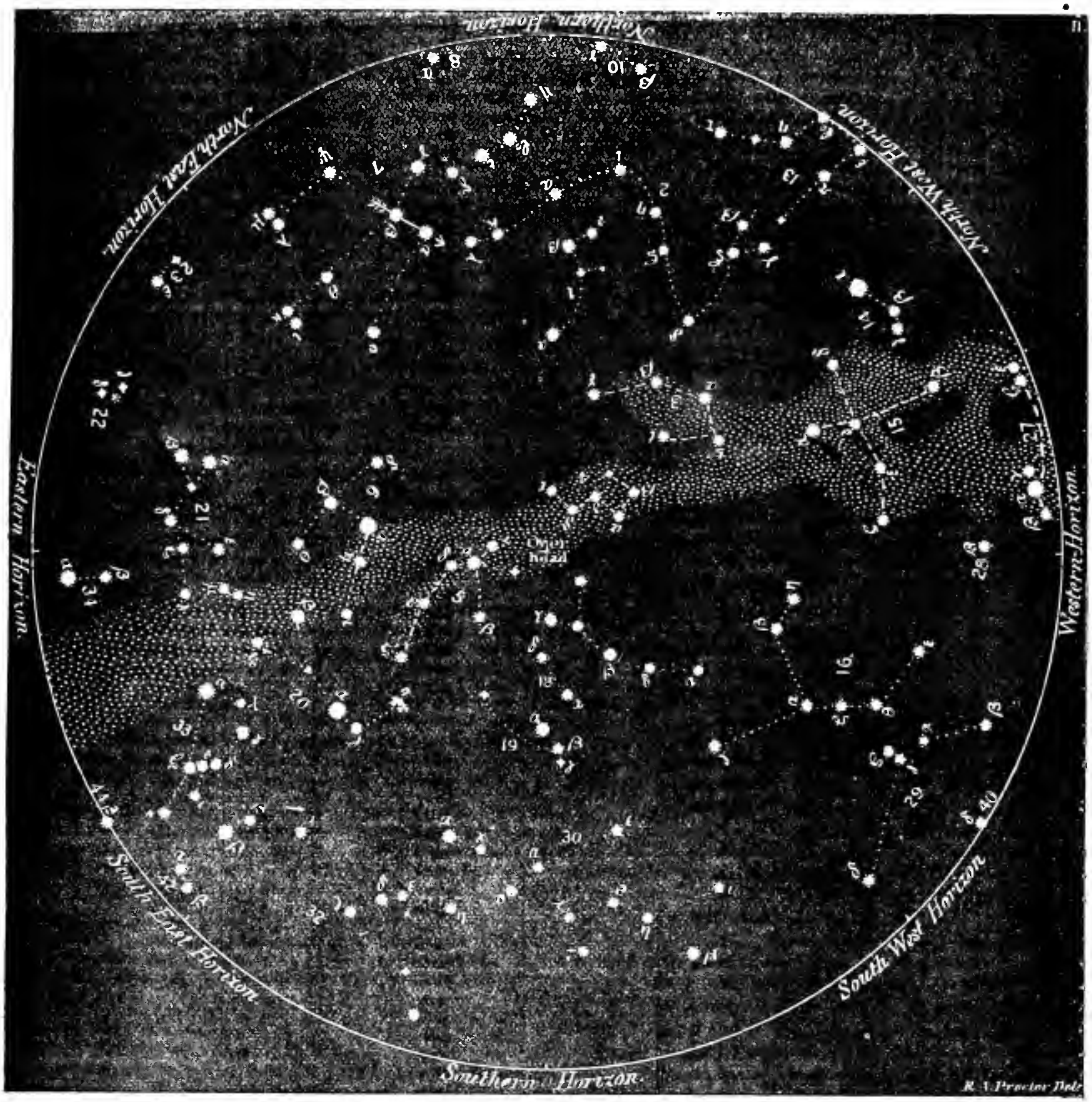
FIRST STAR LESSONS.

By Richard A. Proctor.

THE map of the stellar heavens, as presented this week. needs scarcely any explanation. It will be observed

NIGHT SKY FOR NOVEMBER AND DECEMBER.

SECOND MAP OF PAIR.



Showing the heavens as they appear at the following hours:—

November 22 at 10 o'clock.	December 4 at 9¼ o'clock.	December 15 at 8½ o'clock.
November 26 at 9¾ o'clock.	December 7 at 9 o'clock.	December 19 at 8¼ o'clock.
November 30 at 9½ o'clock.	December 11 at 8¾ o'clock.	December 23 at 8 o'clock.

that the map has not, properly speaking, top, bottom, or sides; the centre represents the point overhead, the circumference marks the horizon. The stars of the first three magnitudes only are shown, and the constellations are numbered, not named. The numbering begins with the Little Bear, to see which in its proper position the map must, of course, be held with the "Northern Horizon" downwards. The other constellations are taken as nearly as possible in the order of their distance from the pole (α in 1 is the pole star), from Draco, the Dragon, which being nearest the polar constellation is numbered 2, to Argo, the Ship, which being the farthest from the pole of all those included in this series of maps is numbered 45, the last number in our list. The constellations are also taken around the pole in the order of their right ascension,—or in the direction in which the hands of a watch move, around the north pole, which in the southern skies means from right to left.

The constellations included in the set of maps are numbered throughout as follows:—

1. *Ursa Minor*, the *Little Bear* (α, the *Pole Star*).
2. *Draco*, the *Dragon* (α, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (β, *Algol*, famous variable).

[*This List is continued on the next page.*

6. *Auriga*, the *Charioteer* (α, *Capella*)
7. *Ursa Major*, the *Greater Bear* (α, β, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (α, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Bootes*, the *Herdsman* (α, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (α, *Vega*).
15. *Cygnus*, the *Swan* (α, *Arided*; β, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (α, *Aldebaran*; η, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (α, *Castor*; β, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (α, *Regulus*).
24. *Virgo*, the *Virgin* (α, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (α, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (o, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (α, *Betelgeux*; β, *Rigel*).
31. *Canis Minor*, the *Lesser Dog* (α, *Procyon*).
35. *Hydra*, the *Sea Serpent* (α, *Alphard*).
36. *Crater*, the *Cup* (α, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (α, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (α, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (α, *Sirius*).
45. *Argo*, the *Ship*.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

III.—THE FRAMEWORK OF THE DWELLING-HOUSE (*continued*).

GENERAL PRINCIPLES OF CONSTRUCTION.

It is now generally understood that the admission of fresh air into buildings and its maintenance therein under suitable conditions of temperature and pressure, is almost, if not quite, as important as the exclusion of damp and the choice of a thoroughly sound foundation and sub-basement.

Pure air consists of about 79 per cent. of oxygen, and 21 per cent. of nitrogen by measure, with 1 part of carbonic-acid gas in every 2,500 parts of the atmosphere. Air of this nature, at a temperature varying from 55° to 65° Fahr., may be considered to be typically perfect for the promotion of health in the average human being. To secure and maintain such an atmosphere in the dwelling-house is a practical impossibility, for reasons which we shall give hereafter; but it must not be imagined that, because of this, an insalubrious state of affairs must inevitably follow. There is a margin, and a very wide margin, within the bounds of which freedom from all evils, arising from impure air, is available.

The process of slow combustion which goes on in the animal body requires the presence of oxygen; and the nitrogen of the air acts as a dilutant. A somewhat similar combustion goes on more rapidly in the employment of fires, gas, and oil flames. The animal body, again, throws off waste products from its other glandular organs, such as the secretion of noxious liquids and gases, which emanate from the skin, tegumentary organs, and mucous membranes.

A qualitative analysis of the products of combustion in an ordinarily-inhabited apartment would show that the air is vitiated with carbonic acid, the vapour of water, waste animal tissues, carbon in the form of smoke and soot, carburetted and sulphuretted hydrogen, and a trace of various salts. To these must be added the indirect accession of germs of putrefaction, and, may be, of disease, together with vapours and gases from vegetable matters and the external atmosphere.

It has been estimated that, on an average, the adult human being inhales from about 15 to 20 cubic feet of air during the course of an hour, and exhales almost an equivalent amount of carbonic acid gas. During that period, also, about 2½ oz. of aqueous vapour, charged with effete matters, are given off from the respiratory passages, other mucous membranes, and the skin. It has also been calculated that a jet of gas, which consumes 5 cubic feet per hour, uses up all the oxygen from 50 cubic feet of air, and produces 5 cubic feet of carbonic acid, 10 cubic feet of aqueous vapour, and an appreciable proportion of carbon particles and carburetted and sulphuretted hydrogen. Yet, nevertheless, the generation of impurities from any given flame is not directly proportional to the size of the flame, for a jet turned on to three-quarters of its full extent will consume almost as much oxygen as one fully turned on; so that it is more advisable to employ a few burners fully turned on, than a larger number partially turned down, in the production of a given degree of illumination.*

From what has been stated, it is evident that the combined influence of natural and artificial combustion tends to render the atmosphere unwholesome, and that it does so from a variety of causes. It has, moreover, been found that the quantity of carbonic acid gas in the atmosphere serves as an index to the suitability of the latter; not so much on account of its direct action as a poison to the respiratory system of animals, as being in constant association with other more powerfully noxious elements. Physiological biologists have shown that the processes of life in both plants and animals are essentially the same. The old notion that plants respire the products of exhalation from animals is not strictly correct. The carbonic acid given off in the process of animal respiration would act as a poison upon that animal if it were re-inhaled; but taken as a food into the alimentary system, it would act beneficially. Now, that is exactly what happens in the vegetable kingdom; the carbonic acid resulting from the expiration of animals, and the decay of dank vegetable and animal matter, is taken up through the stomata of the leaves of plants, which are in reality a part of their assimilative system, and through the metabolism which goes on there, the oxygen is liberated, and the carbon appropriated, in the elaboration of the sap. Thus a balance is secured, and the purity of the general atmosphere remains unimpaired.

Decaying matters are always associated with the fostering of germs, and the elimination of poisonous, foul-smelling gases, the most deleterious of which is sulphuretted hydrogen, easily recognisable by its characteristic odour of putrid eggs. As we have already stated, however, the quantity of carbonic acid in the air may be taken as a reliable indicator of its purity or impurity. Wholesome air ought not to contain more than about ·06 per cent. of carbonic acid; the presence of 1 per cent. is harmful, but when it reaches the proportion of about from 10 to 12 per cent., the air becomes absolutely poisonous.

In virtue of the laws which regulate the diffusion of gases, the carbonic acid and other gases given off as the products of combustion tend to spread themselves throughout the apartment, although, bulk for bulk, the carbon dioxide is one-and-a-half times as heavy as ordinary air. Its distribution is further accelerated on account of its greater temperature, for it usually leaves the body at about 98° Fahr., and the flame of a lamp at a considerably higher temperature, whereby it tends to rise towards the ceiling. The course of circulation is as follows:—On reaching the

* "The Medical Annual." London, 1883-4, p. 119.

ceiling the vitiated air passes horizontally to the walls of the apartment, where, becoming cool, it descends to the lower levels, to be rebreathed and consumed, and to escape partially through the chimney. When the room is overheated, or the outer atmosphere is very much colder than that within, the currents which descend along the walls, especially along window-frames and unsheltered walls, become suddenly reduced in temperature, and in their consequent rapidity of falling become a constant source of draughts.

It is thus easy to understand how it is that unventilated rooms which are more or less constantly occupied tend to promote every form of disease, from a simple headache and a sensitiveness to cold to pulmonary consumption, fever, asphyxia, and death. The introduction of fresh air and the removal of foul air, not only without the production, but with the abolition, of draughts, combined with a due regulation of the temperature of the room, must be regarded as indispensables in the construction of a healthy house. To accomplish these results at a minimum of expense has been the aim of many inventors since "Tobin's Tubes" were brought into use. It may interest our readers to learn that a most efficient instrument has been devised for this purpose at a trifling cost by Mr. J. E. Ellison, of Leeds, the recipient of Silver and Bronze Medals at the recent Health Exhibition. The following is a brief description of his patents.

"Ellison's Patent Conical-Perforated Bricks and Air-Grates" consist of red, white, or salt-glazed bricks of standard dimensions. The thickness of the brick is perforated by a series of conical apertures, terminating by a wide mouth at one, and by a narrow mouth at the opposite, face. When used as inlets for fresh air, the larger opening ought to be placed inside; the incoming current of air is by this means effectually radiated and diffused, so that all draught is avoided. This may be readily demonstrated by blowing a column of air through the conical aperture with a pair of bellows.

Fig. I is an explanatory sketch of the "Radiator Ventilator," which has been constructed in such a way as to admit air into any apartment without draught. It is one of the best appliances that has hitherto been brought forward; it not only accomplishes the purposes for which it was specially designed, but is worthy of the highest recommendation, inasmuch as it comes within the reach of all, and can be fixed to any existing dwelling-house. The "Radiator" is composed of a flat disc, bearing divisional planes placed crosswise behind its surface, which, on closing the apparatus, slide into the box, B, Fig. 1, fixed in the wall of the building. By means of its four wedge-shaped compartments, the air which is admitted through the outer grate, A, is dispersed in all directions in the apartment, as shown by the arrows in the figure; and so effectually that no draught is felt. The ventilator should be fixed preferably from 4 ft. to 8 ft. above the floor of the room, and in a position free from obstruction for about a foot on every side; it ought not to be opened more than about 1½ in. If placed behind a hot-water pipe, the incoming air is warmed; the same result may be accomplished by supplying the air to the ventilator through a shaft built in the wall, which can thus admit of being suitably warmed. It thus fulfils all the requirements of a perfect inlet ventilator.

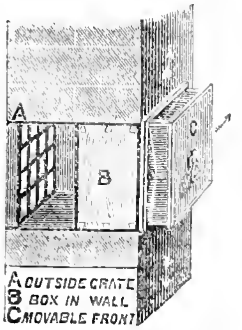


Fig. 1.—Ellison's "Radiator" Ventilator.

Reviews.

THE ANTIQUITY OF MAN.*

By Edward Clodd.

NUMEROUS as have been the discoveries of unground stone tools and weapons, which are characteristic of the Palæolithic Age, in the valleys of the Thames, Lea, and other rivers, there had been until the fall of last year no fragment of man's skeleton found which could be referred to that remote period.

Various satisfactory reasons for this absence of human bones are adduced, among others, the absence of bones of other animals of corresponding size, the liability to decay, or, if not burned, to being devoured by the hyænas which then abounded. But none the less was some evidence desired which might enable us to know what were the physical features of these chippers of flint.

When, therefore, in the judgment of such an expert in palæontology as Sir Richard Owen, the remains of a veritable man of the Ancient Stone Age have been unearthed, the interest of the volume before us, describing and illustrating the subject, is manifest. It would seem that in the course of some excavations at the East and West India Dockworks, at Tilbury, in October, 1883, portions of a human skeleton were found at thirty-four feet below the surface in a bed of sand, and although these were more or less detached and, in the case of the pelvis, smashed by the navvy's pick and scattered by the shoveller, enough was recovered by the care of Mr. Donald Baynes, the company's engineer, for transmission to Sir Richard Owen. He identifies them as having belonged to a male, the jawbone indicating, by the loss of masticating teeth, that he had reached, what was probably then exceptional, old age. In a technical description, which thinly veils its humour, Sir Richard says: "The smooth, unbroken surface of the molar tract tells plainly that the aged palæolithic individual went on labouring for his subsistence long after the loss of his grinders, and putting such few teeth as remained to their utmost powers of trituration."

With his heavy polished flint weapons he had slain the mammoth or captured it in a pitfall. In the days of his youth, "iron-jointed, supple-sinew'd," he had chased the deer, the bison, and other wild beasts that roamed through the thickets then covering the site above which Westminster Abbey and the Tower of London stand. During the short and special seasons of the variable climate of that epoch his dainties would be the crab-apple, the sloe, the hips and haws; while for winter store hazel-nuts, beech-nuts, and acorns would be gathered. But as eye grew dim and natural force abated, "the preparation for swallowing raw and hard fruit polished off the crowns of the few remaining teeth of the ancient, probably primitive, dweller of the Thames valley."

The report which Sir Richard Owen gives concerning the cranial capacity of this specimen is of value, although it affords no clue to connect it with any existing race, such as, according to Professor Boyd Dawkins, we have to connect the cave-men of the Old Stone Age with the Eskimos. In shape, the skull approaches the dolicho-cephalic, or long-headed, and "the contraction and slope of the low and narrow forehead and the prominence of the frontal sinuses are matched by low Australian and Andamanese skulls," whilst the eminences and depressions indicative of cerebral convolutions are few and feebly indicated. As the higher

* "Antiquity of Man, as deduced from the discovery of a Human Skeleton at Tilbury, North Bank of the Thames." By Sir Richard Owen, K.C.B., &c. (London: Van Voorst. 1884.)

the animal, the more complex, more numerous, and irregular are these creases or convolutions, the skull of this palæolithic man is of the character we should have expected, and like indications of brute force are given by the rest of the skeleton in the contrast of strong muscular characters with the low cerebral ones.

The bones had derived a dark brown colour from the powdery sand in which they were imbedded. Below this is the gravel known as "ballast," and above it are successive layers of thirty feet in thickness, the time of deposition of which is the measure of the period from the time of Drift-man until now. The present level of the surface of the banks of the Thames is about the same, geologically speaking, as it was when it was forded at Corday-Stakes by the second batch of Roman invaders (52 B.C.), and the different and various soils from surface to sand have been laid down tranquilly in keeping with that uniformity of causation which excludes theories of rapid or violent action. In the stratum just above the sand, fragments of decayed and blackened wood were found, showing the existence of vegetation long ago imbedded in the overlaying mud. Above this, beds of peat, mixed with clayey matter, alternate with layers of mud till we reach the surface clay. Data for reckoning the lapse of time in which years are "as moments in the eternal silence" fail us, and we are, as Sir Richard observes, unable to conceive the difference between the recorded times "since the actual surface was first trod by a Roman soldier, and the unrecorded time since the sandy soil, eight strata and thirty feet lower down, was trod by the man whose osteological characters are given above." It is a question whether the sand is a more recent foundation than the celebrated gravel-beds of the Somme Valley in which M. Boucher de Perthes first discovered unpolished stone implements, and revolutionised all past ideas of man's place in geological time. Be it contemporary or later, the Tilbury skeleton throws no light on the presence of man in tertiary times, whether of *Homo alalus* (dumb-man) in the Miocene age, or of *Homo pithecanthropus* (ape-man) in the Eocene age. It is enough that this skeleton adds confirmation of the already superabundant evidence of the remote antiquity of man in western Europe, and of his primitive condition as one inferior to the lowest savages extant.

SOME BOOKS ON OUR TABLE.

Geology of Weymouth, Portland, and Coast of Dorsetshire. By ROBERT DAMON, F.G.S. (London: Edward Stanford. 1884.)—The tourist or visitor to the Dorsetshire coast can have no better guide to its physical structure, its geological, palæontological, and archæological history, or its existing fauna and flora, than Mr. Damon's excellent work, the new and enlarged edition of which lies before us. It is fully illustrated by maps, plans, and capital drawings of the most common and characteristic fossils, and contains an amount of detail on all the subjects treated of which may fairly entitle it to be ranked as exhaustive. The student who will spend a fortnight exploring the coast between Swanage and Bridport with Mr. Damon's book in his hand, will acquire a more intimate knowledge of geological phenomena, and realise in an infinitely more impressive way the strange history of past life upon our globe, than he can by any possibility ever do by six months of mere "grind" at the whole of the South Kensington cram-books put together. We cordially recommend it.

The Saxon Invasion, and its Influence on our Character as a Race. By J. FOSTER PALMER, L.R.C.P., &c. Transactions of the Royal Historical Society. (London. 1884.)—All Englishmen who are curious to know something of the rock whence they were hewn, and the hole of the pit whence they were digged, will find a mass of curious and interesting information in Mr. Palmer's pamphlet. He regards Vortigern, Arthur, Hengist, and Horsa, &c., as really historical personages, and not as the mere myths it is now fashionable to consider them.

London Water Supply. By Colonel Sir FRANCIS BOLTON, C.E. (William Clowes & Son. 1884.)—This is the third volume on the subject of the London Water Supply which has reached us for review since the opening of the Health Exhibition, and it is the most exhaustive of them all. As a manual at once for the consumer and for the waterworks shareholder, it leaves nothing to be desired; in fact, it may be regarded as a kind of encyclopædia of the subject. The physicist, the mechanic, the statistician, and the lawyer, as well as the householder may each find matter of interest within the covers of Colonel Bolton's portly volume. We fail to see how it can be sold without a serious loss at the almost nominal sum charged for it.

The Spitalfields Genius; the Story of Wm. Allen, F.R.S. Re-told by J. FAYLE, B.A. (London: Hodder & Stoughton. 1884.)—In a proem and seven effective chapters, Mr. Fayle tells the interesting story of the life of the Quaker chemist of Plough-court, Lombard-street, who, born in Spitalfields in 1770, subsequently became famous as one of the most popular lecturers on chemistry of his time, and whose philanthropy was as extensive as his scientific knowledge. How a business man in a dingy City court became the friend and associate of men of the highest social rank and of world-wide eminence, may be learned from the volume before us, in which there is scarcely a dull or dry page to be found. We will not spoil the reader's pleasure by any attempted *précis* of its contents, but refer him to the work itself.

The First Principles of Natural Philosophy. By W. T. LYNN, B.A., F.R.A.S. Second edition. (London: J. Van Voorst, 1884.) As an introduction to physics for use in schools, or for the self-taught student, Mr. Lynn's excellent little book appears to be particularly well adapted. In simple and intelligible language, illustrated, wherever necessary, by diagrams, our author expounds the fundamental principles of Statics, Dynamics, Hydrostatics and Hydrodynamics, Pneumatics, and Optics: treating of the nature of Light and Sound in a concluding chapter. The only mathematical knowledge presupposed on the part of the reader is that of the first six books of Euclid, and some elementary algebra. Should Mr. Lynn ever expand this work, some reference to the conservation of energy might well find a place in its pages.

Reasons for Dissenting from the Philosophy of M. Comte. By HERBERT SPENCER. (London. Williams & Norgate. 1884.)—That Comte was one of the greatest thinkers that this century has produced, it would be idle to deny. His followers, however, are but indifferently contented with this admission, and virtually claim that all exponents of modern scientific thought are indebted to their apostle and prophet for inspiration. Among others who have been accused of borrowing from the "Philosophie Positive" of the famous Frenchman is our own great English philosopher, Herbert Spencer, an accusation which he sets himself to rebut in the pamphlet before us. By the simple method of placing quotations from Comte's writings and from his own in parallel columns, Mr. Spencer shows triumphantly that so far from deriving his inspiration from Comte, he differs from him, *toto cœlo*, on the most vital points. Every one interested in the controversy should read his tract.

Miscellanea.

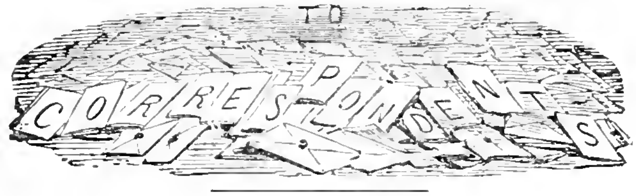
A Gigantic Oil Well.—On Saturday, October 11, the Christie Brothers' drilling well at Phillips City, Butler Co., Pa., struck the oil-bearing sand and began to flow at a tremendous rate, gushing forth the crude petroleum at the rate of 5,000 barrels per day, and the well will go down in history as being one of the largest wells ever struck in the oil region. The well is still producing at the rate of 180 barrels per hour. This well of Christie Brothers is only 365 feet from the famous Phillips well, which was struck August 30, and is yet producing 2,200 barrels per day. These great wells have paralysed the oil trade, and the oil market has sagged from 75 cents to 62 cents per barrel.

International Exhibition at the Alexandra Palace.—An International Exhibition is to be held at the Alexandra Palace next year, commencing about March 31, and remaining open for six months. Ten per cent. of the gross receipts from admission money is to be set apart for distribution among the principal London hospitals. For this purpose a committee has been appointed as follows:—Chairman, Colonel Sir Herbert Sandford; vice-chairman, Admiral Sir Edward Inglefield; General Sir Michael Kennedy, Sir Henry Pitman, Sir Andrew Clark, Mr. F. D. Dixon-Hartland, and Dr. George Johnson. The exhibition, like those at South Kensington, will not rely simply upon the attractiveness of the exhibits, but will include amusements of a varied nature. The building and grounds are to be brilliantly illuminated by the electric light. Machinery is to be largely represented. A small charge is to be made for space. Mr. E. Ray, 21, Queen Victoria-street, is the secretary.

At a meeting of the Anthropological Institute, Nov. 11, Professor Flower, F.R.S., President, in the chair, Mr. Francis Galton described the object, method, and appliances of the late Anthropometric Laboratory at the International Health Exhibition. He stated that 9,344 persons passed through the Laboratory, each of them being measured in seventeen distinct particulars for the sum of 3d., in a compartment only 6 ft. wide and 36 ft. long. The popularity of the Laboratory was so great that its door was besieged by far more applicants than could be admitted, and many persons made repeated attempts and waited long for their turn, but at last gave up their attempts as hopeless. So many applications have been made abroad and at home for duplicates of the instrumental outfit that it was advisable that any suggested improvements in them should be considered before they became established in use. The present paper was to invite discussion.

Petrified Wood.—The petrified wood which is so abundant in the United States territories of Arizona, Wyoming, and Rocky Mountain regions is rapidly becoming utilised by the practical American. In San Francisco there is now a factory for cutting and polishing these petrifactions into mantelpieces, tiles, tablets, and other architectural parts for which marble or slate is commonly used. Petrified wood is said to be susceptible of a finer polish than marble, or even onyx, the latter of which it is driving from the market. The raw material employed comes mostly from the forests of petrified wood along the line of the Atlantic and Pacific Railway. Several other companies have also been formed to obtain concessions of different portions of these forests. Geologists will regret the destruction of such interesting primeval remains, and some steps ought to be taken to preserve certain tracts in their original state.—*Engineering.*

Mr. T. Mellard Reade, C.E., who has devoted much attention to chemical denudation of the earth's surface, in his presidential address to the Liverpool Geological Society this session, dealt with "The Denudation of the Two Americas." He showed that 150,000,000 tons of matter in solution are annually poured into the Gulf of Mexico by the river Mississippi; this, it was estimated, would reduce the time for the denudation of 1 ft. of land over the whole basin—which time has hitherto been calculated solely from the matter in suspension—from 1 ft. in 6,000 years to 1 ft. in 4,500 years. Similar calculations were applied to the La Plata, the Amazons, and the St. Lawrence, Mr. Reade arriving at the result that an average of 100 tons per square mile per annum are removed from the whole American continent. This agrees with results he previously arrived at for Europe, from which it was inferred that the whole of the land draining into the Atlantic Ocean from America, Africa, Europe, and Asia contributes matter in solution, which, if reduced to rock at two tons to the cubic yard, would equal one cubic mile every six years. [In connection with this, the attention of our readers is drawn to an article on "River Action on Land," Knowledge Vol V., p. 270, in which such statistics are shown to be unreliable.—Ed.]



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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SOME OF YOUR CORRESPONDENTS.

[1511]—It appears to me that if Mr. Fowler's facts are correct, his explanation of the "talisman" is a sufficient one. The question is not, "What connection is there between the figures and the powers attributed to them?" but "What connection did the Egyptians or Asiatics, or any one else, suppose them to have?" And it is quite conceivable that superstitious people would see "magic" in the fact that the same total could be obtained in several ways. Why they saw it was probably because they knew no better.

Mr. Mathias will find his "problem" abundantly answered in letter 1501. If he will take the trouble to put four such squares together in the form of a square (or arrange the numbers four times over on a chess-board), he may obtain 34 in a sufficient number of ways to satisfy him. Any consecutive four numbers in a straight line, whether horizontal, perpendicular, or diagonal, will cast to 34; and so will any square of four numbers, or the four corner numbers in squares of 9, 16, 36, 49, or 64 numbers. And there is a perfectly mechanical process by which he may produce from this "magic square" a very large number of others having precisely the same properties.

But, sir, would it not be well to stamp out the "magic square" epidemic before it sets in badly. Some time ago we had a severe attack of it, which was only cured by a rigid refusal to publish any more squares. You stand a good chance of being deluged with them for the next few weeks.

"W. S. B." tries to galvanise the long-defunct "Fifteen puzzle" into life. "O! W. S. B.," don't you know your question (in which, by the bye, I suppose 13, 14, 15 is wrongly printed for 13, 15, 14) has been asked and answered a thousand times? If *all* questions were answered as often, the world itself would not contain the replies to correspondents that would be written. You want to know how to get the numbers consecutive. There is one most simple and effectual way. Carefully remove "15" from the box and place it after "14." Should you not be satisfied with this method, invert the "6" and the "9" and work the puzzle over again; you will find it will come right.

If this will not suit you either, it will be time your friends should look carefully after you, for your case will soon be hopeless. W.

[I entirely agree with "W." that we have had more than enough of the "Magic Square" and the Fifteen game. Any future contributions, be they letters or queries, on either of these subjects, must be "declined, with thanks."—Ed.]

FOREGLOW.

[1512]—There was a very fine foreglow here (Maidstone) on Nov. 7, almost equal in brilliancy, if not in duration, to any seen by me last winter. For some time the sky next the horizon was of a deep orange colour. At 6.30 this band of orange became almost white, whilst above this was the splendid crimson glow, almost an equal-sided triangle in shape, the apex reaching half way to the zenith. At 6.45 it quickly disappeared, there being no colouration after that time. The rest of the sky was deep blue, absolutely no clouds being visible on the eastern half. About 7.10 the sun rose, but there was no red colouration.

It seems to me that these glows differ in two respects from a usual dawn: that they occur and *disappear* some considerable time *before* the sun rises; and that the crimson tint is often apparently *upon the ground of the sky itself*, and not upon clouds, as in an ordinary sunrise. OPIFER.

Nov. 10, 1884.

[It is, of course, *the* characteristic of these fore- and after-glows that they appear long before the ordinary dawn and after sunset: showing evidently that the light must be reflected from *something* at a very great altitude in our atmosphere. The interesting and important question is: What is that something? The cause, whatever it is, has been in operation for at least a year and ten months. There seems to have been a splendid foreglow visible in Paris during the early morning of Nov. 10.—ED.]

THE WEATHER OF 1665 AND OF 1884.

[1513]—Have any of your readers noticed the similarity between the weather of the present year and that described to have prevailed during the great plague in London? We are told that the summer was unusually hot and fine, and the account of the afterglow and the crimson glories of the sky would exactly describe what we have seen during the last twelve months. We have had no plague, but there have been the outbreaks of cholera in Egypt, France, and Italy. Can this have been only a coincidence? On the other hand, the winter before the plague was very severe, and the atmosphere appears to have been more dry and stagnant than it has been this year. K.

A SPLENDID GROUP OF SUN-SPOTS.

[1514]—As we have had of late much to interest us in the activity displayed on the sun's disc—rather against "official" orders—I enclose the drawings of a splendid group that I have done in the interval of three rotations, which is interesting from the fine forms it takes from the straight to the undulating, then to the more detached, still showing a relative affinity.

Aug. 23, 2.30 p.m.

Sept. 13, 3 p.m.

Oct. 5, 10 a.m. (Definition splendid).

Oct. 29, 9 a.m. (Screen definition not good; air unsteady).

Change in a Group of Sun-spots, in the interval of three Rotations. Drawn at the Screen. Power 120, Wray, $3\frac{1}{2}$ in.

GEO. L. BROWN.

LETTERS RECEIVED AND SHORT ANSWERS.

DR. GROTH. You invited my candid opinion on your theories, and I gave it. Now you modestly ask me to insert five sheets (!) of your reasons for adhering to your own notions. I cannot possibly afford the space. There is a growing evil to which a peremptory stop must be put. It is this: that every one whose literary work or pseudo-scientific guesses are unfavourably commented upon here seems to have the idea that he is entitled to occupy columns of KNOWLEDGE in reiterating his ideas. A little more of this, and no paradoxical or quasi-paradoxical work will ever be noticed again, and the authors of such must seek some other form of advertisement.—Some CORRESPONDENT of artistic proclivities sends a picture of "R. A. P." coming condignly to grief in—or out of—a flying-machine. By way of emphasis, the head of the said R. A. P. is coloured green as he moves horizontally, and blue as he is ascending. Like Peter, the policeman, in the "Bab Ballads," the limner "was a merry, genial wag, who loved a mad conceit."—METEOR. Scott's "Meteorology" in the "International Scientific Series" is excellent. So is Buchan's "Handy-book," for practical information. I do not fancy that readers, as a rule, seem to care much for meteorology. The Weather Maps published in our earlier volumes apparently excited but little interest. The solar prominences are uprushes of glowing gas, chiefly hydrogen. See "The Sun," published by Messrs. Longmans & Co.—J. FERGUSON. The "Comozants," or "St. Elmo's Fire" of sailors, is simply a form of the so-called "brush discharge" of the ordinary electrical machine. It is common enough at the mast-heads and yard-arms of ships during thunderstorms.—AN ANONYMOUS CORRESPONDENT sends me (in connection with Mr. Tindall's letter, 1500) a cutting from "Industry" for May 13, 1880, describing an eye-photometer, the invention of Mr. William Ackroyd, dependent on the sudden shortening of the rays from an artificial star, as the source of light to be measured is approached.—WALTER G. WOOLCOMBE. Once more, Mr. Proctor has ceased to lecture for good and all, and cannot relax this rule for *anybody*. Besides, he is not in England.—ANONYMOUS. Thanks for correction *re* p. 382. It is noted elsewhere. E. A. TINDALL. Will test the apparatus when it reaches me.—THOS. ALLSOP. The semi-diameter of the earth's penumbra = the parallax of the moon + the parallax of the Sun + the Sun's semi-diameter, *i.e.* (*vide* p. 383), 59′ 17·1′ + 8·9″ + 16′ 2·4″ or 1° 15′ 28·4″, add $\frac{1}{60}$th (say 1′ 15·5″) to this and we have 1° 16′ 43·9″. Now, in our figure, the radius of the earth's shadow = 44′ 7″ is 1·1 inch. Then we say 44′ 7″ : 1° 16′ 43·9″ :: 1·1 inch : what we shall find to be 1·9 inch; so that we have only to open our compasses to a width of 1·9 inch, and, putting one leg on C in the figure, describe a circle round it. This will represent the penumbra, the times of contact with which we shall obtain from inspection by the aid of our hour-line, LN.—HUGH CLEMENTS. No more room to spare for details of your "Weather Cycle."—HALLYARDS. Nothing akin to M. Flammarion's observation has been made anywhere else. He can *not* mean the penumbra ordinarily so called (see reply above) as it would be ridiculous to speak of that as "égale à la 35e. partie de l'ombre de la terre." How, though, he separated his penumbra from the real one does not occur to me. Liais's observations of twilight in Rio gave a height of about 200 miles as that of the atmosphere, so Flammarion does not seem much out with his 221 miles, however he arrived at it.—A. H. "The Herring and Sea Temperature" much too long for extract. —G. D. EVANS. The only "Almanac Lessons" which have, so far, appear, will be found on pp. 23 and 206 of our fifth volume.—MUSAFIR sends a curious story of his own seeming recognition of a group of deserted buildings and enclosures upon which he came, for the first time in his life, during a walking tour in the Eastern Alps. He heads his communication, "Coincidences," but his experience would rather seem cognate with many of those related in connection with the discussion over Our Two Brains.—OLD MOON spins an amusing yarn about being knocked up by one of the crew of a schooner which he commanded, while lying in Loch Inver to see "two stars" which had fallen down and pitched on the "crosstrees, one on each side!" the said stars being a couple of "Comozants" (*vide* reply to J. Ferguson above).—CHAS. RICE tells, at considerable length, how his drowned brother was resuscitated by a man who inflated the boy's lungs with his own brandy-laden breath. Many have been recovered in similar cases by artificial respiration. The brandy had nothing whatever to do with it.—H. S. S. I, like you, seem to remember a connected essay by Darwin on the mental development of an infant; but I forget where it appeared. Try back volumes of *Nature*. He quotes observations on an infant of his own, though, on pp. 151 to 153 of his "Expression of the Emotions," &c.—CHAS. FEW. W. H. FRANCE. It is wholly needless for you, and other correspondents, to continue to write that the figure in letter 1490, p. 372, is a magic square. That is evident on inspection. What a "Lover of Things Occult" wished to know—as I understood—was the connection between the figures he gave and the supernal powers attributed to them, and this nobody but Mr. Mathias has attempted to touch.—ANONYMOUS. The headless chicken of your paragraph is obviously a "Great gooseberry," from some American paper.—W. R. P. You must use your own discretion. The fact of such a form of expression appearing "in print" proves but little, indeed. What is to hinder a swimming-master or a conjurer from dubbing himself "professor"; the proprietor of a middle-class day-school, held in one room, from calling it a "college"; or a man from advertising a common needle as "a sewing-machine"?—J. JONES. See Glazebrook's "Physical Optics," published in Longmans' "Text-books of Science."—ONE WHO WANTS TO LEARN. "Whitaker's Almanack" is the best and most trustworthy after the "Nautical," but, of course, it does not contain the mass of information which the latter does. Yes; a 2½-inch telescope with a power of 180 ought to divide ε^1 Lyræ, and even theoretically ε^2.—M. WELDON. The conductor of this journal has nothing to add to his quoted expression of opinion. See paragraph (in capital letters) with which the heading to the Correspondence Column concludes.—W. YOUNG. Received. Regret my inability to attend your conference.—PERSIFAL M. YEARSLEY. Is the story in any way authenticated? or is it merely a magazine novelette?—JOHN E. CHASTER. The Editor of this Journal does not buy back numbers with the advertisement sheets missing! You must advertise them if you want to get rid of them. Were any articles required on the subject you mention, they would, of course, be committed to Mr. Slingo.—WILLIAM REID. Returned with thanks.—J. T. E. Thanks: but the method you illustrate is "as old as the hills." Certainly, I was familiar with it when I was fifteen. The figure *looks* more simple, but, if you try for yourself, you will find that the necessary calculations are certainly longer and more complicated.—J. DUNCAN. I cannot engrave a figure here, but see Loomis's "Treatise on Astronomy" (not his "Practical Astronomy"), pp. 154 and 158; or Brinkley's "Astronomy" (by Stubbs & Brünnow), pp. 132 and 133, though into the latter demonstration rudimentary trigonometry enters.—C. Roscoe's "Elementary Chemistry," published by Macmillan, and Ganot's "Physics," Longmans & Co.—W. WRONG. I really cannot afford the space merely to give the English names of the letters of the Greek alphabet. See Cassell's "Elementary Lessons in Greek."—SHARP & CO. Delayed through being addressed to the Editor, instead of to the Publishers.—A CASUAL READER. See answer to—well, to every initial in the alphabet—*re* letter 1490.—J. A. M. See Darwin on sexual selection in his "Descent of Man."—NIGEL DOBLE. Put your eye-pieces 10 inches behind the object glasses. There are two sorts of black colouring used in optical instruments; the dead-black in the inside of eye-pieces, tubes, and the like is made of lamp-black, mixed as thick as putty with gold-size, then diluted with turpentine, and painted on with a camel's-hair brush. Stages and outside brass work are generally blackened with chloride of platinum, brushed on while they are hot.—STARCH. The formation and evaporation of clouds is far from being an uncommon phenomenon in daylight. It was seeing them black upon the night sky which must have attracted your attention. As to their shape, &c., see Vol. II. of KNOWLEDGE pp. 278 and 326. —W. G. WORLD. No; the focus of the object-glass falls between the lenses of a Huyghenian eye-piece. A 6-inch objective should carry powers from 20 (for comets and nebulæ) to 600 (for very close double stars only). I cannot recommend tradesmen. Read the advertisement columns.—E. P. L. and X. Y. Z. both complain that Mr. Clodd's papers trench, indefensibly, on purely theological grounds. The difficulty of discussing the origin of primitive beliefs —in fact, the origin of man himself—without offending theological prejudices is doubtless very great.—A. PEARSON. Thomé's "Structural and Physiological Botany" in Longmans' "Text-books of Science," is excellent. I know nothing of what is demanded of the advanced student in the wretched cram system at Brompton. ANONYMOUS (Ipswich).—Why do you not address the Chess Editor?

A SMART trick has, says the *Athenæum*, been played Mr. Max O'Rell by a Yankee firm. Before the sheets of "John Bull's Womankind," sent in advance of publication to America, could be got into type, the work had been translated from an early copy of the French original, and issued by a New York publisher. The author's chance of any profit from the American sale of his book is, therefore, destroyed.

CHRISTMAS PRESENTS.—Doubtless for some very good reason, Christmas-tide, now so rapidly approaching, has ever been associated with the giving and receiving of presents. We do not propose, however, to write a homily either in support of or against the custom, though possibly a few adequate reasons from the latter point of view would find favour in the eyes of Paterfamilias. Knowing, however, how much thought is often wasted in selecting suitable presents, frequently with unsatisfactory results, we venture to offer to our readers a suggestion in this direction by again calling attention to the unrivalled claims of photography as an attractive and enduring amusement, not only for young folks, but, we make bold to say, for all who may put it to the test. A day or so back we had an opportunity of inspecting some of the newest sets of portable photographic apparatus offered to the public by the London Stereoscopic Company, of 110, Regent-street, and we were struck by their extreme suitability as presents. Sets completely fitted with all the latest improvements devised for rendering photography a pleasure, can be procured at prices to suit all pockets: the purchase of the most expensive qualities, however, does not involve unreasonable outlay. We may remind our readers, too, that buyers of the better descriptions of apparatus are entitled to avail themselves of a course of free lessons in photography, given by competent instructors on the Company's premises in Regent-street. We saw many desirable sets of apparatus during our visit to the studio, but we can specially recommend to intending purchasers those known as the "Cyclists' ¼-plate," the "Company's ½-plate," and the "Company's whole-plate." These three sets are of different prices, and manifestly of varying sizes; but each is a thoroughly reliable and complete apparatus which cannot fail to please.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

AN IMPROVED PAINT-POT.

Paint-pots do not concern everybody, but the number of amateur painters constantly increases, especially, as the "British workman" grows more and more impracticable and independent. Those who do use paint-pots at home should have them as perfect as possible, and such may be interested to know that Messrs. Charles Winn & Co., of Birmingham, and 41, Holborn-viaduct, E.C., are now making an improved paint-pot, in which the improvement consists of a corrugated ring just below the edge of the pot, which gives the necessary strength without having to stiffen the vessel with a wire round the rim. In the new pot the rim is continued after the corrugation for a little distance, and then turned over flat, so as to leave a sharp edge against which the brush can be scraped dry. The old plan of the rounded wire did not wipe it dry, and tended also to allow the paint to run down the outside. This pot is made without solder, so that the old paint can be burnt out without spoiling the joints.

A SAFETY CAP FOR DRAUGHTSMEN'S INK-BOTTLES.

Technical education alone is adding enormously to the number of our draughtsmen of all kinds, and for such habitually using Indian ink or different washes of water-colour in bottles there is constant annoyance occasioned by the accidentally upsetting of these bottles while the cork is out, frequently spoiling their drawings and also losing the ink or wash. It is difficult, too, to use up such inks or washes when they get low in the bottle. If the bottle is at all narrow, when tipping it and inserting the brush or pen to get at the fluid, the brush gets stained higher up than necessary, and marks the fingers, so that it is difficult to keep a drawing clean and neat. In view of this, Mr. F. Fson Almquist, of 100, Finborough-road, South Kensington, has invented a contrivance, consisting of a small cap of indiarubber, to do away with all this trouble. The bigger end of the cap fits over the neck of the bottle. The cork should first be bored with a small hole in the centre, enough to take a glass tube, which is placed through the cork well down into the bottle, leaving above a sort of cup or receiver, to which the smaller end of the indiarubber cap is fitted. The cork should have a small slot previously cut in the side, so that when in the bottle it forms a small air tube. In one side of the indiarubber cap, is a small hole to allow egress to the air. When fitted upon the bottle, it is only necessary to press the cap with the thumb so as to cover the air-hole, and the finger on the other side with a pinching action, so as to compress the air inside the bottle. This drives the fluid up the little glass tube into the receiver at the top, from which a supply is easily taken by brush or pen. The moment the pressure upon the cap is released the air escapes, and the fluid retires from the tube. As long as the cap remains on, the bottle may be thrown about or knocked down with impunity.

A PATENT MARMALADE MACHINE.

Although preserving is mainly a factory business, there are still many persons who prefer to make their own preserves, and especially their own marmalade; and in view of this contingency, Messrs. Follows & Bate (Limited), of Manchester, have invented an orange-cutter designed to prepare oranges for marmalade. The fruit is placed in the hopper at the back of the machine, and by simply working a handle backward and forward the oranges are neatly sliced. This appliance is specifically for kitchen use, since in factories pulping-machines and peel-cutters are required on a large scale. The machine in question is strong and very simple, and its cost is, we believe, exceedingly moderate.

THE PATENT SMOKE-PREVENTOR.

Few domestic nuisances are worse than smoky chimneys, and yet how various are the so-called specific cures for this often intolerable evil. At the recent International Health Exhibition there were many examples of inventions designed to prevent chimneys from smoking, and most decidedly among these was an ingenious contrivance for entirely preventing smoke, and enabling coke, bituminous coal, and even anthracite to be burned. This contrivance is known as the "Patent Smoke-Preventor," and is applicable to any existing grate. It is the property of the "Patent Smoke-Preventor" Association, having offices at 16, Duke-street, Grosvenor-street, W. The invention consists first of an inner and loose fire-basket, a hood reaching entirely to the top of the fire and excluding all cold air from the chimney, and a swinging diaphragm within the hood. Now, the construction is such that the loose fire-basket allows a channel for the passage of air under and at the back of the fire, and it thus becomes highly heated and creates a strong draught. The hot air and the increased draught ensures nearly perfect combustion of the fuel, and very little smoke is formed. The smoke and products of combustion from the fire pass through and over the back of the loose fire-basket and within the hood, and, mixing with the hot air whilst at a high temperature, are effectually oxidised. When the diaphragm is pressed forward—as regulated by the top nob of the hood—the draught is increased, and the whole of the smoke and products of combustion are drawn directly into the current of hot air, and the diaphragm having gills at the back, these form mixing chambers, and by compression the smoke is more completely destroyed. The door in the hood may be closed and opened, and the rate of combustion is thereby regulated. It is claimed to be a perfect cure for smoky chimneys, and any fuel can be burnt. As there cannot be a down draught from the chimney, neither chimney-pots nor cowls are needed. The main advantages of this invention are cheapness, simplicity, thorough ventilation, a fine blazing fire well forward in the grate, a maximum of heat from a minimum of fuel, and, finally, perfect radiation. Another good point claimed is that, with this arrangement, any kind of rubbish and refuse can be burned without the least unpleasantness.

A NEW OCTAGONAL "SYPHON."

Syphon-bottles for aërated waters are now the order of the day, and are in such increasing demand among all sections of the public that any real improvement therein is of very far-reaching importance. The invention known as the new Octagonal Syphon (Vidie's patent), manufactured by Messrs. James Videl & Son, of the Pantin Glass Works, Paris, is externally like the usual syphon-bottle, but the interior of the glass vase is blown into an octagonal form by a new process. The result is a brilliant and sparkling appearance, while the strength is so increased that these new bottles can bear double the pressure of the ordinary, and are therefore twice as safe. The only agent for the United Kingdom and the colonies is Mr. C. Melin, 37, Crutched Friars, Mark-lane, E.C.

THE BALL FILTER.

Filters are now very properly regarded as indispensable to the proper furnishing and equipment of any well-regulated household, indeed, filters are now found in very modest homes, and, probably in time will be common to all. Meanwhile, to many, the question is chiefly, what filter is best? Well, that is not a question to be answered here; but it will interest many to hear of an ingenious invention, the production of the Revolving Ball Filter Company, of 67, St. James's-street, London, S.W., which is certainly worthy of full consideration. This filter may be briefly described as consisting of a spherical metal case, containing a hollow metal ball, filled with animal charcoal or other filtering medium, through which all water designed to be filtered must pass, such passage being secured by a washer, which forms a tight joint around the ball; all organic or other matter in suspense being arrested and held within the filter. A specialty of the filter is the simple method of cleansing, which is done by reversing the ball within the case without removal from the tap, the first passage of water thereafter cleansing the filter of all impurities. There is also a straight passage for water not requiring filtration. Water, after being compelled under pressure to pass into the filter, is again compelled to spread through the filtering material.

SOMETHING NEW IN PERAMBULATORS.

Children are decidedly fortunate in the present age, when so much inventive ingenuity is concentrated on their various needs. Mr. W. H. Dunkley, of Dean-street, Birmingham, has, we believe, for over six years past devoted his thoughts to the improvement of the perambulator, and his latest invention in this line is quaintly known as the "Eclipse" perambucot, the body of which, of papier-mâché, presents an elegant appearance. It is handsomely upholstered, either in silk, satins, velvet, or carriage cloth, and fitted with Dunkley's patent reversible handle. The perambucot has been, we are told, the most successful child's vehicle ever manufactured, Mr. Dunkley having sold 5,000. The bicycle-wheel, with india-rubber tires, is now universally adopted by the manufacturer; this, together with a recently patented spring, being entirely free from vibrations, and also noiseless, is most conducive to the comfort of the child. Mr. Dunkley has just opened show-rooms at 76, Houndsditch, London.

Our Whist Column.

["FIVE OF CLUBS" has been ill most of the time since his last papers appeared, with malarial fever, and is but now beginning to be himself again. He trusts that weekly or fortnightly games will now appear regularly. They will chiefly be fully annotated games from the *Westminster Papers*. The following is a good game. *Z* was our esteemed correspondent Mr. F. H. Lewis.]

THE HANDS.

B { D. 5, 4, 3. C. 9, 8, 2.
S. K, Q, 10, 3, 2. H. A, 3. }

A-B, 4. **B**

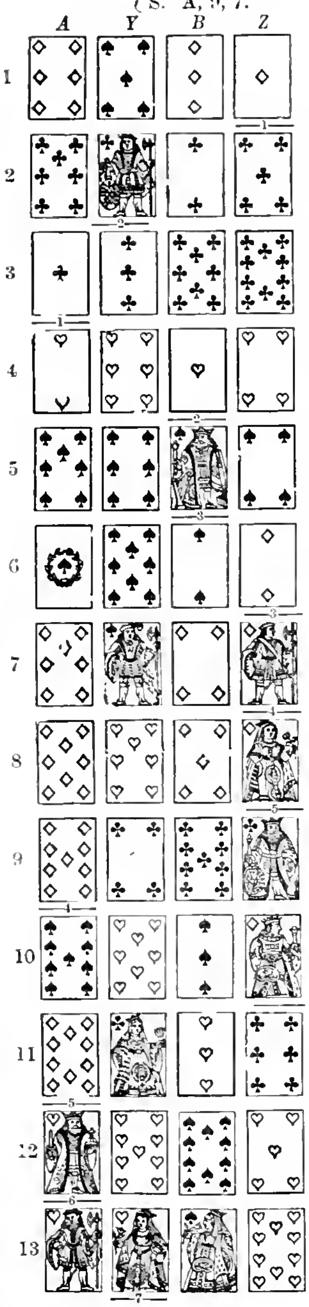
Y { D. None.
S. Kn, 8, 6, 5.
H. Q, 9, 8, 7, 6.
C. Q, Kn, 4, 3. }

Y *Y-Z*, 4. *Tr. D. Kn.* **Z**

Z { A, K, Q, Kn, 2. D.
4. S.
10, 5, 4. H.
K, 10, 6, 5. C. }

A leads.

A { D. 10, 9, 8, 7, 6. C. A, 7.
S. A, 9, 7. H. K, Kn, 2. }



THE PLAY.

Card underlined wins trick.

1. The score being at "four all," the trump lead from five was not good. Heart Two would have been the correct card. But, *under the circumstances*, Club Ace, followed by the Seven, would not have been bad. *A* lead from a short suit at such times, especially when weakness is not thereby disclosed too quickly, is sound enough. The hand was played before the days of the penultimate, or Diamond Seven would have been led. *Z* shows his partner his great strength; for it is not to be supposed that *Y* having no trumps, and *B* being presumably very weak, *Z* could not have taken the trick with a smaller card than the Ace.

2. *Z* plays a surer game than *A*.

3. From the fall of *B*'s Eight and *A*'s Seven in trick 2, *Z* knows *Y* must have the four, and therefore (from his lead) another Club. The play of the Ten is no *finesse*, as, if *A* holds the Queen besides the Ace, nothing is lost by letting Queen make. After the Ace has fallen, *Z* knows Queen to be with *Y*.

4. *A* should have led a Spade, as that is most probably his partner's suit.

5 and 6. *A-B* have command of Spades. *Z* is now numerically weaker in trumps than *A*, but he is not sure of this till trick 8. *A* throws Spade Ace, that he may not stop his partner.

7. *Y* discards his useless Spade. Had he originally discarded from his longest suite—the general rule now when the adversaries have led trumps—his Spade Knave would have been guarded, and worth keeping.

8. *B* has no more trumps; for had he held any above the Seven, he would have headed *A*, first round.

9. If *Z* goes on with trumps, *A* will be left with the long trump, will bring in Spades, and *A-B* will make every other trick. *Z* therefore forces *A*. The point is a pretty one, and shows the importance of attention to details. By leading a Heart at trick 2, and afterwards showing that he held Spade Ace, *A* has left it tolerably clear that he holds the King card in Hearts, without which *A-B* would still have lost, even had *Z* gone on with trumps.

10. The trump King can now be safely played, for *A* has no Spades left. Of course it has to be played anyhow at this stage, as *B* would have gone on with his winning Spades.

11, 12, 13. *A* is forced again; the Queen of Clubs being already "placed" with *Y*, and *A* having to lead from his major tenace, *Y* makes the seventh trick and the game.

*** The notes on Whist, by "Five of Clubs," extended and carefully corrected, are now in the press, and will form a small treatise "How to Play Whist." They will be accompanied by forty fully annotated games, from actual play, illustrating all the principal points of Whist strategy; and by Whist gossip, and the rules, etiquette, &c., of the game.

THE VARIETY OF WHIST.

SIR,—There seems room for another word on the old problem of the hands at Whist, first approached in a satisfactory manner by "Cavendish," in the *Field* of June 10, 1865. His investigation is undeniable, as far as it goes; but I think it overlooks one consideration of some importance in determining the true number of essentially different hands, *i.e.*, hands so different as to require different treatment. It will be best, however, for me to give my own solution first, and then to compare it with others.

It is easy to show that the total possible number of different deals, having no regard to dealer or trump-card, is

$$\frac{\underline{|52}}{\underline{|39}\,\underline{|13}} \times \frac{\underline{|39}}{\underline{|26}\,\underline{|13}} \times \frac{\underline{|26}}{\underline{|13}\,\underline{|13}} = \frac{\underline{|52}}{(\underline{|13})^4}.$$

So far all are agreed. Let us call this quantity N, its numerical value being something over fifty-three thousand quadrillions. The question is, what corrections are to be applied to this in order to obtain the true number required?

(1.) If we take any one of these N arrangements we can make 52 different games by making each card in turn the trump. Hence we must multiply N by 52.

(2.) The number N includes as different games those cases in which the hands are *numerically* identical, but the *suits* are interchanged. But the play is not altered by turning a suit of Clubs into the same suit of Hearts, and the Hearts into Clubs, provided the exchange is similarly performed in each player's hand. We must then divide N by the number of possible permutations of the four suits, *i.e.* by 4 or 24.

(3.) Finally, we must allow for the fact that, supposing the hands in any deal to be passed round the table in order, such rearrangements appear separately in the total N, although the game is not altered thereby, as we have supposed the lead also to move round, to circulate, in fact, thirteen times in each arrangement. Obviously the correction here is made by dividing N by 4.

It follows from these considerations that the real number of essentially different games is represented by

$$\frac{52}{24 \times 4} N,$$

and this, when worked out, gives the number

29,057,566,289,639,762,787,920,280,000.

The result obtained by Cavendish is twenty-four times as great as this, as he omits the second correction given above. It seems, however, quite necessary, the four suits being equivalent, apart from consideration of trumps, which are otherwise allowed for. The agreement otherwise between the two results is satisfactory, as the methods of solution differ in some respect. This is most likely the correction intended by a somewhat obscure passage in the treatise on "Probability" (written, I believe, by the late Sir J. W. Lubbock), in the Library of Useful Knowledge, which is quoted, but apparently misunderstood, by Cavendish. The first and third of our corrections do not seem to be made in the essay on "Probability," which is naturally concerned with the problem rather from the mathematical than from the practical Whist-player's point of view.

It may assist the mind to grasp the result above stated, if we put it in this form:—Taking the population of the world as sixteen hundred millions, let them all—man, woman, and child—start to play Whist, night and day, at the rate of ten deals per hour; they will exhaust the variety of Whist in about one thousand billion years.—I am, &c., W. ARNISON SLATER.

Our Chess Column.

By Mephisto.

SOLUTION.

Problem No. 135, by J. Berger, p. 394.

	1. B to Kt7	R × P, or (a)
	2. Q to Q4 (ch)	K or P × Q
	3. R to QB6 or B4 mates accordingly.	
(a)	1.	R to K3, or (b)
	2. R to B2	P × R
	3. Q to Q5 mate.	
(b)	1.	K to B6
	2. R to QB6	Any
	3. Q to Q4 mate	

The following game, at the odds of a Rook, was played on the 14th inst., in the second round of the Handicap Tournament now progressing at the City C. C. The quality of Black's play will be found above the usual standard of Rook players.

Remove White's Queen's Rook.

King's Gambit Declined.

White Mr. Gunsberg. (Class I.)	Black Mr. Glover. (Class V.)	White. Mr. Gunsberg. (Class I.)	Black. Mr. Glover. (Class V.)
1. P to K4	P to K4	15. Q to Kt3	QKt to B3 (i)
2. P to KB4	B to B4	16. P to R3	P to R4
3. Kt to KB3	P to Q3	17. P × Kt	P × P (ch)
4. P to B5 (a)	Kt to KB3	18. Kt to R2	Kt × P ! (j)
5. Kt to B3	P to B3 (b)	19. Q × P	Kt × B
6. P to Q3	B to Kt5	20. R to Q sq.	Kt × P (k)
7. B to K2	B × Kt (ch) (c)	21. Q × P (l)	R to B sq. (m)
8. P × B	P to KR3	22. Kt to Kt4 (n)	P to Q4 (o)
9. Castles	QKt to Q2	23. P × Kt	Q to K2
10. K to R sq.	Q to R4 (d)	24. Kt to B6 (ch)	K to Q sq.
11. P to B4 (e)	Q × P	25. P × P	Q to B4 (p)
12. B to K3	Kt to Kt5 (f)	26. P to Q6	R to K sq.
13. B to Q2	Q to R6 (g)	27. Kt × R	B to Q2 (q)
14. Q to K sq.	P to QR4 (h)	28. Q to B8	B × Kt

White mates in two moves.

NOTES.

(a) Here is a paradox for Mr. Foster to explain. Why should good work be capable of injuriously affecting its author? Instead of accepting the Gambit with that courage, minus discretion, characteristic of players receiving large odds, Black is actually prepared to beat us with our own analysis, by playing the Gambit Declined, previously analysed in these pages. 4. P to B5 is played with the desire to lead Black off the beaten track, as much depends, in giving the odds of a Rook, to gain an advantage in the opening. Against even play, it is not a good move, as Black can attack the P on K4, and thus break up White's centre, with the probable loss of a Pawn.

(b) This move effectually disposes of White's chance to develop his game; he is now compelled to play P to Q3, which blocks in his B. B to B4 would be bad, on account of P to Q4. This shows the weakness of 4. P to B5. Moral—"Never make use of bad means."

(c) It is of some advantage to White to have the Black KB off, that commanding diagonal. As a rule, a KB in the opening of a game is more useful than the opponents QKt. Now, P to Q4 was the proper move.

(d) White had fondly hoped that, having missed the opening, Black would give him a chance in the middle game, by Castling K's side. Instead of which, Black aims at reducing the game by simple liquidation. To win the RP has its drawbacks, as it mostly puts the Q out of play in the early part of the game, but "a Pawn's a Pawn for all that," especially when it gives Black a powerful passed P.

(e) Preferable to P to QR3, as it blocks Black's advance.

(f) With a view to an attack.

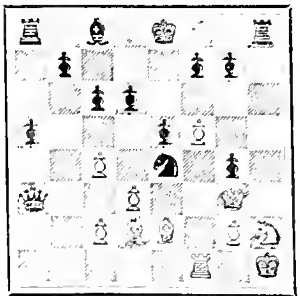
(g) To reach B4.

(h) Necessary, to prevent B to Kt4, but overlooking White's next move.

(i) Black had an inconvenient alternative, to submit to Q × KtP, but in playing QKt to B3, Black initiates a remarkable combination to reduce the disadvantage of his position, arising from his loss of time in capturing the QRP, also from his neglect to take advantage of 4. P to B5 by playing P to Q4 at the proper moment.

(j) A very good move. Black has opened his R on the White K, and now threatens to regain his piece. If Q defends B, then Kt × B, followed by P to Kt6. At this stage White had some misgivings as to the ultimate result of the game.

Black.



White.

(k) A plausible idea, showing sound judgment. If now P × Kt, as Black expected, then P to KKt3 with a safe game and a winning superiority. If Black had attempted to defend the Kt, then the following might be the result:—Q to Kt5. 21. Q × P, R to B sq. 22. Q to Kt5, Kt to Kt3. 23. Kt to Kt4, R to R sq.(ch). 24. K to Kt sq., Kt to B6. 25. Kt to B6 (ch), K to B sq. Now, we do not see any way for White but to draw by 26. Kt to R7 (ch), R × Kt, and now give perpetual check on Q8 and Kt5. Other ways of playing might lead Black into danger.

(l) A desperate move, as Black may reply with R × Kt (ch) and then withdraw the Kt, but, considering that White, if he played P × Kt, would not have had much chance left to win, this was the most likely, though daring, move to play in a game at odds, and, as the result proved, White was right in his choice of evils.

(m) Apparently afraid of allowing free play to the Q, but Black could aford to do so without much danger; *i.e.*, R × Kt (ch). 22. K × R, Kt to Kt3. 24. Q to Kt8 (ch), K to Q2. 25. Q × P (ch), K to Q sq. 26. P to B6, P to Q4, with a safe game.

(n) "The strategy, the sacrifice, the blow,
Sudden, but strong, that lays the victim low."

More strategy than anything else. Had White now played P × Kt, then B × P would have given Black a good game. The position is now an interesting one: we have spent some time in examining it, the result of our analysis being that, whatever Black did, White would obtain some attack. Of course he might avoid disaster by taking his chance with B to Q2, to which White would have replied with 23. Kt to B6 (ch), K to K2. 24. Q to Kt5, K to Q sq. 25. P × Kt, K to B2. 26. B to Kt1. In this case, unless there is more in the position than we have seen, Black (considering the odds given) might have successfully resisted White's attack.

(o) Black played P to Q4 with the intention of bringing his Q into play. Kt to Kt3 would have led to an attack, but not, as Black feared, to the loss of the game; *i.e.*, Kt to Kt3. 23. Kt to B6 (ch), K to K2. 24. Q to Kt5. K to Q sq. (best). 25. Kt to R7 (ch), P to B3. 26. Q to Kt7, R to K sq. 27. Kt × P, B to Q2. 28. B to R5, &c.

(p) He had no good move to prevent the threatened advance of the QP.

(q) If K × Kt, mate in three follows.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

E. R. M.—Why, certainly. Every piece on the board must have its use, even if only to prevent a dual, but therein lies the difference between a fine composer and an ordinary one. While the former will execute an idea with but few pieces, the latter will require much more force for the same object.

R. P. H., C. Planck, H. W. Sherrard.—Problems received with thanks.

Tyro.—In Problem 134, if 1. P to Q4 (ch), P × P en passant (that is, as if the P had only played to Q3) and no mate follows.

S. B. C.—If in 135, after 1. B to Kt7, R × P, you play R to B4 (ch), then Kt × R, and there is no mate.

W. Parker.—Solutions incorrect.

Uncle John.—How about 1. R × P.? 135 incorrect.

Littlehampton.—In Berger's Problem, if 1. Q to B sq, P Queens.

W. Mathias.—Solution right.

W., H. W. Sherrard, Geo. W. Thompson.—Solutions correct.

J. Allport.—Problem is quite right. Try again.

Contents of No. 159.

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Contents of No. 161.

OUR TWO BRAINS.

By Richard A. Proctor.

(*Continued from p. 355.*)

Among the arguments adduced by Dr. Wigan in favour of his theory of the duality of the brain is the "sentiment of pre-existence" which most of us have recognised. Dr. Wigan says that he has never met a person who had not experienced it more than once; and, though I believe there are a few who know nothing of it, nearly every one when the sentiment is described recognises it as one with which he is more or less familiar. It is a sudden feeling, as if some scene just witnessed had been presented before in all its details, with "the same speakers, seated in the same positions, saying the same words, and uttering the same sentiments." As Dr. Wigan remarks, "the postures, the expression of countenance, the gestures, the tone of voice, all seem to be *remembered* and to be now attracting attention for the second time: *never* is it supposed to be the *third* time."

The attempt has more than once been made to explain the phenomenon we are considering as merely the reproduction of some early and all but forgotten impressions of a scene more or less resembling the one actually before us at the moment when the sensation is experienced. But no one who rightly apprehends the nature of this "sentiment of pre-existence" can for a moment adopt such an explanation as this. When experienced in its full force it always presents the person himself who experiences it as of the same mental capacity, with the same ideas, the same views, as at the moment when the phenomenon is noticed. In what seems a recollection, he sees such and such persons around him as persons familiar to him, he hears their words, notices their actions, and (so far as the suddenness of the conception will permit) considers their conduct, as he could only do at the particular part of his life which he has actually reached. It *can* be no recollection of long-past events; for at no long-past part of his life had he such persons among his friends, or such ideas and views as to them and their actions. Or it may be that events are in progress which cannot possibly have occurred before in the experience of the person who yet seems to recollect them. It is absurd to refer such cases to the recollection of events which had happened in early infancy.

As an illustration of the weakness of this explanation, I quote an interesting case, on which great stress was laid in the article to which I refer: it is taken from Dr. Carpenter's valuable work on "Mental Physiology":—"Several years ago," he says, "the Rev. S. Hansard was doing clerical duty for a time at Hurstmonceaux, in Sussex; and while there, he one day went over with a party of friends to Pevensey Castle, which he did not remember to have ever previously visited. As he approached the gateway, he became conscious of a very vivid impression of having seen it before; and 'he seemed to himself to see,' *not only the gateway itself, but donkeys beneath the arch and people on the top of it.* His conviction that he must have visited the castle on some former occasion,—although he had neither the slightest remembrance of such a visit, nor any knowledge of having ever been in the neighbourhood previously to his residence at Hurstmonceaux,—made him inquire from his mother if she could throw any light on the matter. She at once informed him that being in that part of the country when he was about *eighteen months* old, she had gone over with a large party, and had taken him in the pannier of a donkey; that the elders of the party having brought lunch with them, had eaten it on the roof of the gateway where they would have been seen from below, whilst he had been left on the ground with the attendants and donkeys." "This case," adds Dr. Carpenter, "is remarkable for the vividness of the sensorial impression (it may be worth mentioning that Mr. Hansard has a decidedly artistic temperament) and for the reproduction of details which were not likely to have been brought up in conversation, even if he had happened to hear the visit itself mentioned as an event of his childhood, and of such mention he has no remembrance whatever."

Here is undoubtedly an interesting case of early recollection suggesting to a person in a particular place that he had been there before. In this case the remarkable gateway of Pevensey Castle recalled the time when the gateway had last been seen; but so far back was that time that no circumstances not immediately related to the aspect of the gateway were recalled, nor could the observer tell to what part of his past life his "recollection" had gone back, though he felt assured he had himself witnessed what he recalled. In other words the only "sentiment of pre-existence" in question was the familiar idea that he had existed for some time before. Beyond the early age to which Mr. Hansard's recollection went back, his remembrance of the gateway has no more scientific interest, and certainly has no more bearing on "the sentiment of pre-existence," than has young John's remembrance in the "Professor of the Breakfast Table" that he had often in his past life been occupied as he was at that moment,—to wit, smoking a cigar. As might be expected too, in every case of mere recollection, details not actually present when remembrance was brought back, came as vividly before Mr. Hansard as the gateway itself. He saw with his mind's eye *not* the scene before him but another scene: what has to be explained is the sudden and vivid perception that the very same sights and sounds seen and heard at the moment had been seen and heard before, as if in some previous state of existence.

Still less available is the dream theory which Dr. Carpenter himself seems to favour. He says that most persons, however unimaginative they may be, have noticed the reproduction of ideas which have previously only passed through the mind in dreams; "for," he goes on, "almost every one has had occasion, at some time or other, to say, 'Did this really happen or did I dream it?'" He cites a remarkable case of a lady known to him who seemed entirely unable to distinguish between her dreaming and waking experiences. But the "sentiment of pre-existence" is more precise than any mere dream recollections, and is always directly associated with some actual scene and with a series of events actually in progress when it is momentarily excited.

I will take as an illustration of this remarkable mental phenomenon the last occasion when it presented itself in my own experience:—

I was watching for the first time in my life one of those remarkable political processions with which Americans amuse themselves as the time for a presidential election draws near. Before me were passing a number of men and boys on horseback, bearing torches, and occasionally giving vent to that singular noise—something between a squeak and a catcall—which does duty in America for a hurrah. I was rather wearied with the noise and turmoil, and had ceased to pay attention to the proceedings. Suddenly a band of men forming what they call in America a "shot-gun brigade," came along, and as they passed my house (which my American kinsfolk, who have strong political sympathies, had illuminated), they fired several volleys, which roused me from my reverie. Suddenly it appeared to me that at some remote time—thousands of years ago—all that was then passing had been experienced before. The same procession in every detail had passed before me, lit up by the same glow from an illuminated house behind; my wife and children had at that remote time stood beside me as they stood beside me now. Persons whose acquaintance I had only made a few weeks before were there *then*—thousands of years ago—even as *now*: and stranger still, if the matter be thought of a little, I had had the same views about the events in progress and the persons standing by me, then as at the moment of time when this sentiment of pre-existence took possession of my mind.

No one who has ever seen an American procession, especially in the Far West, will for a moment imagine that I was deceived by the remembrance of some procession I had seen in England, for there is no resemblance—especially in the matter of that most objectionable "shot-gun brigade," at the thought of which my ears still tingle. Then I have seen no torchlight procession since I was a boy, and when I watched such a procession as a boy I had not, to the best of my recollection, an American lady—my wife—beside me, nor children of my own around me, nor assuredly was a boy of mine disporting himself, as on this occasion, with an American torch (quite unlike our English ones). Yet, again, I rather enjoyed the noise and confusion of the English procession, being but a boy myself, and therefore necessarily in the savage stage of existence. I certainly had not then the idea which filled my mind at the moment when "the sentiment of pre-existence" came upon me, that all such demonstrations—all waving of lights, and yelling of shouts, and beating of drums, and firing of guns—are fit only for people passing through the savage stage of their existence, whether as individuals or as a nation. Yet everything belonging to the scene before me, and everything belonging to my own conscious individuality at the moment, was presented as part of an experience belonging to an indefinitely remote past.

I know of no explanation of this sentiment of pre-existence which has the least semblance of fitness to account for the phenomena but that which Dr. Wigan has advanced. He notes first, what I believe is in the experience of all, that "the delusion occurs only when the mind has been exhausted by excitement, or is from indisposition or any other cause languid. The persuasion of the scene being a repetition, comes on when the attention has been roused by some accidental circumstance, and we become as the phrase is 'wide awake.'" "I believe the explanation to be this," he proceeds: "only one brain has been used in the immediately preceding part of the scene,—the other brain has been asleep, or in an analogous state nearly approaching it. When the attention of both brains is roused to the topic, there is the same vague consciousness that the ideas have passed through the mind before, which takes place on reperusing the page we had read while thinking on some other subject. The ideas *have* passed through the mind before, and as there was not sufficient consciousness to fix them in the memory without a renewal, we have no means of knowing the length of time that had elapsed between the *faint* impression received by the single brain, and the *distinct* impression received by the double brain. It may seem to have been many years." In my own case it invariably seems to exceed enormously the whole of my past life.

Dr. Wigan gives an example in his own experience which is akin in some respects to the one I have just cited, especially in being inconsistent with all explanations which have been advanced respecting this interesting mental phenomenon, and so far as I can see, with any conceivable explanation, other than that which regards the phenomenon as depending on the duality of the brain. He was present at the funeral of the Princess Charlotte, an occasion of so remarkable a kind (if we consider the circumstances attending that Princess's death, and the feelings excited by the event) that assuredly none will suppose he had ever had a similar experience:—"I had been standing four hours," he says, "and on taking my place by the side of the coffin, in St. George's Chapel, was only prevented from fainting by the interest of the scene. All that our truncated ceremonies could bestow of pomp was there, and the exquisite music produced a sort of hallucination. Suddenly, after the pathetic 'Miserere' of Mozart, the music ceased, and there was an absolute silence. The coffin, which was placed on a kind of altar covered with black cloth (united to the black cloth which covered the pavement), sank down so slowly through the floor, that it was only in measuring its progress by some brilliant object beyond it that any motion could be perceived. I had fallen into a sort of torpid reverie, when I was recalled to consciousness by a paroxysm of violent grief on the part of the bereaved husband, as his eye suddenly caught the coffin sinking into its black grave, formed by the inverted covering of the altar. In an instant I felt not merely an *impression*, but a *conviction*, that I had seen the whole scene before on some former occasion, and had heard even the very words addressed to myself by Sir George Naylor."

(*To be continued.*)

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

GEOLOGY OF CRICCIETH AND PWLLHELI (*continued*).

III.

THE CAMBRIAN FORMATION.—Strata of Cambrian age—the first rocks which yield us evidences of life in the form of fossils—occur in the east and in the west of our district. In the west of Carnarvonshire the lowest Cambrian beds there exposed—the Lingula Flags—form the promontory which extends southward of Abersoch and Llanengan. Taking the mail-car from Pwllheli to the former village, we walk across the sandhills which fringe the beach to the rounded moorland ridge of Penrhyn-ddu, where St. Tudwal's twin isles lie at our feet, their rocks being an extension of those of the mainland. Walking southwards along the precipitous cliffs, the little bay of Porth-Ceiriad is soon reached. Here the Lingula Flags* form magnificent cliffs 350 ft. in height, the rocks dipping to the east at an angle of 45 deg.; in the middle of the bay they have been eroded down to the sea level, and the hollow so formed is filled by a great mass of boulder clay rising perpendicularly 80 ft. or 100 ft. above the shore (Fig. 1).

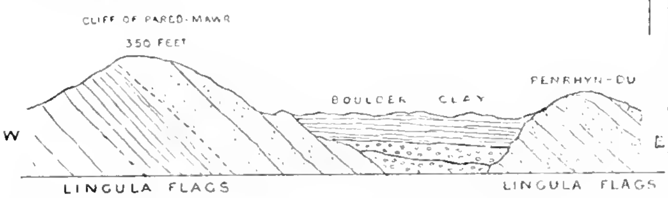


Fig. 1.—Section in Bay of Porth-Ceiriad. Lingula Flags form cliffs on the east and on the west; the hollow between being filled up by glacial deposits.

The stratified Cambrian rocks here consist of hard micaceous sandstones (ripple-marked and showing worm-tracks on the surfaces) with dark-grey and black slabs. Similar beds extend westwards as far as the broad bay called "Hell's Mouth," whose low shore is marked by a little cliff of boulder-clay and fringed by green fields which, smiling in the summer-sun, belie the ominous name. But woe to the sailing-vessel which gets becalmed between its two projecting headlands! Strong currents set towards the beach, and the projecting ribs and timbers of wrecked ships mark their fatal effect. A little girl, who acted as my guide, told me that sealed bottles which had been thrown overboard from ships in peril were not uncommonly found on the shore of Hell's Mouth, and I saw in a cottage a number of West Indian seeds picked up there. In the absence of fossils, the hard grits and shales—1,200 feet in thickness—which we have just described, were long considered to belong to the *Harlech Series*, which lies at or near the base of the Cambrian formation. But, in 1876, Professor Ramsay found specimens of the trilobites *Agnostus* and *Olenus*, with the little brachiopod shell *Lingulella lepis* in roadside quarries near Porth-Ceiriad; and as these fossils are peculiar to the Lingula Flags, this fortunate discovery at once settled the question of the true age of the strata.

Passing now to the north-east from Abersoch, through Pwllheli, it is a distance of fifteen miles before we reach the Lingula Flags, in the east of our district, where they mantle round the hill called Moel-y-gest, whose profile is a gigantic Wellington *silhouette*. Here the whitish flaggy sandstones form successive step-like terraces at the western foot of the hill, whence they run down to the coast at Ogof-ddu, about a mile east of Criccieth. Their thickness here is above 2,000 ft., forming a dome-shaped mass, of which the northern half only is visible. The sandy beds are surmounted by black slates, and there are black slates underneath them also, in which the caves at Y-graig-ddu—the Black Rock—have been hollowed out. Fossils are numerous, but not easy to find or to extract; the best localities are Ogof-ddu, Penmorfa Church, Carreg-wen, and Borth (south-west of Portmadoc).

* This name is derived from the abundance of the brachiopod shell *Lingula* (now *Lingulella*) Davisii, discovered by Mr. Davis in 1845.

The *Tremadoc Slates* lie above the Lingula Flags, between Portmadoc and Criccieth, but they decrease in thickness from 3,000 ft. near the former, to 200 ft. near the latter, town, and they probably die out altogether further west, for there is no trace of them above the Lingula Flags south of Abersoch. They derive their name from the pretty little town of Tremadoc—which, in its turn, was christened after its founder, a Mr. Madocks, who flourished as a notable land-reclaimer in this region, at the close of the last century.

It is not possible for me to leave the Cambrian beds of Carnarvonshire without acknowledging the great services rendered in the study of these rocks by Messrs. David Homfray and Ash, of Portmadoc, to the former of whom I am personally indebted for guidance and information. The late Mr. Salter did some of his best work down here, about 1860; but the main relations of the different beds had been ascertained by Sedgwick some ten years previously.

Lower Silurian Formation.—The junction of the great Cambrian and Silurian formation is marked by a bed of grit, well seen at Garth Hill, near Portmadoc, but only 10 feet thick where it runs out to sea at Ogof-ddu, east of Criccieth. This grit forms the base of the *Arenig Group*, which consists mainly of iron-stained black slates, containing beds of pisolitic iron ore and a large collection of fossils—the *graptolites* being especially numerous and noteworthy. Arenig Rocks also occur in the western tract, between Abersoch and Llanengan. Here they dip northwards, and are separated from the Lingula Flags beneath by a line of fault, whose direction, east and west, can be clearly traced by the line of chimneys marking the numerous lead-mines; for the "fault" has been filled up with (among other things) much galena (sulphide of lead) deposited by the heated water which traversed the line of weakness, resulting from the severance of the rocks. The rubbish heaps and heaps of picked ore surrounding the mouths of the shafts of the lead-mines form a fine collecting-ground for the mineralogist. The pisolitic iron-ore, by which the Arenig strata can be best recognised in this western portion of Carnarvonshire, is only known to occur at one other place in Lleyn, viz., at Trwyn-y-tâl, on the coast, about a mile north-west of Yr Eifl.

If it be asked why the line of demarcation between two great geological series is drawn at the base of the Arenig Beds, the answer is to be found in the great change which there takes place in the *fossils*—the remains by which we judge of the life of the period. No fewer than fifty-five new genera of animals make their first appearance in the Arenig Beds, including the remarkable fossils called graptolites, which Prof. Lapworth has shown to be so useful as marking by distinct species distinct beds of rock, and so enabling us to identify the order of succession among strata which may be hundreds of miles apart.

The Arenig Beds are also interesting, because they tell us of the volcanic action on a grand scale which took place during the time of their deposition. In the Arenig Mountains, the Arans, Cader Idris, and elsewhere, we find the Arenig slates interbedded with enormous masses of old lava and beds of volcanic ashes. In the district we are now describing, a bed of igneous rock of this age forms the top of Moel-y-gest, and constitutes the grand precipices north of that hill between Tremadoc and Brynkir (Fig. 3). On the Survey Map it is styled *greenstone*, a name which now means nothing save that *some* igneous rock is meant. Modern petrologists would call the Moel-y-gest rock an ancient basalt.

(To be continued.)

DREAMS:

THEIR PLACE IN THE GROWTH OF PRIMITIVE BELIEFS.

By Edward Clodd.

CONCLUSION.

Reference has now to be made to the part played by dreams as supposed channels of communication between heaven and earth; as portents, omens, &c. The common belief among the nations of antiquity that they were sent by the gods, and the like belief lurking in the minds of the superstitious to this day, are the scarcely-altered survivals of barbaric confusion respecting them.

When man had advanced from the earlier stages of undefined wonder and bewilderment concerning the powers around and above him to anthropomorphic conceptions of them, *i.e.*, to making them in his own image, the events of his dreams were striking confirmation of his notions about the constant intervention of spiritual beings, gods, chiefs, and ancestors, in the affairs of life. That personal life and will with which the rude intelligence invests the objects of its awe; waving trees, swirling waters, drifting clouds, whirling winds, stately march of sun and star, seemed especially manifest in dreams and visions. In their unrelated and bewildering, or, on the other hand, their surpassingly clear incidents, the powers indwelling in all things seemed to come nearer than in the less sensational occurrences of the day, uttering their monitions, or making known their will. They were the media by which this and that thing was commanded or forbidden, or by which guidance and counsel and knowledge of the future were given. To induce them, therefore, became a constant effort. The discovery that fasting is a certain method of procuring them is one reason of its prevalence in the lower culture. Amongst all the indigenous races of North America abstinence has been practised as a chief means of securing supernatural inspiration. It is believed that whatever is seen in the first dream thus produced by fasting becomes the manitou, or guardian spirit of life, corresponding to the "daimon" of Socrates. And whoever by much fasting is favoured with dreams, and cultivates the art of explaining them as bearing on the future, becomes the feared and consulted "Medicine Man" of his tribe. His *kee-kée-wins*, or records, are finally shown to the old people, who meet together an consult upon them. They in the end give their approval, and declare that he is gifted as a prophet, is inspired with wisdom, and is fit to lead in the councils of the people.*

Very slender data were needed for the conclusions first drawn from dreams; let the death of a friend or foe be the incident and the event happen; let a hunting-path fill the half-torpid fancy and a day's fasting follow; let the mother of a young sportsman dream that she saw a bear in a certain place, and the son, guided by her account, find the bear where indicated, and kill it, the arbitrary relation is set up forthwith. As Lord Bacon says, "Men mark the hits, but not the misses," and a thousand dreams unfulfilled count as nothing against one dream fulfilled. Out of that is shaped, as dream-lore shows, a canon of interpretation by which whole races will explain their dreams, never staying, when experience happens to confirm it, to wonder that the correspondences are not more frequent than they are. Where the arbitrary act was wrought, the isolated or conflicting influences manifest, there deity or demon was working. So the passage from the crude interpretation of his dreams by the barbarian to the formal elaboration of the dream-oracle is obvious. It was only one of many modes by which the gods were thought to hold converse with man, and by which their will was divined. It was one phase of that many-sided belief in power for good or evil inhering in everything, and which led man to see omens in the common events of life, in births, in the objects anyone met in a journey or saw in the sky; to divine the future by numbers, by the lines in the hand, by the song and flight of birds (lurking in the word *augury*), by the entrails of sacrificed men and animals.* Sometimes the god sends the message through a spiritual being, an angel (literally "messenger"); sometimes he, himself, speaks in vision, but more often through the symbolism of both familiar and unfamiliar things. To interpret this is a serious science, and skill and shrewdness applied therein with success were passports to high place and royal favour. In this, we have the familiar illustrations of Joseph and Daniel, and, indeed, we need not travel beyond the covers of the Old and New Testaments for abundant and varied examples of the importance attached to dreams and visions, and of the place accorded to dreams,† an importance undiminished until we come to the literature of the centuries just before Christ. For example, in the Book of Jesus the Son of Sirac, we read—

> Vain and deceitful hopes befit the senseless man,
> And dreams make fools rejoice.
> Like one who grasps at a shadow and chases the wind,
> Is he who puts trust in dreams.‡

In the belief that through dreams and oracles Yahweh made known his will, the influence of older beliefs and their literature is apparent. Among the Accadians, a pre-Semitic race in Babylonia, there existed a mass of treatises on magic and divination by dreams and visions, and both from this and from Egyptian sources, blended with survivals from their barbaric past, the Hebrews largely drew.

In this, too, "there is nothing new under the sun." Homer, painting the vividness and agonising incompleteness of the passing visions, affirms that dreams from Jove proceed, although sometimes to deceive men; Plato assigns prophetic character to the images seen in them; Aristotle sees a divination concerning some things in dreams which is not incredible; the answer to oracles was sought in them, as when the worshipper slept in a temple on the skin of a sacrificed ram, and learned his destiny through the dream that came. The Stoics argued that if the gods love and care for men and are all-knowing, they will tell their purposes to men in sleep. Cicero attaches high importance to the faculty of interpreting them: their phenomena, like those of oracles and predictions should, he contends, be explained just as the grammarians and the commentators explain the poets.

With the influence of these beliefs in the air, and with the legend-visions of Scripture as authority, the divine origin of dreams became a doctrine of the Christian Church. Tertullian says that "we receive dreams from God, there being no man so foolish as never to have known any dreams come true," and in his *De Anima* reference is made to a host of writers of dream treatises. For the most part they are but names; their treatises have perished, but enough

* The following Mohammedan recipe for summoning spirits is given in Kunzinger's "Upper Egypt." "Fast seven days in a lonely place, and take incense with you, such as benzoin, aloes-wood, mastic, and odoriferous wood from Soudan, and read the chapter 1,001 times (from the Koran) in the seven days—a certain number of readings, namely, for every day one of the five daily prayers. That is the secret, and you will see indescribable wonders: drums will be beaten beside you, and flags hoisted over your head, and you will see spirits full of light and of beautiful and benign aspect."

* In Roger's *Thesaurus*, Sect. 511, a curious and instructive list of terms expressive of the different forms of divination is given.

† Numbers xii. 6; I. Samuel xxviii. 6, 15, &c.

‡ Ch. xxxiv.

remains for the perusal of the curious regarding ancient rules of interpretation and the particular significance of certain dreams. The current views of dreams in classic antiquity are believed to be partly embodied in the 'Ονειροκριτικά' of Artemidorus of Ephesus, who flourished about the middle of the second century, and who reduces dream interpretation to a body of elaborate rules, while amongst Christian writers Synesius of Cyrene, who lived two centuries later, holds a corresponding place.

Both classic and patristic writers supply copious details concerning the classes into which dreams were divided, and which have some curious correspondences among the Oriental nations, as well as in our dream-lore: *e.g.*, when Artemidorus says that he who dreams he hath lost a tooth shall lose a friend, we may compare with this a quotation which Brand gives from the "Sapho and Phao" of Lily, a playwright of the time of Elizabeth. "Dreams have their trueth. Dreams are but dotings, which come either by things we see in the day or meates that we eat, and so the common-sense preferring it to be the imaginative. 'I dreamed,' says Ismena, 'mine eyetooth was loose, and that I thrust it out with my tongue.' 'It foretelleth,' replies Mileta, 'the loss of a friend; and I ever thought thee so full of prattle that thou wouldst thrust out the best friend with thy tatling.'"

It is, however, needless to quote from Artemidorus and others of their kin. They do but furnish samples of the ingenuity applied to profitless speculations on matters which were fundamental then, and around which the mind played unchecked and unchallenged. Moreover, the subtle distinctions made between dreams in former times were slowly effaced, or sank to their proper level in the gossip of chap books—our European *kee-kee-wins*. But the belief in the dream as having a serious meaning, and in the spectral appearances in visions as real existences, remained as strong as in any barbarian or pagan. In an atmosphere charged with the supernatural, apparitions and the like were matters of course, the particular form of the illusion to which the senses testified being in harmony with the ideas of the age. The devil does not appear to Greek or Roman, but he sorely troubled the saints, unless their nerves were, like Luther's, strong enough to overmaster him. Luther speaks of him as coming into his cell, and making a great noise behind the stove, and of his walking in the cloister above his cell at night; "but as I knew it was the devil," he says, "I paid no attention to him, and went to sleep." Sceptics now and again arose protesting against the current belief, but they were as a voice crying in the desert. One Henry Cornelius Agrippa, in the fifteenth century, a man born out of due time, says, "To this delusion not a few great philosophers have given not a little credit, especially Democritus, Aristotle, Sinesius, &c., so far building on examples of dreams, which some accident hath made to be true, that thence they endeavour to persuade men that there are no dreams but what are real."

His words have not yet lost their purport. For the credulity of man, the persistence with which he clings to the shadow of the supernatural after having surrendered the substance, seem almost a constant quantity, varying only in form. Unteachable by experience, fools still pay their guineas to mediums to rap out inane messages from the departed, and send postage stamps to the Astronomer Royal, asking him to "work the planets" for them, and secure them luck in love and law-suits. Nor is there any cure for this but in wise culture of the mind, wise correction, and wholesome control of the emotions. By faithfully intending the mind to the realities of nature, as Bacon has it, and by living and working among men in a healthy, sympathetic way, exaggeration of a particular line of thought or feeling is prevented, and the balance of the faculties best preserved. For, adds Dr. Maudsley,* in pregnant and well-chosen words, "there are not two worlds—a world of nature and a world of human nature—standing over against one another in a sort of antagonism, but one world of nature, in the orderly evolution of which human nature has its subordinate part. Delusions and hallucinations may be described as discordant notes in the grand harmony. It should, then, be every man's steadfast aim, as a part of nature—his patient work—to cultivate such entire sincerity of relations with it; so to think, feel, and act always in intimate unison with it; to be so completely one with it in life, that when the summons comes to surrender his mortal part to absorption into it, he does so, not fearfully, as to an enemy who has vanquished him, but trustfully, as to a mother who, when the day's task is done, bids him lie down to sleep."

NOTE.—The papers now concluded, as also the former series on the "Birth and Growth of Myth," will, with the Editor's permission, and after revision and additions, be shortly published in one volume under the title of "Myths and Dreams." The series of papers on "Evolution" already announced will, it is hoped, be commenced at an early date.

DICKENS'S STORY LEFT HALF TOLD.

NOW that Mr. Foster has explained his theory at length, I should like to reply, as briefly as possible, to some of his arguments.

In my former letter (1343) I quoted from the *Century Magazine*, to show that Mr. Fildes' opinion was that Jasper murdered Edwin Drood. The following extract is taken from Forster's "Life of Dickens," which I have not till lately read, viz.:—

"The story, I learnt immediately afterward, was to be that of the murder of a nephew by his uncle; the originality of which was to consist in the review of the murderer's career by himself at the close, when its temptations were to be dwelt upon as if not he the culprit, but some other man, were the tempted. The last chapters were to be written in the condemned cell, to which his wickedness, all elaborately elicited from him as if told by another, had brought him. Discovery by the murderer of the utter needlessness of the murder for its object, was to follow hard upon commission of the deed; but all discovery of the murderer was to be baffled till towards the close, when by means of a gold ring which had resisted the corrosive effects of the lime into which he had thrown the body, not only the person murdered was to be identified, but the locality of the crime and the man who committed it. So much was told to me before any of the book was written; and it will be recollected that the ring taken by Drood to be given to his betrothed only if their engagement went on, was brought away with him from their last interview. Rosa was to marry Tartar, and Crisparkle the sister of Landless, who was himself, I think, to have perished in assisting Tartar finally to unmask and seize the murderer."

This in the main agrees with my article in the *Cornhill*, which was *solely* based on internal evidence.

Forster adds that Dickens had a "fear that he might have plunged too soon into the incidents leading on to the catastrophe, such as the Datchery assumption in the fifth number (a misgiving he had certainly expressed to his sister-in-law)." Forster mentions this without giving the

* *Fortnightly Review*, Sept., 1878, p. 386.

slightest hint of Dickens having remodelled his idea since explaining it *in confidence* to himself. Had Datchery been Edwin Drood in disguise, would not Forster (speaking as he does here) have told how it was that Dickens had altered his original design?

Which idea would an unprejudiced reader think the more worthy of belief—that put forward by Mr. Foster, or that supported by the testimony of Dickens's dearest friend, and by Mr. Fildes, the illustrator of "Edwin Drood," to say nothing of the evidence contained in the tale itself?

However, it is only fair to examine some of Mr. Foster's arguments, since it is impossible to examine all in the course of a necessarily short letter. He quotes the heading of a chapter, viz., "When will these three meet again?" and adds, "showing clearly that Neville, Drood, and Jasper were to meet again." Where did Mr. Foster learn logic?

He insists that the tone taken by Grewgious towards Jasper, at their meeting after Edwin's disappearance, admits of but one interpretation, which of course is his own. But what was there to prevent Grewgious being present when Neville was first brought back to Cloisterham? If he did so see him, he might draw his own conclusions from Neville's demeanour whether he was innocent or not. And if he concluded Neville to be innocent, on whom should his suspicion fall but on Jasper, whose affection for his nephew is certainly overdone? The very fact that Grewgious did *not* call on Jasper directly, and that, when he *did* call, his behaviour was almost brutal, admit of the interpretation that in the interval he had learnt all that Rosa and Neville could tell him, and had formed an opinion which he kept to himself for the present.

Mr. Foster has evidently a great belief in human credibility. He asks us to believe that Edwin is first of all drugged by Jasper (an expert in the art); then half-strangled by the thick black scarf; then thrown from the top of the tower (albeit something conveniently breaks his fall on the way); then placed in quicklime; and finally locked up in the tomb in which the lime has been arranged. Yet in spite of all this he asks us to believe that Edwin (still half-strangled by the scarf) is able to shout loudly enough to be heard and rescued by the drunken Durdles!

Is all this meant seriously, or is Mr. Foster laughing at us? Why, cats with their nine lives are nothing to *his* Edwin's one!

Again, what would Jasper's motive be in throwing Edwin from the top of the great tower? Mark the *great!* A body falling from such a height would to a certainty be more or less mangled, and blood might be expected to remain upon the ground, if nowhere else; while Jasper in the darkness would have no means of effacing any such fatal traces. Supposing Mr. Foster's theory to be correct, is it credible that a man like Jasper should run the risk of leaving such tell-tale witnesses upon the scene? Why not strangle Edwin near the tomb, especially as he may be supposed to have been drugged to make him less capable of offering resistance?

"We may suppose that Durdles dragged the body out of the tomb and out of the crypt." So says Mr. Foster, who has here convicted himself. He has before said that Edwin's body was placed by Jasper in Mrs. Sapsea's tomb. Now, had he read the book as one would expect such an appreciator of Dickens's prose poetry to read it, he would have noticed that Mrs. Sapsea's tomb was *not* in the crypt, but in the churchyard; as is shown in two different passages of the book. This error has, of course, led Mr. Foster into others, especially in the concluding papers.

Full half a year after Edwin's disappearance, Datchery is introduced, and Mr. Foster invites—nay, bullies us to believe, that Datchery is Edwin disguised. Disguised! but is it possible that in less than a year Edwin could have changed so much that Jasper, the Topes, *and others* should fail to recognise him? To completely disguise face, and eyes, and voice, after so short an interval, would not be easy; and Datchery speaks in Jasper's presence.

When Datchery meets with the opium woman, and "reddens" as he stoops to pick up the money he has purposely dropped, he reddens when she mentions the name Edwin. From this, Mr. Foster deduces that Datchery and Edwin are one and the same person. But were it so, the woman's former words (before this mention of Edwin's name) alone would have enabled him to identify her with the woman he had befriended on that Christmas Eve; and therefore Datchery's reddening *with surprise* at the name Edwin seems to me to be the result of his suddenly obtaining a clue to the mystery. The scene, to my mind, helps to prove that Datchery is *not* Edwin.

There are two or three questions that may fairly be asked of Mr. Foster, viz.:—

Would Durdles be able to keep so momentous a secret as that of having rescued a man who was locked in a tomb and nearly covered with quicklime? He could scarcely have been so drunk as to *forget*, for he was sober enough to effect the rescue; and drunken men are scarcely the ones to keep secrets. Would Deputy hold his tongue—especially if a reward for information were offered?

How high is "the great tower"?

And, hardest question of all to answer satisfactorily—How could Edwin in common fairness (if alive) have permitted Neville Landless to bear for six months and more the terrible suspicion of being his murderer? Also, would not the reappearance of Edwin be somewhat of an anti-climax, a mistake just as the bringing to life again of Athelstane in "Ivanhoe" is felt to be a mistake?

Mr. Foster's conclusion does not add much to be commented on. Grewgious's conduct about the missing ring admits of another interpretation to that there put on it. Knowing that Edwin had the ring, he waits to see if by it Edwin's body may yet be found and identified. Jasper, he argued apparently, did not know of the ring; and to find the ring is to solve the mystery; therefore, he is for awhile silent about it. In Mr. Foster's account of Jasper's re-opening the tomb, he again places it in the crypt, which I have pointed out to be wrong; hence the idea of the flight up the staircase is at any rate incorrectly introduced.

The illustrations are certainly important evidence; but I fail to see that the figure in the tomb *must* be Edwin. The retribution would be terrible enough were it Neville or anyone else, for Jasper, in horrified surprise, could but conclude it to be his victim brought to life to condemn him.

Mr. Foster might write column on column to support his theory; but when coolly and impartially viewed, I cannot see how it can be pronounced to be more than a highly ingenious but highly unsatisfactory attempt to graft upon the facts as told by Dickens a conclusion as imagined by himself.

H. L.

OPTICAL RECREATIONS.

By A Fellow of the Royal Astronomical Society.

(*Continued from p. 280.*)

We concluded our last article on pp. 278 *et seq.* with some account of the optical effects produced by the persistence of vision for a very short time after the image of the object viewed actually ceases to fall on the retina. We propose to-day to describe a very interesting

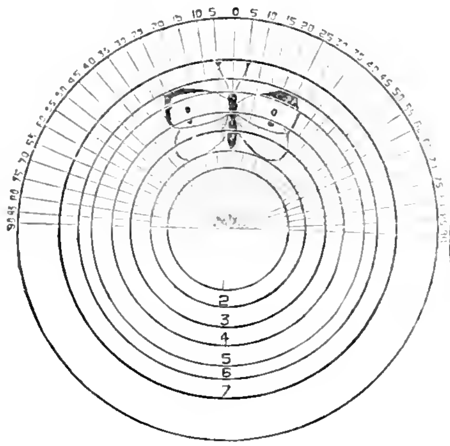


Fig. 31.

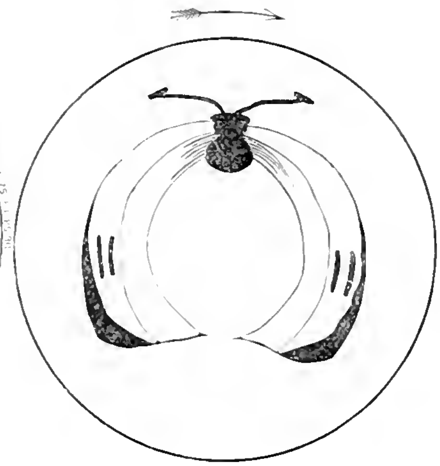


Fig. 32.

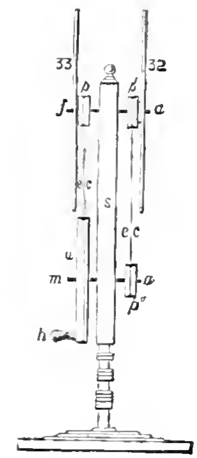


Fig. 34.

illusion referable to some extent to this property of retention which the eye possesses, and to instruct the student how to construct the necessary apparatus for exhibiting it. The toy—if it be a toy, and not rather a refined philosophical instrument—was brought out a good many years ago, under the name of the Anorthoscope, from two Greek words signifying to set the vision right. That it is very appropriately named the reader will immediately see. It seems hard to understand why it has so utterly fallen into oblivion. As our object here is rather to provide the student with striking and amusing illustrative experiments than to enter into expositions of recondite optical laws, we will proceed to our description at once. If, then, a figure, distorted according to principles immediately to be explained, is delineated on a disc, and this disc turned round, while a black disc with four radial slots is caused to rotate four times as fast, and in an opposite direction in front of it, the spectator will see five stationary images of this distorted figure, but restored to its natural proportions!

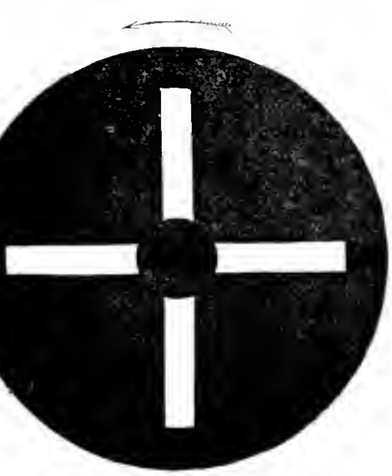


Fig. 33.

First, then, to draw the figure, which we will suppose, for the sake of illustration, to be a butterfly. We begin by striking two circles (Figs. 31 and 32), dividing them by radial lines at any convenient distance. In Fig. 31, such division is made at every 5°. Only half the circle, or 180°, is so divided in our figure; but Fig. 32 was similarly divided right round the circle for a reason which will be immediately obvious. We also strike a series of circles interior to our larger one to fix certain points in our drawing. Very well; in our first divided circle (Fig. 31) we now proceed to draw the best butterfly we can, and, having finished it, note with the greatest care where the different points of the figure fall. In copying it, we must be careful to preserve the radial length or central distance of each part with the utmost accuracy, *but we must expand it laterally to five times its original angular dimensions.* For example, the tips of the butterfly's antennæ are each in circle 7, and the lines marking 5° on each side of the median one. Hence, we must put the same tips in Fig. 32, still in circle 7, but on the lines marking 25° (*i.e.*, 5 × 5°). The upper corners of the wings fall on circle 6, and on the lines marking 25°. The corresponding points in Fig. 32 are, of course, as before, on circle 6, but on the 125° (or 5 × 25°) lines; and so with the markings and other leading features.

It now only remains to join the points thus obtained, rub out our division lines, and we have Fig. 32. Fig. 33 shows the disc of black cardboard with four radial slots, which is to rotate before the diagram which we have just produced, and Fig. 34 represents in section the apparatus by the aid of which the necessary motion is given to them both. Here S is a stout, square, wooden stem on a stand, through which pass two axes—*f*, *a*, a fixed axis, and *m*, *a*, an axis moving with the wheel upon it. On the fixed axis rotate two pulleys (or grooved wheels) *p p'*, obviously independently of each other. A third pulley *p''* is immovably attached to the axis *m*, *a*, so as to turn with it. These three pulleys are all of precisely the same diameter. The wheel *w*, also fixed to the axis *m a*, is four times the diameter of *p*, *p'*, *p''*. Hence it will be seen that if endless cords *e c*, *e'*, *c'*, go round *p'*, *p''* and *w*, *p* respectively, *p* will rotate four times as fast as *p'*. It will be noted that the cord *e' c'* is crossed in order that *p* may turn in an opposite direction to *p'* also. Finally we attach our black disc with the radial slots, 33, to *p* and our distorted figure (32) to *p'*, light the latter well, turn the handle *h*, and look through the slots. The spectator who sees the five stationary butterflies for the first time, will, we venture to think, hardly do so without an exclamation of astonishment. Of course, any figure whatever may be distorted on the same principle.

It is stated that the entire number of the cases of cholera, and of the deaths from it, at Naples has now been computed. In the city of Naples there were 12,402 cases and 6,629 deaths. In the whole of the province of Naples there were 14,037 cases, and 7,576 deaths.

ELECTRO-PLATING.

By W. Slingo.

XIV.—PREPARING THE OBJECTS.

In the practice of electro-plating, one of the first necessities is to ensure that the surface of the object to be plated is clean, and this not in the ordinary acceptation of the term, but as a chemist understands it—that is to say, the surface must be free from particles of foreign matter of all kinds. The smallest particle of grease or dirt adhering to the object is quite sufficient to spoil the deposit, for wherever that particle happens to be the deposit will be little or nothing.

There is, perhaps, no species of work which calls so imperatively for absolute cleanliness. The touch of a finger, unless the skin be covered with some preventible material, is sure to leave a very distinct impression; and, even when the surface of the object is chemically pure, there is some danger of the deposit only partially adhering in consequence of the intervention of a film of air between the object and the solution. The film of air which associates itself, more or less, with every object exposed to it, must, therefore, be carefully and completely removed; but of this a word will have to be said presently. Then, again, there are some metals which are so easily oxidised that a brief exposure to the air of the clean surface is sufficient to cause it to be coated with a thin film of oxide, and oxides are more or less non-conductors of electricity.

The metals which are most likely to be called into requisition for planting purposes are iron, lead, tin, copper, brass, Britannia metal, and German silver.

Iron is a metal which has generally a somewhat extensive supply of superficial impurities, to remove which it may be placed in a weak acid solution consisting of 1 oz. of hydrochloric acid, and 1 oz. of sulphuric acid to the gallon of water. After remaining in this solution for some little time it may be removed and the surface rubbed with a wet brush and a little sand. If this fails to cleanse the surface, the iron must be re-immersed, and the rubbing operation repeated until a clean metallic surface is produced.

Sometimes emery-cloth will be sufficient to remove the dirt; but the wet process is, perhaps, preferable, and has the advantage of leaving a smoother surface, unless, indeed, the degree of rust or oxidation is very variable—deep in some places and very thin in others—when special means must be resorted to in order to procure a level surface. It must be borne in mind that the ultimate coating will present a surface the very counterpart of that upon which it is deposited, and that, therefore, it is necessary that the surface of the object should be freed from all "foreign" or undesirable irregularities, including file-marks, hammer-marks, &c. The acid solution is very efficacious for the removal of oxides of the metals, but must not be relied upon for the removal of grease-spots, unless they are very small, and likely to be so far under-eaten as to ensure their being removed by the sand and brush. When a quantity of grease is present, it may be removed by immersing the object in a solution of caustic soda, which will effectually dissolve away the troublesome fats. This should be done prior to immersing the iron in the acid solution. The object having been subjected to these cleansing processes, is then well washed with clean water, and immersed in the electrolytic bath.

It is to be noticed, however, that a silver coating deposited direct upon iron is generally very unsatisfactory, and likely to strip off. To prevent this, a thin layer of copper is interposed. As, however, iron would be dissolved in a sulphate of copper solution, the copper is best deposited in a cyanide of copper solution of which there are several, one of them being mentioned in a previous article. Another one is very easily prepared by adding to a solution of sulphate of copper a solution of cyanide of potassium, adding it gradually until the whole of the copper is thrown down as a greenish precipitate of cyanide of copper. After allowing this precipitate to settle, the supernatant sulphate of potassium solution is carefully poured off, and the cyanide of copper washed several times with clean water, thus effectually removing any trace of the acid solution that might otherwise have clung to the precipitated cyanide, and subsequently caused some little trouble by dissolving a portion of the iron. The precipitate has then poured over it a solution of cyanide of potassium, until the whole of it is again dissolved. In this, as it is not a solvent for iron, the ferruginous object may be placed and connected with the negative pole of a battery, the positive pole of which is connected with a sheet of copper placed in the same bath as the iron. In a short time a sufficiently thick coating of copper will be deposited, when the object may be removed, and, after being well rinsed, placed in the silver-plating bath.

Zinc may be treated in a similar way, except that the hydrocholoric acid may be omitted from the acid solution, or the action will probably be too energetic for the purpose.

Tin, lead, and Britannia metal should not be placed in the acid solution, but should be immersed in the caustic-soda solution, by which process oxides of the metals, as well as superficial grease spots, &c., are removed.

On being withdrawn from the caustic-soda solution, such articles should be transferred to the depositing-bath without being subjected to the washing process. When very dirty, it is advisable to rub them first with silver-sand and water, applied with a tolerably stiff brush. The deposition of a preliminary or intermediate coating of copper is almost as advantageous in the case of lead or tin objects as it is in the case of iron. When this method is adopted, it is necessary to prepare the surface of the copper-film by slightly burnishing it, and then well rinsing it in clean water. A high degree of finish to the burnishing is, however, rather advantageous than otherwise, as it is likely to render the deposit of silver more or less non-adherent. The necessary condition of the surface is best produced by means of a "scratch-brush," which consists of a number of bundles of fine brass wire fixed round the edge of a flat wooden disc. This brush is placed as a chuck on a lathe and made to revolve rapidly, the metal to be brushed being pressed against the wires, while a small barrel or other vessel containing a quantity of stale beer is fixed above the brush and provided with a tap through which the beer is allowed to run on to the object. It is not, however, necessary that a lathe should be called into requisition for this purpose There are any number of simple devices possible for attaining the object quite as efficiently as could be done with a lathe. Perhaps the simplest method is to attach a small pulley-wheel to the side of the scratch-brush, and then, mounting them on a smooth metal spindle, connect the pulley wheel by means of a gut or other band with a considerably larger wheel, similarly mounted, at a short distance from, but in the same plane as the smaller wheel. Very good results may be obtained with apparatus of this kind. The scratch-brush is a tool which is best purchased, and which is not very expensive.

German silver, if dirty or greasy, is first washed in a solution of caustic soda, and then well rinsed. After this it is treated with powdered bath-brick applied with a hard brush, the fingers holding the object being well provided with a quantity of the powder to prevent their impression being left on the article to the detriment of the silver surface to be presently provided. When the surface is extensive, it is very desirable that, in applying the bath-brick, it should be worked as evenly as possible. It is a good practice to finish cleansing by rubbing the surface with a piece of damp chamois leather, provided with some finely-powdered bath-brick, the fingers being moved in circles. In this way a tolerably smooth surface may be imparted. When the bath-brick process is finished, the object is thoroughly washed with clean water. Superficial impurities may be removed by brief immersion in a solution composed of equal quantities of sulphuric acid and water, with a little nitric acid added. Verdigris is removed by the application of a little hydrochloric acid.

AMERICAN FOREST FIRES.

THIS is the season for forest fires, and in many parts of the country we hear of great destruction already from burnt fields and forests. The New Bedford *Evening Standard*, in an article on the subject, says:—Few people realise how serious a calamity these fires have become. Already in the most thickly-settled parts of the country good working wood is becoming scarce and high, although there is often a glut of inferior grades, and therefore very low prices for them. The correspondents of the lumber journals report from almost all quarters that the demand for really good material is generally in excess of the supply. The only hope for the future lies in economy of what we have, and in whatever will encourage those owning young timber to keep it and prune it, and thin it out so as to bring it on to fill up the gap. But forest fires destroy an amazing amount of the precious mature stock—how much no one knows—but it is said by experts that the amount destroyed probably equals the amount cut. Now, we know that the sawed stuff (to say nothing of fuel and charcoal, ties, telegraph, and hop poles, &c.) reaches an annual value of over 230,000,000 dols. at the mills, so that, counting other forest products besides sawed stuff thus destroyed, it is, no doubt, within reason to say this waste, largely needless, is not less than 300,000,000 dols. a year. But this is not all, and very likely it is not the worst. Such fires burn up a great amount of young growth and of seed, and in some cases even the soil itself is roasted to death, so that for a long time afterward it will not bear anything of value.

MR. SWAN states that he has obtained 5,800 hours as the life of an incandescent lamp, and large numbers of the Swan lamps are said to have reached 4,000 hours.

WE hear that a Working Man's Club and Institute is to be established in connection with the Royal Victoria Coffee Hall. It will be supported by the subscriptions of the members (minimum 1s. per quarter), and the donations of those who are interested in the movement. Mr. Robert W. Bowers, of 89, Blackfriars-road, will furnish any information needed by those who may wish to co-operate in so praiseworthy an object.

A CHURCH BUILT FROM A SINGLE TREE.—A redwood tree, cut in this county, furnishes all the timber for the Baptist church in Santa Rosa, one of the largest church edifices in the country. The interior of the building is finished in wood, there being no plastered wall. Sixty thousand shingles were made from the tree after enough was taken for the church. Another redwood tree, cut near Murphy's Mill, in this county, about ten years ago, furnished shingles that required the constant labour of two industrious men for two years before the tree was used up. The above statements are vouched for as true by Supervisor T. J. Proctor.—*Santa Rosa (Cal.) Republican.*

A TOTAL LUNAR ECLIPSE.

By RICHARD A. PROCTOR.

THE recent total eclipse of the moon presented phenomena of considerable interest; and as usual with lunar eclipses was made the subject of comments indicating considerable misapprehension of the real circumstances of such eclipses. So much more interest attaches to total solar eclipses, that most of their phenomena are pretty fairly understood; but with lunar eclipses the case is different. Thus in the case of the recent eclipse, even the account given in the *Times* of Oct. 6, though obviously written by official astronomers at Greenwich, contained errors in regard to the physical phenomena of the eclipse. It assigned as a reason for the darkness of the moon during totality the (presumed) freedom of the earth's atmosphere from vapour, which would indeed have explained the absence of ruddiness, but would have left the darkness of the moon during totality a greater mystery than ever. It also repeated the well-worn mistake of assigning diversities of illumination of the moon's disc to the passage of the sun's rays "through parts of our atmosphere of different degrees of saturation." Irregular diversities of illumination, such as are actually observed during total lunar eclipses, cannot possibly be explained in this way.

I propose to take this opportunity to discuss the circumstances of a lunar eclipse in a new way, which possesses the advantage of being simpler than the customary plan, and is also more instructive in regard to the physical problems involved. I take the eclipse of Oct. 4th, but any other total lunar eclipse would have served my purpose equally well.

Every student of astronomy knows the usual way of dealing with lunar eclipses, in which the passage of the moon through the earth's shadow is considered*, and the station of the observer is supposed to be on the earth, the general elements of the eclipse being taken for the earth's centre. Let us, instead, set our observer on the moon, or for convenience at the moon's centre, and consider the way in which the earth's disc would seem to pass athwart the face of the sun.

The elements of the eclipse, as given in the *Nautical Almanac*, are obviously translatable at once into the following (only differing in taking the motion of the earth's centre, as seen from the moon's, as the exact opposite of the motion of the moon's centre seen from the earth's):—

Greenwich Mean Time of Conjunction in R.A., Oct. 4		h. 10	m. 8	s. 5·1
Right Ascension of Earth and Sun		12	44	25·02
		°	′	″
Earth's Declination	S	4	57	57·9
Sun's Declination	S	4	46	33·6
Earth's Daily Motion in R.A.			31	13·5
Sun's Hourly Motion in R.A.			2	16·7
Earth's Hourly Motion in Declination	S		10	52·9
Sun's Hourly Motion in Declination	S			57·7
Earth's Equatorial Semi-diameter			59	23·0
Sun's True Semi-diameter (seen from Moon)			15	59·9

The only element here altered is the sun's semi-diameter, which in the *Nautical Almanac* is given as 16′ 2″·4″: this of course has to be reduced as seen from the moon; and to reduce it, we have to use the only element omitted above, viz., the solar parallax, or 8″·9; for the moon's parallax 59′ 23″·0 divided by the sun's gives the sun's distance as compared with the moon's, or almost exactly as 400 to 1;

* This seems the most natural and obvious way of dealing with the problem; but it gives no information as to the cause of diversities of illumination depending on the condition of various parts of that zone of the earth's atmosphere through which the sun's rays are refracted towards the moon.

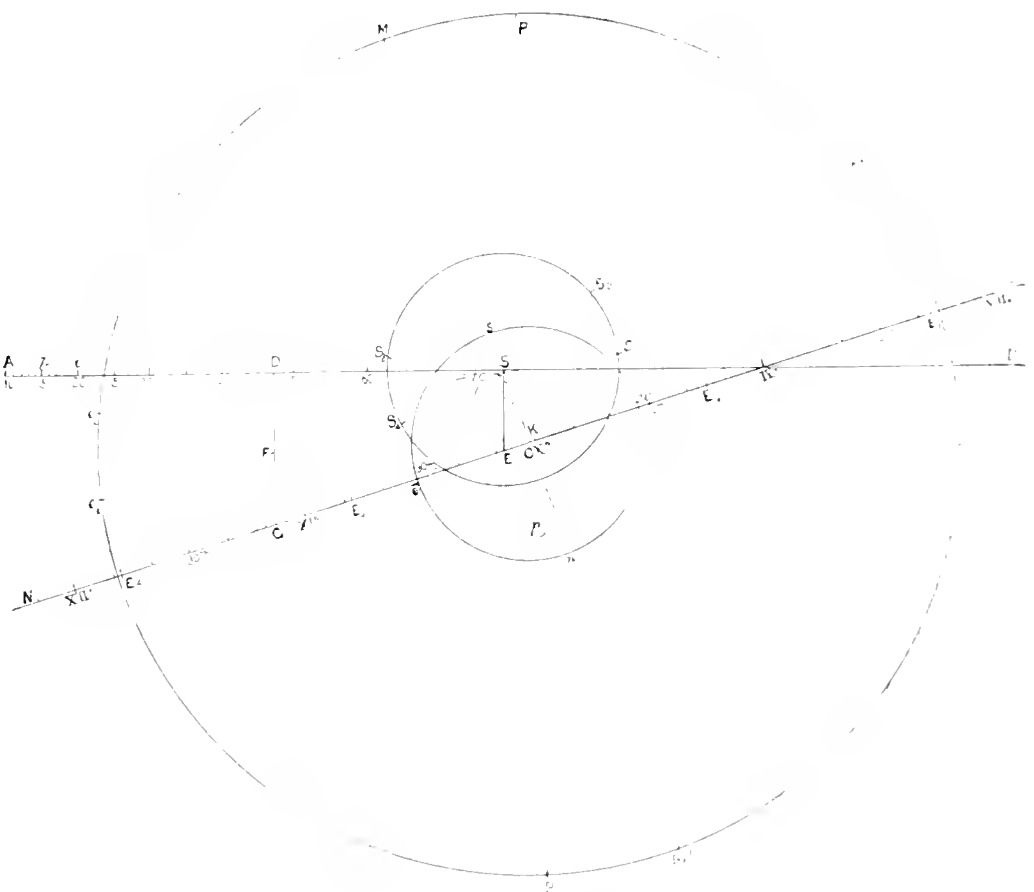


Fig. 1.—Illustrating the Geometrical Investigation of a Lunar Eclipse.

and we must subtract a 400th part from the sun's semi-diameter as seen from the earth to get that semi-diameter as seen from the moon.

With these elements our work is easy :—

We note first that at 10 h. 8 m. 5s.·1, Greenwich mean time, the earth's centre is 11′ 24″·3 (the difference between the declinations given above) south of the sun's centre. Draw then a straight line A S B, Fig. 1, to represent a parallel of declination through S the sun's centre, and with any convenient length A b to represent 5′, take S E square to A B to represent 11′ 24″·3 : then E of course represents the earth's centre at the time of conjunction of earth and sun, in R.A. Now it will be obviously convenient to keep the sun's centre at S throughout our investigation ; so instead of having both the sun and earth moving, we note that the earth gains on the sun, hourly, in R.A. 31′ 56″·2, and in declination 9′ 55″·2 (we get these by taking the difference between the hourly motions of the sun and earth tabulated above). Now if A S B represented a declination-parallel farther from the equator we ought to note that a degree in R A along A B is less than a degree along the equator ; but as a matter of fact the difference is not more than 1-250th part, and need not here trouble us. So, first making a little scale of arc-minutes along A B, we set off along S A a distance S D to represent 31′ 56″·2, and along D F square to S A take D F = 11′ 24″·3, and F G = 9′ 55″·2 ; or D G = 21′ 19″·5 : then E G represents the earth's motion from the sun during the hour following conjunction in R.A. We draw L E G N to represent the track of the earth's centre ; and S C square to L N, gives the position of the earth's centre C at the time of nearest approach to the sun's, or the time of mid totality. E C will be found to be about a tenth of E G the hourly motion ; that is, E C corresponds to about 6 min., and central eclipse occurs therefore 6 min. before conjunction in R.A.

It will be convenient to take K a point one-third of E C to the right of C, corresponding to the position of the earth's centre at 10h., and then to mark in, carefully, the hour and minute divisions corresponding to the earth's motion already determined.*

Now describe round S a circle with radius 15′ 59″·9 (16 will do well enough) to represent the sun's disc ; and round C a circle with radius 59′ 23″ to represent the earth's ; thus we have the relative position of the sun and earth, and their relative dimensions, at the time of central totality,—the observer being supposed to be at the moon's centre.

We see that were it not for the refractive action of the earth's atmosphere the sun ought to be entirely hidden at this time. This action brings the sun into view all round (since C, the earth's centre, falls within the circle corresponding to the sun's disc). But we note that more light will be brought round the northern side of the earth than

* Also, we have,—

$$S C : S E :: S D : G E$$

$$\text{or } S C : 11\tfrac{1}{3} :: 32 : \sqrt{(32)^2 + (10)^2}, \text{ nearly enough}$$

(we have given approximate values to S E, S D, and F G). Or

$$S C = 11\tfrac{1}{3} \times 32 \div 33\tfrac{2}{3} \text{ approximately,}$$

$$= \frac{34}{3} \times 32 \times \frac{5}{168}$$

$$= \frac{34 \times 20}{63} = 10\tfrac{4}{5}' \text{ very nearly.}$$

round the southern, the actual maximum (apart from cloudiness of the air) being at the point marked M, on C S produced. The north pole of the earth is at P, supposed to be on the face of the earth turned moonwards at this moment. This face is shown in Fig 2.

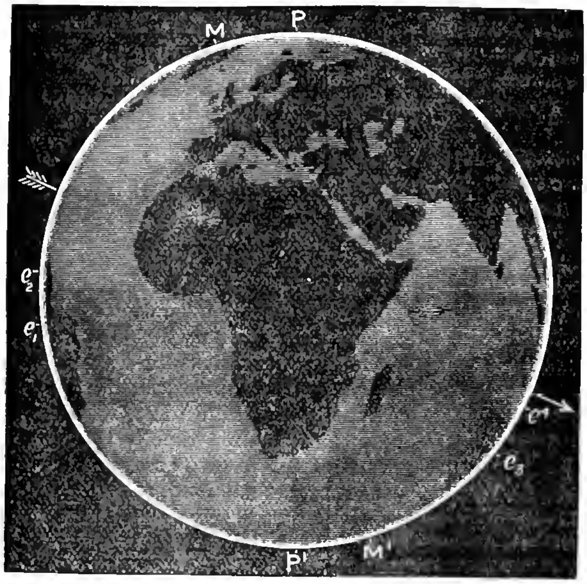


Fig. 2.—Earth's Face turned Moonwards at the time of Central Eclipse.

Fig. 1 shows how the earth's centre, C, is situated with respect to the centre of the sun, S. Both figures are for the centre of the moon's earthward face. For other parts of that face we should of course get different relations. An observer on the moon travelling northwards or southwards from the centre of the moon's earthward face* would shift the earth's centre southwards or northwards as from C towards *s* or *n* respectively; and it is easily seen he could raise it no farther than *s* or *n*, where C*s* or C*n* represents the semi-diameter of the moon's disc in the above table, reduced by one-400th part (because as the earth's centre is shifted the sun's centre is shifted by about one-400th part as much, his distance exceeding the earth's distance 400 times). Travelling eastwards or westwards from the centre of the moon's earthward face, the earth's centre would be thrown eastwards or westwards,† by distances which cannot exceed 16′ 10″ represented by C *w* and C *e*. Thus we can describe the circle *s e n w* with radius 16′ 10″ to show the area within which the centre of the earth's disc would lie at the time of central eclipse as seen from different parts of the moon's earthward face. It will be seen that the eclipse was absolutely central for a point on the moon corresponding to the position of S on the disc *s e n w*. This was not far from the place of Tycho, shown at *t*. A lunar observer on Plato would have had the centre of the earth situate nearly as at *p*—outside the disc $S_1S_2S_4$—and therefore would have had an arc of sunlight round a part only of the earth's disc. In any other place on the moon we have only to set the place in its proper quadrant of the moon, as indicated by the letters *s*, *e*, *n*, *w*. We might make a map of the moon within the circle *s e n w* (as suggested by the rays from Tycho), the only difference from an ordinary map of the moon being that our map would interchange east and west, or appear as the usual map does when held opposite a looking-glass.

In Fig. 1, E_1 and E_4 are the positions of the earth's centre at the time of first and last contact with the total shadow, and are obtained by describing an arc round S as centre with radius C M – C*s* + C S to cut L N in E_1 and E_4; E_2 and E_3 are the positions of the earth's centre when total eclipse was just beginning and just ending, and are obtained by describing an arc round S as centre with radius equal to C M – C*s* – C S, to cut L N in E_2 and E_3. S_1, S_2, S_3, and S_4, are the points where E_1, S_1, E_2, S (produced), E_3 S (produced) and E_4 S meet the edge of the sun's disc. Lines from C parallel to these four lines meet the circle representing the earth's disc in the points e_1, e_2, e_3, and e_4, corresponding to those parts of the edge of the disc which give the part of the umbra (i) first seen on the moon's face, (ii) just completing totality by coming up to the moon's edge; (iii) just ending totality by leaving the moon's edge, and (iv) last seen on the moon's face.* The corresponding points are marked on Fig. 2, and also on Fig. 3, which represent the "sun-view of the earth" for the time of central eclipse. Only, of course, it will be noticed that as both these maps are for 10 h. 2 m. Greenwich mean time (p.m.), the aspect for the four epochs just dealt with will be considerably different. The times for these are respectively:—

(i)	8 h. 15·2 m.	Greenwich mean time (p.m.),
(ii)	9 h. 15·8 m.	
(iii)	11 h. 48·8 m.	
and (iv)	12 h. 47·2 m.	

and about 11½ m. later for Greenwich solar time. It will be easy for the student to make corresponding projections

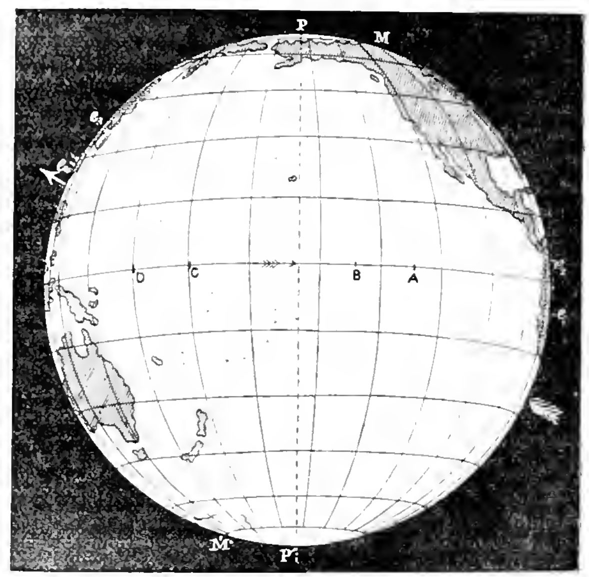


Fig. 3.—Sun view of the Earth at the time of central Eclipse. Oct. 4, 10.2 p.m. (G.M.T.)

from Fig. 3, in which the longitude and latitude lines have been left in for his guidance. For (i) the point A in Fig. 3 must be brought on the central meridian PP′; for (ii) the point B; for (iii) the point C; and for (iv) the point D. Corresponding changes may be made in Fig. 2; but, as a matter of fact, there is no occasion to use both projections.

* Not the same as northwards or southwards relatively to the celestial equator,—but nearly northwards or southwards relatively to the ecliptic.

† Not westwards for an easterly movement, and *vice versâ*, because as we face the full moon the eastward side is on the left, whereas as an observer on the moon faces the earth the eastward side of her disc is towards the right.

* These radii, C M – C *s* ± C S are deduced from the consideration that the earth's disc (radius C M) is just to touch the sun's disc (radius C S) (i) externally (ii) internally, as seen from only one point on the moon's surface, that point being on the edge of the moon's disc (radius C *s*).

It will be seen that when M. Ad. de Boe, of Antwerp, noticed the remarkable appearance pictured at p. 325, the Cordilleras were not at the edge of the earth's disc near e_1, as my friend, Captain Noble, suggested. Probably the projection at a in M. de Boe's figure corresponded with cloud-layers above the western parts of the North Atlantic, near the shores of French Guiana, and northern Brazil (north of the mouth of the Amazon), or it may have been an effect of irradiation only.

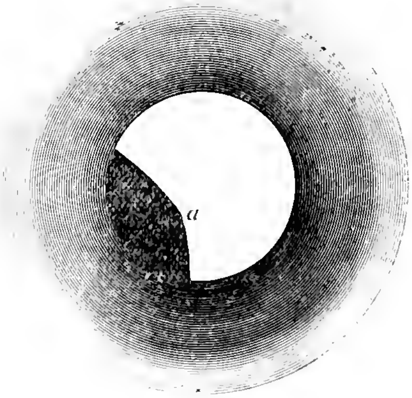


Fig. 4.—The Lunar Eclipse of Oct. 4.

Many pretty problems will suggest themselves to the student in connection with the outline of the subject here presented. But the majority of our readers will probably consider that space ought not further to be given to a subject belonging wholly to the geometry of astronomy.

I shall take occasion shortly, however, to touch on the way in which the sun, when geometrically behind the disc of the earth as seen from the moon, is brought into view by refraction,—a matter about which much misapprehension exists, even among professional (by which I mean official) astronomers.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

IV.—THE FRAMEWORK OF THE DWELLING-HOUSE (*continued*).

GENERAL PRINCIPLES OF CONSTRUCTION.

TOBIN'S tubes, which we were led to mention incidentally last week, whilst discussing the subject of inlet ventilators, consist of wooden or metal tubes, a few inches square and about five feet in length. They are usually fixed in the corners of rooms, are open at the top, and communicate with the outer atmosphere at the bottom, through air-bricks or gratings. It is sometimes advisable to have the external portions of these pipes bent vertically downwards, outside of the walls to which they are affixed—a method which diminishes the quantity of air-borne dirt which is liable at all times to enter the apartment in spite of every care. The tubes need not interfere with the artistic arrangements of the room. Indeed, they may be made to add to its general beauty—*e.g.*, in the drawing and dining rooms they may be introduced beneath bottomless vases of Doulton ware, or in many other ways to harmonise with the internal decorations.

A decided improvement upon these simple vertical tubes is that known by the name of "Ellison's Expanding Ventilating Tubes." The principle of the "conical ventilator," noticed in our last communication, is here added to the vertical tube in its expanding upper free extremity. This has the effect of spreading the air over a large area, and thus preventing draughtiness. These ventilators ought to be inserted through the wall at the height—from 6 ft. to 8 ft. above the floor—at which they are to be fixed; it is not necessary, as in the long "Tobin's tubes," to carry them upwards from the level of the floor. Mr. Ellison, the inventor, recommends that they should be placed above the spaces allocated to seats, or similar low pieces of furniture. They are made of zinc, either with or without closing and opening valves, and are to be recommended on account of their cheapness, durability, and effective action.

We have considered how fresh air ought to be conveyed into the apartments of a house by simple passive means, and it now remains to provide for the removal of the vitiated air in the establishment of a rational system of house-ventilation. A suitable outlet ought to be made beneath the cornice, or at the highest available part, a few inches below the ceiling in the smoke-flue, and a mica ventilator, or other valvate arrangement, fixed therein in such a way as to prevent the regurgitation of smoke and its unpleasant passage into the house. Smoky and sluggish chimneys, however, are very apt to give great trouble with such an apparatus, which is best adapted to work in conjunction with chimneys which have a good upward daught, and are not exposed to the influence of the prevailing winds through the use of well-devised cowls and protectors. It is a very difficult matter to fix an outlet ventilator which shall work with any degree of success in opposition to the chimney in an opening made through an external wall, otherwise the aerial circulation would be considerably simplified.

The removal of heated air and the products of combustion from gas and other analogous illuminators can be effected by the simple expedient of inverted tubes with expanded mouths placed directly over the flames, and constructed in such a way as to lend a pleasing and artistic aspect to the room. We shall give a few special illustrations of this when we come to treat of the question of domestic lighting.

It is a very common error to suppose that lofty ceilings are conducive to good ventilation in proportion to their greater height. Such is not the case; the contaminated air, in consequence of its relatively high temperature, ascends; it goes on parting with its heat, and, if the ceiling is very high, it descends with redoubled speed in virtue of its greater specific gravity, instead of escaping through the outlet ventilator, whilst its warmth is still sufficient to cause it to ascend through the aperture in the chimney flue. In a moderately low-ceilinged room the foul air escapes readily, and the purity of the atmosphere is thus secured. Hence it is advisable, volume for volume, to have breadth and width rather than height.

The fireplaces in a house exercise an important influence over its ventilation. As the kitchen fire is the one which is most constantly employed, it often happens that its action induces a down-current in the other rooms, which may reach from the highest floor even to the very basement. It is, therefore, important to isolate the several apartments and passages of a house as much as possible, in the event of communicable disease from one room to another through these general draughts.

We have laid great stress upon the ventilation of inhabited apartments, because it is a subject which seems to be almost universally neglected in practice. We have endeavoured to show how all the benefits of a pure atmosphere indoors can be easily gained, through the use of simple and inexpensive apparatus, and we are confident that if our readers adopt the measures we have indicated, they will be amply repaid by the enjoyment of increased bodily health, and freedom from the many ills which are attendant on a defective system of ventilation or an entire absence thereof.

We presume that the majority of minor dwelling-houses are devoid of any well-regulated system of ventilation; the holders of such abodes would do well to test the atmosphere of their apartments, and improve their condition if necessary. As the percentage of carbonic acid gas usually indicates the state of atmospheric impurity, it is of advantage to ascertain its relative quantity by some simple expedient, such as the following tentative test:—

Conjecture the percentage of carbonic acid in the air to be tested. Then take half an ounce of perfectly clear lime-water, and agitate it, with the contained air, in a bottle holding the number of ounces standing in the following Table opposite to the supposed percentage. If a white turbidity is produced, the air contains more than the attributed quantity of carbonic acid, and the experiment may be repeated for higher proportions. The first column gives the content of the bottle, in avoirdupois ounces, including the space occupied by half an ounce of lime-water; the second column gives the percentage of carbonic acid in the air.*

Av. oz.	CO_2	Av. oz.	CO_2
15·60	·04	2·51	·30
10·57	·06	2·01	·40
8·05	·08	1·71	·50
6·54	·10	1·51	·60
5·53	·12	1·36	·70
4·53	·15	1·25	·80
3·52	·20	1·17	·90
2·92	·25	1·10	1·00

On April 18, 1881, a letter appeared in the *Times*, signed "F. R. C. S.," in which the writer, whom we have reason to believe is an eminent London surgeon, detailed his experiences in converting an insanitary abode into a healthy home. After recounting the various evils to be apprehended from the incursion of dust and dirt, such as colds, headaches, &c., which are attributed not so much to

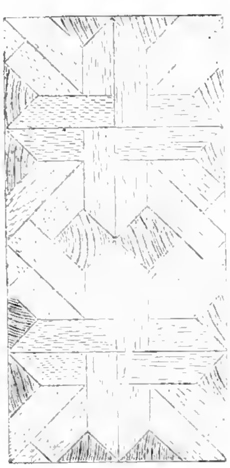


Fig. 2.

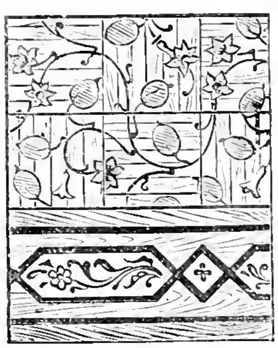


Fig. 3.

the cold temperature and chills, as to the "poisonous influence upon the mucous membrane of the respiratory passages of the septic dust which people breathe, and which, in the majority of instances, they trample out of their filthy carpets," he goes on to give an outline of the methods which he so successfully adopted. He says:—

"The first thing, of course, was to see carefully to the drainage and water arrangements, to the ventilation of soil-pipes, the condition of cisterns, and so forth. . . . . The next thing was to cover the old floors with thin oak parqueterie, both in living-rooms and in bedrooms. This was done for me by Messrs. Howard at a very moderate charge, a fact which I am the more desirous to place on record because, for one room, I employed another firm, and paid a larger sum for bad material and defective workmanship. . . . . The parquet surface was not waxed, but French polished, so that it is not slippery. It is dusted or swept every day like the top of a table, and it is washed with a sponge and spirit of turpentine when dirt is deposited upon it. The turpentine not only cleans it effectually, but also affords the benefit of its fragrant and antiseptic odour for some hours after it has been used."

Figs. 2 and 3, for which we are indebted to the kindness of Messrs. Howard & Sons, of Berner's-street, W., are examples of plain and decorative parquet floorings. Although the initial cost of this system of flooring is much over that of ordinary carpets, it must be borne in mind that they are so much more durable that, in the long run, they are in reality the least expensive of the two. The parqueterie is of two principal kinds—viz., $\frac{1}{4}$ in. and 1 in. in thickness, respectively; the former is permanently fastened to the floor of the room, whilst the latter, on a patent laminated back, admits of being taken up, in case of removal.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE THIRD EVENING (*Continued from p. 378*).

"LEAVING the moon on the side next the sun, we see Venus, which puts me again in mind of St. Dennis. Venus turns upon herself, and round the sun, as well as the moon; they likewise discover by their telescopes that Venus, like the moon (if I may speak after the same manner), is sometimes new, and sometimes in the wain, according to the different situations she is in with respect to the earth. The moon, to all appearance, is inhabited; why should not Venus be so, too?"

"You are so full of your why's and your wherefore's," says the Marchioness, interrupting me, "that I fancy you are sending colonies to all the planets."

"You may be certain, madam," I reply'd, "that I will; for I see no reason to the contrary. We find that all the planets are of the same nature, all obscure bodies, which receive no light but from the sun, and then send it to one another: their motions are the same, so that hitherto they are alike; and yet, if we are to believe that these vast bodies are not inhabited, I think they were made but to little purpose. Why should nature be so partial, as to except only the earth? But let who will say the contrary, I must believe the planets are peopled as well as the earth."

"I find," says the Marchioness with some concern, "a philosopher will never make a good martyr, you can so quickly shift your opinion; 'twas not many minutes since, the moon was a perfect desert; now I see you would be very angry if any one should say all the rest of the planets are not inhabited."

"Why truly, madam," said I, "there is a time for all things; and your true philosopher believes any thing, or nothing, as the maggot bites. And this is not so very improbable as you think it: for I cannot help thinking it would be very strange, that the earth should be so well peopled, and the other planets not inhabited at all; for do you believe we discover (as I may say) all the inhabitants

* This passage is quoted from the "Medical Annual" for 1883-4, p. 119, published by H. Kimpton, 82, High Holborn, London—a volume which contains an able digest of everything pertaining to health, and, as such, will be found of great value, not only to the medical practitioner, but to every intelligent reader.

of the earth? There are as many kinds of invisible as visible creatures. We see from the elephant to the very ant, beyond which our sight fails us; and yet, counting from that minute creature, there are an infinity of lesser animals, which would be imperceptible without the aid of glasses. But our magnifying glasses show us, that in the least drop of rain-water, vinegar, or any other liquid, there are great numbers of little fishes or serpents, [!] which we could never have suspected there: and philosophers believe that the acid taste of these liquids proceeds from a sharpness issued through the forked stings of these animals, lodged under their tongues; and further, that by mixing certain things with any one of these liquors, and letting them stand and corrupt, will produce a new species of little animals. Several, even of the most solid bodies, are nothing but an immense swarm of imperceptible insects. Do but consider this mulberry leaf: it is a great world inhabited by multitudes of these invisible worlds. It is to them a country of a vast extent: what mountains, what abysses are there in it! The insects of one side know no more of their fellow creatures on t'other than you and I can tell what they are now doing at the Antipodes. Is it not reasonable, then, to imagine that a great planet should be inhabited? In the hardest stones, for example, in marble there are an infinity of worms which fill up the vacuums, and feed upon the substance of the stone. Fancy, then, millions of living creatures to subsist many years on a grain of sand; so that were the moon but one continued rock, I would rather she should be gnaw'd by these invisible mites than not be inhabited.

"In short, everything is animated. Imagine, then, those animals which are yet undiscovered, and add them and those which are but lately discovered to those we have always seen, you will find the earth swarms with inhabitants, and that Nature has so liberally furnished it with animals, that she is not in the least concerned for our not seeing above one half of them. Why, then, should Nature, which is fruitful to an excess here, be so very barren as to produce no living things in the rest of the planets?"

"I must own," said the Marchioness, "you have convince'd my reason: but you have confounded my fancy with such variety that I cannot imagine how Nature, which hates repetitions, should produce so many different kinds."

"There is no need of fancy," replied I. "Do but trust your eyes, and you will easily perceive how Nature diversifies in these several worlds. All human faces in general are of the same model, and yet the Europeans and the Africans have two particular molds: nay, commonly every family has a different aspect. What secret, then, has Nature to show so much variety in a single face. Our world, in respect of the universe, is but a little family, where all the faces bear some resemblance to each other; in another place is another family, whose faces have quite a different air and make. The difference, too, increases with the distance; for whosoever should see an inhabitant of the moon and an inhabitant of the earth would soon perceive they were nearer neighbours than one of the earth and one of Saturn. Here, for example, we have the use of voice; in another world they speak by signs, and at a greater distance they do not speak at all. Here our reason is formed by experience, in the next world experience contributes little towards it, and in the next to that old men know no more than children. Here we are troubled more with what is to come than with what is past; in the next world they are more troubled for what is past than for what is to come; further off they are not concern'd with either—which, by the way, I think is much the better. Here 'tis thought we want a sixth sense, which would teach us many things of which we are now ignorant. This sixth sense is apparently in another world, where they want one of the five which we enjoy. Nay, perhaps there is a much greater number of senses; but in the partition we have made of 'em with the inhabitants of the other planets there are but five fallen to our share, with which we are well contented for want of being acquainted with the rest. Our sciences have bounds which the wit of man could never pass. There is a point where they fail us on a sudden; the rest is reserved for other worlds, where somewhat which we know is unknown to them. This planet enjoys the pleasures of love, but lies desolate in several places by the fury of war; in another planet they enjoy perpetual peace, yet in the midst of that peace know nothing of love, and time lies on their hands. In a word, that which Nature practices here in little, in distributing her gifts among mankind, she does at large in other worlds, where she makes use of that admirable secret she has to diversify all things, and at the same time makes 'em equal, by compensating for the inequality.

"But is it not time, madam, to be serious? How will you dispose of all those notions?"

"Trouble not yourself," says she, "Fancy is a great traveller: I already comprehend these several worlds, and represent to myself their different characters and customs; some of them, I assure you, are *very* extraordinary. I see at this moment a thousand different figures, tho' I cannot well describe 'em."

"Oh, leave them," said I, "to your dreams: we shall know to-morrow whether they represent the matter faithfully, and what they have taught you in relation to the inhabitants of any of the planets."

(*To be continued.*)

Reviews.

SOME BOOKS ON OUR TABLE.

A Treatise on the Principles of Chemistry. By M. M. Pattison Muir, M.A., &c. (Cambridge: The University Press. 1884.)—This is a book worthy at once of its author and of the channel through which it is given to the world. As a systematic treatise on chemical philosophy, it has, probably, nothing at present to rival it in the English language. Mr. Muir sets forth the principles and laws of chemistry in a definite and perspicuous form, treating of the theories by which the relations between its facts are established, to a considerable extent from an historical point of view. He begins with an exposition of the atomic and molecular theory, and shows how it is applied to explain the phenomena of allotropy, isomerism, &c., and to chemical classification. Thermal, optical, and physical chemistry generally, make up the remainder of our author's first division of his work, to which he has applied the title. "Chemical Statics." Under the head of "Chemical Kinetics," the remaining portion of the volume is devoted to dissociation, change, and affinity, and to the relations between chemical action and the distribution of the energy of the changing system. All this is admirably done. Great pains have obviously been taken to assign to every worker his precise share in the advances effected in the science. This is as apparent in the tracing of the atomic theory through Richter, Fischer, Higgins, and Dalton, and others, down to its latest development; as in the careful balancing of the proportion of credit respectively due to those by whom the so-called "Periodic Law" has been established. It will be gathered from this précis that Mr. Muir does not address the mere beginner. To the student, however, already possessing a certain amount of familiarity with chemical facts, his book will be found invaluable. As we close the volume, the words of the writer of Ecclesiastes, "There is no new thing under the sun," recurs to us, and we are struck by the strangeness of the reflection, that we have been perusing a masterly exposition and defence of that doctrine of atoms which, first formally enunciated by Democritus 2,300 years ago, sank for more than two chiliads into oblivion.

Among the Stars. By AGNES GIBERNE. (London: Seeley & Co. 1885.)—Why Miss Giberne should imagine that any sane English gentleman would christen his son "Ikon" is not very apparent, but when we ignore, or get accustomed to, the little bit of affectation which this indicates, we find that she really does contrive to convey a considerable amount of elementary astronomical knowledge in the volume before us. What "Ikon" learned from Herr Lehrer, Fraulein Stella, and Mr. Fritz, the young reader must go to the book himself to discover. We may pretty safely predict that, if it does not find him with a taste for astronomy, it will leave him with one. The title-page bears the date 1885; we trust, however, that so very appropriate a Christmas present for good little children, for whom it is proposed to provide a high and ennobling recreation, will be issued in time to be put to so legitimate a use.

Healthy Manufacture of Bread. By BENJAMIN WARD RICHARDSON, M.D. (London: Baillière, Tindall, & Cox. 1884.)—From time to time readers of the newspapers are startled with revelations as to the condition of many of the bakehouses in the metropolis and in other large cities and towns, and learn, with disgust and dismay, that they are liable to eat bread contaminated with alum, human perspiration and exhalations, sewer gas, cockroaches, and other abominations incidental to its manufacture in closely-confined and heated cellars. In the ordinary process of bread-making flour, potatoes, and yeast are mixed to form a "ferment," to which, at the end of six hours or so, a quarter of the flour ultimately to be used is added, and this (now called the "sponge") is set further to rise. When it is ready, the remaining three-quarters of the flour are added, and the whole kneaded into dough. This is cut into pieces of proper size, put into the oven, and baked. Such, in the briefest terms, is the process of bread-making carried on sometimes, but happily more rarely than formerly, in overheated and ill-ventilated cellars, with occasional sewers running beside or even through them. In these stifling dungeons the perspiring workmen knead the dough with their hands or feet, and sleep in their clothes upon the "boards" on which the dough is weighed out. Now, the sole object of the fermenting process is to generate carbonic acid gas (the gas which makes soda-water, champagne, and bottled ale sparkle)—the object is, we say, to cause this gas to permeate the bread in bubbles, and so make it light and spongy. In Dr. Richardson's book he shows how this may be done by forcing the gas itself directly into the mixture of flour and water, as effected under Dr. Dauglish's patent: Dr. Dauglish's process not only involving this manifest improvement, but actually producing the loaf from the flour in the sack without its being touched by human hands, until it issues baked from the oven and ready for consumption. This is the well-known and popular aerated bread, and it is to an explanation of its mode of manufacture, and the advantages accruing from its use, that our author addresses himself. Every one who is concerned in procuring absolutely pure and wholesome bread—and who is not?—should read through the work whose title heads this notice from cover to cover.

The Principles of Parliamentary Representation. By CHAS. L. DODGSON, M.A. (London: Harrison & Sons. 1884.)—Now that a redistribution of seats in Parliament appears imminent, it behoves every one who has the welfare of his country at heart to endeavour to ensure that such distribution shall have the effect of affording the greatest chance possible to each individual elector of being represented in the House. That every elector should be so represented is, of course, impossible; but the *tendency* of legislation should be in the direction indicated. As a contribution towards the attainment of this desideratum we must afford unstinted praise to Mr. Dodgson's tract, which lays down, on mathematical principles, the numbers of voters to be assigned to each electoral district, and the number of members to be returned. He treats also of the mode of counting the votes, and goes into other practical details, which cannot fail to be of the highest value to all who approach the consideration of the subject from a scientific—as contradistinguished from the merely party—point of view. The party politician may look askance at equations as applied to the question of representation, but the wise man will read, mark, learn, and inwardly digest this little book, with the result of finding that its conclusions are at once sound and valuable.

Ethnology of Egyptian Sudan. By Prof. A. H. KEANE, B.A. (London: Edward Stanford. 1884.)—With the fate of that gallant hero, Gordon, trembling in the balance, to say nothing of complications in connection with the country itself, whereof no man may see the end, everything concerning the Sudan at present is a matter of great popular interest. In the work before us that well-known anthropologist and philologist, Prof. Keane, gives a descriptive account of the various tribes who inhabit the Sudan, furnishing details of what is known as to their origin, language, &c. Readers will be considerably surprised to learn what a heterogeneous population inhabits the area to the elucidation of the ethnology of which Mr. Keane's pamphlet is devoted.

Flatland: a Romance of many Dimensions. By A. SQUARE. (London: Seeley & Co. 1884.)—The *jeu d'esprit* whose title heads this notice is obviously the production of a follower of Lobatschewsky and Riemann—his end seemingly being to familiarise his readers with the idea that it may, after all, be only the *shape* of the space accessible to our observation which binds us down rigidly to the conception of its possession of three dimensions, and three only. The writer, whose universe is a plane, finds it utterly impossible to imagine the existence of thickness prior to his visit to this part of the cosmos, length and breadth being the only ones recognisable. He gets a certain amount of fun out of his description of "Flatland," in which the lower classes (and soldiers) are isosceles triangles, the middle classes squares, the upper middle with a tendency to a pentagonal, or even hexagonal, forms, and the aristocracy circles—the female sex in all classes being practically only straight lines. Nor does terrestrial sociology escape numerous sly pokes in the descriptions of political and domestic life in "Flatland." This daintily got-up work will afford any one (and, notably, the mathematician) half-an-hour's amusing reading.

How to Live on a Shilling a Week. By ONE WHO HAS TRIED IT. (London: T. & R. Maxwell, 1884.)—That men leading sedentary lives would enjoy better health if a larger proportion of their food were vegetable may readily be conceded. To insist, however, that every human being shall forthwith take to grazing, like a sheep (or Nebuchadnezzar), is the very *reductio ad absurdum*, and is simply calculated to set people against vegetarianism, even in a modified form, altogether. The author of the work before us, however, tells us how he and a small boy lived upon two shillingsworth of vegetables for a whole week—the "vegetables," by the way, though, including two quarts of skim milk and three ounces of lard. It is needless to add that this was all washed down by the beverage of the lowest and most degraded races the world has yet seen—water. "One who has Tried it" overdoes the whole thing.

Mottoes and Motives. (London: Elliott Stock, 1884.)—"This," said the lamented Mrs. Gamp, "is my mortar, which I sticks to." Would that she were at our elbow to satisfy us as to which are the "mottoes" and which the "motives," in the wonderful farrago before us; inasmuch as we are utterly unable to do so by the limited light vouchsafed to us.

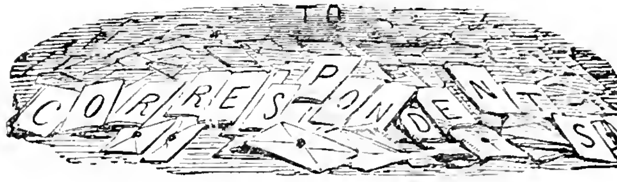
We have, too, on our table, Part VII. of Heath's *Fern Portfolio*, with its exquisite plates of the Maiden-hair, Polypody, and Bristle ferns, the venation in the latter being startlingly natural. Also the *Kansas City Review*, a very able Scientific Journal, *Bradstreet's*, *The Medical Press and Circular*, *The Tricyclist*, *The Sidereal Messenger*, *Society* (with its readable and exciting Christmas Number, and a large cartoon of celebrities), and *The American Druggist*.

THE FACE OF THE SKY.

From November 21st to December 5th.

By F.R.A.S.

THE usual daily examination of the Sun's disc will be made for spots and faculæ. Maps XI. and XII. of "The Stars in their Seasons" may be consulted for the aspect of the night sky. Mercury is an evening star, but as badly placed for observation as he well can be. Venus is a morning star, and is still a bright object before sunrise, though now somewhat shorn of her glory. Mars is invisible. Jupiter rises about 11h. 22m. to-night, and a little after half-past 10 by the 5th prox., but, of course, he does not attain sufficient altitude to be favourably seen during the working hours of the ordinary amateur's night. On the night of the 29th an eclipse of his third satellite may possibly be seen at 11h. 46m. 28s., a similar phenomenon occurring with his second satellite on December 1st, at 12h. 44m. 8s. p.m. Satellite I. will pass off his disc at 11h. 15m. p.m. on December 4th, but he will be very low down. Saturn continues visible practically all night long. He is travelling away to the westward, to the north of ζ Tauri. He is a glorious object in the telescope. Uranus is invisible, but Neptune is above the horizon all night long, and may be found from directions previously given in these columns. The Moon enters her first quarter at 10h. 15·9m. p.m. on November 25, and is full on December 2nd, at 6h. 59·7m. in the evening. There will be high tides about this date. Four occultations of stars will occur at convenient times during the next fortnight. On the 25th, θ Aquarii, a star of the 4½ mag., will disappear at the Moon's dark limb at 5h. 39m. p.m., at an angle from her vertex of 135°, reappearing at her bright limb at 6h. 52m. p.m. at a vertical angle of 281°. On the 27th, a 6½ mag. star, B.A.C. 8311, will disappear at the dark limb at 4h. 19m. at a vertical angle of 104°, to reappear at the bright limb of the Moon at 5h. 25m. p.m., at an angle of 252° from her vertex. On the 30th, 38 Arietis, a star of the 5th mag., will disappear at the dark limb at 6h. 35m. p.m., at an angle of 40° from the vertex of the Moon. It will reappear at the bright limb at a vertical angle of 293° at 7h. 29m. p.m. Lastly, on December 3rd, B.A.C. 1930, of the 6½ mag. will disappear at the bright limb at 10h. 20m. at a vertical angle of 355°, reappearing at the dark limb at 10.51 p.m. at an angle from the vertex of the Moon of 305°. The Moon is in Sagittarius to-day and to-morrow, quitting it for Capricornus at 2 a.m. on the 23rd. At one o'clock that night she crosses into Aquarius, through which she is travelling until 9 p.m. on the 26th. She then enters Pisces, her journey through which large constellation it takes her until 10 p.m. until the 29th to accomplish. At this hour she passes into Aries. She quits Aries for Taurus at noon on Dec. 1, and that in turn for the northern part of Orion at 7 p.m. on the 3rd. It takes her until 6.30 the next morning to traverse this and emerge in Gemini. She crosses the boundary between Gemini and Cancer at 6 p.m. on Dec. 5, and we there leave her. [The above was inadvertently omitted from our last issue.]



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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DOCTORING WINE.

[1515]—I see that Mr. Mattieu Williams, at page 331 of Knowledge, revives the old cry about the dangerous properties of the gypsum frequently used in the preparation of wine.

I think that the correctness of his chemical theory and opinion on this point is very doubtful. In the first place, sulphate of lime is very slightly soluble in water, and so is bi-tartrate of potash; and it is contrary to the usual theory of chemical combination to suppose that the constituents of these two salts would separate and re-combine as sulphate of potash, which is more soluble than either, unless the tartrate of lime which must be formed were absolutely insoluble and at once precipitated.

If this were the result of mixing sulphate of lime and bi-tartrate of potash in wine, the same result would ensue if bi-tartrate of potash were added to hard water, which contains salts of lime, and the water would be clouded and softened, which is not the case.

Again, as to the chemical effect in the body, would Mr. M. Williams explain on what authority he asserts that sulphate of potash or sulphuric acid is a precipitant of lithic acid? The analysis given in Miller's "Chemistry" shows that they exist together in solution. If it did precipitate uric acid, the sulphate of lime in hard water and the sulphate of soda in Carlsbad water would have the same effect.

It seems to be a dangerous doctrine to say port is less productive of gout than a dry sherry, because the latter may contain a trace of gypsum, and I think the opinion of Dr. H. Dobell, in "Diet and Regimen," and that expressed in "From Vineyard to Decanter," by Don Pedro Verdad, as to its harmlessness, is more reliable. Gypsum.

IS GYPSUM IN BEER INJURIOUS?

[1516]—At the recent Brewers' Exhibition, large quantities of prepared gypsum, warranted "to dissolve freely in water," were exposed for sale. It seems that brewers cannot make good beer except with hard water, and that the hardness produced by gypsum is preferable to that produced by chalk. Possibly this addition is not so injurious in beer as in wine, but I think we should all like to hear Mr. W. Mattieu Williams's opinion on the subject.

John J. Scargill.

PREVISION IN A DREAM.

[1517]—Many years ago I had just joined the East India College, Haileybury, in the winter term, and, the morning after my arrival, was seated at breakfast with a friend—another freshman. I told him I had had one of my curious dreams the previous night, and I said: "I know there must be a cricket pavilion here with a verandah round it, for I dreamed that you and I were sitting in the verandah watching a match. Two men were standing in front of us talking; one of them was tall and dark, and the other was short, with red, curly hair. The former said so-and-so to the latter, and addressed him as 'Stumpwich.' Was not that a queer name? The actual name was not this, but it was one quite as odd and unmeaning." Next day we were again in my room when I saw a man crossing the quad, and I pointed him out to my friend, saying: "That is the man who was called 'Stumpwich'; let us find out if that is his name." Other things put this matter out of our heads, and we forgot all about it. However, one day during the summer term following, my friend and I were seated in the verandah of the cricket pavilion watching a match, and two men—who, of course, we knew then—were talking in front of us. As soon as they began to converse I clutched hold of my friend and said: "Now, listen! You remember what I told you the first day last term?" The conversation we listened to was not apropos of anything in particular, but it seemed all quite familiar to me; and the tall man addressed the man with curly red hair as "Stumpwich"—which, in fact, was not his name, but his nickname. Now, I could not have known anything of this before I dreamt it. There was no significance attached to it; but I have a witness now living who can prove that this prophetic dream was not an hallucination.—Yours faithfully, H. B. L.

NO MATTER!

[1518]—Is the materialistic theory necessarily true? Matter is said to be composed of atoms—some say atoms of one kind only—others, atoms of hydrogen, oxygen, &c. In any case, these atoms never alter. An atom of hydrogen in a glass of water to-day was an atom of hydrogen in the primeval nebula. Combinations of atoms form molecules. Groups of molecules form solid liquid or gaseous matter, according to circumstances. Different arrangements of atoms produce different kinds of matter, but the atom never alters. Can an atom which never alters have any potentiality? There is no growth in the atom. No power of evolution in itself. To say all atoms are mutually attracted or mutually repelled is not true. The power, therefore, which arranges the atoms is outside them. That no two atoms touch one another may be taken as an axiom. But the distance between them may be great or small; our senses cannot perceive it so long as it remains relatively the same in all matter. At one time it may be many miles, at another but a few inches. So with time. Time may be composed of small periods. In fact, the only rational conception of continuous time is a number of small periods following one another. So again with motion. How does an atom get from one place to another? We can only imagine it in one place one moment and in another the next. It is not, therefore, an irrational conclusion to come to that the universe is carried on by a system of destructions and creations of matter. If so, the periods between the destructions and re-creations may vary in length without our senses being aware of it, and the terms "cause and effect" would have to be substituted by "antecedent and consequence." The cause would be outside. What that cause is is a matter of speculation. It may be the will of a single Deity, or of several demons, or of gods, demons, and human beings working harmoniously or otherwise. All I ask is, Is not the theory as probable as the purely materialistic one, which results in a continuous cycle of endless eras, exactly alike? During the last ten years *scientific* and *materialistic* have become too nearly convertible terms. It is to the advantage of neither science nor materialism. Jos. W. Alexander.

THE FAST OF TABERNACLES.

[1519]—Apropos of your editorial note (Vol. V., p. 272) wherein you express surprise that the Christian Church, though still celebrating the Passover, should "somehow have gotten rid of that particular fast" (of Tabernacles), it may interest you to know that we in Scotland still (as I believe) retain its equivalent.

Until within quite recent years the Church of Scotland celebrated the Holy Communion only twice a year, in spring and autumn; and in the great majority of parishes that is still the case. Previous to the "Sacrament Sunday," a day was (and still is) appointed to be "a day of solemn fasting, humiliation, and prayer." There is reason to believe that these "Fast-days," as they are termed, are much older than the Reformation.

Can you account for their being fixed for "the Thursday (in some parts Wednesday) before the last Friday" in April and October, instead of in *March* and *September*. Curious.

CHILDREN'S DRESS.

[1520]—About two years ago you favoured me by inserting in your valuable Knowledge a letter on children's dress. I venture again to call the attention of your readers to this subject, for I do not think that the reform is gaining ground as quickly as it should, notwithstanding lectures, dress associations, and exhibitions.

I find all my Liberal friends most conservative in dress, and, although my personal demonstration of the good resulting from our reform convinces them that we are right, they will not (exceptions are so few) act upon their convictions. We may hope, perhaps, that the introduction of Dr. Jaeger's sanitary system of woollen clothing will do much to aid our cause. I am myself deriving great benefit from the adoption of the *all woollen materials*, even to sleeping in blankets, discarding linen and calico sheets altogether; and I do feel that if mothers would just read the little book on "Health Culture" (by Dr. Jaeger), that they would, for the comfort and well-being of their nursery inmates, at any rate, adopt the principles of clothing therein advocated, and maybe they would themselves become converts to what is rational, comfortable, and healthful in the fashion of dress.

Fearing to trespass on your limited space, I abstain from further remarks, hoping the above suggestion, as a flying thought, may stimulate some one to try the innovation. E. Phillips.

THE SAMIAN TUNNEL.

[1521]—In No. 157 you reprint from *Iron* the account of the re-discovery of this ancient monument. (Reading Herodotus straight through for the first time I came on his account of it just after reading your extract.) It seems to me especially valuable as a test of the correctness of our ideas of ancient measures. (Herodotus (iii. 60) says its length was 7 stadia = 4.245 ft. *Iron* says about 5,000. Height and breadth 8 ft.; *Iron*, $5\frac{1}{2} \times 6$. Canal, depth 20 cubits; *Iron*, about 5 ft. Width, 3 ft.; *Iron*, *nearly* 3 ft. The Greek foot was one-eighth of an inch longer than ours.

There were different kinds of cubits, but it is reasonable to suppose that the Samian cubit is here meant. Now, it was $18\frac{1}{4}$ in. —20 ∴ = 30 ft. 5 in. The other cubits were *greater* than the Samian. How can this enormous discrepancy be explained? Is it possible that only one-sixth of the canal has been dug out? That seems improbable, because the pipes have been discovered *in situ*. It seems more likely that Herodotus, generally so exact, misunderstood the figure.

By the way, he says nothing to lead us to suppose it "a work of the 10th century B.C." He mentions it after stories about Cambyses, Polycrates, and Periander, all late in the 6th century B.C.; but there is no reason to suppose it was constructed then.

Is not the "peaked arch" of bricks a hitherto unknown feature in Greek architecture?

He says the mountain was 300 yards high, and mentions the pipes without detail. Hallyards.

FOSSIL AND MODERN EYES.

[1522]—Neither you nor any correspondent proposes a reason for the contrast I remarked between the general size of eyes in the elder fossil animals, from the Palæozoic strata up to the Oolite, and the very reduced eyes of all later times; and so I will, as promised, suggest one. My notion is that the large-eyed creatures may probably have flourished in the days before there was a sun.

You must be well aware how essential a point it is of the Kantian or Laplace cosmogony now in vogue that the sun has to be held younger, by vast ages, than any of his planets. The smallest bodies are assumed to have condensed the first; and our earth, however diminutive among them, is the biggest body that we have yet, remember, any ground for supposing partly solidified. Very much of her crust, and even of her ocean, she must have had for long ages before our day-star became aught more than a diffuse nebula, somewhat like that in Andromeda. Calculate the light that the brightest such nebula would yield us, if subtending an oval, say of 20° by 40°—which, at the sun's distance, would imply it to occupy about 200,000 times his present bulk—and you will find it but a small fraction of our present daylight; though it may have radiated far more heat. Now, in process of ages, a time came that this great fire-mist shrank down into its present compactness, within its enclosing bubble of metallic liquids, and with its brilliant photosphere. Then, for the first time, did the other planets, previously invisible here, and our moon, visible only as a black spot transiting by day, become lights at night. And then, I suppose, the big eyes of ichthyosauri, &c., no longer being needed or advantageous, those creatures were superseded by such as the iguanodon, &c., with eyes on no bigger a scale than the animals of to-day have. E. L. Garbett.

Nov. 17, 1884.

[I fear that, in popular parlance, Mr. Garbett's theory "will not hold water." The eyes of the trilobites differ in no material respect from those of the recent dragon-fly, while those of the Silurian crustacea generally, the fish of the old red sandstone, &c., are certainly not abnormally large. Moreover, it is not easy to see how the superabundant Carboniferous flora can have flourished without sunlight, dimmed as it may possibly have been by large quantities of vapour; while that the abundant Jurassic fauna could have existed by the light of a diffuse nebula will meet with scant credence indeed among zoologists. Ed.]

A PROPERTY OF CERTAIN NUMBERS.

[1523]—Let n be any number prime to 10; that is, any number whose unit figure is 1, 3, 7, or 9.

Work out the decimal equivalent of $\frac{1}{n}$.

Let A represent the first figure, a the remainder; B the second figure, b the remainder; and so on. Finally, we shall get a figure (say N) giving 1 as remainder. Clearly the decimal will *recur* after N.

Thus, $$\frac{1}{n} = .\dot{A}BCD\ldots\ldots\dot{N},$$

And the successive remainders are

$$a, b, c, d, \ldots\ldots 1$$

Now, $$\frac{a}{n} = .\dot{B}CD\ldots\ldots N\dot{A}$$

(since $\frac{10a}{n}$ gives B, and b remainder, &c.)

And the remainders are $b, c, d \ldots\ldots 1, a$.

Similarly, $$\frac{b}{n} = .\dot{C}D\ldots\ldots NA\dot{B}.$$

with remainders $c, d \ldots\ldots 1, a, b$.

And so on, using each of the remainders in turn as multiplier. This is the whole mystery of the so-called figure puzzles 1398 and 1507, and of as many more as there are numbers prime to 10.

On referring to each of these "puzzles," it will be seen that in each case the multipliers are the *successive remainders* in working out the decimal equivalent of $\frac{1}{7}$ or $\frac{1}{13}$.

I have assumed that all numbers prime to 10 give *pure* recurring decimals. Readers may like to work out the proof of this for themselves. It is not difficult. W.

LETTERS RECEIVED AND SHORT ANSWERS.

K. K. Thanks for your offer, but we are so over-crowded that papers by members of our regular staff are now standing in type because no room can be found for them.—H. F. sends an account of the finding by a gentleman at Rurutoa, an island in the South Pacific, of a plate belonging to a Royal Mail steamer, no vessel of that company's fleet ever having sailed within thousands of miles of the place. Prior to this the brother of the finder, who was purser on board of the *Mexican* R.M.S., went down on that vessel; and the suggestion (for no proof is attempted) is that the plate *may* have belonged to the lost steamer. He also forwards an account of a Mrs. France, the wife of a betting-man in Button-street, Liverpool, who, the night before the Derby was run in 1867, dreamed that Hermit won it in a snowstorm—which, as a matter of fact, he did under those meteorological conditions. The "queer query" might more appropriately go to the *Family Herald*, or some similar paper. I cannot insert mere arithmetical puzzles.—E. W. Barton. I am glad that our Reviews and Inventors' Column please you so. Lectures, unfortunately, irrevocably at an end.—Romeike and Curtice. If you could see, for one brief five minutes, the torrent of matter showered upon the head of the unfortunate Editor of this paper, you would hardly expect him to subscribe for any addition to it in the shape of newspaper cuttings.—F. W. Rudler. Received with thanks.—H. Pilley. If you will look at a globe, you will see that hour circles all meet at the pole. Hence, the farther you go north or south of the equator, the slower any star or heavenly body seems to move in its path. Hence the reduction. I really cannot define cosine here. Buy Hunter's "Elements of Plane Trigonometry," in Gleig's School Series, published by Longmans. OP is got by simply joining O and P; directions being given for finding C O and C P.—Starch asks whether either of the years 1479 or 2992 indicate some great historical era? because, if so, the square in letter 1490 may owe its tremendous powers to the fact. He omits to say whether he refers to the years B.C., Anno Mundi, or what.—W. C. Gurley. Many thanks. It is both curious and interesting. The penumbra certainly arises from reflection from the back of the plate.—J. Murray. My *dear* sir, I know that it must be my own stupidity, I feel it painfully; but I cannot for the life of me make out how (even supposing, as you say, "a sudden change of temperature were to set in, and making everything vice verse") our earth could ever become "as gentle at one end as it is severe at the other." I am equally unable to grasp the idea of temperature and the law of gravitation being "on one scale." While as for drawing "a right angle line through the perpendicular scale of knowledge" (!) I can't do it—I can't, indeed.—H. Edwards. Received.—R. Knight. Light, *per se*, exercises no repulsive influence. Heat is the operative factor in causing the vanes to move in the radiometer.—Samuel Kinns. The Conductor of this journal is not in England.—W. Your general proof will be utilised. In your hypercritical temper you quite ignore the fact that a concrete arithmetical example addresses and interests ten people for every one who cares about the formula whence it is derived.—J. Mercer. I believe that your method (which, by the way, seems to save little or no work) was described in a back volume of the *English Mechanic*.—Henry Peters. The game you describe has been a popular one in drawing-rooms any time during the last two or three years. Undoubtedly the operators, quite unconsciously and innocently, give indications of their wishes to the subject. Presumably you have read the published accounts of the performances of Mr. Stuart Cumberland, Mr. Edwyns, and Mr. Irving Bishop.—Sam Brook. The thing to which you refer was mentioned as a quasi-fraud. Even if I knew its composition I would not communicate it to anybody; but I do not, and do not want to do. See concluding paragraph (in capital letters) of those which head the Correspondence Column.—Nigel Doble. Your dream experiences are of a very common character.—Mark H. Judge. I entirely agree with you that the sooner the British Museum is opened during a portion, at all events, of Sunday, the better.—Henry George. Politics, equally with theology, are excluded from these columns.—James Gillespie. I will *not* write. The gentleman who says that Ursa Major was "right over head" in Australia in June, lies—under some terrible mistake.—Joseph Hudley. Received.—Anonymous. Thanks for kindly sending *The Christian Life*.—W. T. Burn Callander. I have received your "Morven," but, my goodness me! what does it all mean?—Anonymous. The question of Stores *v.* Retail Traders utterly foreign to our purpose.—W. A. says, apropos of letter 1503, that his son writes from the southern hemisphere that he has visited places which he had seen years ago in dreams. The coincidence in the case of his own dream is hardly sufficiently striking to deserve record.—John Gorham. A paper descriptive of your remarkably ingenious and efficient pupil-photometer will appear next week, containing the result of personal experiments with it.—H. A. L. S. Forgive me, I really have no space for sums whose solution may be found in every shilling elementary treatise on algebra ever published.—An Anonymous Correspondent sends me some newspaper cuttings commenting on the fact that, while the English "Fine Art Society" have been refused permission to photograph the pictures in the National Gallery, a German firm, called Braun & Co., have been permitted to do so. This affords but another illustration of the pure and lofty patriotism of Ralph Rackstraw, A.B. of H.M.S. *Pinafore*, who, "in spite of all temptations to belong to other nations, remains an Englishman."—Enquirer. See p. 235.—John Herbert asks Mr. T. Foster to inform him (in connection with "The Mystery of Edwin Drood"), first, whether the correspondence between Dickens and Miss Hogarth and Mr. Forster has been published or not? Secondly, Where the engravings were published which were reproduced on p. 401? Thirdly, What became of Drood's projected visit to Egypt? And fourthly, Why did the old Opium Woman follow Jasper down to Rochester? Mr. Foster is at this moment travelling abroad, but I am pretty sure that Knowledge is posted to him from the office, so that Mr. Herbert's queries will probably reach his eye sooner or later. The pictures appeared on the cover of the monthly numbers as issued.—J. A. Robson. Your first method is neither "legitimate nor reliable. Try another example with different figures (say an obtuse-angled triangle), and see where your formula will land you. There is no more simple geometrical method than your second. If you know the angles at the base of your triangle, it is needless to tell you that the side adjacent to either of such angles × its sine = perpendicular.—Benj. W. Austin. The conductor of this journal has been compelled to make a rigid rule to refuse his autograph: applications for it being too numerous for him to comply with.—Buntona. It is, I think, very doubtful whether the papers by our contributor "Five of Clubs" will appear in a collected form before next year.—Engineer. It is a purely medical question, on which I am incompetent to form an opinion.—Dr. Groth. Your anger only tends to confirm my determination. I did not seek out your theory to attack or assail it gratuitously. You, as I understood, wished for my unbiassed opinion of it; and, preoccupied as I was, I actually read every word of your pamphlet before giving that opinion. Of course, it may be a case of Athanasius *contra mundum*. You may be right and all the rest of the world wrong, but then I am only one of the rest of the world.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

A NEW METHOD OF VENTILATION.

Although good ventilation is universally allowed to be the cardinal condition of a really sanitary house, few buildings, as a rule, are properly ventilated. Ventilation should be simple, as nearly automatic as practicable, and independent of mechanical aids. Mr. W. P. Buchan, sanitary engineer, 21, Renfrew-street, Glasgow, has invented what is known as Buchan's Patent Induced-Current Fixed Ventilator, which is in all ways unique. The ventilator normally has a square chamber in the body, the sides being perforated in the middle.

Opposite each perforated portion there is a metallic double baffle-plate, flat on the inside, but undulating or wave-lined on the outside, thickest in the middle, and tapering off on each side to a sharp edge. Between each two baffle-plates there is a vertical opening. The wind or horizontal air current, in rushing past and between the outside perpendicular plates and the body of the ventilator, draws out with it the air contained within the ventilator, and so causes an up current in the pipe or ventilating shaft upon which the ventilator is fixed. They are free to work with the slightest breath of air, and have shown the most favourable results in experiments made between them and other ventilators. From its construction the induced-current ventilator has not only a strong exhaust power when acted upon by the passing wind, but where there is an inclination to down-draught in the ventilating pipe, upon which it is fixed, this tendency is especially combated. These ventilators are all fixed, and are not liable to get out of order. They are made in a variety of styles, and to suit various purposes.

Mr. Buchan's ventilators and other sanitary appliances hold, we are told, the highest position in the market, being patronised by the Government Departments and the leading architects, physicians, and sanitarians in the kingdom. At Balmoral Castle, the Highland residence of her Majesty the Queen, his ventilators and traps are both in use, the style of the former harmonising remarkably well with the towers and turrets of the Castle.

NON-POISONOUS WATER-PIPES.

Popular science has at length pretty well convinced the public mind of the many perils incurred through defects, mechanical and otherwise, in our ordinary water-service. Messrs. Quirk, Barton, & Co., of 61, Gracechurch-street, E.C., have, by the invention of their patent tin-lined lead-piping, insured to all users thereof an absolute security against lead-poisoning. The piping in question is an improved medium for the supply of pure water to dwellings, affording absolute security from the danger of lead-poisoning. It consists of an inner pipe of pure block-tin encased by one of lead, the two metals being so united as to be inseparable by any contortion. The highest medical and scientific authorities report upon it, as the best and most advisable substitute for lead-pipe. The tin-lined sheet-lead has obviously the same recommendation for lining cisterns, &c., for storing water or other liquids for dietetic purposes.

A SMOKE PREVENTER.

An ingenious device has been patented by Mr. R. Wright Richmond, of Yorkshire, for entirely preventing smoke in any open fireplace. The means employed are simply a fine powder sprinkled on the fire by the agency of an improved kind of dredger. The powder is said to be composed of burned limestone and sea-coal compounded.

THE "UNIVERSITY" DUMB-BELL.

Now that personal hygiene is systematically studied in its muscular aspects by so many among us, an improved dumb-bell is likely to be in great popular demand. Messrs. Hardy & Padmore, of Worcester Foundry, Worcester, have introduced a new invention in this line known as the "University" Dumb-bell, which really supplies the users of dumb-bells with an article whose weight can be increased as the arms become stronger. To effect this end, the extremities of the dumb-bell are made hollow, and fitted with loose screw-caps; into these hollows weights of various diameters can be fitted, so that if one only is used, no noise is heard. The weights are half a pound each. These dumb-bells are well-balanced, and obviously one pair can be made to suit a whole household.

DR. SPENCER THOMPSON'S ORO-NASAL STEAM INHALER.

To those needing vapourised medicines, the substantial comfort of a really good inhaler can hardly be over-estimated. Dr. Spencer Thompson's oro-nasal inhaler is now being introduced into general use by Mr. W. Toogood, of Mount, St. Grosvenor-square, W., and is, *inter alia*, of an unusually elegant form for an inhaler. It is made in terra-cotta, and when nicely painted forms quite an ornament for a bracket or the mantelshelf. The lip of the inhaler is cut away so as to admit mouth and nose; and when filled with hot water, plain or medicated, with mouth and nose in proper position, and a handkerchief thrown round the crevices, it would be difficult to prevent all the air passages from being filled with the vapour, no exertion being needed to draw it to the desired spot. Inhalers are likely to be in demand this winter, and this one has much to commend it to popular use.

IMPROVED BOOT-LASTS.

There can be no question but that it is best, when possible, to have all boots and shoes made to order, and when once a good fit is thus obtained the use of the last renders this advantage permanent. A difficulty hitherto in the way has been the objection of bootmakers to give a small waist and heel with a broad tread, owing to the extreme trouble experienced in getting such a last out of the boot when the welt has been attached to the sole. In repairing boots, too, full-sized lasts cannot be used with certain classes of work. Messrs. Hartley, of 50, Abbey-road, Accrington, have now, however, patented a shoemakers' last and stand specially designed to remedy these defects. The lasts are divided vertically, or nearly so, and in such a manner as to lock themselves fast in when in use, in place of being, as heretofore, in one solid piece. Thus the separate pieces may be inserted in the boot or shoe separately, and removed by the agency of the usual last-hook. The frames are made to suit all sizes, and the patent swivel, self-locking, riveting, and finishing stand holds the last in any required position. This invention will be found a great advantage to those persons who desire to have boots or shoes made to order, and sometimes in a special manner.

MIDLOTHIAN OAT FLOUR.

Messrs. A. R. Scott, of 59, Crookston-street, Kingston, Glasgow, claim to have an important dietetic invention in what is known as Scott's Midlothian Oat Flour. The value of oatmeal is well known *per se*, and in this preparation both the husk and vegetable fibre are entirely removed, this beneficial process being effected by machinery of the most recent type, constructed with all the latest improvements, and with special attention to its adaptation to the production of the finest and purest quality of flour. To the elimination of the innutritious portions of the oatmeal, Messrs. Scott have devoted particular care, as may be inferred when we state that the result of a careful analysis made by Dr. William Wallace (the public analyst of Glasgow, Perth, Ayr, &c., and for the counties of Lanark, Renfrew and Sutherland), shows that the flour contains 80 per cent. more flesh and bone-forming properties than the finest oatmeal. This is a fact that is not generally known, but one that will not be lost on those who value health, especially in the cases of young growing children.

A TECHNICAL DRAWING APPARATUS.

Draughtsmanship is so much on the increase in these days of technics popularised, that many will be practically interested to know that a technical drawing apparatus, patented by Messrs. Cory & Barczinsky, is manufactured by Mr. W. H. Harling, 40, Hatton-garden, London, E.C. It is a combination of square, set squares of all angles, and protractor; and besides doing the work of each and all of these, it will divide circles or parts of circles into any number of equal parts without calculation. The instrument consists of a square (42 in. or 32 in.) with two stocks, one of which is fixed and the other movable. The blade of the square has two inverted grooves in which slides the dial. This dial, which is made of brass, is graduated into half-degrees, and is fitted with an indicator and arm, or ruler, also of brass (these latter in one piece, and so arranged that when the indicator shows a certain angle the ruler forms that angle with a perpendicular to the edge of the square), at the important angles, viz., 30°, 45°, 60°, 67½°, and 90°. There are special divisions near the edge into which a small knife fitted to the indicator drops and fixes it firmly, the degrees being read through an aperture in the end of the indicator. There is a small screw to lift the knife out of the division when the angle is wanted to be altered. This apparatus is made to divide circles into equal parts from two to thirty-two; but it can also be constructed so as to divide circles into more than 32 parts. The advantages of such an apparatus are sufficiently obvious.

Our Chess Column.

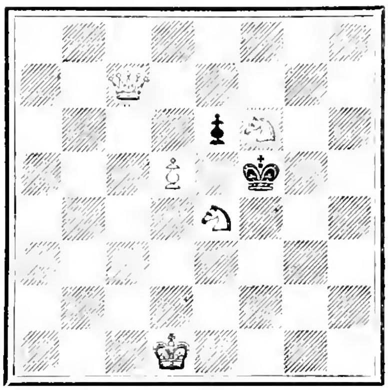
By Mephisto.

PROBLEM No. 137.

By J. B. (of Bridport).

(Selected.)

Black.



White.

White to play and mate in three moves.

SOLUTION.

Problem No. 135, by H. F. L. Meyer, p. 414.

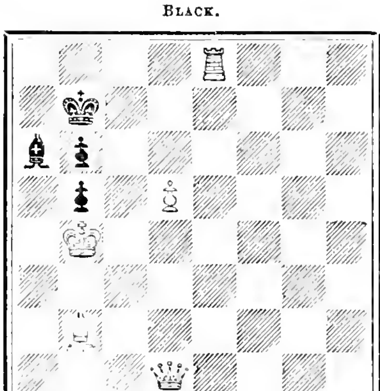
1. R to KKt sq.	K to Q6
2. R to R sq.	K to K5 or 7, B5 or 7
3. Q to QKt sq., Q sq., or KB sq. mate.	
1. (a)	K to B4
2. Kt to B2	P × Kt
3. P to Kt4 mate.	
1. (b)	P × R
2. Kt to B2 (ch)	Any
3. Q to R7 mate.	

In reference to this beautiful Problem and the remarks of "Clarence," a correspondent informs us that "Clarence" is not quite correct in stating that the above Problem is after Healey, though it is true that Meyer improved upon Healey's idea by substituting a move of the B for the R. The idea of No. 135 was worked out both by Lloyd and Thinkman in two separate problems, both of which, however, were incorrect. The following is the Problem:—

PROBLEM No. 138.

By H. F. L. Meyer.

Black.



White.

White to play and mate in three moves.

One of thirty simultaneous games played by Mr. Zukertort, at Bradford, on the 20th inst.:—

Ruy Lopez.

White. Mr. Macmaster.	Black. Mr. Zukertort.	White Mr. Macmaster.	Black Mr. Zukertort.
1. P to K4	P to K4	12. P to K5	Kt to Q2 (a)
2. Kt to KB3	Kt to QB3	13. P to Q4	P to B3
3. B to Kt5	Kt to B3	14. P to B4	Q to Kt3
4. P to Q3	B to B4	15. R to K sq.	P × P
5. Castles	Kt to Q5	16. P × P	P to B4 (b)
6. B to K3	P to B3	17. P to K6	Kt to B3
7. B × Kt	B × B	18. P to K7	R to K sq.
8. Kt × B	P × Kt	19. B × R	Kt × B
9. B to R4	Castles	20. R to KB sq.	Kt to B3
10. P to QB3	P × P	21. R × Kt	Resigns
11. Kt × P	P to Q4		

NOTES.

(a) Black had up to now the better game, but here he ought t have continued with 12. Kt to Kt5, and, after White's forced answer, P to Q4, 13. P to B3, &c.

(b) A blunder, which loses the game. White takes immediate advantage in very good style.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Littlehampton.—See solution above.

S. B. C., J. J. Credlon, M. T. Hooton, R. Champ, and W. Furnival.—Solutions correct.

We hear that "John Bull's Neighbour in her True Light," which we reviewed on p. 75, is being translated into Russian, and will be issued in St. Petersburg at the beginning of the new year.

The Queen has forwarded, through General the Right Hon. Sir Henry F. Ponsonby, K.C.B., a present of books to the Bethnal Green Free Library. The books contain an inscription with her Majesty's signature.

Experiments have for some time been made in Belgium for preserving wood by exhausting the air from the pores and filling them with liquid gutta-percha. The gutta-percha is liquefied by mixing it with paraffin and subjecting it to heat. After it is introduced into the pores it hardens as it becomes cold.

Mr. Lowthian Bell has given figures showing that in the aggregate 156,499,000 tons of coal were brought to the surface in the United Kingdom in 1882, and that of this vast quantity 99,189,100 tons were applied to mechanical uses, while 57,309,800 were employed for heating only. The following table shows approximately the destination of the year's produce:—

Use.	Out of every 1,000 tons.	Total estimate of appliance —tons.
Paper-making and tanning	6	939,000
Copper, lead, tin, and zinc smelting	8	1,252,000
Waterworks	14	2,191,000
Breweries and distilleries	18	2,817,000
Chemical manufactories	19	2,973,000
Railways	20	3,130,000
Steam navigation	30	4,695,000
Clay, glass, and lime kilns	31	4,851,500
Textiles	42	6,573,000
Gasworks	60	9,390,000
Mining operations	67	10,485,500
Coal exported	92	14,398,000
Steam-engines	121	18,936,000
Iron and steel works	300	46,950,000
Domestic use	172	26,918,000
	1,000	156,499,000

Contents of No. 160.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED-EXACTLY DESCRIBED

LONDON: FRIDAY, DEC. 5, 1884.

CONTENTS OF No. 162.

THE CHEMISTRY OF COOKERY.

BY W. MATTIEU WILLIAMS.

XLVIII.—THE WEAR AND TEAR OF THE BODY.

IN the course of these papers I have repeatedly spoken of the nitrogenous and non-nitrogenous constituents of food, assuming that the nitrogenous are the most nutritious, are the plastic or flesh-building materials; and that the non-nitrogenous materials cannot build up flesh or bone or nervous matter, can only supply the material of fat, and by their combustion maintain the animal heat.

In doing so I have been treading on loose ground—I may say, on a scientific quicksand. When I first taught practical physiology to children in Edinburgh, many years ago, this part of the subject was much easier to teach than now. The simple and elegant theory of Liebig was then generally accepted, and appeared quite sound.

According to this, every muscular effort is performed at the expense of muscular tissue; every mental effort, at the expense of cerebral tissue; and so on with all the forces of life. This consumption or degradation of tissue demands continual supplies of food for its renewal, and as all the working organs of the animal are composed of nitrogenous tissue, it is clearly necessary, according to this, that we should be supplied with nitrogenous food to renew them, seeing that the nitrogen of the air cannot be assimilated by animals at all.

But besides doing mechanical and mental work, the animal body is continually giving out heat, and its temperature must be maintained. Food is also demanded for this, and the non-nitrogenous food is the most readily combustible, especially the hydro-carbons, or fats; the carbo-hydrates—starch, sugar, &c.—also, but in lower degree. These, then, were described as fuel food, or heat-producers.

This view is strongly confirmed by a multitude of familiar facts. Men, horses, and other animals cannot do continuous hard work without a supply of nitrogenous food; the harder the work the more they require, and the greater becomes their craving for it. On the other hand, when such food is eaten in large quantities by idle people, they become victims of inflammatory disease, or their health otherwise suffers, according, probably, to whether they assimilate or reject it.

Man is a cosmopolitan as well as an omnivorous animal, and the variations of his natural demand for food in different climates affords very direct support to Liebig's theory. Enormous quantities of hydro-carbon, in the form of fat, is consumed by the Esquimaux and by Europeans when they winter in the Arctic regions. They cannot live there without it. In hot climates *some* fuel food is required, and the milder form of carbo-hydrates is chosen, and found to be most suitable; rice, which is mainly composed of starch, is an example. Sugar, also. Offer an Esquimaux a tallow candle and a rice pudding, he will reject the latter, and eat the former with great relish.

A multitude of other facts might be stated, all supporting Liebig's theory.

There is one that just occurs to me as I write, which I will state, as it appears to have been hitherto unnoticed. Some organs which act in such wise that we can *see* their mode of action are visibly disintegrated and consumed by their own activity, and may be seen to demand the perpetual renewal described by Liebig. There are certain glands of cellular structure which cast off their terminal cells containing the fluid they secrete; do their work by giving up their own structural substance at their peripheral working surface.

Where, then, is the quicksand? It is here. If muscular and mental work were done at the expense of the nitrogenous muscular and cerebral tissues, the quantity of nitrogen excreted should vary with the amount of work done. This was formerly stated to be the case without hesitation, as the following passage from Carpenter's "Manual of Physiology" (3rd Edition, 1856, page 256) shows: "Every action of the nervous and muscular systems involves the death and decay of a certain amount of the living tissue—as is indicated by the appearance of the products of that decay in the excretions."

More recent experiments by Fick and Wislicenus, Parkes, Houghton, Ranke, Voit, Flint, and others contradict this by showing that the waste nitrogen varies with the quantity of nitrogenous food that is eaten, but not with the muscular work done. For the details of these experiments I must refer the reader to standard *modern* physiological treatises, as a description of them would carry me too far away from my immediate subject. (Dr. Pavy's "Treatise on Food" has an introductory chapter on "The Dynamic Relations of Food," in which this subject is clearly treated in sufficient detail for popular reading.)

It is quite the fashion now to rely upon these later experiments; but, for my own part, I am by no means satisfied with them—and for this reason, that the perspiration from the skin and the vapour from the lungs were not examined. It is just these which are greatly increased by exercise, and their quantity is very large, especially those from the skin, which are threefold, viz., the insensible perspiration, which is transpired by the skin as invisible vapour, the sweat, which is liquid, and the solid particles of exuded cuticle.

Lavoisier and Seguin long ago made very laborious experiments upon themselves in order to determine the amount of the insensible perspiration. Seguin enclosed himself in a bag of glazed taffeta, which was tied over him with no other opening than a hole corresponding to his mouth; the edges of this hole were glued to his lips with a mixture of turpentine and pitch. He carefully weighed himself and the bag before and after his enclosure therein. His own loss of weight being partly from the lungs and partly from the skin, the amount gained by the bag represented the quantity of the latter; the difference between this and the loss of his own weight gave the amount exhaled from the lungs.

He thus found that the largest quantity of *insensible* exhalation from the lungs and skin together amounted to 3½ ounces per hour, or 5¼ lb. per day. The smallest quantity was 1 lb. 14 oz., and the mean was 3 lb. 11 oz. Three-fourths of this was cutaneous.

These figures only show the quantity of insensible perspiration during repose. Valentin found that his hourly loss by cutaneous exhalation while sitting amounted to 32·8 grammes, or rather less than 1¼ ounce. On taking exercise, with an empty stomach, in the sun, the hourly loss increased to 89·3 grammes, or nearly three times as much. After a meal followed by violent exercise, with the temperature of the air at 72° F., it amounted to 132·7 grammes, or nearly 4½ times as much as during repose. A robust man, taking violent exercise in hot weather, may give off as much as 5 lb. in an hour.

The third excretion from the skin, the epithelial or superficial scales of the epidermis, is small in weight, but it is solid, and of similar composition to gelatine. It should be understood that this increases largely with exercise. The practice of sponging and "rubbing down" of athletes removes the excess; but I am not aware of any attempt that has been made to determine the quantity thus removed.

Does the skin excrete nitrogenous matter that may be, like urea, a product of the degradation or destruction of muscular tissue?

The following passage from Lehmann's "Physiological Chemistry," Vol. ii., 389, shows that the skin picks up plenty of nitrogen from somewhere :—"It has been shown by the experiments of Milly, Jurine, Ingenhouss, Spallanzani, Abernethy, Barruel, and Collard di Martigny, that *gases*, and especially *carbonic acid* and *nitrogen*, are likewise exhaled with the liquid secretion of the sudiparious glands. According to the last-named experimentalist, the ratio between these two gases is very variable; thus, in the gas developed after vegetable food, there is a preponderance of carbonic acid, and after animal food, there is an excess of nitrogen. Abernethy found that on an average the collective gas contained rather more than two-thirds of carbonic acid and rather less than one-third of nitrogen." But it appears that less gas is exhaled when there is much liquid perspiration.

Lehmann's summary of the experiments of Abernethy, Brunner, and Valentin (Vol. ii., page 391), gives the amount of hourly exudation, under ordinary circumstances, as 50·71 grammes of water, 0·25 of a gramme of carbon, and 0·92 of a gramme of nitrogen. This amounts to 21½ grammes of nitrogen per day in the *insensible* perspiration; three-quarters of an ounce avoirdupois, or as much nitrogen as is contained in 4½ oz. of dried muscle, or more than 1 lb. of natural living muscle.

That the liquid perspiration contains compounds of nitrogen, and just such compounds as would result from the degradation of nitrogenous tissue, is unquestionable. As Lehmann says (Vol. ii., page 389) "the sweat very easily decomposes, and gives rise to the secondary formation of ammonia." Simon and Berzelius found salts of ammonia in the sweat, that the ammonia is combined both with hydrochloric acid and with organic acids; that it probably exists as carbonate of ammonia in alkaline sweat.

The existence of urea in sweat appears to be uncertain; some chemists assert its presence, others deny it. Favre and Schottin, for example, who have both studied the subject very carefully, are at direct variance. I suspect that both are right, as its presence or absence is variable, and appears to depend on the condition of the subject of the experiment.

Favre describes a special nitrogenous acid which he discovered in sweat, and names it *hydrotic* or *sudoric acid.* Its composition corresponds, according to his analysis, to the formula $C_{10}H_8NO_{13}$.

I have summarised these facts, as they show clearly enough that conclusions based on an examination of the quantity of nitrogen excreted by the kidneys alone (and such is the sole basis of the modern theories), are of little or no value in determining whether or not muscular work is accompanied with degradation of muscular tissue. The well-known fact that the total quantity of excretory work done by the skin increases with muscular work, while that from the kidneys rather diminishes, indicates in the plainest possible manner that an examination of the skin secretion should be primary in connection with this question.

Seeing that this has been entirely neglected, I am justified in expressing, very plainly and positively, my opinion of the worthlessness of all the modern research upon which the alleged refutation of Liebig's theory of the destruction and renewal of living tissue in the performance of vital work is based, and my rejection of the modern alternative hypothesis concerning the manner in which food supplies the material demanded for muscular and mental work.

I may be accused of rashness and presumption in thus standing almost, if not quite, alone in opposition to the overwhelming current of modern scientific progress. Such, however, is not the case. It is modern scientific *fashion*, rather than scientific *progress*, that I oppose. We have too much of this millinery spirit in the scientific world just now; too much eagerness to run after "the last thing out," and assume, with undue readiness, that the "latest researches" are of course, the best—especially where fashionable physicians are concerned.

CHATS ABOUT GEOMETRICAL MEASUREMENT.

BY RICHARD A. PROCTOR.

(*Continued from p.* 417.)

A. We come now to the measurement of areas bounded by curves. Does this involve a new application of the principle you have indicated, or are new principles involved?

M. No new principles are involved. In all problems of geometrical measurement you have to determine an amount, and you must do it by dividing up the quantity you wish to measure into parts which you can deal with simply and add together conveniently,—

A. But that sounds like a truism.

M. It is one. But you spoke too soon. As a matter of fact, you cannot divide curved arcs or areas bounded by such curves, or curved surfaces, or volumes, into such parts, —that is where the difficulty comes in. You must adopt some device by which though you necessarily leave out portions of the quantity you are dealing with, you may yet be able to show that those portions can be neglected, *because* they may be made less than any quantity, however small, which can be named.

A. Give me an example,—something concrete.

M. An area bounded by a curved line will be just what you want :—Suppose O M X, O A Y, two lines at right angles to each other; A P B a curved arc; B M perp. to O X, and that the area you wish to determine is that enclosed between the straight lines O A, O M, M B, and the curved arc A P B. You can divide this area by a series of such parallels as are shown in Fig. 1,—say equidistant parallels,—into spaces such as L P Q N, in which, since P Q is curved, you would seem to have the same difficulty to deal with as in the original figure. But if you complete the rectangles N l, L n, you see that the area P Q l is very small compared with either of these rectangles; and you can easily see that if the strip P N is made very narrow indeed the area P Q l might be neglected, compared with Q L or P N, either of which rectangles you might take, instead of P Q L, without appreciable error. Doing this for the whole area you have rectangles to deal with, instead of surfaces bounded by a curved line, or by curved lines.

A. Yes!—but—though you thus make each little area as P Q l very small, you make the number of such areas very large, and a very large number of very small things may make an appreciable total.

M. True; but if each such part as P Q l is very small compared with the total area P Q N L, must not the sum of all such parts be very small compared with the sum of all such areas?—or in other words must not all the little areas like P l Q, taken together, be insignificant compared with the area A B M O?

A. I cannot say I quite see this.

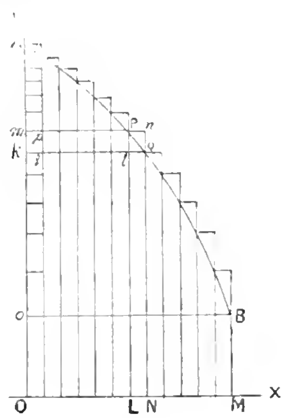


Fig. 1.

M. Suppose P l Q a millionth part of P Q N L, and none of the other small areas like P l Q to be *more* than a millionth part of the area like P Q N L of which it is a portion. Would not all such areas as P l Q, together, be less than a millionth part of the area A B M O?

A. Yes. I see that. But it does not seem possible to prove that you can so arrange matters that such areas as P l Q may be any given very small proportion of such areas as P Q N L.

M. Why, regarding P for the moment as fixed, may not Q be brought so close up to P that P l may be as small as we please, and therefore the rectangle $l\,n$ bear as small a ratio as we please to the rectangle Q L. If this is done, then assuredly the area P l Q will bear a smaller ratio still to Q L. Suppose you wanted P l to have some given value; well, all you have to do is to measure off P l of that value, and from l to draw l Q parallel to O X; then you have your points P, Q, from which to draw parallel perpendiculars to O X.

A. The proof, I see, depends on making the parallels of Fig. 1 as close together as possible.

M. Quite so. And we may easily prove the soundness of the conclusion we have just reached. From P Q draw P p m, Q q k, perpendicular to A O, and let a series of such perpendiculars be drawn from all such points as P, Q, &c., B o being the last of them. Then if the parallels are equidistant the rectangle $l\,n$ is equal to the rectangle $p\,k$, and the like for all such rectangles as $l\,n$; giving, for the sum of them all, the rectangle $o\,a$, and therefore for the sum of all such areas as P l Q an area less than the rectangle $o\,a$. But $o\,a$ may be made as small as we please by sufficiently increasing the number of the parallels. Even if the parallels are not equidistant, the proof remains good, so long as the greatest distance between the parallels may be made eventually as small as we please. For obviously the rectangle we then get instead of $a\,o$ may also be made less than any area which can be assigned.

A. But now, all this is very indefinite. What *is* the curve A P B? and how can such a series of parallels be drawn as your argument requires?

M. There is no more occasion for actually drawing such parallels, than for making our straight lines, circles, &c., in ordinary geometry, be perfectly accordant with the definitions.

A. But will you not give an instance of the actual application of this method?

M. Certainly. Let us take my old friend the cycloid, which affords more examples of various ways of measuring areas than any curve I know of. I will take one of the simplest proofs of the area of the cycloid from among nearly a score which I have given in my "Geometry of Cycloids."

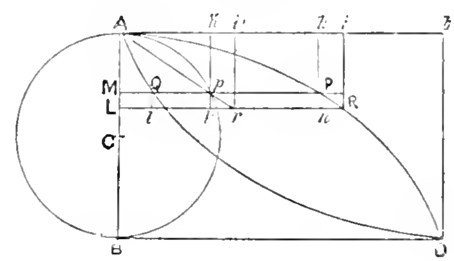


Fig. 2.

Let A P D, Fig. 2, be a half cycloid, A B its axis, A p B half the rolling circle. We want to find the area A P D B. Complete the rectangle A B D b, whose area (since B D is equal to arc A p B) is equal to twice that of the rolling circle. Let A Q D be an equal half cycloid having D b as axis. Then if m Q p P be drawn parallel to A b we know that

$$\text{M P} = \text{arc A}p + \text{M}p$$
$$\text{and M Q} = \text{arc A}p - \text{M}p$$

Hence, subtracting, Q P = 2 M p

Therefore, if we draw a parallel L $l\,k\,n$ R very near indeed to M P, as in Fig. 2,

$$\text{rectangle Q}n = 2 \text{ rect. M}k.$$

Imagine an immense number of such parallels athwart the semicircle and the cycloids. The sum of all the rectangles in the space A P D Q is equal to twice the sum of all the rectangles in the semicircle Ap B. Wherefore eventually (when the number of parallels becomes indefinitely large) we have

$$\text{Area A P D Q} = 2 \text{ semicircle A}p\text{B} \quad \text{(i.)}$$

But (since rect. B6 = 2 rolling circle),

$$\text{A Q D B} + \text{A P D}b = 2 \text{ semicircle A}p\text{B}$$

or, $$\text{Area A Q D B} = \text{semicircle A}p\text{B} \quad \text{(ii.)}$$

∴ adding (i.) and (ii.),

$$\text{Area A P D B} = 3 \text{ semicircle A}p\text{B}$$

or, the *area of a cycloid is equal to thrice the area of its generating circle.*

A. That is very curious. Let me see,—I want another figure to make the matter clear to me, and to see some of its consequences. I take the oddly-shaped space A Q D P, and set the rolling circle of either cycloid midway upon it, as at $L a M b$, so that $L c M$ its horizontal diameter meets A Q D, D P A in L and M. Then the circle $a L a M b$ is equal to the figure A P D L. I join A D (passing, obviously, through c). Then A P D Q is divided into two equal parts, each equal to a semicircle F A G or F b G. The spaces A K L, M N D, are equal; and each is obviously equal to either of the equal spaces K a M, L b N. Again, any space like A P Q is equal to the corresponding segment

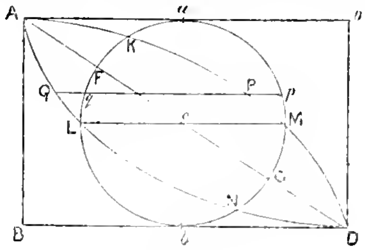


Fig. 3.

$a q p$,—Q q P p being parallel to A b, B D. Also A K q Q is equal to a K P p; and Q q L is equal to P p M. What a number of odd relations, each one of which seems unprovable directly, seem to come in!

M. You would find each one of these relations readily demonstrable, independently of the general result. Considering such corollaries one often recognises simpler proofs of the main proposition. You will find several examples of this in my "Geometry of Cycloids."

A. I see that, reverting to Fig. 2, the area A P D b must be equal to the semicircle A p B. Can this be proved directly?

M. It can; but I will leave this to you as an exercise. Begin thus,—From P, R, draw P h, R i perp. to A b. Then, noting that by a property of the cycloid the tangent at P or R has ultimately (when these points come near enough together) a direction parallel to A p, show that the rectangle P i is equal to the rectangle L p. This you will find easy by making a rectangle corresponding to P i, in all respects, as shown at $p i'$: this rectangle and L p are complementary, and therefore equal. The rest should be easy. But, should you fail, note that the next example, which will relate to the area of a parabolic segment, will show the method fully.

(*To be continued.*)

SUN-SPOTS, TEMPERATURE, AND THE AFTERGLOW.

In an excerpt from his "Memoirs of Life and Work," Dr. C. J. B. Williams, F.R.S., has published an account of a series of observations made at Cannes which possess sufficient interest to render some notice of them desirable. After speaking of the beginning of 1883 as a period of sun-spot maximum, he goes on to say:—"But on Feb. 28, 1883, I was surprised to find the sun without a spot. On March 3 I observed again, and still found no spot. The next day began a fall of temperature of 6° Fahr., with a high wind from the north-east, which continued till March 7, when there came on a heavy snowstorm, covering the ground to the depth of eight inches, and causing great destruction in my garden, bearing down and breaking many valuable trees and shrubs. This was followed by a fall of temperature to five, six, and seven degrees below freezing, even in my sheltered situation: in more exposed places it fell four and five degrees lower. Such cold had not visited Cannes before for sixty years; and it was the more remarkable as the previous part of the winter had been quite mild, only two or three times reaching the freezing-point. This severe weather lasted till the middle of March, when the sun-spots began to re-appear, and the average temperature to rise in proportion." A similar fall in temperature, we may note, occurred in the month of December, at a time when the solar disc was free from signs of disturbance.

In order, however, to prove that this quiescence of the sun's surface, and a merely local fall in terrestrial temperature, stood in the relation of cause and effect, it would be very desirable, if possible, to collect data as to the meteorological conditions at Cannes during the years 1870 (maximum period), 1878 (minimum), and so on; and to ascertain how far temperature was simultaneously affected elsewhere.

Another statement of Dr. Williams's will certainly possess the charm of novelty. We refer to his announcement that Mr. J. F. Campbell, of Islay, has invented what he calls a "Pictorial Thermometer, which marks degrees of heat by certain changes of colour in Prussian blue, Scheele's green, and other pigments." Assuming (in the absence of any description) the indications of this instrument to be trustworthy, it is interesting to read:—"1. That an area in a solar image, focussed on a sensitive screen, in the proportion of $\frac{2}{3}$, is much hotter than the rest, as proved by colours which record temperatures. 2. It was clearly proved that sun-spots, while within the hot area, radiate much more heat than the rest of the area. Spots were seen to draw hot traces repeatedly. 3. The same spot, when outside of that hotter area, radiates less heat than the rest of the visible sun. Mr. Campbell further informs me that he actually measured the heat of the sun on the spotless day, December 5, which I have recorded, and that it did not rise higher than 1100° Fahr.; while on many previous days, with many spots, it reached 1600° and upwards."

Here again, however, some check on or control of the observations recorded would seem desirable. Dr. Williams' observations of the afterglow differ in no material respect from those of hundreds of others which have been made all over the world. In opposition, however, to what he excellently describes as the "sensational expansion of Mr. Meldrum's hypothesis of volcanic dust," which appeared in the *Times* at the beginning of last December, he makes the infinitely more rational and scientific suggestion that it is ice-dust in the higher regions of the atmosphere which has been the chief operative agent in the production of the exquisite phenomena with which we are now familiar. It is needless to point out that this, if accepted as a *vera causa*, would explain the apparition of the afterglow at the beginning of 1883, six months before the Krakatoa eruption ever took place at all! (*Vide* Knowledge, Vol. V., p. 418.)

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

ABOVE THE SURFACE (*continued*).

The transition from the obscure, sluggish, and inoffensive stone-flies and alder-flies to the brilliant, active, and rapacious dragon-flies, which are the most highly predaceous of all the insect denizens of the air, is, indeed, a passage from one extreme to the other, so far as habits are concerned, and well illustrates the heterogeneous composition of the order Neuroptera, of which the dragon-flies are usually regarded as forming the section Odonata. We have already seen how these creatures comport themselves in their early days, and we left them airing their newly-acquired wings just after exclusion from the pupa or nymph-case. In general appearance a dragon-fly is probably as well known and as easily recognised as any insect. The glistening aspect of the four ample wings, the length and slenderness of body, the brilliancy of colour, the vigour of flight, are all characteristics which even careless observers must have noticed again and again, and which, once seen, are not easily forgotten.

We have about fifty British species of these insects. Some of them are popularly called Horse-stingers, a sobriquet which, suggested no doubt by the long, narrow body and bold and ferocious aspect of the insects, and apparently confirmed by their writhing contortions when seized, and their attempts to reach with their tails the hand that seizes them, is nevertheless an instance of most absurd misnaming. They have no power whatever of stinging, any more than any other of the Neuroptera, the members of which order are, so far as any *such* power is concerned, the most harmless set of insects imaginable. The body is very generally narrow and cylindrical, but not always so; there are a few instances in which it is broad and somewhat flattened, and at the same time proportionately shorter than usual. It is at its broadest in the genus *Platetrum*, the single species of which—*P. depressum*—with its pale blue (male) or yellow (female) body, is one of the most familiar of the whole group. Though so long, the body does not consist of a larger number of segments than usually compose this part of an insect; but, just as there is the same number of vertebræ in the long neck of the giraffe as in the short one of the elephant, so the linear extension of the body of the dragon-fly is produced, not by a multiplication of the number of the joints, but by their individual elongation. To so great an extent is this carried that in one exotic species we find a body of 6 in. long, though the wings are only of ordinary size.

No doubt these long bodies are serviceable in guiding the creatures in their flight, and they also render possible the deposition of the eggs in suitable positions at some distance below the surface, without the disagreeable expedient of a dive on the part of the mother, though, in some cases, maternal solicitude does not hesitate even to run this risk, if the supreme end cannot otherwise be attained. Westwood says that he has also seen the females beat their tails upon the surface of the water with rapid succession, till the eggs form a mass like a bunch of grapes; and another author records having seen them beating the sand close by the edge of the water, an operation which, it has been suggested, may have for its object rather the covering of eggs already laid, than the actual laying of them.

The thorax has a great vertical diameter, and thereby acquires a hunchbacked appearance; this is, of course, necessary for the proper lodgment of the powerful muscles that move the wings. The wings themselves are remarkable for the enormous number of reticulations with which they are covered. There are a few main nervures branching out from the base of the wing, and running more or less longitudinally, and the spaces between these are divided into a vast number of minute four-, five-, or six-sided spaces, which are smallest at the tip and hinder edge. The number of meshes is smallest, and the individual meshes largest, in the smallest and most delicate and slender species, the Agrionidæ, while the Calopterygidæ—*i.e.*, those whose wings are dark metallic blue or green—have the greatest number of reticulations, extending to some 1,500 or more on each wing.

The head is differently shaped in different families, but the huge masses of compound eyes almost always occupy a very large proportion of its surface. These insects are the keenest possible of hunters, relentlessly pursuing to the death any creature on whose tender body they have set their gastronomic affections, and hence their remarkably good eyesight, which, by giving them a wide range of vision, enables them easily to descry their prey in the first instance, and also to follow it in all the intricacies of its movements, dodging it from place to place till it is hunted down. There are few more beautiful objects in the whole range of the insect world than the eye of a *living* dragon-fly, such as that which is often seen hawking about over ponds or down the neighbouring woody glades, the great *Æchna cyanea*, one of the largest and commonest of our native species, with clear wings, and body prettily spotted with green and blue on a black ground. Apart from the mere glistening of the surface, which is in itself no slight adornment, there is a marvellous play of colours in the interior as the light falls at different angles that altogether baffles description, and must be seen to be appreciated; unfortunately, no trace of these beauties can be preserved after death, and the eyes become little more than opaque brown masses, retaining only the most shadowy relics of their former brilliancy. The nature of the exterior, however, can be seen better in the dead than in the living insect. Very little magnification is necessary to show that the surface is not uniform, but is broken up into an enormous number of extremely minute spaces, which greater magnification shows to be of hexagonal form. The chitinous skin that covers the whole body of the insect is continued over the eye as a transparent layer, or—to use the terminology of vertebrate anatomy—cornea, and it is this that is divided into hexagonal facets, each one of which is generally somewhat convex on both its external and internal surfaces, and contains in and beneath itself all that is necessary to produce complete vision, and this is what is meant when it is said that an insect's eye is compound. But it no more follows from this arrangement that an insect is gifted with multiple vision than that we ourselves with our two eyes see double. The eyes in our present insects form two rounded surfaces, which occupy the whole of the sides of the head, and often even meet above on the middle of the crown, thus extending all round the head from one angle of the mouth to the other. From that part of the nervous system which, in an insect, to some extent does duty for a brain, passes the optic nerve on each side into the centre of the rounded space thus enclosed, and there expands into a broad knob, from which delicate threads, surrounded with dark colouring matter, and ending in inverted cones of a highly-refracting medium, pass to the inner edge of the facetted parts of the cornea. The latter act as lenses, and produce the necessary convergence of the rays of light, and thus at every point of this vast surface light can be received and utilised for the production of vision. What the exact nature of the image produced, what the degree of accuracy with which it is perceived, who shall attempt authoritatively to decide? though it can scarcely be doubted that vision is of a high order, else the insect would hardly be able so readily and speedily to adapt its own movements to those of the quarry it pursues.

In the centre of the head, at the inner edge of the eye-masses, are two apparently bristle-like, but really jointed, appendages, which are all the insect possesses in the way of antennæ, and they are so inconspicuous as easily to escape notice altogether. Just below these, the centre of the head bulges out into a rounded protuberance, below which again are placed the organs of the mouth. These are very complicated; two flaps open above and below, and then the jaws proper are seen working laterally. They are armed with sharp-pointed and powerful teeth, which easily make havoc with the tissues of any insect that once gets within range of their action. The head is attached to the thorax by a very slender junction, and can, therefore, to some extent, be rotated thereon. When the insect is dead, this slenderness of attachment is a serious trouble to the collector, as his dried specimens manifest great readiness to part with their heads if at all rudely handled, or even if suddenly jarred, and he is then fain to collect the scattered members and gum them on again to the best of his ability. With equal, or even greater, readiness do the long slender bodies break off, and to guard against such a calamity, collectors have been recommended to run a fine piece of wire up the body while it is still fresh, and fix one end of it firmly in the thorax.

The male carries at the end of his abdomen some appendages which are, no doubt, partly responsible for the rustic theory of stinging, before alluded to; but they are simply clasping organs used by the gentleman for the abduction of his bride; for the courtship of these insects is conducted in a most peculiar way. With his claspers the lover seizes his betrothed by the neck, and the two then fly about in line, one behind the other, tandem-fashion, ever and anon dipping down towards the water till the lady's tail just touches the surface, then darting up again to resume their social flight.

When at rest, the wings are either spread out horizontally, as is the case with the larger and stouter-bodied kinds, or folded up over the back like those of a butterfly, as with the smaller and more slender-bodied ones. Amongst the larger species, an individual will often manifest a remarkable predilection for some particular twig as a place of rest, and notwithstanding repeated disturbances and dislodgments, will persistently return to that small perch, which seems to stand to it in place of home, though, so far as the ignorant human biped, who is evidently no connoisseur in such matters, can judge, there are plenty of others all round that seem equally well adapted for the purpose. Here, however, the creature sits, motionless as death, with its body placed at an angle with the twig, till the spirit of adventure again seizes it, when it suddenly darts off on its dashing career, ever seeking whom it may devour. Dragon-flies feed upon all sorts of insects that are found in such numbers in the neighbourhood of water, easily catching and devouring their prey on the wing. Their voracity is great, and their appetite not easily satisfied, and in consequence they are favoured with a degree of longevity greatly in excess of that of the rest of the Neuroptera. On the continent and in America prodigious swarms are sometimes observed migrating from one district to another. Each swarm consists of insects belonging to a single species, and so vast are their numbers that they sometimes take many hours to pass a given spot. Predaceous and courageous though they are, while thus migrating many fall victims to the attacks of insectivorous birds, which pursue them, nothing daunted by their numbers. A tropical species of bee-eater is said to line its nest with the wings of dragon-flies.

(*To be continued.*)

Erratum.—Column two, p. 443, "Table of Elements":—"Earth's *Daily* Motion in R.A., 34′ 13″·5," should have been "Earth's *Hourly* Motion in R.A., 34′ 13″·5."

It is proposed to establish a memorial to Dr. Rabbeth, who lost his life in attempting to save a child suffering from diphtheria, at the Royal Free Hospital, on Oct. 20. Any who may wish to express their practical appreciation of the brave and gallant conduct of this most worthy and lamented young member of a noble profession, can send their subscriptions to Drs. Cromon and Hayes, or to Mr. T. S. Short, at King's College.

THE WORLD'S FIRST MERIDIAN.

By Richard A. Proctor.

Despite the opposition of the French, Brazilian, and Haytian astronomers (a rather singular combination), the meridian of Greenwich has been adopted as the astronomical and geographical reference meridian for the world, and hereafter we may expect uniformity to prevail in maps and charts, in nautical almanacs, and in tables of reference alike for terrestrial and celestial computations. Of course, there will be no noteworthy change in the ordinary measurement of time in different countries or cities. At New York and Washington, for instance, where when it is noon in England it is only about seven in the morning, and only seven in the evening when it is midnight in England, they will not, because of the adoption of the Greenwich meridian, call it noon or midnight when the sun gives them so different a time of day. Ordinary or civil time will always be reckoned pretty nearly by the sun—not exactly, of course, for the simple reason that in that case every journey east or west would involve a change of clock time. Just as Ireland has a different time from England, not because of any native cantankerousness on either side of St. George's Channel, but because the sun gives different hours, so in the United States they must have their clocks and watches agreeing tolerably well with the sun, and so must have different local time from ours. In different sections of the States they will have, also, times differing by a full hour—earlier and earlier for more and more westward sections—an arrangement by which no place will have time much more than half-an-hour different from sun time. Half-an-hour is not a matter of any great importance, as we may know by the fact that no one in the business of life recognises the circumstance that sun time changes by more than half-an-hour in the course of each year in every part of the world. If we set a perfect clock or watch—that is, one steadily recording day after day 24 true hours of mean time, so that at the end of a hundred years or more it would be as near sun time as at the beginning—to show 12 noon when the sun was exactly south in February, then, tested by the sun, that clock would seem half-an-hour wrong at solar noon after about half a year had passed, which would *seem* to show that in a year it would be an hour wrong, and in six years would show six o'clock at 12, and in twelve years would show 12 noon for 12 midnight. Yet the discrepancy would be entirely due to a want of uniformity in the sun's motion, to which none except astronomers pay the slightest attention. In like manner, in the United States there are places where, judged by the sun (even when he is with the clock at Greenwich), the clocks seem half an hour too fast or too slow on the average all the time; yet business goes on undisturbed. The same arrangements will continue, now that the meridian of Greenwich is adopted as the reference meridian, which were in vogue before, except that possibly the American hour system may be brought into correspondence with Greenwich time instead of Washington time—so that, for instance, a traveller from England to New York or Washington would find his watch *exactly* instead of *nearly* five hours fast by New York or Washington time. In this way the whole world may one day be divided into hour zones, so that every change of time for a voyager travelling westwards would be made by putting back his watch exactly an hour, and every change for a voyager travelling eastwards would be made by putting his watch forward one hour exactly. Though, even then, at sea, the present system would have probably to be retained, by which each noon the approximate local noon is adopted.

In what, then, it may be asked, does the importance of the recent change consist? The astronomer and the geographer do not need to ask the question, knowing as they do the multitudinous inconveniences which arise from the use, in the astronomical computations, and the geographical charts made in different countries, of the longitudes of Greenwich, Vienna, Berlin, Paris, Washington, and so forth. I take up, for example, in the old time of the controversy about the transit of Venus, a treatise or paper written by Puiseux at Paris, or by Newcomb at Washington, and I find that before I can compare properly the results deduced or discussed by the French or American astronomer with my own, or with others dealt with by English astronomers, I must translate the French or American longitudes and times into Greenwich longitudes and times. Even in the case of a single treatise, the time thus wasted (there is no other word for it) is considerable; but when a great number of such works, on different astronomical subjects, pass through an astronomer's hands weekly or monthly, as is the case with me, the nuisance becomes quite serious; and when we remember that this is so in the case of one person alone, we see how large the total waste of time and trouble thus arising must necessarily be.

The geographer is similarly annoyed. In comparing French, German, or American maps with English maps, or geographical statements by geographers of other countries with similar ones made in England, the geographer finds that every detail depending on longitude has to be corrected or translated before the full significance of the foreign charts or statements can be appreciated.

In fact, this question of a meridian of reference may be regarded as affecting our view of the earth from without, as it were, more importantly than the view we take of the earth as residents in this or that part of her surface. It is the earth as a rotating planet which has now been definitely marked for reference, so that all astronomers and all geographers measure from one and the same mark, not each set from a mark of their own. Just as astronomers use a fixed meridianal marking on Mars by which to time the rotations of the planet, so in future will astronomers and geographers act with regard to the earth. Strange that they should have assigned a fixed meridian to a planet many millions of miles away, many years before they assigned a fixed meridian to their own planetary home!

It may be asked whether the adoption of a fixed meridian for the whole earth will affect the question many find so perplexing, as to what day of the week it is at particular places, and at particular times. Here it is to be noticed that the usage of astronomers and the usage of business folk must of necessity differ. To the astronomer there will now be, what hitherto there has not been, a definite series of days, the same all over the world. What people in England call, for instance, November 17, viz., the interval of time between midnight and midnight on either side of that day whose middle is noon November 17, has been for the English astronomer, and will hereafter be for the astronomers of all countries, divisable into the last twelve hours of November 16 (which ends for the astronomer at noon November 17) and the first twelve hours of November 17, whose remaining twelve hours, numbered from 13 to 24, end at noon November 18, civil time. So, all round the year,—December 25, for instance, in astronomical time, will include for all astronomers, the twenty-four hours from December 25, 12 noon Greenwich mean time, to 12 noon Greenwich mean time, December 26.

But as to what day of the week it is at any particular place and time, the difficulty, which many imagine to exist only along the meridian half-way round the earth, west or east of Greenwich, has always existed, and will continue to exist, all over the earth. It is true that when we travel westwards or eastwards from Greenwich, we have to make a change of a full day, one way or the other, when near the meridian, which lies 180 deg. east (or west) of Greenwich. But that is only because we have not made the necessary partial change at each successive stage of our journey west or east of Greenwich. Or it might, perhaps, be rather said that small partial changes are made stage by stage in passing westwards or eastwards, which amount to half a day where two voyagers travelling westwardly and eastwardly at equal rates would meet; and these changes being in opposite directions, the two half days must be made into a whole day at the place where the voyagers cross each other, the westwardly voyager now taking the days (one ahead of those he had been using) of the eastwardly voyager, and *vice versâ*. But the difficulty as to the day of the week exists all along, and is actually felt (which is different) wherever we pass across a line dividing two regions where different local time is used. Thus, suppose we are on a train travelling westwards from New York, and pass, at half-past twelve at night, a place where, along that railroad line, the change of an hour is made. It is, let us say, Tuesday morning early (half-an-hour after midnight) before we pass that place; but so soon as we have passed the place of change, it is no longer Tuesday morning but Monday —night—half-past 11 p.m. By passing to and fro across the line of change, at any hour between 12 midnight and 1 a.m., for the eastward region, or (which is the same thing) between 11 p.m. and 12 midnight for the westward region, we can make the day of the week change as often as we please, or have any number of Mondays and Tuesdays, Tuesdays and Wednesdays, &c. (as the case may be), in the course of a single hour. But the difference of day in such a case as this is a matter of no moment, and needs no correction, whereas it would be a matter of serious moment if every one who had circled around the earth either eastward or westward remained a whole day behind or in advance of those among whom he lived. It is obvious that as the westward traveller keeps on adding hour after hour to his time, he must add a full day by the time he has gone completely round, and unless he dropped a day somewhere, he would be a day behind the friends whom he had left at home by the time he rejoined them. The opposite change must be made by a traveller going eastwards; and clearly the proper place for the change is when either is half-way round; for by making it there the discrepancy never exceeds half a day.

It is noteworthy, however, that the only place where the day exactly corresponds with the Greenwich astronomical day is along the meridian just westward of but touching the meridian farthest from Greenwich. Thus, the astronomical day—November 17th—runs from November 17th noon to November 18th noon (Greenwich mean time); and at a place just short of 180° west of Greenwich November 17th also begins at noon November 17th (Greenwich mean time) and ends at noon November 18th.—*Newcastle Weekly Chronicle.*

In the December number of the "Miscellanea Genealogica et Heraldica" there is the facsimile of a very rare, perhaps unique, funeral card; the original is at Hardwick, among the collections formed by Sir John Cullum, Bart. This card entitled the bearer "to accompany the Corps of Mr. *Thomas Moody*, from *Armourers-Hall* in *Coleman-Street*, to the Burying Ground on *Bun-Hill*, on *Friday, May* the 18th, 1716, by Five of the Clock in the Afternoon precisely.—And bring this Ticket with you." Although the Bunhill Fields Registers corroborate the date of Mr. Moody's burial, yet there is no monument now in existence to his memory.

OUR SCIENTIFIC INDUSTRIES.

By W. Slingo.

II.—GAS AND ITS USES—MANUFACTURE—(*continued*).

If anything were wanting to demonstrate the truth of the old saying that "history repeats itself," we can surely find it in the history of illuminants. To-day it is proposed, with all seriousness, to deliver at our doors daily a source of electricity whence to derive the current to maintain the electric light, and ninety years ago the self-same proposition was urged, and more than urged, on behalf of gas.

In the first days of gas manufacture it was collected in bladders, leather, varnished silk, and metallic vessels provided with a small tube and stopcock, through which "the gas issuing from a minute orifice was ignited and made to serve as a lantern." Important as is the question of gas-storage, it is scarcely more so than is the question of orifices or burners, and we shall find that there are many interesting features concerning them well worthy of consideration.

Murdoch, to whom brief reference was made at the close of the previous article, had some little prescience of the value of the work he had taken in hand, and tried very hard to induce James Watt, son of *the* James Watt, to take out a patent with him for the process. But his efforts were unavailing, and the process for obtaining an illuminant from coal became public property, although in France an engineer, Lebon by name, obtained in 1799 a patent for a similar process. Exhibitions of the new light were made by Murdoch at Birmingham in 1798, and on a larger scale four years later. Lebon's experiments were repeated in London in 1804 by Winsor, who then and subsequently strove very hard, albeit ineffectually, to prove the priority of Lebon's invention. During the earlier years of the century Murdoch appears to have been busily engaged in erecting works for private houses, mills, &c. One of the more important of these "installations" was that in the extensive cotton-mills of Messrs. Phillips & Lee, of Manchester. "The burners were of two kinds, one on the principle of the argand lamp, the other a cock-spur burner, consisting of a small curved tube with a conical end having three circular apertures or perforations about one-thirtieth of an inch in diameter, one at the point of the cone and two lateral ones. The gas issuing through these apertures formed three divergent jets of flame somewhat like a fleur-de-lis. The whole of the burners erected in the mills amounted to 271 argands, each of which gave a light equal to four mould candles of six to the pound, and 633 cockspurs, each of which gave a light equal to two and a quarter of the same candles. The quantity of tallow consumed by each candle was at the rate of four-tenths of an ounce per hour." The cost of the gas even then was computed at less than a third of that involved in the use of candles. An account of this work having been communicated by Murdoch to the Royal Society in 1808, he was awarded the Rumford Gold Medal, and a year later Clegg, another worker in the same field, was awarded a silver medal for a communication to the less exclusive Society of Arts.

Winsor had, however, in 1804, obtained a patent for the extraction of gas from coal, and, although Murdoch succeeded afterwards in proving his priority, his competitor had the field very much to himself. The path of Winsor was, however, no more bestrewn with roses than are those which lay before the electricians of to-day. Prejudices and interests of all kinds had to be confronted and borne down ere the supremacy of gas over oil and tallow were established. We are all well acquainted with the scarecrow held up to the followers of Stephenson, whereby it was gravely predicted that the breed of horses would diminish in consequence of a decrease in the demand for those animals. Some, in their enthusiasm, went so far as to prophesy an almost total extinction of the breed, and to express a fear that the time was not far distant when we should regard the noble equine as a something relegated to the pages of more or less ancient natural history. But even worse evils were foreshadowed for those who would have the misfortune to exist in post-oil days. The early portion of this century was notorious for the victories of Nelson, which demonstrated the naval supremacy of England, but, said the opponents of the newly-introduced illuminant, "if this (gas-light) becomes successful, then our naval supremacy is gone, for at present we obtain principally our artificial light from the Whale Fisheries. These are the nurseries of our best sailors; therefore, if we destroy the one, the other must be affected. If the fisheries no longer exist, our navy must degenerate."

Great dangers to the community were anticipated in the event of steam being adopted for locomotive purposes, as also are they at the present day from electricity. Similarly it was feared that the explosion of a gas-main under the streets would destroy a town. Another parallel is, however, unfortunately, discernible. As in the present day ignorant and over-sanguine "electricians" have taken upon themselves to champion the electric light, and have tried their hardest to make the world imagine that it is to be revolutionised by the electric light, so likewise did many would-be fathers of gas-lighting do a deal of harm, and bring down upon the system ridicule and trouble. Even Winsor himself could not keep to fair and truthful lines, for it is recorded that he "often committed the most egregious errors, at one time asserting that our atmosphere in its pure state was too powerful, and that a mixture of coal-gas rendered it more salubrious: again, that gas would not explode when intermixed with air, and that its adoption would purify the atmosphere; whilst the prospectus issued by him contained most extraordinary exaggerated and fabulous accounts of the enormous profits to be derived from gas-lighting."

However, progress was made, although, of course, less rapidly than would have been the case had less extravagant pretensions been urged, and in 1807 Pall Mall was lighted with gas; Westminster Bridge was similarly lighted in 1813, and in 1814 gas lamps were substituted for the oil lamps in the parish of St. Margaret's, Westminster. In the latter year, a great effect was produced by illuminating a pagoda erected in St. James's Park with 10,000 jets of gas, lighted instantaneously, and forming "an immense and brilliant fountain."

Many of these and other experimental displays were made by a company formed by Winsor. The original company was formed in 1808, and their object was to obtain the exclusive privilege of lighting all the British possessions with gas. And for this task they proposed to raise a capital of £1,000,000! After several reverses the "Gas-Light and Coke Company," with a capital of £200,000 was established, and secured a royal charter in 1812, with privileges, however, far short of their original ambitious desires, and teeming with disadvantages. They were not allowed to extend their operations outside London, and were not in the least degree protected against competition, should any possible rival have the temerity to enter the field against them.

Under such inauspicious circumstances was the first gas company started. They had many other troubles to contend with, both inside and out, and the only wonder is that they survived the ordeal. If it proves anything, it proves that there were good and substantial grounds for the promoters to work upon, that the commodity they were offering was valuable, and must ere long take its place, and that a prominent one, in the market. A few years served to demonstrate this, and in 1820 nearly every town of importance had made a start, the light having created in the minds of the people a great feeling in its favour; so much so, that we read of a prominent Frenchman who, in writing to a friend says, "Where gas-light exists there is no night; where gas-light is, there is continuous day."

Having said thus much on the early history of gas production and lighting, it would best accord with the object in view if attention is now turned to the manufacture as at present carried on. There is one thing to be noticed, however, before quitting this portion of the subject, viz., that before many months had passed over the heads of the Gas-light and Coke Company they had competitors in the field, and then began one of the most ruinous struggles for supremacy ever known in the history of any industry. The futility and cost of these struggles should read to us to-day an important lesson. There was room for many gas companies; in 1829 two hundred were formed in the United Kingdom, and there was, doubtless, scope for more. We have a few electric light companies, but they are given up too much to fighting; there is room for the gas companies, as well as for them and for others too, but they must learn how to discriminate between a good market and a bad one.

THE TRICYCLE IN 1884.

By John Browning,

Chairman of the London Tricycle Club.

SAFETY BREAKS.

Before the year closes I should like to say a few words respecting breaks.

The break is one of the most important parts of a tricycle. Since vertical pedalling—that is, sitting directly over the pedals—has been the rule, the rider has lost much of the power formerly possessed of arresting the forward motion of the machine, whenever it is necessary, by back-pedalling.

Again, many machines are now ridden with clutches, and these, of course, give the riders no power of back-pedalling. In all such machines a most efficient break is indispensable.

The band-break introduced by the elder Starley, the father of the modern tricycle, has never been beaten in efficiency. On one of the first Sociables he made I descended the worst of the two hills at Westerham with my wife, and, although I have done this many times since on various machines, I have never had another Sociable in which I could descend it so safely and easily, for, while with every other Sociable I had to ride down carefully, with the Starley machine I could let it run at ten or twelve miles an hour, and pull it up on a steep part of the incline in twenty or thirty yards.

Many Sociables I have tried for my friends have proved efficient in every other respect, but, the break being ineffective, have caused them months of trouble and anxiety.

Nearly the worst accident that can happen to a tricyclist is for the break to give way on a steep hill.

When it does so, the best thing to do is to turn the machine round, if possible, into the side of the road, before the pace becomes alarming.

I have done this once on a Sociable, and twice on single machines without getting a scratch myself or in any way injuring the machine.

On the last occasion I was descending from Chipstead to Merstham, by what I suppose the parish authorities call a road, but I should call a water-shoot, when it came on to rain suddenly and heavily. I was on my small Humber, which I was holding in by the break easily. But, after a few minutes, I found my pace increasing in spite of the utmost pressure I could apply to the break. As the machine had a clutch in the lower chain-wheel, I could not pedal backwards. I was at a sharp corner and heard the sound of wheels below me, so immediately put my machine into the bank, and the shock threw me off backwards, unhurt.

My reason for mentioning this little mishap is that I find few riders are aware that heavy rain will lubricate a break so as to render it nearly useless. The moral, of course, is that you should dismount if you have to descend a steep hill when it is raining heavily.

I have long been of opinion that to avoid such mishaps all tricycles should be provided with a second, or safety, break. The first safety-break which I thought useful was that introduced by Pausey, who put two breaks upon a machine of the Humber type. They were two separate band-breaks, acting on the same drum, provided with separate levers, one actuated by the right hand, and the other by the left. As either or both of these levers could be used without leaving go of the steering-handles, this appeared to me an admirable arrangement, and I am surprised that it was not generally adopted.

The Sparkbrook Tricycle Company have just introduced a new safety-break specially adapted for the Humber Tricycle. This is a band-break, working on a drum attached to the lower chain-wheel, the band being acted on by the step which is just behind the lower bracket. The break is applied by placing the foot on the step. To do this the weight of the rider must be thrown so far back that it is contended that there will be no risk of his being thrown over the handles.

I shall certainly adopt this as a safety-break on my small Humber, if I can do so without relinquishing the excellent two-speed gearing which Mr. Bown has just fitted to the machine for me.

By far the simplest and most efficient safety-break yet seen has just been introduced by Messrs. Lloyd Bros. on their new No. 8 and No. 9 front-steering Quadrants.

Instead of attaching the mud-guard of the front wheel as a fixture by the upper end, they have made it stout, and attached it by a spring and hinge fixed at the lower part. In case of need, the rider can place his foot on the upper part of the mud guard and press it firmly against the tire. As the front wheel in this machine is 26 inches diameter, this would no doubt prove a sufficiently-powerful break even were there no other on the machine, but with the band-break which Messrs. Lloyd Bros. put to their roadsters, it might be said that the break arrangements would be perfect, and an accident from deficiency of break-power impossible.

According to the *Drugman*, the Japanese are threatened with severe losses on account of the extinction of the lacquer industry. The tree from which the varnish is made is disappearing. An old law compelled the people to rear lacquer trees, but it is not now in force. Another law compelled every person who cut down any kind of tree to plant two in its place. This also has become a dead letter, and the native newspapers fear the deforestation of Japan.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER VI.—THE EARTH'S ROTATION.

(*Continued from page* 421.)

WE note then that if a ring of particles A B C D (Figs 1 and 2) is rotating in direction A B C D, and we wish it to rotate in direction *a* B *c* D, we must apply forces tending to carry B in a direction contrary to that in which we wish A to be carried, and in the same direction as we wish C to be carried. On the contrary D must be thrust in the same direction as A is to be carried and in the direction contrary to that in which we wish C to be shifted.

The rule may be thus stated:—Having a rotating disc A B C D, whose plane of rotation we wish to change, so that two opposite points as A and C, in Figs. 3 and 4, may be shifted in opposite directions, at right angles to the disc's plane, the intermediate points B and D not shifting, we must move the disc as if trying to make the points B and D move in the direction in which C and A, respectively *a quadrant in advance* of them (according to the direction of rotation), are required to move.

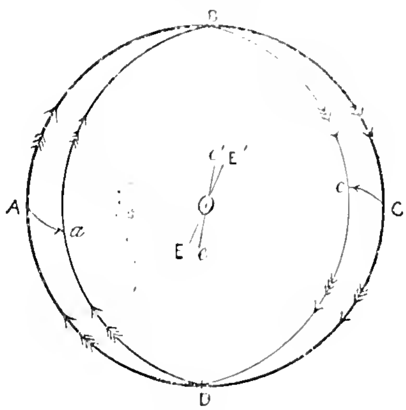


Fig. 1.

The converse rule may be thus stated:—If a rotating disc A B C D be so urged by impressed forces that were it at rest the points B and D would be carried in opposite directions at right angles to the disc's plane, the points A and C not shifting, then will the plane of rotation be actually shifted as though the points A and C, *a quadrant behind* B and D respectively, had been carried in the directions in which B and D are respectively urged.

In all such cases the bodily translation of the rotating disc must be considered separately.

I have been careful to explain thus far the principles on which the ordinary experiments with the gyroscope depend. They serve to show how and why the median plane of a heavy rotating disc, spheroid, or sphere, resists any attempt to change the position of its axis of rotation, and why such change as does take place is at right angles to the direction in which the external forces would move the axis of the disc were it not rotating. Moreover we can understand why even considerable external forces acting on a heavy disc rotating very rapidly, change very slightly the position of its axis of rotation.

But in Foucault's experiment for exhibiting the earth's rotation by means of the gyroscope, everything was done to prevent the rotating disc from being externally influenced. In the first place, the gyroscope is made very heavy, and set in very rapid rotation. This makes its power of resisting a pressure tending to change the position of its axis very great. Then, secondly, all possible care is taken to diminish the effect of the tendency which really acts upon it to change the position of its axis. This force is the earth's rotation acting upon the gyroscope, through its supports, whatever they may be. If we make the gyroscope as free as possible this force will be diminished as much as possible. Now this is precisely what Foucault sought to do. In his gyroscope for exhibiting the earth's rotation, there is first a vertical ring suspended by a thread, and supported on a pointed pivot which rests on an agate plane. So carefully is this suspension managed that when the vertical ring is loaded with the heavy disc (at rest), the merest breath causes it to shift its place. Next within the vertical ring there is one placed horizontally, supported on knife edges which rest on two suitable shoulders at the extremities of

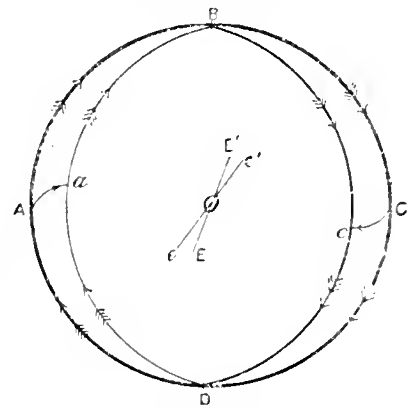


Fig. 2.

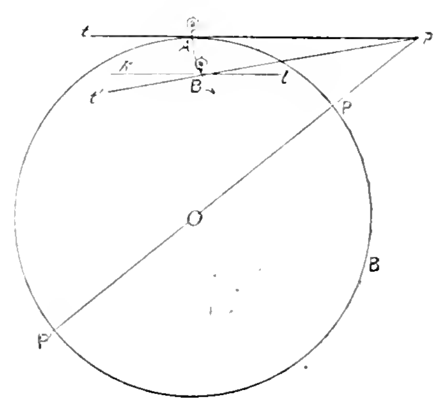


Fig. 3.

Fig. 4.

the horizontal diameter of the vertical ring. Thus this ring can oscillate freely on a horizontal axis. Lastly within the horizontal ring, and on an axis at right angles to the last-named one and also horizontal, is the massive disc.

When the disc is set by suitable machinery in rapid rotation, it tends, according to the principles already enunciated, to preserve its axis of rotation in a fixed position. If the earth were not rotating, it is clear that the axis of the disc's rotation would preserve its position unchanged without any appreciable effect resulting. But if the earth rotates, the axis of the disc can only maintain itself in an unchanged position in *space* by an apparent motion within its supports.

Suppose, for example, that there is a gyroscope at a point A in the rotating earth P A P' (Fig 3), with the median plane of its heavy rotating disc north-and-south, as shown in Fig. 6 at N S. Let this gyroscope be carried by the earth's rotation around her axis P O P', to the position B.

Then if the gyroscope were not rotating the median plane of the disc would still remain north-and-south. Thus, supposing t A p, the tangent north-and-south line to the earth's surface at A, meeting the earth's axis, produced, at p, the median plane of the gyroscopic disc which had coincided with t A p when the gyroscope was at A, would coincide with t' B p the north-and-south tangent line through B, when the gyroscope was at B. This would correspond with the direction n C s in Fig. 6, a direction inclined to (or displaced from) N S. But in the actual case of a heavy rotating disc, there would be no such displacement, unless the attachments of the axial supports were rigid, in which case of course the rotating disc would be forced irresistibly by the overwhelming power of the earth's motion to retain its north-and-south position. In the case of the delicately-poised gyroscope of Foucault, the median line N S would only be affected by such portion of the earth's action as was conveyed through the suspending line, and at the knife-edges supporting the internal ring, and this action—in accordance with the principle we have considered—instead of shifting N C S to the position n C s (Fig. 4), can only slightly shift the uppermost point C towards c (the rotation being in the direction indicated by the arrows), leaving the points l and k (corresponding to N and S) on a line parallel to N S. Thus if a horizontal telescope is directed to the median line of the disc, at N or at S, this line will appear to move in a direction opposed to that of the earth's rotation, the northern side moving towards the east as at l, the southern side moving towards the west as at k.

Thus, when observed under telescopic power, the gyroscope is seen steadily travelling against the direction of the earth's rotation, at the precise rate which calculation shows to correspond to the latitude of the place of observation. For the time being, the gyroscope is, so to speak, like *an independent planetary body with its own proper polar axis directed constantly to the same point of the celestial sphere.*

We are led naturally to the proof of the earth's rotation derived from the precession of the equinoxes. The earth's mass in rotation is a species of gyroscope; and were the earth a perfect sphere it would rotate for ever with its polar axis in a constant position. But the earth being oblately spheroidal, external bodies have a sort of pull upon it, in a manner precisely resembling that which we have conceived as operating upon our experimental gyroscope as above illustrated. The proof of the earth's rotation derived from the consequent slow change in the position of the earth's axis is not, however, founded on the accordance of the observed effects, with dynamical theories—though this accordance is a very strong argument *per se.* It is the fact that by the *precessional* motion of the earth's axis, and the similar but smaller motion called *nutation*, all the stars in the heavens, *and the planets also*, seem to be affected with a species of tremor, which affords the most convincing proofs of the earth's rotation. It is obviously unreasonable to suppose that the stars and planets which we have already seen to be disassociated from each other as respects their principal movements, should only resemble each other in the matter of these strange, tremulous motions. When we see, on the other hand, that a simple dynamical theory, the results of which we can readily confirm by experiment, accounts for all these observed tremors, as due to a peculiarity of the earth's rotation, we can afford to smile at the philosophers who hope to simplify astronomical conceptions by setting the earth at rest in the centre of the universe. Indeed, the proof of the earth's rotation thus derived is as effective as the proof of the earth's revolution derived from the aberration of the fixed stars; it is not, however, so readily rendered convincing to those unfamiliar with the abstruse branches of mathematics.

Lastly, there remains to be mentioned the proof of the earth's rotation derived from the observed rotation of the primary planets. It has been established by the most satisfactory modes of measurement, that the planets are globes like our earth, some inferior to her in magnitude, but others far surpassing her. These bodies are seen to be in rapid rotation upon their axis, those of them which most closely resemble the earth performing a complete rotation in about twenty-four hours. The argument deduced from this circumstance is powerful in itself; but its force will be more clearly seen when we proceed, as we are now to do, to consider the proofs of the earth's revolution round the sun.

(To be continued.)

GORHAM'S PUPIL PHOTOMETER.

THIS beautiful and most ingenious instrument, to which our attention was first called by Mr. Tindall, in a letter (1500) which appeared on p. 391, is as simple as it appears to be effective. It consists of a piece of bronzed tubing about 1·9 in. long, and 1·5 in. in diameter, with one end closed by a disc, in which are a series of pairs of minute holes pierced on radii of the circle, and drilled with absolute accuracy at distances varying from ·05 in. to ·28 in. apart. A cap with a radial slot in it so narrow as only to leave one of these pairs of holes visible at a time rotates over the brass disc; and round the cylinder just below the edge of the cap the linear distance of each pair of holes is engraved exactly opposite to it. Our first figure represents

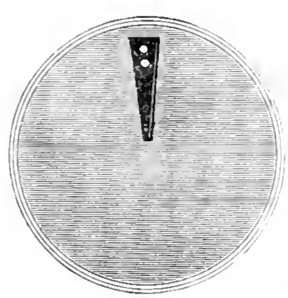


Fig. 1.

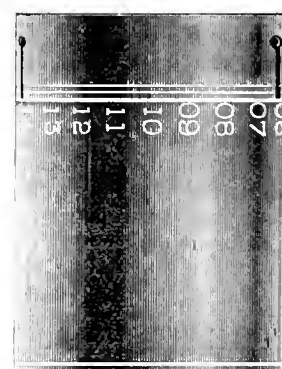


Fig. 2.

the cap as seen when looking down on to it. The pair of holes ·10 in. apart are shown as visible through the slot. Fig. 2 exhibits the tube as seen sideways, to show how the figures are engraved upon it. The instrument seems to have been originally devised by Mr. Gorham for measuring the diameter of the pupil of the eye under the stimulus of light of varying intensities. It is used by looking through the open end of the tube (the bottom in Fig. 2), when two discs of light will be seen, like a double-star. The cap is turned until a pair of these discs appear which are precisely tangent, or *just* touch one another at their edges. Then may the diameter of the pupil be read off on the scale by mere inspection to ·01 in. But this is by no means the only—or, in fact, the chief—use of Dr. Gorham's instrument, inasmuch as the magnitudes of the pupil really furnish the measures of the intensities of the lights under whose influence its diameter varies. Hence it may be used as a photometer; and for this purpose we proceed as follows :—We set a Sugg's standard candle at a distance of 1 ft. from the eye, with a white surface (such as a sheet of foolscap paper) behind it, in a room otherwise totally dark. We now take the diameter of the pupil in the way just indicated, and read it off from the scale. Leaving the photometer intact, we substitute for the candle the source of light whose intensity we wish to measure, placing a white background behind it, as in the previous case. Suppose that it is a duplex lamp which replaces our original candle. If we regard this from a distance of 1 ft., as before, we shall find our two discs of light, so far from touching, will be pretty widely separated, and we must slowly retire from the lamp until the circles have expanded sufficiently to become tangent again; when, of course, the pupil will have regained its original dimensions, from the light falling upon it being of identical intensity with that of the candle. It only remains to measure the distance of the lamp from the eye in feet and decimals of a foot to find its illuminating power, which obviously will vary as the square of the distance (vide p. 130), *i.e.*, if we have to retire to a distance of 4 ft. the lamp must give the light of sixteen candles, and so on. In a foot-note to Mr. Tindall's letter on p. 391, a doubt was expressed as to the efficiency of Dr. Gorham's invention as a *quantitative* light-measurer. In connection with this we may mention that, as a preliminary to penning this article we have been experimenting with a candle and a small reading-lamp, the relative intensities of whose lights we measured in succession by Rumford's method (Fig. 24, p. 130) and by the instrument we are describing. By the former mode of measurement we found that the lamp gave 7·1113 times the light of the candle; by the new photometer it came out 7·111! It would perhaps be idle to contend that no element of "fluke" entered into this extraordinary coincidence; but it may serve to show with what minute accuracy the relative intensities of various illuminating agents can be measured by this most simple apparatus. The incipient user of it will find it politic to keep his unused eye open; as, if it be closed, and then opened while the photometer is being employed, the stimulus of the light on the freshly-exposed pupil will cause the one viewing the hole itself to contract sympathetically; and so derange the measurement. Mr. C. Coppock, of New Bond-street, is the maker of this photometer.

THE STANDARD OF POLITICS IN AMERICA.

THE Rev. Heber Newton, in the course of an eloquent discourse on the low standard of moral ideas in American politics, made the following remarks, which will be read with pleasure by all who wish well to the great nation of our kinsmen on the other side of the Atlantic :—"I have nothing to do," he said, "with the truth or falsity of the charges preferred against the man who has barely missed election to the highest office in the gift of our people. But I would point out the danger which menaces our country through the easy deflecting of the conscience to party interests. Hosts of men have practically said: 'This is a big fuss about nothing. Our leader is not charged with having directly stolen anything. The most than can be said about him is that he has kept his weather eye open to the main chance, and that he used his ruling as a speaker as a plea on which to obtain private wealth. Why should he not have done all these things? If he threw away good chances that did not involve stealing to enrich him, the more fool he. Who of us would not do what he has been accused of doing if we had the opportunity? We like him all the better for not being over scrupulous. The great American people believe in a smart man.' I fear that a great body of by no means bad men have followed a really able leader, not because they believed him to be free from fault, but because they rather like the faults alleged against him. Lots of men regarded him as the great American, because of his supposed acting forth of those by no means noble qualities which unfortunately characterise us as a people—because of which we ought to feel alarmed. If he really typifies our average American idea of smartness, then again we have not merely a sad feature of a political campaign, but a sadder symptom of a low tone of honour—a sign of the times which it behoves us to ponder. The sting of Dickens' cut at American smartness yet remains. The *Fortnightly Review* recently compared us to Russia, of which the Czar Nicholas said :—'I and my son are the only people who do not steal.'"

CHAPTERS ON MODERN DOMESTIC ECONOMY.

IV.—THE FRAMEWORK OF THE DWELLING-HOUSE (*continued*).

GENERAL PRINCIPLES OF CONSTRUCTION.

THE laying of the parqueterie is, of course, best understood by those whose special avocation it happens to be. The parts of the house adapted to this kind of flooring have been decided upon through a long course of practical experience, until a kind of standard or general routine to be followed has been unconsciously established. The result of our inquiries at Messrs. Howard & Sons' works in Berners-street, W., may be briefly formulated thus :—In a drawing-room the entire floor ought to be covered; skins and eastern rugs, which can be readily taken up and freed from dust, will be found quite sufficient, upon such a groundwork, to satisfy the most fastidious æsthete. The dining-room should be preferably bordered with parquet, and the central portion carpeted. The bed-rooms ought to be completely covered with this flooring, to which a rug at the bedside may be superadded. The bath-room requires a special lining of cork parquet, the thermal conductivity of cork being such as to afford a comparatively warm sense of touch to the feet on getting out of the bath.

The benefits to be derived from the use of these varieties of flooring are chiefly of sanitary importance :—(1) freedom from accumulations of dust; (2) the ease with which they may be cleansed; (3) even when washed with a wet cloth they do not absorb water, and hence are not liable to create damp; (4) they are beautiful and durable.

Although private dwelling-houses would be immeasurably superior in every respect if floored with parquet work, the system is particularly to be commended for public and other large buildings. In ball-rooms the floors may be polished with wax, and thereby rendered delightfully smooth, in addition to their quality of being and remaining absolutely level; but for hospitals it is the flooring *par excellence*. When Messrs. Howard were engaged in laying the floors of Westminster Hospital, they were obliged to take up the boards and match them properly before laying on the parqueterie. In doing so they discovered little conical heaps of dust over every supporting joist between the ill-matched floor-boards. It is needless to conjecture the evil effects of such a state of affairs; every time that water was made use of in cleansing and scrubbing, the little cones of dust, probably teeming with zymotic disease-germs, would be irrigated, and thus favour the special conditions for the propagation and dissemination of the deadly *bacteria*.

This leads us to observe that where the question of outlay interferes with the employment of parquet floorings, it is incumbent on the builder to pay special attention to the construction of his floors. He ought either to have the floor-boards accurately matched and fastened, to prevent the after-effects of possible warping or shrinkage of the wood, or he ought to have all the interspaces carefully caulked, as on the deck of a ship. We shall revert to the employment of sanitary floorings in a subsequent chapter, when we come to deal with the subject of house furniture.

Closely related to ventilation and the exclusion or ready removal of dust and dirt from a house, comes the consideration of door and window construction. Where no special provision is made for the introduction and outlet of air, it usually happens that the defective fitting of doors and windows is forced to fulfil those functions in a peculiarly disagreeable manner. Not only do they ventilate the rooms by constant draughty currents of air, but they permit of the entry of damp, dust, and dirt from the passages of the house, and even from the streets; so that, when we come to apply a reform to doors and windows, we must look to the adequate admission of fresh, and the expulsion of polluted, air. To a large extent, the average door and window would suffice, provided that the ventilation is well attended to. The air would in such a case find its way into the room more readily through a well-devised inlet than by means of the adventitious chinks of doors and windows. Yet, to provide against the extraordinary incursion of air, the fitting of the latter ought to be as perfect as possible. This, however, is not so easy to accomplish as it would seem to be at first sight. The enormous expenditure involved in the necessary outlay for thoroughly well-seasoned wood and skilled, careful workmanship would swallow up the profits of the builder in the erection of that class of houses, such as artisans' dwellings, &c., which bring him in his most easily-realised income.

As a rule, the doors of houses, in the course of time, tend to shrink; and in such a way as to increase the space at the bottom which has been left for the easy working of the arrangement. Let us premise that the room or passage to which the door gives access is provided with suitable ventilators; then the base of the door ought to fit so closely as to prevent the entrance of draught, dust, or rain. Now, apart from great expense, this is almost impossible to secure in ordinary joinery, inasmuch as the wear and tear of the floor would alone suffice to renew the evil in the course of time. It is possible, however, to adapt a movable piece to the basal edge of the door which shall be simple, self-acting, not liable to get out of order, inexpensive, and quite effective. Such an apparatus is Warhurst's "Automatic Draught Preventer."

Mortality statistics show that, in London alone, no fewer than 80 persons annually lose their lives through falling out of windows. In the majority of instances, the primary cause of death may be traced to the incautious cleansing of the windows. Although it is possible to clean the outer face of the panes of glass in an ordinary window from within the room, it is so excessively awkward a task that the greater number of servants and professional window-cleaners prefer the risk of getting out on to the ledge, and they are thus often over-balanced, and either killed or severely injured. To prevent the possibility of such accidents, the sashes of the window ought to be capable of a wicket, or revolving, as well as a sliding, motion; these not only serve to enable the operator to clean both the inside and outside of each pane easily without incurring any dangerous risk, but they afford a space, when swung open, large enough to allow of the admission of pieces of furniture which are too bulky for removal through doorways and passages. Patent arrangements, which incorporate the advantages which we have indicated, and are in addition draught and dust tight and not more expensive than those in general use, are now in the market. Of these, Adams' "Anti-Accident" Window and Penny's "Double-Action" Window-sash and Frame are the most noteworthy.

The improvements in locks and fastenings for window-sashes, doors, &c., have hitherto been devised chiefly as protective measures against housebreakers. Although they occupy but a subordinate place in the general structure of the house, they are nevertheless well worthy of careful consideration. Burglar-proof sash-fasteners and locks are usually of superior quality and construction, and, as such, secure a firm fastening which prevents rattling, and thereby contributes to the sanitary condition of a house by excluding dust and dirt. In future chapters we shall give examples of the several inventions which illustrate the principles we have here noted, so that our readers may be able to glean benefits of a practical character from our observations.

Reviews.

SOME BOOKS ON OUR TABLE.

Elementary Text-book of Trigonometry. By R. H. Pinkerton, B.A., Oxon. (London: Blackie & Son.)—For those who have the advantage of a tutor, we have little but praise to give Mr. Pinkerton's little book, treating, as it does, in a lucid form, of plane trigonometry as now taught. One excellent feature is the number of numerical examples supplied in it. It is surprising how much more readily the beginner grasps the meaning of a concrete example than he does that of the formula whence it is derived. Our author's sole innovation, so far as we have been able to detect, lies in the substitution of the word "radian" for what we have hitherto been accustomed to call "circular" measure. The two comparatively trivial faults we have to find with the book are, first, the wasting of more than a page by a description of the "Grade" and its application, this form of measurement being now absolutely exploded and disused; and, secondly, the omission of all reference to arcs in the description of the trigonometrical ratios. This is all very well in the case of the student with some preliminary knowledge of the subject, or who has a tutor at his elbow; but seems too abstract for any one approaching it for the first time. The space wasted on the "Grade" had better have been occupied with the time-honoured circle of our fathers' days. The learner would then have seen to *what* certain lines were tangents and secants, at all events.

Charles Darwin. By Edward Woodall. (London: Trübner & Co.)—This reprint (from the Transactions of the Shropshire Archæological Society) of a succinct biography of one of the (if not the) very greatest and most philosophical naturalists the world has ever seen, supplies material for thought to Englishmen of all ages, rousing, as it must do, emulation in the young, far from unmixed sorrow in their seniors, but pride in all. In this record of a noble life we trace the grandson of the author of "Zoönomia" and the "Loves of the Plants"; from his birth at Shrewsbury in 1807, through the Grammar School of that town, the Edinburgh University, and that of Cambridge, until, on the recommendation of Professor Henshaw, he was appointed naturalist to the *Beagle* expedition to

South America in 1831. This was a turning-point in Darwin's career; and but few of those who will read these lines can be ignorant of his narration of his own adventures and observations in his "Journal of Researches." It was during this voyage that those observations were made which culminated in the publication, in 1859, of his imperishable work, "The Origin of Species." How this was howled and thundered at from thousands of pulpits, how it was derided and denounced by the *Quarterly Review* (which, nine or ten years later, had to eat its own words with what relish it might), and how the theologians raved against it at the meeting of the British Association in 1860, will all be found recorded in Mr. Woodall's pages. Truly, the record may make us blush as a nation that such ignorance, fanaticism, and bigotry should be rampant in England during the latter half of the nineteenth century. Of Darwin's subsequent works on "The Expression of the Emotions," Orchids, and structural and physiological botany generally, culminating in the remarkable one on the "Formation of Vegetable Mould" (by earthworms), this is not the place to speak. It may suffice to adduce as an illustration of his astounding patience and love of truth that this last volume was not published until the completion of an experiment which lasted *twenty-nine years*. Probably, of no one who has flourished during the past two hundred years can it be more truly said than of Charles Darwin, that *Exegit monumentum ære perennius.*

The State and Education. By C. H. Schaible, Ph.D., M.D. (London: T. Hodgson. 1884.)—With true German patience, and attention to minute detail, does Dr. Schaible, in his 129 pages, discuss the whole system of State education, from that of the Spartans and Cretans, down to our own School-board epoch. He is, so to speak, a Mundella-ite of the Mundella-ites, and would seemingly, had he the power, give a gratuitous education—we mean, of course, gratuitous so far as the pupils or their parents are concerned—to a large number who now, righteously enough, are compelled to pay for it. Why the half-pay officer or the struggling barrister should have to pinch and deny himself in every possible way in order to educate his children, while the working man is not to do without a single pint of beer or ounce of tobacco that his family may be taught, is not immediately apparent to the man who is no partisan. To all, however, who wish to see a one-sided view of the question ably maintained, we may say that they will find a mass of argument in the work before us.

Drawing to Scale. (London: Moffatt & Paige.)—We have one solitary fault to find with this, otherwise excellent, little tract. It is that in places ′ and ″ are used for feet and inches. These symbols signify minutes and seconds of arc, and nothing in the world else; and it is as legitimate —or illegitimate—to employ them in this way as it would be to make them stand for pounds and shillings, or gallons and quarts.

The Season. (London: 1884.)—Professedly scientific in our aim and purpose, Fashion, in the ordinary sense of that term, is rather outside of our scope. We know not if there be a science of dressmaking; but, if so, it may, we should imagine, be advantageously studied in the pages of the profusely-illustrated magazine whose first number lies before us, and which ought to be invaluable to ladies whose maids are their milliners too.

The Asclepiad. By B. W. Richardson, M.D. (London: Cade & Caulfield.)—There is no falling-off in the interest of Dr. Richardson's journal, valuable as it is to the pathologist and physiologist. The number before us contains a contribution to Dermatology, in shape of two coloured photographs of a man's hand poisoned by bichromate of potassa, so dreadfully natural (and nasty) as almost to deter the layman from touching the page on which it is depicted.

Natural Reason versus Divine Revelation. By Julian. Edited by Robert Lewins, M.D. (London: Freethought Publishing Company.)—The rule which strictly excludes theological subjects from these columns prevents any criticism of the work whose title heads this notice; and we only refer to it here in connection with certain assertions on its seventeenth and eighteenth pages. We there find statements categorically made with reference to utterances in Convocation in 1870 of the then Bishops of Winchester, Gloucester and Bristol, St. David's and Llandaff, which the writer should either be compelled to withdraw, or which demand the most serious consideration on the part of churchmen and orthodox believers generally.

The Disk. By E. A. Robinson and G. A. Wall. (London: Griffith, Farran, Okeden, & Welsh. 1884.)—This weird little American story is full of that pseudo-science which distinguishes more than one of the remarkable romances of M. Jules Verne. It is unnaturally natural, naturally unnatural—we hardly know in which way to describe it—but it is not without interest and a fair modicum of excitement. It is the very book to while away a railway journey with.

Calvert's Mechanic's Almanack for 1885. (Manchester: the Editor.)—An exceedingly useful little hand book for those engaged in the mechanical trades. This is the twelfth year of publication.

Energy and Motion. By William Paice, M.A. (London: Cassell & Company, Limited, 1884.)—An admirably compiled text-book on elementary mechanics, designed and eminently adapted for beginners. The author essays to "lead up to the laws of motion from simple notions rather than, beginning with those laws, to deduce simple notions from them." One important feature noticeable about the printing is that the laws, and other portions which would ordinarily be set up in italics, are set up in an exceptionally heavy type, and are made, therefore, what they ought to be, the prominent and striking feature in an introductory work.

Exercises in Electrical and Magnetic Measurement. By R. E. Day, M.A. New Edition. (London: Longmans, Green, & Co., 1884.)—There is no doubt that electricity is now so far developed as to warrant its being included amongst the exact sciences. Any work on the subject of electricity that ignores or only deals superficially with its measurements is seriously discounted in the eyes of electricians. This book is of the greatest possible utility to the student, and is full of exercises worked out in concrete quantities, and deprived thereby of the forbidding blankness that too often enshrouds purely algebraic formulæ. The book is highly commendable.

The Popular Guide to the Telegraph and Postal Service. By William Lynd. (London: Wyman & Sons, 1884.)—This, to those who purpose devoting their attention to postal and telegraph duties, affords one of the best possible means of attaining that knowledge which is essential to the work. We know of no other publication, except official and therefore exclusive books, which may be resorted to for the purpose. It cannot fail to find a ready market.

Proceedings of the Perthshire Society of Natural Science. Vol. I. Part IV. (Perth: 1884.)—The *Proceedings* before us show what a large amount of real, original, and valuable work may be effected in Natural Science by a local Society devoting itself to an exhaustive examination of its own district. The record of excursions made and papers read is both interesting and instructive.

THE FACE OF THE SKY.

From December 5th to December 19th.

By F.R.A.S.

THE Sun, though low down in the sky, may still be examined for spots, &c. Map XII. of "The Stars in their Seasons" shows the aspect of the night sky. Mercury is an evening star, but is, to all intents and purposes, invisible. Venus glitters still in the morning sky before sunrise, but is losing interest as a telescopic object. Mars is invisible. Jupiter is improving in position for the observer. He rises soon after 10h. 30m. to-night, and before 9h. 40m. p.m. by the 19th. By midnight now he is at a sufficient height for the detail of his belts to be well seen. On the night of the 10th (when, though he is very close to the horizon) Satellite III. will begin its transit at 10h. 28m. Later, Satellite I. will be eclipsed at 12h. 24m. 56s., and Satellite II. will begin its transit at 12h. 34m. Its shadow will pass off at 1h. 2m. a.m. on the 11th. On the night of the 11th Satellite I. will begin its transit at 10h. 47m.; its shadow will leave Jupiter's disc at 11h. 55m., and the satellite itself follow it at 1h. 7m. a.m. on the 12th. On the 17th, the shadow of Satellite II. will enter on to Jupiter's face at 12h. 39m., and that of Satellite III. pass off at 1h. 12m. the next morning. On the 18th, the shadow of Satellite I. will begin to cross the disc at 11h. 28m. p.m., followed by the Satellite casting it at 12h. 38m. The egress of both will take place early on the following morning. Lastly, on the 19th, Satellite I. will reappear from occultation 12 minutes, and Satellite II. 29 minutes, after midnight. Saturn is visible all night long, and is a splendid object in almost any telescope. He continues to travel slowly away from ζ Tauri in a westerly direction ("The Stars in their Seasons," Map I.). Uranus is invisible, and Neptune is still in the blank region in the eastern confines of Taurus. The Moon enters her last quarter at 11h. 30·5m. a.m., on the 9th, and is new at 1h. 24·5m. p.m. on the 17th. Hence comparatively little will be seen of her during the next fortnight. Only two occultations occur during it. The first is of B.A.C. 3122, a $6\frac{1}{2}$ mag. star, which will disappear at the bright limb of the Moon at 11h. 38m. p.m. on Dec. 6, at an angle from her vertex of 95°, reappearing at her dark limb at 12h. 14m. p.m., at a vertical angle of 164° The next night, the 7th, π Leonis will have been occulted before moonrise. It will reappear from behind her dark limb at 10h. 16m. p.m., at an angle of 174° from her vertex. The Moon is in Cancer when our notes begin, but quits it at 6 a.m. on the 7th for Leo, through which she travels until 11 a.m. on the 8th, when she descends into Sextans, only, however, to re-emerge in Leo at 10 o'clock the same night. She finally quits Leo for Virgo at 11 p.m. on the 9th. Her passage through this great constellation occupies her until 8 a.m. on the 13th, when she enters Libra. At 9 a.m. on the 15th she crosses into the narrow northern strip of Scorpio, which at 8 o'clock the same evening she leaves for Ophiuchus. At 5 p.m. on the 17th she passes the boundary into Sagittarius, and is still in that constellation when these notes terminate.

CROWS *versus* WOODCHUCK.

A WOODCHUCK (or ground hog) had its burrow in an elevated piece of ground at the edge of a field of buckwheat stubble along the public road between Monticello and Thompsonville, in Sullivan County. It had been seen occasionally playing in the stubble. A few days ago a flock of crows took up their quarters in a piece of woods near the field, and have since passed their time feeding on the buckwheat, which they seem to find in abundance in the stubble. The other day, a resident of Monticello was driving along the road when he heard a great tumult among the crows. The entire flock was centred about a certain spot in the field, and individual members were darting up and down and to and fro, and always returning savagely to the same spot. The noise of the combined cawing of the fifty throats was deafening, and of that peculiar character which always denotes that the crow has more serious business on hand that the ordinary duties of its every-day life. The man stopped his horse and looked to see what the cause of the tumult was, and discovered that the woodchuck had wandered unsuspectingly into the stubble, and that the crows, taking offence at his presence on their feeding-ground, had attacked him in force. The woodchuck was trying to make his way to his burrow, but, assailed on every side by the sharp beaks and strong claws of the crows, he found his progress exceedingly slow and painful. Now and then, goaded by some especially savage dig from a crow, he would make a show of fighting back, but this only increased the noise and the fierceness of his assailants. Fortunately for the woodchuck, he had been surprised by the jealous crows before he had gone far from his hole. If he had been set upon in the middle of the field he would have been killed, and doubtless eaten, before he got back to his home. As it was, he gradually edged along toward the burrow. The air was filled with flying fur and feathers. The woodchuck would have had some show with a dog or two, but the sort of warfare carried on by the crows was something that rendered his best tactics utterly worthless. After a struggle of ten minutes the poor animal succeeded in dragging himself to the mouth of his hole, and it needed all of his remaining strength to pull himself safely inside of it. The crows circled around and around the spot where the woodchuck had disappeared, filling the air with the most hideous cries, but whether of disappointment or triumph the spectator was unable to say.

Finally, they all alighted on the ground, a few feet away from the burrow, and apparently held a council of war. They cawed and strutted about, first one and then another flying up to the woodchuck's hole, and then back to the council. These movements lasted for five minutes, and resulted in two old crows posting themselves on the fence directly opposite the woodchuck's hole, and only a few feet away from it. The remainder of the flock returned to their work in the field, and not a sound was heard from any of them. The spectator was so interested in the proceedings that he waited for half-an-hour to see if anything new developed. The two crows on the fence, where they had been placed, evidently to give notice if the woodchuck appeared again, remained at their posts as dumb as oysters. No change in the situation taking place, the spectator was about to drive on, when he heard a caw from one of the sentinel crows. The man, supposing that the woodchuck had been unwise enough again to venture out, expected to see the entire flock once more hurry to the scene. Such was not the case. In response to the cry two crows left the flock and flew to the fence, took the places of the two sentinels, and the latter returned to the field. The spectator, unwilling to remain any longer for fear that he might see something done that would not be believed when he told it, drove on. He returned past the field an hour and a half later. There were still two silent sentinel crows on the fence. Subsequently he returned with another man to see what the result of the difficulty between the crows and the woodchuck had been. There were no sentinels on the fence. The men flushed the crows in the field, and the flock took to the woods. A visit was made to the woodchuck's hole. It had been "dug out." The man who had first seen the proceedings declared his belief that the crows had grown weary of waiting for the woodchuck to come out, and had set to and unearthed him. There were about the spot, however, too many evidences of the small boy and a dog for this theory to hold, and it was abandoned.—*New York Times.*

Royal Microscopical Society.—At the last meeting of the above society, a new "Lantern" Microscope, the invention of Mr. Lewis Wright, worked out and manufactured by Messrs. Newton & Co., of 3, Fleet-street, was exhibited by the oxyhydrogen light to an unusually large number of Fellows. The results obtained were, in the opinion of Dr. Dallinger, F.R.S. (president), Dr. Carpenter, Prof. Stewart, Mr. Crisp (hon. sec.), and others, greatly in advance of anything that has previously been obtained, far exceeding in definition the "Giant Electric Microscope" exhibited last year. Among other objects were exhibited the following:—Human thumb (showing perspiratory glands), circulation of blood in living frog, blowfly's tongue (showing spiral formation), &c., besides several anatomical and other slides (echinus spines, &c.) mounted by Dr. Carpenter and others, which were shown on the 14-ft. screen, in a most brilliant and clearly defined manner.

The Rector and Fellows of Exeter College have, says the *Athenæum*, just obtained for their hall a fine portrait of the late Sir Charles Lyell, the immortal author of the "Principles of Geology." Lyell was an undergraduate of Exeter College from 1815 to 1819, when he took a second class in classics and graduated B.A. He received the honorary degree of D.C.L. in 1855. The present portrait is a copy in oils of that executed by Lowes Dickinson two years before Sir Charles Lyell's death in 1875, now in the possession of Mrs. Henry Lyell. Exeter may justly feel proud of Sir Charles Lyell's connection with the college, and has done well in giving a place of honour to the man who made Darwin possible, and was at one time anathematised by society for his demolition of the Mosaic cosmogony. It is a pleasure to reflect on the fact that the present Fellows of Exeter have taken pains to place a really fine painting of Lyell on their walls; for, as far as we remember, the portraits hitherto serving to decorate the public rooms of that seat of learning have been entirely devoted to the glorification of second-rate ecclesiastical dignitaries, and are eminently worthy of their originals.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

A NEW SAFETY CASH-TILL.

A cash-till designed to show the general takings, and yet keep them safe from any fraud, and so constructed that it cannot be run off with, is surely a desideratum to thousands engaged in various forms of ready-money operations. Mr. A. J. Johnstone, of 140, Mill-street, Liverpool, has, we note, invented a cash-till which is a decided preventive to fraud, is never in the way, and can be seen from any part of the shop. The invention consists of a long, narrow box, having two drawers, the long one moving at right angles to the counter, and the other, which is kept locked, at right angles to the first or parallel to the counter. The first drawer has two compartments for copper and silver respectively. The top is of plate-glass. The small drawer runs below a sliding platform attached to a handle at the side, which takes all gold, notes, or surplus silver passed through the aperture in the plate-glass forming the top of the whole till. Money put in this compartment can remain for the customer to see, and then, by moving the handle, it falls into the locked drawer beneath. On drawing out the larger drawer containing the silver and copper a bell rings, and this effectually prevents any secret tampering with the till. The key of the gold compartment is kept by the principal, who may from time to time transfer the surplus silver from the compartment in which it lies into the drawer, and thus the whole takings of the day need never be at the mercy of any one in the shop. Another special advantage of this improved till is the manner in which it is attached to the counter. Two iron hooks are screwed into the under end of the till below the handle door, so that the hooked part of the iron can run under the edge of the counter. Through these hooks there passes an iron cross rod, as long or short as the requirements of the particular shop may need, and this is fastened to the supports of the counter as far as the length of the rod allows. These tills can be made in any style that may be desired.

DECORTICATING RICE, WHEAT, &c.

Very few persons, comparatively speaking, know how much inventive genius has been expended in the endeavours to remove the outer cuticle of the wheat berry without at the same time depriving it of any of its nutritious properties. Mr. J. H. C. Martin, of "The Drive," Walthamstow, and of 16, Mark-lane, E.C., has invented a machine for thoroughly decorticating rice, wheat, and other grains, which is claimed to possess very great advantages. An emery drum is employed, and made to revolve rapidly within a cylindrical case and set obliquely, and so adjusted that for wheat the machine not only cleans thoroughly, and especially the ends of the grain, but produces the condition needed for roller-milling, the skin in the crease being left thicker than in any other portions, and thence being more easily separated. It is contended that flour made from wheat thus treated would be in preferential demand.

IMPROVEMENTS IN WINDOWS.

The window has long, we think, presented a prominent field for the inventor, and now we observe that Messrs. Verity Brothers, the well-known manufacturers and patentees of sundry special ironmongery appliances for the building and other trades, of 51, Call-lane, Leeds, have patented several important improvements in sash and other windows, whereby perfect ventilation and complete security are secured. The windows, can be cleaned on both sides from the inside, and are rendered perfectly safe by means of Messrs. Verity Brothers' double-locking sash-bolt or fastener. The following are some of the advantages explained :—1. The window can be opened for ventilation without being unlocked or rendered insecure if so left. 2. The strength and safety of the swinging pivots are secured in all positions from the fact that—through the protection and steadiness of the outer sash frame—no undue strain can be put upon them. 3. The above, in combination with the rebate arrangement, renders it impossible for the swinging sash to "tumble bodily into the street," as other constructions have been liable to allow. 4. The construction can be varied, so that the upper sash swings only, without sliding; the bottom sash alone being made to both slide and swing upon pivots, or any other variation architects may suggest or require. 5. The chain opener and fastener has no notched bar or other overhanging projection to become unsightly and objectionable when the window is closed, and can be fixed at the side instead of centre.

CORK-DRAWING.

Although in many quarters screw-stoppers are coming into use for most bottled drinks, the cork is very far from being disestablished yet. Meanwhile, cork-drawing is often attended with much trouble, not the least being the breaking off of pieces, which crumble into the contents of the bottle. Mr. A. Muir, of 2, Walbrook, London, E.C., has, we believe, perfected a machine specially designed for drawing corks with amazing rapidity, certainty, and that by a single operation of the hand. The screw is constructed upon the simplest mechanical principles, and being devoid of complicated arrangements, cannot possibly get out of order, while the leverage power is such that any lady, if need arise, can draw out the tightest cork without effort. Another advantage is that the contents of the bottle remain undisturbed.

THE "CARMICHAEL" PORTABLE BOOT-TREE.

There can be no doubt but that for those who study appearances the boot-tree is an indispensable part of personal *impedimenta* during a round of visits, &c. Boot-trees, however, are cumbrous things, and some time since a cavalry officer conceived the idea of making an india-rubber boot-tree capable of being carried in the pocket, and, when put inside the boot, needing only to be inflated to fill any boot out tightly and render shrinkage, however wet the leather, impossible. This invention has obviously many special advantages over the rigid wooden tree, and should come into very general use. The sole agents for this invention are Messrs. W. Sparkes & Hall & Co., 308, Regent-street, London, W.

A NEW WATCH-KEY.

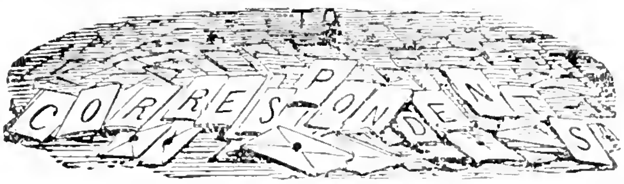
Stem-winding watches have not yet quite disestablished the old-fashioned watch with its separate key. Many endeavours have been made to produce that obvious desideratum, a key adjustable to any watch without any trouble or preparation, and this is now claimed to be accomplished by an invention of Messrs. Vale & Sons. All that the person wishing to wind a watch has to do is to press the key into the winding-square of the watch, which it will at once fit, no matter what the make or size of the watch. We understand that Messrs. Vale & Sons were the very first inventors of a key to wind any watch when, twenty years ago, they produced their screw-adjustable key, and thus a special importance attaches to their new self-adjustable watch-key. This will enable those watchmakers who hold a stock of old-style watches to compete more readily with the keyless variety.

THE NEW BOLANACHI CHOCOLATE.

The invention of a new food-drink, if we may use such a phrase, is surely a matter of no small importance to the community. Some time since M. Bolanachi, a Turkish gentleman, conceived the idea of utilising the ceratonia bean, hitherto used only for cattle-food, and after much labour he succeeded in producing thence a sweet, clear, honey-like extract, the saccharine property of the plant. He next proceeded to try this with chocolate in place of sugar, and as a result of experiments, has now a manufactory of chocolate at Spa-road, Bermondsey, where the cocoa bean, without husk and without flour or starch, is used only with the syrup of the ceratonia bean for making fine chocolates, which do not need boiling, and are claimed to be finer and cheaper far than the ordinary kinds even of the best. The Bolanachi chocolate is a very nourishing and pleasant beverage, and won the highest award in its class at the late International Health Exhibition. The city offices of the company are in St. Clement's House, Clement's-lane, E.C. The new chocolate is a food-drink equally good for the strong and the weak, and is particularly digestive, while its flavour is delicious.

IMPROVED STAIR-ROD "EYES."

Stair-rod eyes of the common sort are often very troublesome, continually coming out and frequently breaking. What is known as Emery's New Patent Stamped Stair-rod Eye appears to be a useful improvement on the old-fashioned cast stair-rod eyes. This eye is fastened by two nails, and, being stamped out of rolled brass, is stronger and cheaper than the ordinary kind. The eyes are at the same time more ornamental. It is obvious that the fixing is much simplified, and the liability to work loose is minimised. Samples of these eyes may be obtained on application to the patentee and manufacturer, Mr. S. C. Emery, 389, Lichfield-road, Aston, near Birmingham.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

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.

IS TEA INJURIOUS?

[1524]—In reply to your correspondents, Messrs. Williams, Gaubert, and Bell, I conclude the above-named gentlemen have had sufficient time to eke out the essence of their subject, but allow me to state the following fact:—viz., that my grandmother lived till the age of eighty-four years, and her sister till ninety-nine years and ten months, each had tea to three meals each day, and both retained all their mental faculties till their decease; and, for my own part, I prefer tea. I also notice a very large proportion of people in far advanced age, and they themselves state that it is preferable to coffee or cocoa, as both the latter cause frequent biliousness. If tea does not prevent longevity, I cannot conceive how it can cause any mental incapacity whatever.

JOE E. LIDDLE.

DOCTORING WINE.

[1525]—In the last number of KNOWLEDGE, page 450, "Gypsum" questions, on theoretical grounds, my inferences concerning his misdoings in the manufacture of wine. My conclusions concerning the substitution of tartrate by sulphates are not theoretical, but are proved by the analysis of many eminent chemists. All are unanimous on this point. "Gypsum" says that "if this were the result of mixing sulphate of lime and bitartrate of potash in wine, the same result would ensue if bitartrate of potash were added to hard water." An action corresponding to that which I described does take place. Everybody who has used cream of tartar as a beverage, or otherwise tried to dissolve it in hard water, knows that there remains an insoluble residuum from which no more flavour of cream of tartar can be extracted by adding more water. This precipitate is a compound of the tartaric acid with the lime in the water; the potash of the cream of tartar having gone over to the acid with which the lime was originally combined. Cream of tartar dissolves in about 180 parts of cold distilled water, very much less as the water is warmed.

I never attributed the mischievous action of plastered or otherwise cooked sherry to "a trace of gypsum," being well aware that the wine cannot possibly dissolve one-tenth of the quantity of gypsum required to produce the precipitate I obtained from the samples as described, and which any body else may obtain by following my instructions concerning the use of chloride of barium. There was free sulphuric acid in some, alum in others, sulphates in all, substituting the natural organic acids, and organic salts of simply fermented grape juice. The evil results of such substitution, either in food or drink, are too well known to demand any further discussion.

I am not able to fully reply to the query of Mr. Scargill which follows the above, not being able to understand how gypsum can be made "to dissolve freely in water." It requires 400 parts of water for its solution. As stated above, this quantity, either in beer or water, can have but a trivial effect. When I first visited Paris in 1842, the water commonly used was saturated with sulphate of lime. The weather was hot; I drank much of it, and suffered some inconvenience. An English resident-physician then told me that sulphate of lime has the same aperient action as its chemical cousin, sulphate of magnesia (Epsom salts). In order, however, to take a dose of half an ounce, ten pints of saturated water, or a corresponding quantity of saturated wine or beer, must be taken. W. MATTIEU WILLIAMS.

"STATISTICS OF BARATARIA."

[1526]—Some time ago, the Editor of KNOWLEDGE remarked that a man's descendants, after some generations, had but a fraction of his blood in them; and this is repeated and amplified by Mr. Grant Allen on p. 416, KNOWLEDGE, vol. vi. It occurred to me that though this is mathematically true, yet there are reasons for thinking it is not physically so. It does not follow that because in the fourth generation a negro's posterity are "white by law," all other peculiarities are lost in other cases—*e.g.*, there may be different results from cross-breeding and from in-and-in breeding. And in his last paragraph Mr. Allen seems rather to modify what he says in the preceding one. "The one certainty upon which the ethnologist can repose is physical peculiarities. These . . . repeat themselves."

How can this be reconciled with (*supra*): "Nobody on earth could possibly detect in the fifth remove the very slightest tinge of negro ancestry"? Why does not an occasional negro turn up in such families, like the lips of the Polish princess in the Hapsburg line?

My belief is that the mothers do little to modify races, but that general physical arrangement follows the patronymic. The Duc de Nemours is the picture of his ancestor, Henri IV. It would be of some value if we could ascertain whether any of his brothers resemble in an equal degree any of their ancestresses.

My attention was fixed on this twenty years ago by a striking circumstance. I knew the names of all my foremothers married to paternal ancestors, up to the beginning of the fourteenth century. My mother was pure English; my father's mother, pure Welsh; his father's, Anglo-Irish; his father's, again, pure English. All before that were pure Lowland Scotch; but my ancestor of the thirteenth century is said to have been Celtic, and for this reason we are reckoned among the Highland clans, though our cradle lies south of the Highland line. In 1863 I made the acquaintance of another branch of our name, absolutely pure Scotch. To my surprise, I found them repeat, not only in general likeness, but in small details, my own near relations. I saw also a fine portrait of my great-grandfather's grand-aunt (of my own name), which was, line for line, that of my own sister, save the forehead. But the most curious thing was that when I entered the room at a meeting of the R.S.A.S., a Fellow remarked to another "What an extraordinary likeness that gentleman bears to the —— of ——" (naming the elder branch of my family, now extinct, whom he had known in youth). How could a mongrel like me be instantly spotted as a scion of a pure Scotch race, unless it be that—at all events, within certain limits of race—the original paternal blood is never washed out; or, at least, not in two hundred years, for it is just that since I had a Scotch ancestress.

As I get old I remind myself, more than of any one else, of my mother-in-law, who was absolutely pure Highland, and not the faintest relation. How can this be, unless I reproduce my last pure Celtic ancestor, who was born certainly not later than 1250? These facts are all the more strange when I add that I am also very like my mother's father.

From the above date I would also draw a political moral. The sovereign of a realm, however limited his powers, must always exercise a very large influence over his people. Now the Prince of Wales will, of course, to a great extent "take after" his august mother. But the *future* kings will repeat, not the line of Guelph, with which we shall be done for ever, but those obscure Dukes of Saxe-Coburg-Gotha, from whom spring the new line of double-German kings.

If we wish to forecast what sort of Royal family we shall have in ages to come, it is these sovereigns whose biographies we should study. Yet there has been, I think, only one book published about them; and it does not seem much sought after. HALLYARDS.

"EDWIN DROOD" (DICKENS'S STORY LEFT HALF TOLD).

[1527]—I think you have recently expressed yourself as of one mind with Mr. Foster on the subject of "Edwin Drood." Will you, then, allow me to be "H. E.'s" ally in the argument. I may be able to notice one or two things in defence of his theory.

Mr. Foster makes a great point of the sight which so horrified Jasper when he was attacking Edwin on "the great tower." May not this horrifying sight have been merely the ugly result of the sudden and violent strangulation which Edwin was undergoing? Jasper would have good cause to say he had never seen *that* before, whatever else he might have seen "in his mind's eye" when planning the murder.

Mr. Foster suggests that, when Edwin was flung into Mrs. Sapsea's tomb, "the strong silk shawl with which Jasper had intended to throttle him" was drawn over his face. According to this, Edwin must have stood a strong chance of being smothered as well as throttled.

As to Datchery's resemblance to Edwin (in Mr. Foster's mind) there is great ingenuity, but nothing sufficiently "commonplace" to make the resemblance rational. Would a few months' mental and bodily suffering change Edwin—the thoroughly English Edwin —into a vindictive, calculating avenger? And could he return to Cloisterham, where he had been pretty well known, and assume a very striking disguise of manner, speech, gait, and appearance without expecting shortly to be exposed, and without being so exposed? Mr. Foster seems to make light of the fact that Datchery's personal appearance is calculated to draw marked attention, which attention must have discovered Edwin immediately.

Whereas a detective might happen to have a strange and striking appearance—having reached a certain period of life—without finding it interfere with his watching of Jasper. Indeed, it seems to me that the open and persistent watching of the supposed murderer is a means to frighten confession from his guilty conscience.

Fancy Edwin sauntering about Cloisterham with a large grey wig on!

That Datchery knows the Deputy's name to be "Winks" is not surprising if Datchery is a detective; he may also know the queer names of a good many more persons who frequent the Traveller's Rest. Mr. Foster contends that no one ever speaks of Edwin as *dead*; but then no one *knows* him to be dead. His death is only assumed because his watch and other trinkets have been found, while his body has not. When a person is missing, even under strong presumptive evidence of foul play, or of suicide, his friends long hesitate to speak of him as dead, or to acknowledge the probability of his fate. Rosa's conduct, and the silence of those around her, is an instance of this.

I agree with "H. E." as to the illustrations which Mr. Foster has produced. They prove nothing; for if they represent Edwin's escape from his uncle's attempt on his life, Charles Dickens would not have published them. Fearing—as we now know—that the story was being unfolded too rapidly, would Dickens have assisted his readers by showing at a glance what he would prefer to reserve for several hours' reading? As to Grewgious' manner, it was at no time genial, excepting, perhaps, where Rosa is immediately concerned. Of course, he cannot make up his mind about Landless. He knows him to be a bad-tempered young man, who has savagely quarrelled with Edwin. Of the two persons last seen with Edwin, Landless is proved innocent: suspicion, therefore, is obviously to be fixed on Jasper, and Grewgious, naturally enough, tests that person in a deliberate and open manner. The result of the test in the celebrated interview is that Jasper conclusively proves to his keen opponent that he is the guilty man.

There is no reason why Deputy should not have betrayed Jasper eventually; but if Jasper was betrayed *immediately after the crime had been committed*, he could not possibly have escaped. Before Edwin—under the most favourable circumstances—could have recovered sufficiently to intercede, Jasper would have been pointed out as the would-be murderer, and would be locked up immediately.

Finally, if a murder is supposed to have taken place, how long will the police and the press and the local busybodies permit suspicion to fasten on an innocent man without sifting the matter thoroughly?

Even in Edwin Drood's time public opinion in all its branches was not unknown, and nothing but the knowledge that the police had not forgotten the crime, nor despaired of discovering the criminal, would cause the matter to be so patiently treated by *Landless*.

As to Edwin's reddening (to hark back a moment) when he (see Mr. Foster's theory) heard the opium woman mention his name, would not any man of Datchery's age and build redden when he stooped? J. B.

THE LUNAR ECLIPSE OF OCTOBER 4.

[1528]—May I be allowed to say, in connection with the editorial remark on p. 446, that it was not I, but M. de Boë himself, who calculated the position of the Cordilleras with reference to tho earth's limb at the instant illustrated in the diagram in my letter (1451) on p. 325. It never occurred to me to check the results of one whom I knew to be so able a mathematician as my learned Belgian friend. William Noble.

Forest Lodge, Nov. 28, 1884.

NOAH'S RAINBOW.

[1529]—In Mr. Garbett's letter in your issue of June 13 he says: "I never met a Jamaica negro who had seen a rainbow, or had more conception of it than snow." After reading this statement I began asking some Jamaica negroes if they had ever seen a rainbow, and I have been asking ever since without ever once coming across one who was not ready to swear to having seen plenty.

This morning, at 6.30, I saw a complete bow with my own eyes. Now, whom am I to believe? I may add that not even the negro children showed any astonishment at the sight. E. Nankivell.

P.S.—At 2.15 p.m. to-day (Nov. 5) I saw a succession of nearly perfect rainbows.—E.N.

Port Royal, Jamaica, Oct. 27, 1884.

LETTERS RECEIVED AND SHORT ANSWERS.

G. St. Clair. Your pamphlet does not lack ingenuity; but the idea of more than one white is one which I fear 999 of every 1,000 students of physical optics must hopelessly fail to grasp.—Alfred Sanders kindly supplies the information that Darwin's "Biographical Sketch of an Infant" was published in the number of "Mind" for July, 1877.—Isidore. No; "the thought has" *not* "occurred to" me "that if the Electric Light is persisted with and becomes a general illuminant it will eventually bring about darkness and destruction." Whether any of my "brother scientists" have suffered under such an hallucination I am unprepared to say.—E. A. Tindall. There are difficulties in the way of increasing the size of the star maps. With reference to your other criticisms the general plan was decided on after very full consideration. To adhere to a definite scale of magnitudes appeared the only consistent way of proceeding. You will see that the pupil photometer has been received.—P. A. R. Wood is petrified by the infiltration of silica (the base of flint) into its tissues, which are replaced by the mineral, just as in the case of other fossils. This is a process which has gone on at a comparatively recent geological date at or near the earth's surface. Coal has been formed by the bituminous fermentation of vast masses of vegetable matter under great pressure. Peat, cannel coal, Bovey coal, and the like, represent stages in the formation of true coal.—Naturalist. See Maynard's "Manual of Taxidermy," sold by Trübner & Co., reviewed on p. 292 of our last volume.—H. F. A. Young's "Strains on Girders, Arches, and Trusses," published by Macmillans, ought to suit you. See Knowledge Vol. V., p. 482.—Zero. When the moon is on the horizon her angular diameter, as measured with a micrometer, is actually *less* than it is when she is high up in the heavens. If you draw a diagram you will see that under the latter circumstance she is really nearer to the spectator than under the former condition. The whole thing is an optical illusion. In the open vault of the sky you have nothing to compare the moon with. When she is on the horizon you have, as a rule, numerous objects of known size in juxtaposition with her. A balloon affords just the same illusion. It looks a very little thing as it goes overhead, but an enormous object as it approaches the earth; albeit it may descend at a considerably greater linear distance.—J. Gillespie. Read any elementary work on physical geography. Did it ever occur to you that the melting of the snow on the equatorial ranges of hills near the source of the Nile had anything to do with its rise?—A Reader of "Knowledge." The (inappropriately) so-called "Harvest-Moon" is the full moon which happens the nearest to September 21st, and this can obviously never occur in August. Whenever the moon is pretty close to the first point of Aries, which, of course, is the case during part of every lunation, she rises on each of two or three nights running a very little later than she did on the previous one. No one notices this when she is a crescent, but when she is full it becomes more striking. Now she is only full in Pisces and Aries at the time of the autumnal equinox; hence the harvest-moon.—W. H. Greene. Shall receive immediate attention.—S. J. H. I regret that you should have had the trouble of sending an answer to Letter 1398 all the way from India, when I have already excluded some quires of replies from English correspondents.—W. Aston. The projection of a solar eclipse is very much too complicated and operose a matter to be popularly explained, and would occupy considerably more space than can be spared. Moreover, unlike an eclipse of the moon, it must be calculated separately for every fresh station.—Bird-Stuffer. A design for sticking 2,000 postage-stamps on to a fire-screen is more in the way of *Myra's Journal* than in that of a professedly scientific periodical like Knowledge.—L. A. W. If the rays round the star disappear after a little gazing, the fault is obviously in your own eye, and not in the object-glass at all; but, as you describe the image as only "tolerably clear" after all, the objective may be faulty too. Too low a power gives indifferent and glaring images of stars. Nothing surpasses the admirable "Celestial Objects for Common Telescopes" of the Rev. Prebendary Webb as a catalogue of all interesting objects. Neptune is in a very blank region of the sky just now. The only direction I can give you for finding him by means of "The Stars in their Seasons" is to refer you to Map 1. of that work. On this you must draw a line joining δ Arietis and 5 Tauri, find the middle of it, and fish with the telescope in the sky to the right of this middle point for the planet. I may add that you will wholly fail to distinguish him from a small, dull, fixed star with a 2·1-inch telescope.—W. Jerome Harrison. Both received; to appear in due course. I fear that it will be some time ere we shall have room for a description of the gelatine plate process.—David Houston. Accepted with thanks.—W. R. Scanlan. The conductor of Knowledge is not at present in England. An answer which applies equally to J. B. Hodgkin and to E. Smyth. Will the two latter correspondents be good enough to read the italicised paragraph which is printed at the end of these "Answers?"—W. M. You may take it that the point at which the eye will be placed must be 200 miles from either of the stations midway between which it is situated; and a line from it to either of such stations will be a tangent to the earth. Regarding the earth as a sphere with a mean radius of 3,956 miles, we have a triangle right-angled at the station, with the base 3,956 miles long, and the perpendicular 200 miles long; so that we have only to square 3,956 and 200, and, after adding the squares of these together, extract the square root of their sum, to get the length of their hypothenuse, from which, if we subtract the earth's radius, the remainder will be the height of the eye above the surface of the earth (Euclid I. 47).—A. Fanatics always have, and always will continue to, abuse those those who differ from them. Deadly as alcohol is to individuals, the alcohol-consuming races have come prominently to the front in life's struggle, and have conquered all the world. There was more in what you complain of than met the eye. You are entirely right as to testimonials. My private impression is that the person to whom you refer is not responsible for his actions. Certainly, for his own sake, I hope so. I unfortunately cannot read Spanish.—S. O. See note on p. 439. Under any circumstances, such reproduction will not occur during the present year.—G. H. L. The list of constellations following the maps on pp. 424 and 425 is a complete one, comprising all those visible in England. Only a portion of these can be seen at once, and those which can be so seen vary with the time of year. During the November and December nights, No. 9, to which you specially refer, is far below our horizon. Scientific astronomers of all nations use the Latin names of the constellations; but, of course, their popular names vary in different parts of the Continent. As a rule, however, they are simply translations of the Latin originals.—R. Tudsbury and Sons. Delayed through being addressed to the Editor, instead of to the Publishers.—Believer. Look through the list of publications issued by the Messrs. Clowes & Sons in connection with the International Health Exhibition. You will find all you need there.—E. Mayo. See Knowledge, Vol. III. p. 262. Probably "The Universe of Stars" would furnish the information you require. Note the concluding paragraph (in capital letters) which heads the correspondence column.—Matthew C. Oatfield. See paragraph at the bottom of column one, p. 62, of the current volume.—Dr. Williams. Many thanks; but mere observations are numerous and not of great interest. Some of your *results*, though, as you will see, have been embodied in a short article. Your contrivance for viewing Solar spots is a familiar one. *Vide* "Elementary Astronomy," published by Cassells, p. 136, and p. 22 of Webb's "Celestial Objects for Common Telescopes," &c.

In reply to numerous letters and communications addressed to the office of Knowledge, *its Editor begs to announce that he has concluded his Lecturing Tour, and has, in fact, definitely ceased to lecture altogether. Should he (which is very doubtful) at any future time resume his lectures on Astronomy, due and ample notice will be given of such resumption in these columns.*

Our Whist Column.

By Five of Clubs.

DISCARDING.

Few points of whist play are more important (and, it might be added, few are more neglected) than the discard. An original discard is like an original lead in its significance; a forced discard has a meaning akin to that of a forced lead; it is as important to distinguish a forced from an original discard as to avoid mistaking a lead from weakness for a lead from strength; and finally, to discard properly at the close of a hand often requires as much skill as the art of rightly placing the lead at that stage of the game.

When you have to discard to the first suit led, that suit being plain, and no indication having been given of trump strength anywhere, your course is simple. If the plain suit is your partner's, you discard from your shortest suit, unless in so doing you have to unguard a King or Queen, when—unless you are very strong in trumps—it is better to discard from the suit which needs least protection: though of course you would unguard a King or Queen unhesitatingly, rather than injure a long and strong suit of your own. If the suit (plain) which you first fail in is your adversary's, you equally discard from your shortest suit, in general; but to the exceptions just noted may be added (i.) the case where you have to leave an Ace single, and (ii.) the case of your shortest suit being a singleton. For when an adversary's suit has been exhausted, your weakest suit is likely to be your partner's best, and it may be a matter of great importance later to give him a lead in it. But if your own suit is strong as well as long, and you are fairly strong in trumps, you may more safely uncover an Ace or discard a singleton, for the close of the hand is more likely to be under *your* control than under your partner's. You must weigh the chances, and take your chance, just as you have to do when forced to lead from a weak suit without knowledge how your partner stands in it.

When trump strength has been disclosed, either by the signal or by a lead, before the occasion comes for a discard, or when you have to discard to trumps, the general rule is, discard from your weakest suit if trump strength lies, or appears to lie, with you and your partner, from your longest and best protected suit when trump strength lies or appears to lie with the adversaries. (But so long as there is a chance of bringing in your long suit, you should not discard from it.) While doubt remains as to the position of trump strength, avoid unguarding King or Queen, uncovering an Ace, or discarding a singleton; but when it is certain that your partner has commanding strength in trumps you need be less careful on these points, for there is little fear but that your partner will get the lead when he wants it. Albeit, cases sometimes arise where your long suit is worthless, and so much manifestly depends on your giving your partner a lead, or keeping guarded a strong card in his suit, that you must discard (even originally) from your long suit. Suppose for instance the first two rounds have shown that Clubs and Diamonds are the best suits of the enemy, and that then the fall of trumps (led by your partner) shows that you and he will remain with a long trump (a Spade) each, the first lead outside trumps coming from your partner: then if you hold Ace, or King, or Queen of Hearts and a small one, along with weak Clubs and Diamonds (of which you originally held three and four, respectively), it would be absurd to follow the usual rule and discard your small Heart: for thereby you lose the chance of taking the first round in Hearts and returning your partner the suit, or of helping to clear his suit in the first round, ruffing Clubs (having discarded in that, your second shortest plain suit) and then returning Hearts. Common sense must guide you in such cases.

Remember, however, as a general rule for learners, that your original discard indicates your shortest suit if trump strength is not declared against you, your longest suit if it is. Subsequent discards have no such significance. One of the most important points in Whist training, is to learn to notice the original discard of each player as carefully as you should notice his lead. Until you do this you cannot properly be said to play Whist at all.

In the later rounds of a hand the question of the discard assumes an entirely different aspect, just as does the question of the lead. You have to consider what suit the enemy threaten to bring in, so that if you have command in that suit you may retain it religiously; and to note what suit, if any, your partner may bring in, so that if you have the command in that suit, in such sort as to be likely to obstruct him, you may give it up by discarding your commanding cards.

Our Chess Column.

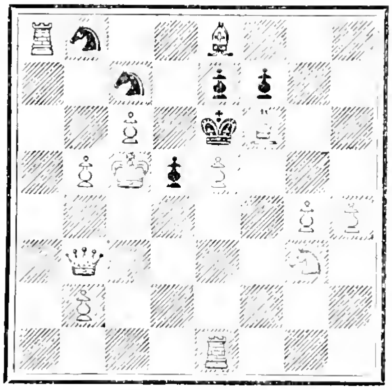
By Mephisto.

PUZZLE No. 139.

By Zukertort.

(From the *Bradford Observer and Budget.*)

Black.



White.

White to play and mate in two moves.

THE EVANS GAMBIT.

(Compromised Defence.)

(*Continued from p.* 394.)

1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. B to B4, B to B4. 4. P to QKt4, B × P. 5. P to B3. In our former articles we have examined Black's reply of B to B4, which is safe to play, as it limits the number of attacking moves at White's disposal. We shall now proceed to discuss Black's reply of

5.	B to R4

which move requires greater care on the part of the defendant player.

6. P to Q4	P × P
7. Castles	P × P

This is the compromised defence, which Zukertort and other analysts pronounce to be sound. We shall hereafter proceed with other variations arising from 5. B to R4. The usual continuation of the compromised defence is

8. Q to Kt3	Q to B3
9. P to K5	

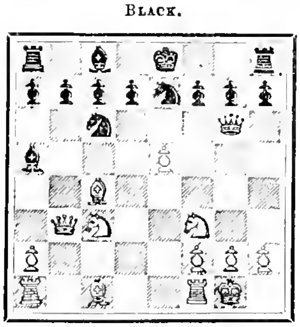
Kt × P would not be good, on account of 10. R to K sq., P to Q3. 11. Q to R4 (ch), K to B sq. 12. Kt × Kt, P to B7. 13. Kt to Kt6 (ch) and mate.

	Q to Kt3.
10. Kt × P	

Here B × Kt would lead to the following:—11. Q × B, KKt to K2. 12. Kt to Kt5, Castles. 13. B to Q3 with advantage.

	KKt to K2

Black.



White.

This is a usual position in this defence. White has now two good moves at his disposal for continuing the attack, one is 11. Kt to K2, and the other 11. B to R3. We must confess to a strong liking for B to R3 in the Evans Gambit. The attacks arising from both lines of play are very interesting.

11. Kt to K2	P to Kt4
(This move is considered best for the defence.)	
12. B to Q3	Q to K3
13. Q to Kt2	Kt to Kt3
14. Kt to B4	Kt × Kt
15. B × Kt	P to KR3
16. QR to B sq.	P to R3
17. KR to Q sq.	B to Kt2
18. Q to Kt sq.	R to Q sq.
(With a defensive position.)	

On the 13th move White may also play—

13. Q to Kt sq.	Kt to Kt3
14. B to Kt2	B to Kt2
15. P to QR4	P to Kt5
16. Kt to Kt3	Castles QR
17. R to B sq.	Kt to B5
18. B to K4	P to KR3
19. P to R3	

In illustration of the move of 11. B to R3, we give the opening moves of games recently played, *vide* diagram of position:—

	Zukertort v. Hirschfeld.	Hirschfeld v. Mason.	Zukertort v. Hirschfeld.
11.	B to R3 / Castles	B to R3 / Castles	B to R3 / Castles
12.	QR to Q sq. / P to Kt4	QR to Q sq. / B × Kt (*b*)	Kt to K2 (*c*) / P to Kt4
13.	B to Q3 / Q to R4	Q × B / P to Q4	B to Q3 / Q to K3 (*d*)
14.	Kt to K4 / K to R sq. (*a*)	P × P (en pas) / P × P	B × P (ch) / K to R sq.
15.	Kt to B6 / P × Kt	R × P / B to K3	Q to K3 / Q to R3
16.	P × P / P to Q3	R to K sq. / Q to R4	Kt to Kt5 / B to Kt2
17.	P × Kt / Kt × P	B × B / P × B	QR to Q sq. / QR to Q sq.
18.	B to Kt2 (ch) / P to B3	QR × P / Kt to Q4	B to K4 / P to Q4
19.	B to K4 / R to QKt sq.	Q to Kt3 / R × Kt	P × P (en pas) / P × P
20.	Kt to Q4 / P to QB4	Q × R	Q to KKt3 / B to B2
	with a good defence.	with the better game.	White has a strong game.

NOTES.

(*a*) Zukertort thinks R to K sq. better.

(*b*) The "Chess Monthly" condemns this exchange, considering the KB necessary for the defence and to prevent R to K sq.

(*c*) Not so good as QR to Q sq.

(*d*) Here Zukertort prefers Q to Kt5. 14. P to R3, Q to QR5.

Correction.—In the game given on p. 411, we have reversed the names of the players, which should read: White, R. M. Macmaster; Black, R. K. Leather.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

A correspondent informs us that Grimshaw has composed the first Problem in which a Rook makes room for a Q. The problem was likewise unsound. It was published in Knowledge March 9th, 1883, Vol. III. Correct solutions received from J. K. Milne, W., H. W. Sherrard, Scribbler, F. Champ.

C. Planck.—Thanks; the three-move published last Saturday. Other Problem not clear where the mate comes in after 2K × Kt.

Contents of No. 161.

KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, DEC. 12, 1884.

Contents of No. 163.

SCIENCE AND THEOLOGY.

By Richard A. Proctor.

WHILE thoroughly recognising the liberal and kindly spirit in which Dr. Healy (letter 1488, p. 372) deals with the relations between science and theology, I cannot but demur to the manner in which he compares the two. He sets on the one hand the study of Science and on the other the study of Theology, as if these were different departments of research. Men of science, according to his view, may become well acquainted with matters belonging to their own department, but are ill-fitted to express opinions on matters relating to theology; and *vice versâ*.

Are men rendered more fit to understand religious relations by giving much time to theological study? The answer to this question will depend on what we understand by theology. Dr. Healy seems to understand by it "our old beliefs and hopes." He appears to identify "revealed religion" with "theology." But, if he is right in this, he surely is wrong in regarding theology as a department of research; for not only in Christian teaching, but in every form of religion claiming to be revealed, it has constantly been held that to the unlearned, nay to those who are as babes and sucklings, the truth has been revealed which the wise and learned have been unable to receive, or by study to understand. Those to whom was entrusted religious teaching in old times were for the most part not men who had given much time, many of them had not given any time at all, to theological study. If but a single one were so selected of old, Dr. Healy's objection to men of science "who seek to become his religious teachers" falls to the ground. If a man who had been all his life a fisherman could be worthily selected to become a fisher of men, I can see no reason why a man who has given a large part of his time to chemical investigations (let us say) might not be a most potent or even a divinely-ordained teacher of religious doctrines. I do not know that any man of science has ever claimed to become a religious teacher, as Dr. Healy appears to imply. I know of no man of science who has ever asked the theologian or any man "to give up his beliefs or hopes." But if any had done so, no one would have a better *à priori* right to object to a man of science who should speak about religious matters, than the Scribes and Pharisees of old had to object against Andrew and Peter, that "though quite ready to admit" these twain as excellent fishermen, "they strongly objected to them as religious teachers." There is nothing in the study of God's universe, any more than there is in net-making with Peter or tent-making with Paul, to render a man objectionable as a religious teacher. It might be urged with at least equal force that *theological* training was unsuitable for a religious teacher, seeing that not one of the founders of wide-spread religions has ever selected a theologian for apostolic work. Paul may be mentioned as an exception. Yet, though he lived according to the straightest sect a Pharisee, and though he had (or it was at least objected to him that he had) "much learning," and has given theologians much to think about, there is nothing to show that, according to the modern acceptance of the term, he was a theologian.

It may perhaps be urged that in our time the teacher of religion *must* be a theologian. I know not what would have been said on this point by the apostles of the early Christian Church. But those who know anything of the system of education and training adopted for religious teachers and theologians in the principal Christian churches of our time, can hardly find that there is much in the system to justify Dr. Healy's tone. I myself passed through all the theological examinations at the University which are required from men who are to become clergymen, except that one which is notoriously the easiest of them all, besides receiving a preliminary training at King's College (the chief Church-of-England College in London) which put me at the "head of my year" in Divinity. Yet, so far as religious teaching is concerned, I can see nothing in anything I then learned that even approaches in its influence the effect of those studies that bring before the mind the infinite vastness of God's domain, its eternal duration, and the perfection of the laws which prevail throughout its whole extent alike in Space and Time. What is really held by many theologians to be anti-theological in science, is in reality that which makes the teachings of science most solemn and impressive: Science teaches that God's domain is not a little circle of the earth's surface arched over by a star-spangled dome which is the floor of heaven, and hiding beneath it the sulphurous caverns of Hades, as appearances once taught men to imagine, but infinite space strewn with infinite multitudes of suns and sun-systems; Science has read from the earth (God's work, and therefore His word, if we can but read it aright), that for millions, nay for tens and hundreds of millions of years in the past, the laws of that domain, as now revealed to us, have been maintained —so perfect are they—without occasion for change or interference; and science has learned to look as far forwards as backwards. Science, in fine, presents the Universe of God as aptly symbolising what we have been taught to consider the attributes of God Himself. It is this that so many theologians regard as anti-theological, because narrow theologies have pictured God after their own image, with which these infinite grandeurs are not consistent.

I am quite aware, however, that Dr. Healy himself disclaims any such feeling. He accepts the teachings of science, but appears to imagine that science wishes to emphasize the discrepancies which he finds between these doctrines and his religious beliefs. I do not know of any man of science, or real student of science, who has done more in this direction than simply to defend his scientific teachings where impugned because of such imagined discrepancies. A host of men, theologians and otherwise, are ever ready to denounce scientific teachings on such grounds. The trouble is that there is no avoiding their denunciations. Those of the milder sort deny that they are troubled because of such objections as the more virulent and foolish are ever ready to raise. But they swell the cry of the opponents of science all the same. Dr. Healy may take exception only to our review of the sillier anti-scientific works as implying that the writers of such works are theologians instead of the dolts and ignoramuses he perceives them to be; or he may only be troubled because a writer on science (who may have given this particular point much more careful study than ninety-nine out of a hundred clergymen) speaks of the Books of the Pentateuch as assuredly not written by Moses (as if by the way *this* were in any sort or degree a theological question; and as if it had not been shown by men who have thoroughly studied this archæological subject, that Moses could not possibly have written those books as they stand). But his objections come in company with those of multitudes of persons whom we could not possibly satisfy, even though we could satisfy Dr. Healy. Why, I have been publicly objurgated for teaching that the stars are suns lying in the midst of infinity (or what to us is practically infinity) of space, in all directions around us—for no better reason than that in one of the books of the bible we are told that the heavens are God's throne and the earth His footstool (a statement which, so understood, would require us further to believe that over Edom God had cast out His shoe). By quite a large number I have been asked whether it is not irreligious to accept the teachings of astronomy, when, if accepted, they leave no place for heaven, or for hell either,—an interpretation of bible phrases which would leave it rather difficult to explain what was intended by the statement that to produce the flood "the windows of heaven were opened."

It has only been in this sense, or rather through such nonsense as this, that anything in the slightest degree anti-theological can ever be said to have appeared in the columns of KNOWLEDGE. Any man can accuse a writer of being anti-theological who chooses to start a theological school of his own, and to say that the teachings of science about God's universe are inconsistent with his own narrow ideas respecting the domain and the power of the Almighty. Any one can educe from his own nature conceptions of what God is and how God acts; and because his own nature is small and spiteful, or cruel and despotic, or conceited and overbearing, may denounce the ever-widening range over which Science extends its survey—seeing God in all and through all, too great to be within our ken, too powerful for us to be able even to conceive His might, too Wise for us to follow the workings of His mind, His Infinite Comprehension of all things that are and have been and will be throughout Eternity. But Science has nothing to fear from such attacks. Her business is to study God's universe without fear or anxiety, lest suddenly she should discover something mean or unworthy therein. She cannot fear lest "some hysteric sense of wrong or insult should convulse the throne where Wisdom reigns supreme." When She is told to take the shoes from off her feet because the ground on which she treads is holy ground, She answers that God's whole domain is holy to them that rightly think of it: not this thought or that feeling, but all our thoughts and all our feelings about the universe should be full of reverence, because all things—the great and the small, the long-lasting and the short-lasting—are full of mystery, instinct with infinite wonder. In the words of the science poet, Goethe (quoted to this effect by one of those most roundly denounced by men regarding themselves absurdly as defenders of religion):—

> Gleams across the mind His light
> Feels the lifted soul His might:
> Who then dare deny His right
> The All-Enfolder?
>
> Who dare to name His name,
> Or belief in Him proclaim—
> Clothed in mystery as He is,
> The All-Upholder?

PLEASANT HOURS WITH THE MICROSCOPE.

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

I AM often asked to advise intending purchasers of microscopes what they should look for, and the question is just now very seasonable, as many parents are anxious to make a really useful and handsome Christmas present to their sons and daughters. No intelligent family should be without a microscope, but the size and sort should be decided by the use likely to be made of it. Medical students find a small, strong, portable instrument of simple structure the most useful for following histological demonstrations, and the powers recommended as essential are 1 in., $\frac{1}{4}$ or $\frac{1}{6}$ in., with two eye-pieces. Instruments of this sort cost from £5 to £6 or £7, and they suffice for ordinary purposes; but they are not adapted either for the best display of beautiful objects or the exhibition of difficult ones. Many English makers follow French and German patterns, and give their microscopes short tubes. This is handy for a student's rough use, but for steady, quiet work the English tube length of about nine inches is to be preferred. It is brought up to ten inches when the objective is added. The length of the tube determines the amount of magnification to be obtained with a given eye-piece and objective. The longer the tube the greater the power, and many instruments are made with draw-tubes for the purpose of obtaining this advantage to a greater extent. It is chiefly applicable to the lower powers, as with a quarter and upwards the performance is injured unless the objective is used with the tube-length best suited to it. In buying foreign high-powers this should be thought of.

A microscope that can only be used in a vertical position is not desirable, as looking through it keeps the head in an uncomfortable and wearisome attitude. For prolonged observation a horizontal position is the best, but for common purposes the tube may slant at about 45 deg.

The range of movement given to the tube for focussing varies with different patterns. The best instruments allow a 4-inch objective to be used for large objects, and so much pleasure and information can be obtained with this low magnification that it is well to require a stand that will permit its employment.

The amount of magnification obtained with various eye-pieces and objectives is reckoned by comparison with their apparent linear dimensions as seen by a sound and normal eye without any assistance at ten inches' distance. The terms four-inch, one-inch, quarter-inch, &c., mean that the compound lenses of the objective magnify as much as simple ones of these focal lengths.

The cheapest form of microscopes has a simple up and down movement of the slide-holder. A better and more expensive sort enables the slide-holder to be readily moved in any direction, and with best instruments there are two rack and pinion motions at right angles to each other. This is very handy, but not essential even for delicate work. The stage on which the slides or other object-holders rest is often made to revolve. This is useful when polarised light is employed, and also to exhibit the effects of illuminating objects by light falling at different angles. Thus the beautiful scales of Morphomenalaus exhibit a fine blue tint when the light strikes in one direction, and when the stage is partly revolved the colour is a brownish drab. Many minerals—hypersthene, for example—show brilliant colours in one position and none in another. There is also a great convenience in a revolving stage, to bring objects into a convenient position for studying or drawing. Perhaps a rotifer is stretched out at an angle that does not show it to advantage, and would appear awkward in a sketch. The rotating stage enables it to be seen upright.

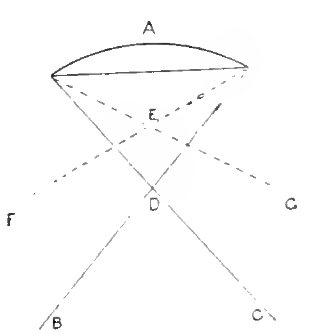
All microscopes are supplied with a mirror below the stage to throw light up, and the best have two mirrors—one flat and the other concave. These should be mounted so that they can be moved considerably on one side, and slanted so that a very oblique light can be sent through any translucent object, which then appears luminous upon a dark ground.

An achromatic condenser fitting under the stage is of great use for the best display of delicate structures. It is provided with stops which keep out more or less of the central rays, and little holes to let only small pencils through. The cheaper instruments are not adapted to carry this apparatus; but, if the price can be afforded, it is better to have one that will, though a beginner is better without it until he has learned to make the best use of the substage-mirror. The condenser should give a good dark ground field when required.

A binocular instrument costs more than a single one. If the prism which diverts part of the light-beams to form a second image is good, an object viewed, say, with half-inch power, should be defined sharply and clearly whichever tube is looked through. If intended for use with high powers, Stephenson's pattern is the best. Before deciding on having a binocular instrument, the person who is to use it should ascertain whether his eyes are an optical *pair*. A slight difference does not matter; but, when one focus is considerably further off than the other, a binocular is of little use. When both eyes match, the effect is excellent, and fatigue from continuous observation is less felt.

Beginners are puzzled to know what is meant by the angle of aperture of object-glasses, and what is the effect of it.

Let A be the front lens of an objective, B C two rays of light making an angle, B D C. That is the angle of



aperture, and it means that the objective is open to, and can bring to a focus, rays of that degree of obliquity. But it may be constructed to bring such rays at F G to a focus, and their angle, as seen at E, is larger than that at D. There are proportions between focal length and angles of aperture which give the best definition. This is often exceeded for the purpose of showing dotted and lined objects, such as diatoms; but naturalists and physiologists condemn the plan on several grounds. Such objectives are less accurate, and have little *penetration*—that is, they cannot show both the surface of object and layers a little below it. They also can only work very close to an object in proportion to their magnifying power, and this is extremely inconvenient, especially when living creatures are under investigation. When it is considered that a good microscope is a permanent treasure in a house, it is worth while to begin with one as good as can be afforded. The most costly instruments are luxuries. All they can do can be done with simpler and much cheaper means, but it is not wise, if it can be helped, to stop short of what are reckoned good second-class stands. The objectives should be of the best quality, and only advanced students will do any good with powers higher than $\frac{1}{4}$ or $\frac{1}{6}$. In all cases they and the microscope tube objectives should be made with the universal screw.

OUR TWO BRAINS.

By Richard A. Proctor.

(*Continued from p.* 136.)

THE remarkable phenomena presented in cases of dual or intermittent consciousness appear to throw light on the subject we are dealing with, because they can apparently be interpreted in no other way (when *all* are considered) than by the theory that the brain is double. Let us consider a few cases of dual consciousness:—

Brown-Sequard mentions the case of a boy at Notting-hill who had two mental lives. Neither life presented anything specially remarkable in itself. The boy was a well-mannered lad in his abnormal as well as in his normal condition—or one might almost say (as will appear more clearly after other cases have been considered) that the *two* boys were quiet and well behaved. But the two mental lives were ent rely distinct. In his normal condition the boy remembered nothing which had happened in his abnormal condition; and *vice versâ*, in his abnormal condition he remembered nothing which had happened in his normal condition. He changed from either condition to the other in the same manner. "The head was seen to fall suddenly, and his eyes closed, but he remained erect if standing at the time, or if sitting he remained in that position (if talking, he stopped for a while, and if moving, he stopped moving); and after a minute or two his head rose, he started up, opened his eyes, and was wide awake again." While the head was drooped he appeared as if either sleeping or falling asleep. He remained in the abnormal state for a period which varied between one hour and three hours; it appears that every day, or nearly every day, he fell once into his abnormal condition.

This case need not detain us long, but there are some points in it which deserve more attention than they seem to have received. It is clear that if the normal and abnormal mental lives of this boy had been entirely distinct, then in the abnormal condition he would have been ignorant and—in those points in which manners depend on training—ill-mannered. He would have known only, in this condition, what he had learned in this condition: and as only about a tenth part of his life was passed in the abnormal condition, and presumably that portion of his life not usually selected as a suitable time for teaching him, the abnormal boy would of necessity have been much more backward in all things which the young are taught than the normal boy. As nothing of this kind was noted, it would appear probable that the boy's earlier years were common to both lives, and that his unconsciousness of his ordinary life during the abnormal condition extended only to those parts of his ordinary life which had passed since these seizures began. Unfortunately, Brown-Sequard's account does not mention when this had happened.

It does not appear that the dual brain theory is required so far as this case is concerned. The phenomena seem rather to suggest a peculiarity in the circulation of the brain corresponding in some degree to the condition probably prevailing during somnambulism or hypnotism though with characteristic differences. It may at least be said that no more valid reason exists for regarding this boy's case as illustrating the distinctive duality of the brain than for so regarding some of the more remarkable cases of somnambulism; for though these differ in certain respects from the boy's case, they resemble it in the circumstances on which Brown-Sequard's argument is founded. Speaking generally of hypnotism—that is, of somnambulism artificially produced—Dr. Carpenter says. "In hypnotism, as in ordinary somnambulism, no remembrance whatever is preserved, in the waking state, of anything that may have occurred during its continuance; although the previous train of thought may be taken up and continued uninterruptedly on the next occasion when hypnotism is induced." In these respects the phenomena of hypnotism precisely resemble those of dual consciousness as observed in the boy's case. In what follows, we observe features of divergence. Thus "when the mind is not excited to activity by the stimulus of external impressions, the hypnotised subject appears to be profoundly asleep; a state of complete torpor, in fact, being usually the first result of the process just described, and any subsequent manifestation of activity being procurable only by the prompting of the operator. The hypnotised subject, too, rarely opens his eyes; his bodily movements are usually slow; his mental operations require a considerable time for their performance; and there is altogether an appearance of heaviness about him which contrasts strongly with the comparatively wide-awake air of him who has not passed beyond the ordinary biological state."

It would not be easy to find an exact parallel to the case of the two-lived boy in any recorded instance of somnambulism. In fact, it is to be remembered that recorded instances of mental phenomena are all selected for the very reason that they are exceptional, so that it would be unreasonable to expect them closely to resemble each other. One case, however, may be cited, which in certain points resembles the case of Dr. Brown-Sequard's patient. It occurred within Dr. Carpenter's own experience. A young lady of highly nervous temperament suffered from a long and severe illness, characterised by all the most marked forms of hysterical disorder. In the course of this illness came a time when she had a succession of somnambulistic seizures. "The state of somnambulism usually supervened in this case in the waking state, instead of arising, as it more commonly does, out of the conditions of ordinary sleep. In this condition her ideas were at first entirely fixed upon one subject—the death of her only brother, which had occurred some years previously. To this brother she had been very strongly attached; she had nursed him in his last illness; and it was perhaps the return of the anniversary of his death, about the time when the somnambulism first occurred, that gave to her thoughts that particular direction. She talked constantly of him, retraced all the circumstances of his illness, and was unconscious of anything that was said to her which had not reference to this subject. . . . Although her eyes were open, she recognised no one in this state—not even her own sister, who, it should be mentioned, had not been at home at the time of her brother's last illness." (It will presently appear, however, that she was able to recognise those who were about her during these attacks, since she retained ill-feeling against one of them; moreover, the sentences which immediately follow suggest that the sense of sight was not dormant.) "It happened on one occasion, that when she passed into this condition, her sister, who was present, was wearing a locket containing some of their deceased brother's hair. As soon as she perceived this locket she made a violent snatch at it, and would not be satisfied until she had got it in her possession, when she began to talk to it in the most endearing and even extravagant terms. Her feelings were so strongly excited on this subject, that it was deemed prudent to check them; and as she was inaccessible to all entreaties for the relinquishment of the locket, force was employed to obtain it from her. She was so determined, however, not to give it up, and was so angry at the gentle violence used, that it was found necessary to abandon the attempt, and having become calmer after a time, she passed off into ordinary sleep. Before going to sleep, however, she placed the locket under her pillow, remarking, 'Now I have hid it safely, and they shall not take it from me.' On awaking in the morning she had not the slightest consciousness of what had passed; but the impression of the excited feelings still remained, for she remarked to her sister, 'I cannot tell what it is that makes me feel so, but every time that S. comes near me I have a kind of shuddering sensation;' the individual named being a servant, whose constant attention to her had given rise to a feeling of strong attachment on the side of the invalid, but who had been the chief actor in the scene of the previous evening. This feeling wore off in the course of a day or two. A few days afterwards the somnambulism again returned; and the patient being upon her bed at the time, immediately began to search for the locket under her pillow." As it had been removed in the interval. "she was unable to find it, at which she expressed great disappointment, and continued searching for it, with the remark, 'It *must* be there—I put it there myself a few minutes ago, and no one can have taken it away.' In this state the presence of S. renewed her previous feelings of anger; and it was only by sending S. out of the room that she could be calmed and induced to sleep. The patient was the subject of many subsequent attacks, in every one of which the anger against S. revived, until the current of thoughts changed, no longer running exclusively upon what related to her brother, but becoming capable of directions by *suggestions* of various kinds presented to her mind, either in conversation, or, more directly, through the several organs of sense."

I have been particular in quoting the above account, because it appears to me to illustrate well, not only the relation between the phenomena of dual consciousness and somnambulism, but the dependence of either class of phenomena on the physical condition. If it should appear that dual consciousness is invariably associated with some disorder either of the nervous system or of the circulation, it would be impossible, or at least very difficult, to maintain Brown-Sequard's explanation of the boy's case. For one can hardly imagine it possible that a disorder of the sort should be localised so far as the brain is concerned, while in other respects affecting the body generally. It so chances that a remarkable case, dealt with a few years since by French men of science, forms a sort of connecting link between the boy's case and the case just cited. It closely resembles the former in certain characteristic features, while it resembles the latter in the evidence which it affords of the influence of the physical condition on the phenomena of double consciousness.

(To be continued.)

THE WORKSHOP AT HOME.

By a Working Man.

(Continued from p. 405.)

BY this time the amateur will have begun to acquire a certain amount of mastery over his tools, and to handle them much more familiarly, and to more immediate purpose, than he did as an absolute beginner. We may now treat ourselves to two tools not mentioned in the list on p. 154, I mean a beading-plane and a brace and bitts. The beading-plane has an iron of an approximately semicircular curve, corresponding with that of a slip of box-wood, inlaid into the bottom of the plane; so that if carried along the edge of a board, it cuts a moulding represented in perspective by A, and in section by B, in Fig. 27. What is known as a $\frac{1}{8}$-inch plane of this sort

Fig. 27.

will be found a handy size by the amateur. It is surprising how much can be done in the way of effective ornamentation by such a simple tool. The brace and bitts are shown in Fig. 28. The head, C, of the brace is pressed

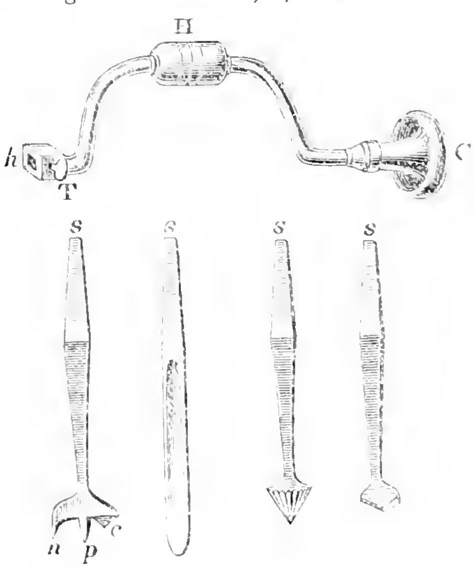


Fig. 28.

against the workman's chest; the shanks of the bitts, S, fit into the square, so that, being retained in position by the thumbscrew, T, their points are forced against the work to be bored by the pressure, and the brace is turned round by the ball or handle, H, which moves quite freely round the iron; as does the iron again inside of the head, C. The first bitt to the left is the ordinary centre-bitt for boring clean cylindrical holes in wood. The point, *p*, is inserted into the centre of the hole to be bored, the nicker, *n*, cuts the hole truly circular as the bitt rotates, while the cutter, *c*, at right angles to the edge of the nicker, cuts spiral shavings within the space marked out by the nicker. The second object is a spoon-bitt, also used for boring cylindrical holes. The third figure shows a rose-bitt which is employed to "countersink" the surface of wood to admit the head of a screw. The fourth object represents a countersink for metal. As the amateur can buy one of these bitts at a time, adding as it were bitt by bitt to his stock, I need not pursue my description any longer here. There is a costly form of wooden brace sold, but the one shown in Fig. 28 is very cheap and just as effective.

To-day we will try and make a set of bookshelves. The dimensions will, of course, depend upon the size of the space which the maker has to fill. As an example I will imagine that they are to fit into a recess in a room, and be "hanging" shelves—*i.e.*, are not to rest on the ground—are to be 4 ft. high, 3 ft. wide, and 6 in. deep. To make them we shall want 28 ft. of 1-in. wood 6 in. wide when planed up, so that we must buy 7-in., or if procurable $6\frac{1}{2}$-in. stuff, 9 or 11-in. planking cutting terribly to waste for our purpose. Fig. 29 represents our set of shelves completed and erected. We first plane and square up all our board

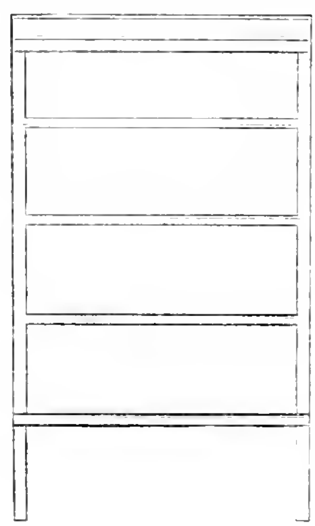


Fig. 29.

carefully, and then mark off two 4-ft. lengths for the sides of the shelves, as we do subsequently three pieces 2 ft. $10\frac{1}{4}$ in. long for the middle shelves on which the books rest, and two pieces 3 ft. long for the top and bottom. Having marked off these lengths with the square, and sawn them off with the tenon-saw, we proceed to "bead" them on both sides of what will ultimately be their front edges, as shown in Fig. 30 both in plan and section. This gives a wonderful finish to the whole thing when put together. 3 ft. of our remaining board we must divide longitudinally into two pieces 3 in. wide each. These are to make a slightly ornamental top to our shelves, to be presently again referred to. Lastly, we must cut out two brackets identically alike (B, Fig. 30), 6 in., of course, wide from *f* to *b*, and 1 ft. deep from *b* to *e*. The best way to do this is to fasten the two pieces of wood side by side, if possible in the bench-vice, draw the form of the bracket carefully on one of them, and saw them both out together with the frame-saw (Fig. 3, p. 154). Still keeping them fastened together, the cut edges may be finished in succession by a rasp, a piece of broken glass, and some fine sand-paper. To make a nice neat job, the top and bottom should be dovetailed into the sides in the way explained on p. 233. This will give us 3 ft. 10 in. clear in the inside height. Starting from the bottom of our frame which will be our bottom shelf, we now measure 11 in. up inside of the sides, and placing the square there, draw a line at that height on each side, and another one parallel to it an inch higher up. The wood must be carefully taken out of this to the exact

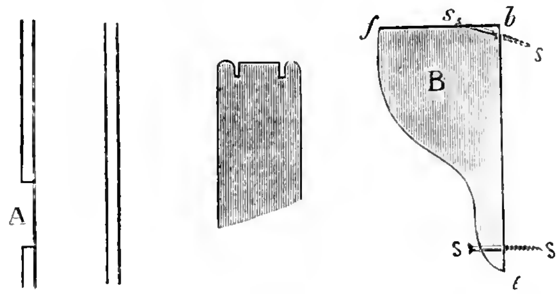


Fig. 30.

depth of the beading ($\frac{1}{2}$ in.) as shown in the lower part of the left-hand figure A in Fig. 30 above; and then, as the inside width of the frame is 3 ft. less 1 in. on each side, or 2 ft. 10 in.; and as the groves on each side is $\frac{1}{2}$ in. deep one of our shelves 2 ft. $10\frac{1}{4}$ in. will accurately fit into the interval, when it may be glued, nailed, or screwed if considered necessary. Eleven inches higher another shelf may be fitted in precisely in the same way. Our third shelf we will fit in at the same distance above the second, and this will leave a somewhat less interval between it and the top board, taking rather smaller books. Out of our two 3-in. strips we finally will make a kind of open box as a top to the whole affair. This we do by planing them up true, beading them on each edge, and mitreing them (p. 356) at the corners; as in Fig. 31, where C shows a corner, *b b* the beading, and *m* the mitre-joint before it is closed up. Fixed on the upper board of the shelves this really quite improves their appearance. But white deal shelves don't look very pretty, so we will proceed to impart a more ornamental appearance to them. To this end, we must buy a bottle of one of Stephens's capital "wood stains;" or, more cheaply still, get a pennyworth of burnt umber at an oilman's, mix it with stale beer, and colour our shelves by rubbing this stain into them, the way of the grain, by the aid of a stiffish brush. An old nail-brush, or even a tooth-brush, answers this purpose very well. When the stain is thoroughly dry, we must size our work—*i.e.*, coat it thoroughly with hot size. And, lastly, when the size is dry in turn, we must varnish everything with oak varnish and a soft brush, taking care not to drive the varnish too bare. *Varnishing should always be*

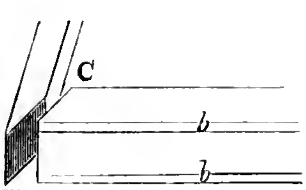


Fig. 31.

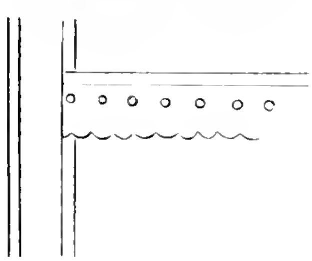


Fig. 32.

done in a hot room, like a kitchen. Cold chills it and makes it assume a dull surface. A very tolerable imitation of oak with the umber, or other wood, according to the (Stephens's) stain used, may be made in the way just described. But we have not finished our ornamentation even yet. We shall require further four yards of the imitation leather made like American cloth, and about sixteen dozen brass-headed nails. As our "leather" is cut into strips 3 in. wide, we only want as much as will make five such strips; in fact, as it is a yard wide, you would only buy *half-a-yard* at the shop, out of which you will get six strips. The bottom edge of this you must "scallop," as shown in Fig. 32, and the top edge must coincide with the groove of the beading as shown in the figure, the brass-headed nails being driven in an inch apart into the flat part of the front edges of the shelves between the grooves. Of course, as the *bottom* edge of each shelf is hidden by the American leather curtain, no absolute necessity exists for beading that at all. With our shelves complete, it only remains to fasten them against the wall. If they are, as I began by supposing, to fit into a recess, screws or nails may go through the sides into the sides of the recess; the brackets being similarly attached. If, though, the shelves are to hang clear, and their sides to remain visible, the brackets must first be fastened to the wall by means of strong screws driven through at the points *s s* (B, Fig. 30). Mind that the holes for these screws are bored in the proper direction—the top one slantingly, the bottom one horizontally, and do not forget to countersink depressions in the wood for the screwheads to enter. The brackets once fixed, the bottom of the shelves will rest on them all right enough. To support the top of the shelves, I have found what are called "angle-irons," to be bought at an ironmonger's for a few pence, very handy. They are simply flat bars of iron bent at right angles, with screw-holes through each arm of them; the upright side being screwed to the wall, the upper flat side to the under-side of the top board. When books are on the shelves these are not seen at all. And now our shelves are completed and put up, I fancy that the amateur will be as pleased with the economy with which he has produced an efficient piece of furniture as he will with the useful result of his labour. He will have a good deal more left to buy books with to fill his shelves than he would had he gone to a cabinet-maker for them.

(To be continued.)

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

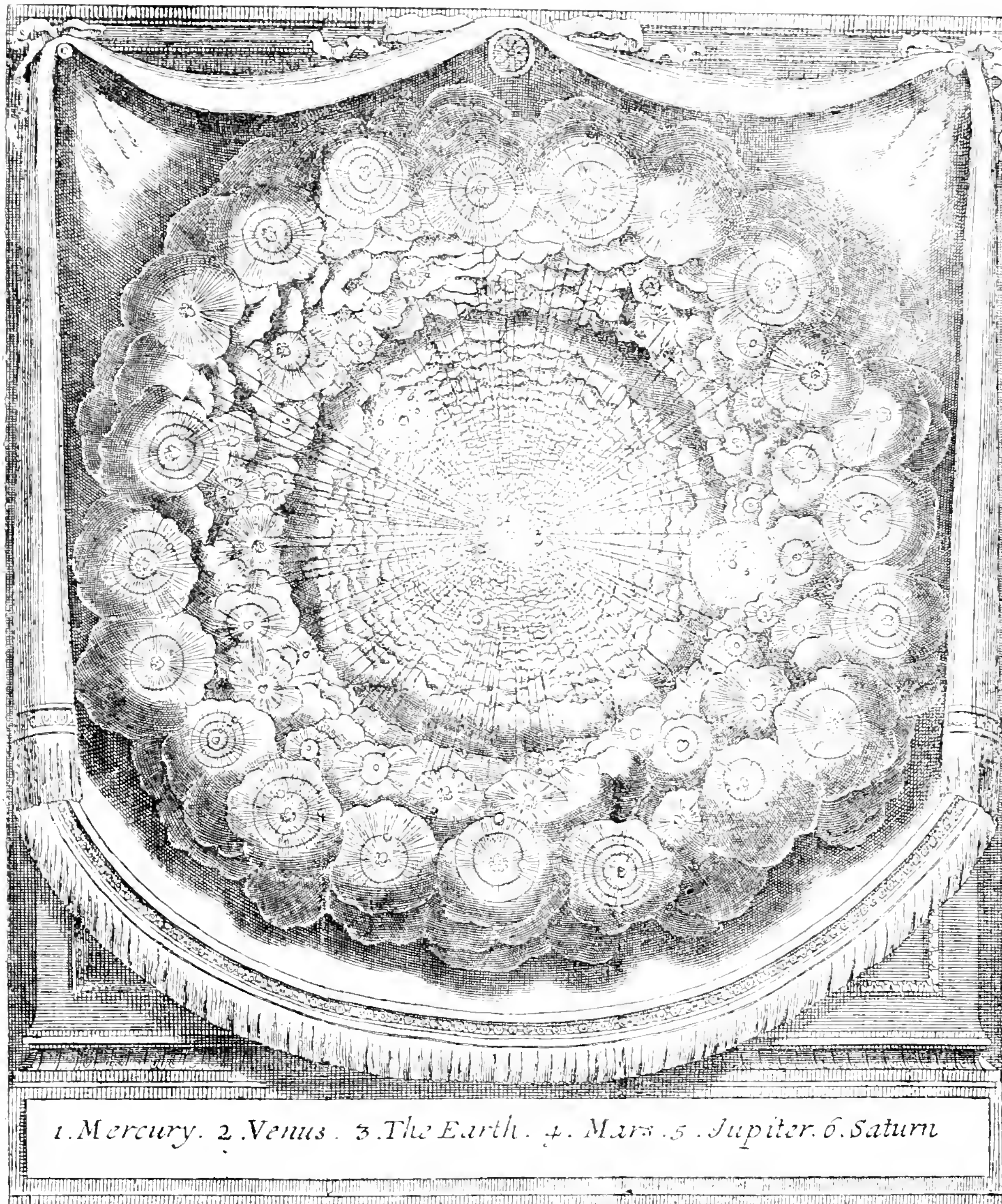
By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE FOURTH EVENING.—Particulars of the Worlds of Venus, Mercury, Mars, Jupiter, and Saturn.

THE dreams of the Marchioness were not very successful; they still represented to her the same objects we are acquainted with here on earth. We were, therefore, forced to conclude ourselves ignorant what sort of inhabitants all these planets had, and content ourselves only to guess at them, and continue the voyage we had begun thro' these several worlds. We were come to Venus, and I told her, that Venus certainly turn'd on itself, tho' nobody could tell in what time; and consequently were ignorant how long her day lasted; but her year was compos'd of eight months, because it is in that time she turns round the sun. And seeing Venus is forty times less than the earth, the earth appears to them in Venus to be a planet, forty times bigger than Venus appears to us on the earth: and as the moon is forty times lesser than the earth, so she seems to be just of the same magnitude, to the inhabitants of Venus, as Venus seems here to us.

"I see, then," says the Marchioness, "that the earth is



1. Mercury. 2 Venus. 3 The Earth. 4. Mars. 5. Jupiter. 6. Saturn

not to Venus what Venus is to the earth: I mean, that the earth is too big to be the Mother of Love, or the Shepherd's Star to Venus; but the moon, which appears to Venus of the same bigness as Venus appears to us, is assigned to be the Mother of Love, and Shepherd's Star to Venus; for such names are only proper for a little brisk, airy panet, bright and shining as the goddess herself. Oh, blessed moon, how happy art thou to preside over the amours of those gallant inhabitants of Venus, where all they say is soft and moving, and perfectly refined!"

"O, without doubt," says I, "the very common people of Venus are all Celadons and Silvanders, and their most trivial discourses are infinitely finer than any in Clelia: their very climate inspires love; Venus is much nearer than the earth to the sun, from whence she receives a more vigorous and active influence."

"I find," says the marchioness," it is easy enough to guess at the inhabitants of Venus; they resemble what I have read of the Moors of Granada, who were a little black people, scorched with the sun, witty, full of fire, very amorous, much inclined to music and poetry, and ever inventing masques and tournaments in honour of their mistresses."

"Pardon me, madam," said I; "you are little acquainted with the planet. Granada, in all its glory, was a perfect Greenland to it; and your gallant Moors, in comparison with that people, were as stupid as so many Laplanders."

"But what do you think, then, of the inhabitants of Mercury? They are yet nearer to the sun, and are so full of fire that they are absolutely mad. I fancy they have no memory at all, like most of the negroes, that they make no reflections; and what they do is by sudden starts, and perfect hap-hazard. In short, Mercury is the bedlam of the universe: the sun appears to them much greater than it does to us, because they are much nearer to it than we: it sends them so vast and strong a light that the most glorious day here would be no more with them than a declining twilight. I know not if they can distinguish objects; but the heat to which they are accustomed, is so excessive, that they would be starved with cold in the torrid zone. Their year is but three months; but we know not the exact length of their day, because Mercury is so little, and so near the sun: it is (as it were) lost in his rays, and is very hardly discovered by the astronomers; so that they cannot observe how it moves on its centre; but because it is so little, fancy it completes its motion in a little time: so that by consequence the day there is very short, and the sun appears to them like a vast fiery furnace at a little distance, whose motion is prodigiously swift and rapid, which is so much the better for them, as it is evident they must long for night*; and during their night, Venus and the earth (which must appear considerably big) gives light to them. As for the other planets which are beyond the earth, towards the firmament, they appear less to them in Mercury, than they do to us here, and they receive but little light from them, perhaps none at all: the fixed stars likewise seem less to them, and some of 'em totally disappear, which, were I there, I should esteem a very great loss. I should be very uneasy to see this large convex studded with but few stars, and those too of the least magnitude and lustre.

"What signifies the loss of a few fixed stars?" says the lady; "I pity them for the excessive heat they endure; let us give them some relief, and send Mercury a few of the refreshing showers they have sometimes four months together in the hottest countries, during their greatest extremity."

"Your fancy is good, Madam," reply'd I; "but we will relieve 'em another way. In China there are countries which are extremely hot by their situation; yet in July and August are so cold that the rivers are frozen: the reason is, they are full of saltpetre, which, being exhal'd in great abundance by the excessive heat of the sun, makes a perfect winter at midsummer. We will fill the little planet with saltpetre, and let the sun shine as hot as he pleases. And yet, after all, who knows but the inhabitants of Mercury may have no occasion either for rain or saltpetre? If it is a certain truth that Nature never gives life to any creature, but where that creature may live: then, thro' custom and ignorance of a better life, these people may live happily."

(*To be continued.*)

It is stated that the January number of the *Cornhill Magazine* will contain an article upon Charles Dickens, written by his eldest daughter, entitled "Charles Dickens at Home," with special reference to his relations with children.

* Only then their nights would be correspondingly short: but perhaps they work at night and hide in caves by day.—R. P.

RAMBLES WITH A HAMMER.

By W. Jerome Harrison, F.G.S.

GEOLOGY OF CRICCIETH AND PWLLHELI (*continued*).

Above the Arenig slates we come to the *Bala Beds*—coarse black and blue slates and shales, with occasional bands of sandstone—which form nearly all the surface of the Lleyn peninsula, except where they wrap round, or are pierced by, rocks of an igneous character. There are many exposures of the Bala beds in quarries, cuttings, and cliffs; and in such spots it is almost always possible, by patient search, to find such characteristic fossils as corals, trilobites, and brachiopods. The roadside cuttings near Pwllheli, the grounds of Boduan Hall, Crugan near Llanbedrog, and Plas-hen, may be named as good localities for fossil-hunting. The coarseness of the sediment and the abundant evidence of contemporaneous life, indicate that the Bala beds were deposited in a shallow sea. This sea-bottom was not so frequently disturbed by volcanic eruptions as the part which lay further east, where—in Snowdon, for example—we have *alternations* of fossiliferous strata of Bala age with lava flows and consolidated ash-beds. But those igneous rocks, which in Lleyn are found to be connected with the Silurian strata, are intrusive in them, cutting across the beds, and altering the rocks *above*, as well as those below. Such intrusive masses must necessarily be of *later* date than the strata which they traverse.

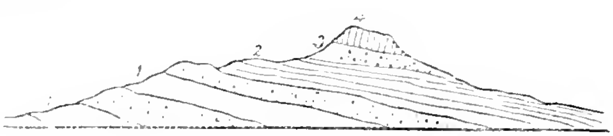


Fig. 1.—Moel-y-gest. 1. Lingula Flags; 2. Tremadoc Slates; 3. Arenig Beds; 4. Greenstone Intrusive in Arenigs.

The thickness of the Bala beds of Lleyn is unknown, but is probably less than 2,000 feet. The strata have no regular dip, but undulate over the surface of the peninsula, so that they cover a very large area, hiding all but a narrow fringe of the Cambrian and Arenig rocks beneath them, and lapping round the harder masses of igneous rocks which rise up as hills. The effect is very striking when we stand on any of these eminences, and look across the low plain of the Bala beds to the distant hills. All the high points owe their present superiority in altitude to the greater *hardness* of their rocks, which has enabled them to resist better the wearing-down forces of sea and river, rain, frost, and ice. The height of the hills is from 900 ft. (Carn Boduan) to 1,887 ft. (Yr Eifl), while the surface of the plain of Bala beds from which they rise does not average more than 400 ft. above sea-level. The Bala beds are the newest, or latest-formed, of the regularly stratified rocks which occur in the peninsula of Lleyn.

The Surface Deposits.—Under the name of *Drift* we include all the relics of the last glacial period—the stones, clay, sand, &c., which formed the moraines of the ancient glaciers. Some quarter of a million years ago, it appears, from causes partly cosmical, but, perhaps, in part geographical, the northern ice-cap of this planet stretched southwards to somewhere near lat. 50° in Western Europe. The mountains of Wales then furnished a gathering ground for important ice-sheets, which radiated in every direction from the hills. But the glaciers of Cumberland were still larger, and, sweeping southwards, they arrested and deflected the northerly flow of the Welsh ice; then, grinding on southwards, they excavated a long narrow valley, which now forms the Menai Straits; or, as Ramsay forcibly puts it, "the Menai Straits is nothing but a glacial groove on a grand scale." The glaciers tore off the rough crags, smoothed down the prominences into rounded hummocks, and carried along with them all the débris, forming the boulder-clay which is now visible at many points along the coast, and which covers over the stratified rocks and renders their examination difficult. In ordinary geological maps all these surface deposits are supposed to be swept away, and the various colours on the maps show the different beds of stratified rock which are believed to lie *beneath* the drift; but, as a matter of fact, these glacial beds offer a great obstacle to our study of the older underlying strata. It has at last been resolved by the Government Survey to publish a *double* set of geological maps; the one (as in the present maps) showing the regular stratified rocks only; the other giving the surface of the country as it actually exists, the deposits of sand, mud, boulder-clay, &c., being indicated by distinct colours—the stratified rocks only shown where they form the actual surface upon which we walk. A few such "Drift Maps" for parts of the eastern counties of England have already been published.

The manner in which the ice (which, as Faraday and Tyndall have shown, acts, when under pressure, like a plastic substance) accommodated itself to the irregularities of the surface, flowing down one side of a valley and up the other, is strikingly shown by a large block of greenstone built into the playground wall of the school at Criccieth. Deep and broad grooves—effected by stones frozen into the superincumbent ice, and carried along with it—run along one face of the block, and are continued on the next face, passing *round the corner* of the stone with scarcely a break. Dr. H. W. Crosskey has noted similar examples in basalt blocks from the Rowley Hills near Dudley, and he found a block in a Swiss moraine showing exactly the same thing. Many of the stones in the boulder-clay forming the low coast cliffs west of Criccieth and in Porth-ceiriad show grooves and striations, and their surfaces are often smoothed. The included stones are mostly of local origin, but along the west coast, as between Bangor and Clynnog, fragments of granite which can be referred to the Lake-district, are not uncommon.

After the retreat of the glaciers, the land appears to have been depressed at least 2,000 feet. This is shown by the patches of sand and gravel, containing shells, which occur on the hill-sides. At Moel Tryfan, five miles south of Carnarvon, there are slate quarries at a height of 1,150 feet, and from the gravels which here rest upon the eroded surface of the slates Mr. Etheridge has identified fifty-five species of shells of species such as now flourish in the seas round Iceland and Greenland. This subsidence was followed by an elevation, during which local glaciers again filled the valleys, and more boulder-clay was formed

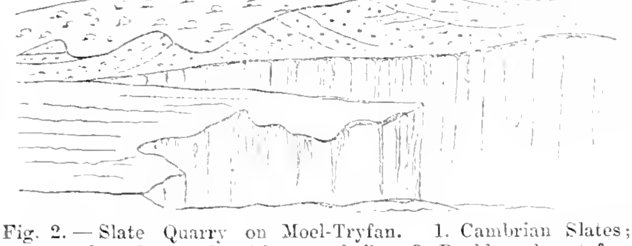


Fig. 2.—Slate Quarry on Moel-Tryfan. 1. Cambrian Slates; 2. Sand and gravel, with sea shells; 3. Boulder clay (after Ramsay).

(Fig. 2). From that time down to the present day other agents of denudation have been at work upon the rocks of Lleyn. The sea has hollowed out the softer strata into bays and inlets; frost has done its wintry work, detaching block after block to form the "screes" which lie at the foot of the "scars;" the rivers have made new valleys, removing a large part of the boulder-clay with which the ancient valleys were filled up; and the rain has aided all these destructive agents in their task. By these means much of the effect of the levelling and smoothing-down done by the great ice-sheet has been obliterated; but although the scenery of Lleyn is to-day full of the most charming variety, yet the evidences of its bygone vicissitudes are, to the geological eye, written clearly upon its surface.

Pre-historic Man in Lleyn.—The stone implements, which elsewhere mark the first appearance of man upon the surface of the earth, occur but scantily in Carnarvonshire. Mr. Darbishire found a roughly-chipped stone celt, or axe-head, at Penmaenmawr, another, not far off, at Dwygyfylchi, and a net-sinker (an oval stone with a groove round it) at Nantlle. Near Aber there is a large stone called Carreg-y-saelhan—stone of the Arrows; it has numerous scorings upon it, from one quarter to half an-inch in depth; but, although it was doubtless used for sharpening tools or weapons of some kind, Mr. Evans thinks it belongs to the Metallic Age. In cairns which he opened near Bangor, Colonel Lane-Fox found numerous rough flakes and splinters of stone, some of which showed signs of rubbing and use on their edges.

Of the Bronze Age—which succeeded the Stone Age—we have a trace in the small bronze dagger-blade which was found, together with a wooden bodkin, at Tomen-y-mur, in an urn, also containing burnt bones.

But the fortifications on the hill-tops, and the cromlechs, are the most striking remains of early man which this region affords to us. The camp on Trer Ceiri—a peak of Yr Eifl—is on a very extensive scale. A double or treble wall of great thickness and extent, and still many feet in height, encloses a number of circular, hut-like stone dwellings. Professor Ramsay calls it, "by far the most striking hold of the kind I have seen in any part of Britain, with its broad parapeted unmortared walls, its flanking defences, and its numerous ruined houses, chiefly circular, enclosed within its bounds." Almost every prominent steep hill-top, as Moel-y-gest, Carn Madryn, Carn Boduan, &c., bears traces of similar camps, possibly erected by the ancient Gaelic inhabitants during the troublous times in the fifth and sixth centuries, which followed the departure of the Romans.

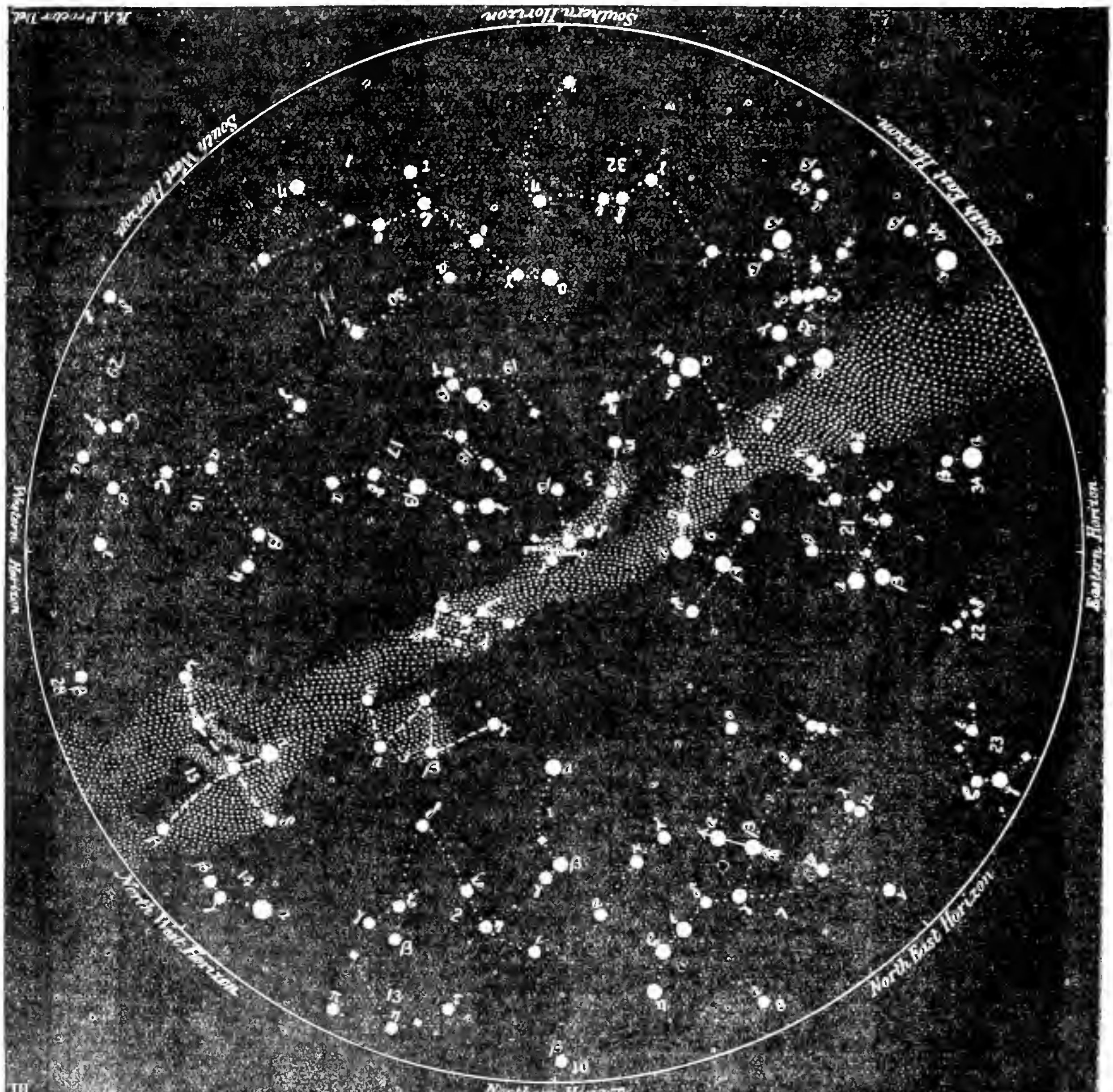
The cromlechs are, without doubt, the burying-places of the chiefs of these early tribes. They are now seen as broad stones, usually five or six feet square, supported by three or four massive corner-stones, four or five feet in height. Probably they were once covered completely with a mound of earth, but this covering has been removed by rain and frost, and by the eager hands of intruders in search of gain, for the mounds, or tumuli, were formerly considered to contain great treasures. There are two fine cromlechs about a mile north of Criccieth. Two others lie three miles north of Pwllheli, but one of these (the northernmost) has only a single stone remaining (if it ever had more, which is very doubtful). There is a fine cromlech near Clynnog, between the village and the sea-shore.

The geologist who visits Lleyn will never regret the time spent there. The eastern part—between Criccieth and Portmadoc—is most interesting to the lover of fossils —the palæontologist—while the student of rocks (the petrologist) will find the extreme west—the tract between Pwllheli and Bardsey Island—a new land, full of problems, which, if he can work them out, will lead him into the eart of the most-debated topics of the geological world. ut for every one this corner of Wales offers lovely scenery, the purest air, capital fishing, both in the little trout streams and in the sea, with a combination of quiet and comfort such as our "popular" seaside resorts know little about.

FIRST STAR LESSONS.

By Richard A. Proctor.

THE map of the stellar heavens, as presented this week, needs scarcely any explanation. It will be observed that the map has not, properly speaking, top, bottom, or sides; the centre represents the point overhead, the circumference marks the horizon. The stars of the first three magnitudes only are shown, and the constellations are numbered, not named. The numbering begins with the Little Bear, to see which in its proper position the map must, of course, be held with the "Northern Horizon" downwards. The other constellations are taken as nearly as possible in the order of their distance from the pole (α in 1 is the Pole star), from Draco, the Dragon, which being nearest the polar constellation is numbered 2. to Argo, the Ship, which being the farthest from the pole of all those included in this series of maps is numbered 45, the last number in our list. The constellations are also taken around the pole in the order of their right ascension,—or in the direction in which the hands of a watch move.



NIGHT SKY FOR DECEMBER (First Map of Pair),

Showing the heavens as they appear at the following hours:—

December 7 at 10 o'clock.
December 11 at 9¾ o'clock.
December 15 at 9½ o'clock.
December 19 at 9¼ o'clock.
December 23 at 9 o'clock.
December 26 at 8¾ o'clock.
December 30 at 8½ o'clock.
January 3 at 8¼ o'clock.
January 7 at 8 o'clock.

around the North Pole, which in the southern skies means from right to left.

The constellations included in the set of maps are numbered throughout as follows:—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.

PHOTOGRAPHIC RECREATIONS.

BY W. SLINGO.

THE winter, with all its dull and unpleasant accompaniments, is now upon us: and to one who is fond of the pictures and workings of nature, the prospect is, perhaps, not over gratifying. Recent improvement in the art and practice of photography offer, however, pleasures and enjoyments of no mean order. A writer in this journal pointed out a few months since the many pleasant ways in which, during the summer, a set of photographic apparatus may be employed to while away what might otherwise be tedious and heavy hours, and this, in addition to the satisfaction of having recorded by one's own work, the many beautiful sights and views that may have presented themselves. The object here in view is somewhat different, being rather to indicate some few of the multitudinous ways in which photography may be employed during the duller and heavier months of the year. The winter season is just that time when one may opportunely turn his attention to the educational advantages offered by the young art. It is then that pictorial representations of geological specimens may be obtained without sacrificing those hours which might be more pleasantly occupied in the fields of nature. It is then that copies may be taken of the many views which have been photographed in the summer. It is then that microscopic objects may be pictured on a larger scale. It is then that those marvels of beauty, photographic transparencies, may be secured. It is then, and manifestly then only, that the beautiful snow may be photographed, as it falls to the ground, and provide a picture of surpassing glory. Such are a few, and only a few, of the many attractions offered by photography for usefully and profitably employing leisure hours in winter, to say nothing of the satisfaction which is to be derived from the exhibition of the pictures, or, better still, of lantern enlargements for the edification of the members of one's own circle, and, may be, for diffusing the knowledge one has gained amongst our less learned brethren. There is very little doubt that the art of photography would for each and all of these objects have received many more votaries than it has been favoured with were it not that there exists in the mind of the great majority of people a preconceived objection to it on the score of dirtiness, uncertainty as to results, and the difficulty of transportation. All these objections are, however, overcome by the really gigantic strides which have been made in the development of the art. There is also a somewhat widespread feeling that photography is, to a considerable extent, enveloped in mystery. This is true of all arts and of all sciences until acquaintance with their minutiæ familiarises us with them. Now, to become familiar with the mysteries of photography, and to acquire a sufficient knowledge of the art to make its practice eminently easy and satisfactory, involve no serious difficulties, and it is worthy of mention that the managers of the London Stereoscopic Company, to whom reference has been made in these columns on more than one occasion, have perceived the sphere that is open to any one who fittingly undertakes to make matters clear to the tyro, and to help those who have a mind to help themselves. The company have, therefore, taken the matter up in earnest, creating a department for this special work, and making it one of their chief features. Their plan is a simple one, viz., to make or prepare such apparatus and appurtenances as the amateur (a term used in its widest sense) is likely to require, and on selling an article to impart gratuitous private instruction to such as require it. The fact that four lessons suffice, as a rule, to convert an ignoramus into a proficient amateur, should make it apparent that the supposed mysteries and difficulties are now reduced to an exceedingly low point, and that they exist more in the mind of the uninitiated than in reality.

It is not, however, my purpose to give a *résumé* of the instruction given, but rather, as above indicated, to enter into a few of the many applications to which the art lends itself.

To the naturalist and geologist, perhaps, more than to any other student, photography is a great aid. The preservation of leaves and flowers is an excellent practice in its way, but the objects lose in the process their vitality, and are often squeezed out of recognisable shape. There can be no doubt that a good photographic image of a flower taken in full bloom and full of life must possess many features and many attractions of which the dead reality is not susceptible. This, however, is more a class of work for the summer season. The geologist may go on collecting his specimens in the warm and more genial weather, deferring until the cold season sets in the task of photographing them. The advantages of photography are too self-evident to require further remark. But to the naturalist and the microscopist there are advantages which are less apparent, but which are, nevertheless, equal, if not superior, in importance.

Fig. 1 will help to explain this feature. Let it be supposed that the microscope has revealed to us some new beauty, which we should like to be able to study and admire subsequently, without the necessity of having to resort to a microscope. The desire may be satisfied by first mounting the object on a microscope-slide, and then supporting it in a frame, B, in front of the eye-piece, A, of a microscope. C, is a reflector or lens, from or through which (according as it is one or the other) a beam of light is sent through the object and then through the microscope into a long bellows camera, E, where it falls upon a sensitised

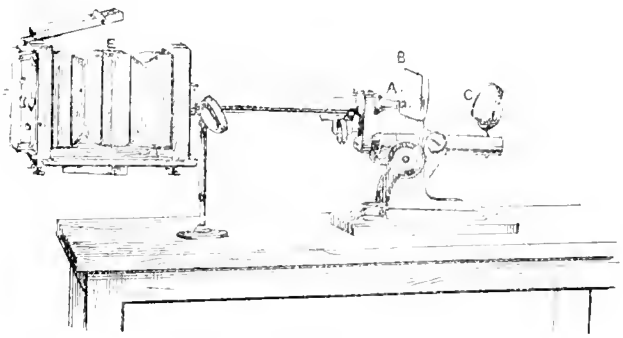


Fig. 1.

plate in the dark slide, F, at the back of the camera. If C be a double convex lens, a paraffin lamp placed to the right will give all the light that is necessary for imparting to the plate at F, an enlarged photographic image of the object, B. The development and fixing of the negative taken at F is a matter of ordinary photographic detail. The myriads of interesting objects that might be thus easily photographed cannot fail to impress one with the fact that there is here alone sufficient recreation for many a long and, perhaps, otherwise tedious winter evening. But when the photographer wishes to display his work to a large circle of friends simultaneously, either at home or in the lecture-hall, what can be better or easier than to adopt the plan illustrated in Fig. 2, where

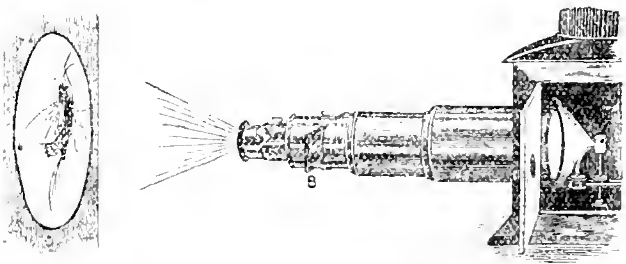


Fig. 2.

a transparent slide, B, is placed in the lantern, and an enlarged projection of the picture thrown on the screen? For large assemblies, lime light or electric light apparatus is necessary; but for drawing-room audiences, one of many good oil-lanterns (and their name is legion) will answer every purpose, while a white window-blind will serve admirably as a screen. Nor need the amateur go far for his transparencies, provided he has a goodly store of negatives. A transparent slide may be easily produced by laying a sensitised plate over the negative (in a dark chamber, of course), and then passing the pair of plates a few times before an ordinary paraffin lamp. The sensitised plate being lifted from the other, the picture may be fixed in the ordinary manner. It is noticeable that these transparencies are being very largely employed on the continent for the purpose of house decoration, windows, more especially those on the staircases, being frequently glazed with them; and I fancy this is a practice which might be adopted nearer home with a pretty and pleasing effect. What I have thus far said is, I imagine, amply sufficient to demonstrate how readily photography may be made to supply us with the means of pleasantly and profitably passing our spare winter evenings. But photography in the present sense of the word, that is to say the taking of negatives during winter, is not altogether a species of Tom Tiddler's ground. There are many views which the winter alone affords—such, for example, as a snowstorm. It is, however, apparent that in taking such a picture the work must be done rapidly, or our flakes of snow will have rather the appearance of icicles. Notwithstanding our comparatively poor light in the colder period of the year, the number of rays reflected by the snow is sufficient to imprint a picture in a very brief space of time. The difficulty is rather to adequately shorten the time during which the plate is exposed. The obstacle is not, however, insurmountable. Fig. 3 is a perspective view of what is at present the best piece of apparatus devised (for ordinary purposes)

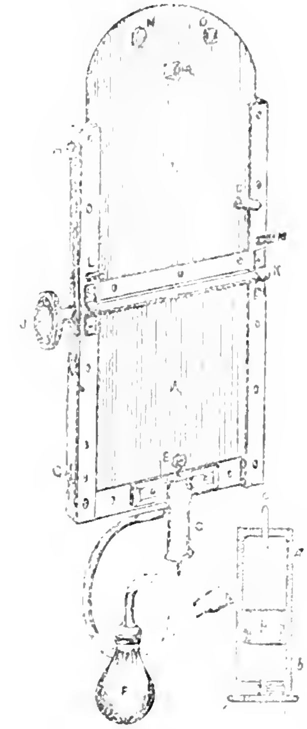


Fig. 3. Fig. 4.

for mechanically limiting the period of exposure. It is known as an instantaneous shutter. A is a shutter which is attached by its upper edge to the inner side of the brass rod, J K. An elastic band attached at one end to the knot or button H passes a little way round J K, and is then attached by its other extremity to another little button near the end J (not shown). E is a small brass stud on the shutter A, and it is held by means of the above-mentioned spring against the little steel pin seen to protrude from the cylinder C. A sectional view of this cylinder is shown in Fig. 4, where *a b* represents the cylinder, *h* an india-rubber tube connected with a pneumatic ball (F, Fig. 3); *g* is an air-tight piston which slides up and down the cylinder; *e f* are two steel pins, the former fitting closely to a hole in the fixed cap of the cylinder, while *f* fits as closely to the screw-cap *c d*. It is evident that if the ball (F, Fig. 3) be squeezed, air will be forced into that part of the cylinder above *g*, and will consequently force the piston downwards, which will also carry with it the pin *e*. Removing the pressure produces a partial vacuum in the ball, whence air will rush out of the cylinder, and the piston will be driven up again by virtue of the greater pressure existing beneath it. Reverting to Fig. 3, it will be seen that a pressure of the ball, F, will cause the pin over the brass stud, E, to be forced downwards, the elastic spring connecting H with J K causes the brass rod to revolve, carrying with it the shutter, A. The beam of light will then pass through the opening, previously covered up by A, and impress a picture on the plate waiting to receive it. The revolution of A, however, allows another shutter, B, to fall into its place, and so to close the orifice once more. A flat spring on the side of the frame carries a small peg, which, as B descends, is pressed into a hole in the side of the shutter, so as to prevent it rebounding. L M N O are small brass buttons, around which, when the duration of exposure is required to be very brief, an elastic band is passed, with the result that the rapidity with which B falls is considerably accelerated. D is an indiarubber buffer against which the shutter A strikes, thereby preventing it coming into contact with the other shutter, B. P is a small stud by means of which B may be raised to its ordinary position. This piece of apparatus is wonderfully well-made, and answers its purpose admirably, and if there is anything which the company supplies that I should feel justified in recommending, it is this really instantaneous shutter. Its rapidity in responding to the demands made upon it is astonishing.

I have, perhaps, exceeded the limits usually prescribed in this journal, but the increasing and deserving popularity of the art, and the often-expressed desire to hear of a few of its many applications, afford, I trust, ample apology. One last word I would utter, and that is a warning to such of my readers as may feel disposed to provide themselves with a photographer's *impedimenta*, to deal only with good houses if they really wish to ensure success. It were, perhaps, somewhat invidious to specialise any one establishment, but since the Stereoscopic Company offer so many exceptional facilities to the amateur, I may, perhaps, be permitted once more to mention them.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

VI.—THE FRAMEWORK OF THE DWELLING-HOUSE (*continued*).

GENERAL PRINCIPLES OF CONSTRUCTION.

THE almost universally adopted form of window frame, with its upper and lower sashes balanced by means of heavy lateral counterpoises, has many disadvantages; so many drawbacks are there, indeed, that it is a matter for surprise why they have not long since been superseded by some more rational contrivance. Like many other old-established and defective systems, a sweeping reform can scarcely be applied successfully here; the type of the frame has been taught to, and mastered by, the practical workman until it has become part and parcel of his operative creed. From a commercial point of view, also, the rapid progress of valuable reform is undesirable, and accordingly receives a powerful check. If the accepted type were abolished suddenly, the demand for special pulleys, weights, sash bolts and fasteners, and the sashes and frames themselves would cease, and so much dead stock would crowd the market. Again, the manufacturers of such wares would suffer directly, in being obliged to discard their present working plant and adopt new models. Even partial innovations make but tardy progress, or we would find sashes with universal movement, such as those alluded to in our last communication, more in vogue.

Windows ought to be constructed upon the following principles:—(i), to assist ventilation; (ii), to exclude draft, dust, and rain; (iii), to admit of being thoroughly cleansed with safety; (iv), to be capable of being opened to the full extent of the framework aperture without any inconvenience; and (v), to afford scope to the artistic designer. All of these items ought further to come with the bounds of reasonable expenditure; that is to say, an outlay which shall not exceed the limitation placed by architects upon such structures. A window-frame which incorporates all the advantages enumerated above, has not yet, to our knowledge, been introduced to public notice. We shall reserve our ideas, in special illustration of this subject, to a future chapter.

A great many dwelling-houses are provided with a flight of stone steps to their main entrances and doorways; but the majority of smaller abodes and shops have merely a doorstone, slightly elevated above the street pavement. In all cases, but especially where there is a constant traffic, as at shop doors and greatly frequented public staircases, the edges of the steps invariably give way after a few years of incessant use, and may, in the course of time, become worn to such a degree as to be positively dangerous. Something harder and more durable than the ordinary building stones now employed is, therefore, requisite, and we consider it to be the duty of every modern builder to take advantage of any invention that may secure immunity from prejudicial wear and tear. Messrs. Doulton & Co., of Lambeth, S.E., have introduced a valuable invention in their patent imperishable "Silicon Tread," which may be used with stone or terra-cotta steps, either in or out of doors, and may be readily adapted to any existing stone staircase or doorway slab. We would draw the attention of tradesmen, and owners of commercial buildings more particularly, to this invention; for, through its employment, they will secure a doorstep made of a specially prepared clay, which produces a tread so hard as to be practically everlasting. When fixed in position it is immovable, and affords a firm foothold, on account of its longitudinally corrugated upper surface.

We may now pass on to the consideration of the relative disposition of the rooms and passages of the dwelling-house, without, however, entering into any details of architectural design; for we are here discussing principles rather than examples. All the doorways into halls and passages ought to be provided with adjustable fanlights; for these do not only serve to admit diffused daylight, but are accessories to a well-regulated system of ventilation. The value of fanlights above doors leading into habitable rooms has been much disputed; a little reflection, however, will soon convince one that they only act as ventilators when the windows are open or the fires burning. At all times they give access either by regular currents, or through diffusion, to air from the hall and passages, which is always open to possible contamination. On the whole they are to be discountenanced, as violating one of the most important principles of sanitary house construction, viz., that which seeks to establish the utmost isolation of the separate chambers in the building. Each room ought to have its own special inlet for fresh air, and an outlet for vitiated air; and although this is not absolutely possible in every dwelling-house, that is no reason why a contrary state of affairs should be permitted to obtain.

Where a choice of position can be exercised the principal windows of the house ought to face to the north. A north light in this country is not only more agreeable, but it contributes towards the preservation of such household furniture as may suffer from direct sunlight. To the naturalist a northern window is a boon, for, in studying the structural details of organic and inorganic nature, especially with the microscope, nothing can be more disagreeable than a strong glare of sunlight, nor can anything be more delightful than a clear diffused northern light. The prevailing winds ought also to be taken into account, but that is a subject which is more nearly related to the special design of the house, and each case must therefore be left to the discretion of the architect.

The isolation of apartments and their efficient ventilation having been provided for, their convenient relative positions next demand a careful study. The lavatories, bath-rooms, and closets, when included within the principal structure, ought to be so situated as in each instance to afford not only ready but unobtrusive access. In every case, the free admission of fresh air and light ought to be secured. The compartments allotted to closets should be most carefully guarded from the other rooms of the house. They should, moreover, be floored with an impervious material, to insure against the evil effects of accident to the pipes, and occupy such a position as to permit of the direct exit of the soil-pipe through the external wall of the building.

The spaces set aside for housemaids' and scullery sinks ought also to be well lighted, ventilated, and sub-externally placed, so as to prevent unnecessary sources of damp. Lastly, the cisterns for water-supply call for special attention in the less expensive houses, since they are almost uniformly neglected. They are not only fastened in inaccessible places, but often in positions which favour the accumulation of filth of every description, not the least harmful among these being that which accrues from the connection of its pipes with, or its contiguity to and beneath, the waste drainage-system of the household. We are thus led to the irresistible conclusion that each individual section of a house, before it can be regarded as thoroughly wholesome, ought to be well ventilated and lighted, free from liability to damp and dirt, conveniently situated, and capable at all times of the most searching scrutiny.

Reviews.

SOME BOOKS ON OUR TABLE.

A Systematic List of the Butterflies of Europe. By H. C. Lang, M.D., F.L.S. (London: L. Reeve & Co.)—This is simply indispensable to the Lepidopterist. An edition is published in which the names are printed on one side of the paper only, to serve as labels for a collection.

Food. Edited by Percy Russell. (London: D. Bain.)—Food is here treated of in its hygienic, historical, culinary, and social aspects. This is a serial which, considering the enormous public it addresses, should have a very wide circulation indeed.

Vere Foster's Painting for Beginners: Studies of Trees in Pencil and in Water-Colours. By J. Needham. (London: Blackie & Son.)—These constitute four volumes of the series known as Vere Foster's Drawing Books. They are all excellently got up, and should prove of inestimable value in the hands of the rising generation.

The Publisher and Bookbuyer's Journal. (London: Wyman & Sons).—The publisher has probably already discovered the value of this serial for himself. It remains for us to point out such value to the bookbuyer, who will find in it a mass of information with reference to works recently published or immediately about to appear. Short reviews of books of the week form one feature of the new serial, while no less than seventeen columns of literary chit-chat present book news in an attractive and readable form.

The Printer's Devil. By "Anglo Scotus." (London: 3, York-street, Covent-garden.)—At a recent Sunday school examination, a like girl, asked to define "an unclean spirit," promptly replied: "Please, teacher, a dirty devil!" Were we ourselves required to furnish an impromptu definition of the author of this brochure, we should probably describe him as being (like the historical demon of Edmonton)—a very merry Devil indeed. Certainly any one who wants an innocent and hearty laugh (or rather succession of laughs) should straightway invest the very few pence needed to render him the possessor of this amusing collection of typographical blunders and curiosities. Moreover, if unrestrained by ethical considerations, the reader may earn a cheap reputation for wit by retailing as his own some of the good stories with which the "Devil's" little pamphlet is filled.

Handbook for Needlework Prize Associations. (London: Griffith, Farran, Okeden, & Welsh.)—This little book is issued under the direction of the Executive Committee of the London Institute for the Advancement of Plain Needlework, and contains the fullest and most explicit directions for the management of local associations, with details as to the nature of the work to be done in the various competitions, the cost of materials, &c. All who think that it is at least as important that a labourer's wife should be able to make a shift for herself, or knit a pair of socks for her husband, as that she should repeat bits of "Paradise Lost" by rote, and parse sentences from "Rasselas," may read it with advantage.

Rabbits, for Exhibition, Pleasure, and Market. By R. O. Edwards. (London: W. Swan Sonnenschein & Co. 1884.)—Obviously the work of a thoroughly practical man, and an enthusiast to boot. Mr. Edwards's well-written and capitally illustrated volume may be unhesitatingly recommended to the incipient rabbit-fancier. Whether rabbits are to be kept to show or to eat, our author may be regarded as an absolutely trustworthy guide. His chapters on hutches will interest the amateur mechanic; while his directions for feeding, breeding, and the treatment of diseases, leave nothing to be desired. His details of the various "points" of the rabbit which are noted in competing from prizes, will be found very useful by the exhibitor unused to the manners and customs of rabbit shows.

Museums of Natural History. By the Rev. H. H. Higgins, M.A. (Liverpool: D. Murphy & Co. 1884.)—As Chairman of the Museum and Mayer Collection Sub-Committee of the Liverpool Free Public Museum, Mr. Higgins speaks with authority and weight as to the arrangement, classification, exhibition, and care of the objects exhibited in that and allied institutions. His pamphlet may safely be commended to those who are either about to establish a Natural History Museum *de novo* or who may be engaged in an ineffectual attempt to render an existing one popular and profitable in an educational point of view.

Tobacco Talk and Smokers' Gossip. (London: George Redway. 1884.)—A prettily-got-up little pocket-volume, brimful of anecdotes concerning the "weed," which will furnish the smoker with a store-house of arguments for his favourite practice.

We have also on our table *Andrew Marvel and his Friends* (Fourth Edition), by Marie Hall (London: Hodder & Stoughton); the Christmas Number (excellently illustrated) of the *Christian Million*, *The Medical Press and Circular*, *The Tricyclist*, *Bradstreet's*, and *The Season* (with a host of fashion-plates, &c.)

THE ROWLAND HILL BENEVOLENT FUND.

We have received the following communication from the Lord Mayor:—"Sir,—I desire, with your kind permission, to make a very special and earnest appeal to the public on behalf of the Rowland Hill Benevolent Fund, of which I am a trustee, and which has for its object the relief and assistance of Post Office employés distressed from poverty, age, or infirmity, and of their widows and orphans throughout the United Kingdom. When it is remembered that the number of persons employed in the Post Office is over 53,000, and that cases of distress are very frequent and pressing, the absolute need of some such organisation as this becomes apparent.

"It is not for a moment suggested that the remuneration given to Post-Office employés is less liberal than it should be, but what I venture to urge is that the necessary and unavoidable conditions of the Service bring about, in many instances, distress and hardships which, though unable to be alleviated by a public department spending public money, might well and very appropriately be dealt with through the charitable and compassionate aid of the trading community, and of private donors throughout the country. I may mention incidentally that while such of the employés of the Post Office as have served over ten years are entitled to a pension on retirement, proportionate to the length of their service, persons who have been less than ten years in the department, and who through illness or other causes are obliged to give up their situations, receive nothing but a small gratuity. In the case of the pensioners, the grant absolutely ceases on the death of the individual, and is in no case continued to his widow or orphans. It is obvious, therefore, that in such a state of things very wide scope is afforded to public benevolence to deal with the numbers of instances in which incapacitated Post Office servants and their families, and the widows and orphans of former employés are involved in great destitution and distress.

"I venture to think that owing to the peculiar conditions incident to the daily work of most of the servants of the Post Office, their exposure to inclement weather and consequent tendency to contract dangerous ailments, they have a special claim upon the sympathy of the public. Again, the very fact of employment in postal work betokens that the employés are persons of exceptionally high character and honesty, and fit to be entrusted with the delivery of those important communications so indispensable to the conduct of trade and commerce throughout the country, and to the requirements of family and public life.

"The Rowland Hill Benevolent Fund has hitherto been so modestly conducted that perhaps its very existence, and, certainly, its needs and merits, have not come prominently before the charitable public. Its annual income is only about £570, and the donations last year amounted to £100. From these sources temporary help was rendered to 74 applicants during the last twelve months, but the small amount at the disposal of the trustees unfortunately precluded them from dealing adequately with many distressing cases brought to their knowledge.

"It is almost impossible to discuss any question bearing on the Post-Office Department, especially in reference to the welfare of its officers, without recurring to the great loss recently sustained by that department by the death of the late lamented Postmaster-General. The trustees of the Rowland Hill Fund have, therefore, resolved to associate his honoured memory with its object by setting apart a limited portion of it—to be called "The Fawcett Memorial Fund"—for the benefit of those employés or their widows or orphans who may be afflicted with blindness.

"In all these circumstances, I have thought it right to open a special fund at the Mansion House, to enable the public to contribute to this very deserving charity; and I earnestly commend it to the attention and sympathy of the country.—I am, sir, your obedient servant, George S. Nottage, Lord Mayor.

"The Mansion House, London, Dec. 3."

Fresh Discoveries at the Fish River Caves.—These natural subterranean wonders, which more than rival the famous Kentucky Caves, have had their name altered by the New South Wales Government, and will henceforth be known as the Jenolan Caves. The keeper reports that he has made another interesting discovery, having found the entrances to several new caves, the existence of which has hitherto been unknown. Having proceeded a short distance into one of them, he was lowered down over a precipice, at the bottom of which he found a number of fossil bones. Some of the remains are stated to be those of an animal of the tiger species, and the others are at present unknown. The exploration of the interior of the caves was, however, retarded for the time being, owing to their being flooded by heavy rains.

Miscellanea.

We hear that Dr. J. E. Taylor, F.L.S., &c., the Editor of *Science Gossip* and author of numerous scientific works, is about to proceed to Australia on a lecturing tour. If he only contrives to import the charm of his "Sagacity and Morality of Plants" into his oral addresses, he can scarcely fail to secure very large audiences indeed.

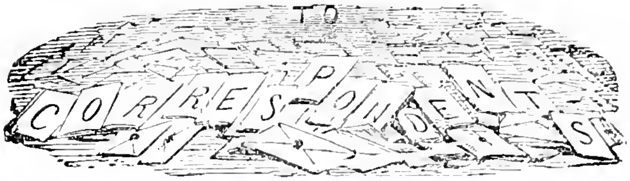
In a volume recently issued by the United States Census Bureau there is an interesting survey of the history and present condition of the American newspaper press. The list of daily papers in the Union reaches the astonishing average of one for every 10,000 of the population. The number of towns having 10,000 inhabitants and no daily newspaper is declared to be very small. In the United Kingdom the average is one daily paper to about 120,000. —*Athenæum.*

The National Health Society, which has done so much during the last thirteen years to improve the hygienic condition of the population, and which may be fairly regarded as the pioneer in the present great sanitary movement, appeals for increased subscriptions. All who agree that it would be regrettable that so very obviously useful an institution should be crippled for want of funds may address the Secretary at 44, Berners-street, W.

The Chairman of the Lancashire and Cheshire Telephone Company (Mr. Chas. Mosley), at a meeting held on Monday, said the Company intended to open "call" offices in various parts of Manchester, Liverpool, and other large towns, as well as at railway stations, and persons using them would be charged threepence per message. Trunk wires would at once be laid which would open communications between Manchester, Liverpool, and other Lancashire towns, and non-subscribers would be able to use the communication at a charge of sixpence for three minutes' conversation. Arrangements had also been made with the National Company, the effect of which would be that the whole of Yorkshire would be placed in communication with Manchester and Lancashire generally. Stations would also be opened in districts around Manchester to bring in domestic subscribers to the exchange.

The first of a series of popular lectures upon the subject of precautions—national, local, and personal—to be taken against cholera was delivered on Monday evening, at the Parkes Museum of Hygiene, by Mr. Ernest Hart, Chairman of the National Health Society, who treated the subject in its national and international aspect. Director-General Crawford, of the Army Medical Staff, presided. The lecturer having sketched the history of international law and custom on the subject, maintained that quarantine had proved useless and mischievous; it had never kept cholera out of any European country or confined it to any district. Referring to the epidemics at Toulon, Marseilles, and elsewhere, he pointed out that those towns which had invited cholera by their neglect of the first laws of sanitation had suffered the most severely. Rome, with its pure supply of water and its relatively efficient drainage, had remained free from cholera; while Naples, with its ground soil impregnated with sewage, and its filthy habitations and polluted water-supply, had suffered most lamentable losses. He believed that the recent outbreak in Paris was due to the temporary supply of a highly polluted water to various districts. It had been repeatedly demonstrated that the incidence of cholera was in exact proportion to the pollution of the water-supply and the absence of means of carrying off refuse. Cleanliness, in its fullest, widest, scientific, and municipal sense, was the prime element of safety.

The new installation of the electric light at the Royal Courts of Justice was successfully inaugurated on Monday, and the whole of the lights were kept running until the rising of the judges. The site of the plant is the vaulted basement beneath the Great Hall, in which also is placed the ventilating and warming apparatus for the vast pile of buildings. The electrical plant consists of two single cylinder Galloway engines, each capable of indicating 110-horse power, and supplied with steam from two fine Lancashire boilers. The dynamos are of the Crompton-Burgin type, and eight in number. One engine and one boiler only are employed in the lighting service; the other engine and boiler being in reserve, as is also one of the dynamos. Two of these machines are employed on the six Crompton arc lights which illuminate the Great Hall, and the other five supply current to the 600 incandescent lamps which light the various courts and corridors. The dynamos run at about 1,500 revolutions per minute, and give off 110 ampères current with an electro-motive force of 85 volts. The incandescent lamps are of 20-candle-power light each, and the arc lights of 2,000 candle-power each. The effect of the lighting is very good, and the power of the one engine employed upon the present installation is sufficiently ample to allow of a considerable addition to the lighting being made when required.



"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

A STRANGE FORM OF AFTERGLOW.

[1530]—At 5.30 p.m. (local mean time) this evening, my attention was drawn to the abnormal appearance of the sea-horizon. From the south to the west a lurid red glow extended at intervals along the horizon for the complete quadrant. In three places the glow was similar to that caused by large conflagrations viewed from a distance of some miles. At the margins of these places what seemed to be minute tongues of red flame flickered above the sea-line. The sun set at 4.49 p.m. (local mean time), and the evening was dull and cloudy. Thermometer, 68° Fah. The barometer stood at 30.35 in., and had been falling all the afternoon. At 6.50 p.m. the glow gradually faded and disappeared. We do not have much twilight in these latitudes, and when I first observed the phenomenon it was nearly dark. Hundredweight.

Papho, Cyprus, Nov. 17, 1884.

ECONOMY.

[1531]—No one will dispute the proposition of "N." (letter 1506) where he says, "No one can afford, or has any right, to be idle; and were this generally acknowledged and acted upon, a certain stigma would attach to those who lost their time doing nothing." If, in addition to those "doing nothing," we consider what a number of persons are employed in assisting their employers in "doing nothing," it is well seen that with our present social system in the matter of waste we make "assurance doubly sure." Take an instance. A grant of £15,000 a year is expected shortly for an individual who may one day occupy a position of doing nothing. The amount of this grant reckoned as interest at 7 per cent. would represent roughly a capital of £214,000, the consumption of which in farming would require 21,000 acres, and absorb the energies of nearly a thousand individuals working for the bare necessaries of life. As facts should speak for themselves, no comment is required.

C. F. N.

DUODECIMAL NOTATION.

[1532]—From Mexico comes the announcement of the discovery of some curious ancient rock dwellings, cut out of a hill of gypsum, upon the walls of whose rooms are numerous hieroglyphics and representations of human beings cut in the rock. A strange feature of these incised figures is that all the hands have six fingers and the feet six toes.

The reflection forced itself upon my mind as I read this: "How changed would the arithmetic of this day be if our Asian forefathers had had six fingers and toes, like these pictured ancient Mexicans." It would involve the desired compromise between the decimal and the duodecimal system. Our scale of notation would then be duodenary, 12 digits instead of 10, and from this improved decimal system would spring many practical advantages, among the chief being that the decimal would then be divisible by 2, 3, 4, and 6, instead of 2 and 5 only as present.

This looked-for change may yet come with a higher civilisation; but we may, perhaps, expect the new universal language first, and the realisation of a few other ideas of the scientific Utopian.

R. Coupland Thomas.

["There's a divinity," says Hamlet, "that shapes our ends;" and which seems to have acted curiously in this respect in the case of the long-vanished race of Mexicans; unless, indeed, the six fingers and six toes were a mere sculptor's conventionalism, like the profile eye in the Egyptian bas-reliefs. Whether we shall ever have a duodecimal system of notation until a sixth digit is developed on the human hand and foot may well be questioned.—Ed.]

THE SENTIENT EYE THE ONLY COLOUR-BOX.

[1533]—Your correspondent, "Cosmopolitan," still clings to the venerable notion of the *externality* of colour; and until the fact be accepted that colour, precisely as sound, has no external existence whatever, but as mechanical, vibratory action, there can by no possibility be a consistent arrangement of the phenomena of light, nor any intelligible science of chromatics. The phrase, "the light is within us," is not only a scriptural metaphor, but a literal, scientific truth. Light and sound are the phenomena alone of the sentient eye and of the sentient ear. Light is the *tertium quid* of the contact of vibratory action with the inner optic sense, just as sound is of mechanical atmospherical vibrations with the auditory sense. That which is actually perceived by the sensorium is, indeed, merely a property or change of condition of our nerves. Why a simple mechanical vibration should in the ear produce sound, and in the eye the sensation of light, will in all probability never be ascertained. But the fact shows us that there are phenomena which defy scientific analysis. It is a fact of which, it has always appeared to me, metaphysicians might have made much. The action of vibratory bodies on the organ of hearing is entirely mechanical. If the action of the mechanical cause on the ear be of continued duration, the sound is also continued, and when caused by a rapid succession of uniform impulses or vibrations, it produces a musical sound; but the unthinking attribute externality to the sound, and to the note, just as they do to light and to colour. The undulatory and mechanical theory of light does not posit more than that the different periodicities of the mechanical vibrations produce in us different sensations of light, different sensations of colour. If a mechanical vibration, plus something else, were required to produce a sensation of colour, the undulatory theory, as it stands, would be insufficient.

External agencies can give rise to no kind of sensation which cannot also be produced by internal causes. Colour, light, and darkness may be perceived independently of all external exciting causes. The appearance of light and of luminous flashes may be excited in the closed eyes independently of any external causes. Everyone is aware how common it is to see bright colours while the eyes are closed. These phenomena are very frequent in children after waking from sleep. And even a person blind from infancy, in consequence of opacity of the transparent media of the eye, must have a perfect internal conception of light, colour, provided the optic nerve be free from lesion.* Light and colours are innate endowments of our nature, and merely require a stimulus to make them manifest. By the corpuscular or emissive hypothesis, colours might be supposed to be inherent in the corpuscules; but we cannot entertain the same notion with respect to the corpuscules of the ether waves, for, if we did, the ether particles, chameleon-like, would have to change their colour to adapt themselves to the different periodicities of their vibrations. This shows very forcibly that light, colours, can by no possibility have externality other than as vibratory action, and that the eye itself is the only colour-box in nature. This admitted, the whole science of chromatics, as popularly understood, has to be reconstructed. The fact, indeed, is admitted by all thinkers on the Continent, and by a few thorough scientists in England. Nevertheless, the science of chromatics lingers on in the sloughs of error by the misleading of the Newtonian nomenclature and false hypothesis. Primaries, secondaries, &c., come of the thinking founded on the dead Newtonian hypothesis, not on the undulatory theory. W. Cave Thomas.

53, Welbeck-street, Nov. 26, 1884.

NO MATTER.

[1534]—Respecting the letter by Mr. I. W. Alexander on "Matter," (1518, p. 451) it is very confusing, if not irrational, to say that matter never alters, and then to maintain that it can be destroyed—*i.e.*, reduced to nothing, to be re-created afresh out of nothing! The materialistic idea, as explained by Haeckel ("Pedigree of Man," page 231), is:—"We must hold that atoms are the smallest separate particles of masses, having an unalterable nature, separated one from another by hypothetical ether. Every atom has an inherent sum of force, and is, in this sense, gifted

* There are many other facts which might be adduced to show that the eye itself is the real seat of light and colour.

with a soul. Without the acceptance of an atom-soul, the commonest, the most general phenomena of chemistry are inexplicable. Pleasure and displeasure, desire and loathing, attraction and repulsion, must be common to all masses of atoms; for the movements of atoms which must occur in the formation and decomposition of every chemical compound, are only explicable if we impute to them sensation and will," &c.

Mr. Alexander will see that materialism needs not an "outside" power; it places "force" within the atom as its innate property. Besides, matter is nowhere "isolated." Atoms exert force on one another incessantly. F. W. H.

FOSSIL AND MODERN EYES.

[1535]—Your correspondent, E. L. Garbett, probably never saw a mole which lives underground in darkness. Its eyes are so small that they are scarcely perceptible. That would prove that creatures living—if such a thing could be thought possible—before there was a sun, light, and warmth, should have had no eyes, or at least very small, diminutive ones. F. W. H.

[1536]—In suggesting that big eyes in animals of the earlier times might imply them to have lived in the days before there was a sun, I should have said this was on the assumption of their optic nerves having somewhat our own relative sensitiveness to the variously refrangible rays. We must bear in mind that rays which are *light*, and rays which are *not* light, are a distinction purely human, or having reference to human physiology. There may be animal eyes ever so near us, even the dog's, to which the yellow may be obscure, and those we call "obscure heat," or "obscure actinism," be the brightest. We cannot tell, of any eyes but our own, that a boiling kettle is less luminous than a candle to them. There may be eyes to which the kettle's rays are light, and the candle's no more so than the ultra-violet actinic rays are to us. To them also the Andromeda nebula may be brighter than Sirius, and things in the starry heavens that are the brightest to them may be for ever invisible to us, though, perhaps, to be photographed on some chemical yet unknown. Far more, then, may there have been, when the sun was a nebula, nerves to which rays that we should call dark heat served as light, and the co-existence of small eyes with the abnormally large ones can prove nothing. Trilobites' eyes appear to have resembled in structure those of modern insects, but in scale they greatly exceeded those of their present equals in bulk, whether as near them in class as shrimps and crayfish, or as distant as birds or mice. E. L. Garbett.

Nov. 30, 1884.

[Save in the case of the ichthyosaurus, it cannot be said that any fossil type of animal was distinguished by abnormally large eyes. I had two beautiful specimens of trilobites before me as I wrote, and assuredly their eyes were not so big relatively as those of the modern dragon-fly. No physiological warrant whatever exists for Mr. Garbett's ideas of what "may be." They are as pure and absolute guesses as the speculation of the negro metaphysician:—

"'Spose that I was you, and 'spose that you was me.
And 'spose we all was somebody else—I wonder who we should be?"
—Ed.]

LETTERS RECEIVED AND SHORT ANSWERS.

Isidore. Unfortunately for your hypothesis, the phenomenon has been just as striking when the sun has been in apogee.—G. W. M. The difficulty of reproducing the lectures in a book-form arises from the fact that they were extemporaneous. Your complaint that subjects are commenced in these columns and not finished is not wholly without foundation. On the other hand, correspondents complain of the length of some of the very series whose non-completion you resent. "Almanack Lessons" and "Star-Mapping" will be resumed, and "Papers on Spectrum Analysis" commenced, all in good time. Your reference is an erroneous one.—Charles Bloomfield. Surely in asking for hints for a "small" observatory "50 feet high (!) and 12 diameter" there must be a *lapsus calami*?—F. Yelwoc. If you wish my candid opinion, I should say that it is impossible.—Hawthorns. Assuming the coin to be a genuine and unweighted one, the first four tosses in no sense whatever affect the probability that of the remaining eight four will be heads and four tails.—J. S. B. Address the Secretary, 14, Dean's-yard, Westminster, S.W.—J. W. Howell. Many thanks for the trouble you have kindly taken, but the question has been already answered (*vide* column two, page 472).—C. F. X. Your mental experience in connection with a neuralgic attack unfortunately only too common a one.—W. H. Stone writes, concerning the paragraph on "Non-poisonous Water Pipes" (column one, page 453), that he is the original inventor of tin-lined lead piping; that he pointed out the advantage of it to Messrs. Davidson & Armstrong, of Manchester, thirty or forty years ago, and that, between the years 1848 and 1852, that firm laid down pipes so tin-lined for the Manchester Corporation.—F. W. Rudler. Received with thanks.—J. E. Fuit (?). Delayed through your addressing the *Editor* instead of the Publishers.—W. St. C. Boscawen. Letter received, but no tickets enclosed.—Mr. Wallace. "Richmond of" was apparently a misprint for "of Richmond." A letter addressed to Mr. Wright, Richmond, Yorkshire, would probably elicit the required information. See concluding paragraph, in capital letters, which heads the Correspondence Column.—Oakley. There is not the very slightest ground for the belief that the Star of Bethlehem will reappear in 1887. No temporary star of the appearance of which any authentic record whatever exists, could in the least fulfil the conditions of the phenomenon to which Matthew ii., vv. 2, 9, and 10 refer. Ideler long ago suggested that a conjunction of Jupiter and Saturn, which occurred B.C. 7, would do so; but this view was speedily shown to be untenable. As for "total eclipse of Sun and Moon *said* to take place about the same time," this is much too vague: as eclipses of the sun total over certain parts of the earth's surface, and total eclipses of the Moon, visible wherever she is above the horizon, are common enough. There was an eclipse of the Moon 3 B.C., March 13. The position of a star or planet in the day-time can only be found by setting the circles of an equatorially-mounted telescope. Two things will prevent Wolf's Comet being seen from Kimberley: the strength of the present summer twilight, and the comet's recession from the earth.—Constant Reader. No explanation has ever yet been given of the *modus operandi* of Maskelyne & Cooke's automata: nor can I personally make any guess that would be worth listening to.—Rev. C. H. Cope. Thanks. Your tracing is from a sketch of contorted strata of the "Millstone Grit" (a group in the Carboniferous formation). These strata, originally deposited horizontally, have been crumpled by lateral pressure in a way which you may understand if you put pieces of coloured cloth one on another with a book on the top of them, and then press them strongly at the sides. Such convolutions are by no means uncommon. I heartily agree with you, though, as to the utilitarian spirit of the age. The finest view, the most precious archæological relic, the most interesting geological section—nothing is sacred to a "board" or a jobbing builder.—T. L. Crawford. Much too long for insertion.—H. Hancock writes, in connection with the effect of the moon's rays, that while in India in 1857–58, a shipmate who slept by his side on deck had a moonstroke; his head swelling so fearfully that the locality of his eyes was only discernible by his eyebrows; while the left side of his mouth was drawn nearly up to his ear. Medical men subsequently informed our correspondent that blindness, epilepsy, paralysis, and idiocy often supervened on such an attack. Mr. Hancock himself has had sunstroke, and earnestly cautions everyone who may have been affected either by the solar or lunar rays to abstain from subsequently drinking spirits.—H. A. (if I understand him, which is, to say the least, questionable) thinks that, just as mustard-seed or an acorn extracts its proper nutriment from the soil which surrounds it, and developes into a bush or an oak tree, as the case may be, so a soul may extract its nourishment from "spiritism," of which he alleges that "not more (nay, less) universal is air itself."—F. J. Wardale. Clausius and Thomson have shown that pressure must raise the melting-point of solids: at least, such solids as *expand* in becoming liquid. In the extremely few which contract (like water) the reverse is the case. Comparatively nothing is known of the internal temperature of the earth.—R. F. H. No "local inundation" could by any possibility submerge a mountain 500 ft. high! Extremely slow subsidence might do so in the course of ages, but then the mountain would remain submerged. On June 16, 1819, a tremendous earthquake occurred at Cutch, on the delta of the Indus. By this convulsion the Eastern Channel of the Indus, which had been only one foot deep at low water, was deepened to 18 ft., at which it remains. Of course, the disturbance was confined to a limited area. Water always, as you say, "finds its own level;" hence, for it to overflow a mountain or anything else, the latter must be *depressed*. I am, I regret to say, wholly ignorant of naval architecture.

In the lead production of different countries, Spain holds the first place, the amount reaching some 120,000 tons in one year, or one-sixth more than America, which comes next on the list, while Germany follows with 90,000. Of Spain's total production, some 67,000 tons are derived from one district, that of Linares, in which more than 800 mines are registered.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

THE MULTIPLE CLOCK.

Clocks having more than one face have hitherto been among the greatest difficulties in horology. The advantage of an ordinary clock with two or three faces is for many positions obvious. Messrs. Blumberg & Co., of Paris and London, have now patented an invention which marks an entirely new departure in clock-making. This invention is known as the "multiple" clock, and is claimed to surpass all known methods of working a clock with a number of dials, inasmuch as it possesses but one movement, which may be placed in any part of the case, and not necessarily in juxtaposition to the dial or dails. It is therefore obviously possible to place the "multiple" clock in positions, and to apply it to purposes not practicable for clocks provided with the ordinary mechanism. Patterns of the "Multiple" clock are now to be seen at the warehouses of the manufacturers in London, at 2, Cannon-street, and in Paris at 64, Rue de Bondy. They are prepared to supply the clock in a large number of designs to suit a variety of requirements, including use in private houses, hotels, reading-rooms and public institutions, railway stations, offices, banks, and ships' saloons. The "Multiple" clock is also made to be suspended from the roof or ceiling at any elevation, a simple mechanism allowing it to be drawn down for winding or cleaning, &c. The "Multiple" clock may be made, too, so as to show the time in different parts of the world simultaneously.

IMPROVED DOOR-KNOBS.

Nearly everyone has had irritating experience of the imperfect way in which door-knobs are usually connected and fastened to the spindle, the fastening being generally quite an infinitesimal quantity of screw, which soon ceases to "bite" after a little wear and tear. Mr. E. V. Bailey, of Birmingham, has invented what is claimed to be an improved form of connection, suitable for most kinds of door-handles, but particularly the movable knobs of lock spindles and cupboard turnlocks. In this invention a knob is fixed at one end of the spindle, at the other end to the spindle the knob is movable. The hole in the neck of the movable knob is screwed at the back with a screw-thread for taking upon the screwed end of the spindle. The front of this hole is square or angular. For determining the position in which the movable knob can be passed on to the screwed end of the spindle a sliding-collar is used, which has a square or angular bush, to match or fit the square or angular hole in the neck of the movable knob. To fix the handle the rose is secured at the end of the spindle, inserted through the door. On the protruding screwed end of the spindle the sliding-collar is passed until it reaches the door. The movable knob is screwed up, and a peculiar pattern of rose-plate screwed on to the spindle to prevent the knob being withdrawn from the spindle.

REGISTERING THE FAMILY MILK SUPPLY.

There is no end to the ingenuity of inventors in these days. It is well known by all housekeepers that milk is frequently tampered with after delivery, and the blame cast unjustly on the milkman. A London dairyman, to obviate this evil, has invented an appliance for receiving and registering the quantity of milk daily supplied to a family. The apparatus has the further advantage of a great saving of cans to the milk vendor. The appliance consists of a framework and stand, which is fixed on the inside of the door, and communicating with it on the outside is a dial-plate numbered 1 to 12, with a hand for pointing, and below this an opening, consisting of a pipe, through which the milk is poured into the vessel placed inside to receive it. The inner outlet of this pipe has a movable plate that passes to and fro over it as required, and there is a certain amount of simple mechanism connected with it. Each figure on the dial represents quarts, and dots between half-pints, and it is presumed the dial is sufficient to indicate a week's supply. Presuming the dial to stand at *nil*, and the domestic being ordered to set it at Fig. 1, representing a quart, she moves the hand, which is actuated by means of a spring, and can only be turned in one direction to that figure, and places the jug upon the stand formed to receive it. This stand is connected with a chain and balance-weight, which in its turn acts upon the plate that moves over the spout, and the weight of the jug depresses the stand, causing the balance-weight to rise, and the plate to move aside, and so open the spout, ready for the milkman to deliver the quantity registered on the dial. This operation is repeated prior to each delivery, and at the week's end the supply received is noted, and the dial reset for the following week.

The manufacturers of this article are Messrs. Bodill, Parker, & Co., of Great Hampton-row, Birmingham.

A NEW COPYING APPARATUS.

In these busy days, the demand for cheap and effective copying-machines is ever on the increase. Several appliances of this kind have recently reached us from the Continent, and one known as the black autocopyist has just been introduced from Germany. The apparatus in question is simple in make, and consists of a wooden frame in which a prepared parchment sheet is fixed. This sheet must be soaked in water for a few minutes, which is effected on the frame itself, after which the original is placed for a minute on the parchment-sheet. By aid of a printing-roller copies can then at once be taken. The frame is fitted with two springs, which span the parchment, and reclean it when necessary. The process is simple and easy, and requires no special training on the part of the copyist, while the precision of the copies taken is undoubted, and the facsimiles closely resemble those obtained by lithography. The autocopyist is introduced by the Autocopyist Company, of 72, London-wall, London, E.C. Circulars, notices, price-lists, music, &c., can by its means be reproduced, and the striking feature is that the original is easily written with an ordinary pen.

IMPROVED GLAZING.

The skylight, and for the matter of that, glazing in general, are open to great improvement, and for one thing we should like to see putty disestablished together with the barbarous "hacking" knife, required as often as a new pane of glass has to be put in. The British Patent Glazing Co., Limited, of 24, Finsbury-circus, have introduced a system of patent glazing patented by Mr. Joseph D. Mackenzie, lately of Glasgow, which appears to have many advantages. It not only supplies the means of securing the glass without the aid of putty or other plastic fixing, but forms part of the framework of the construction. The glazing bar or sash bar is what is known as a composite one, formed of solid rolled malleable iron of a ⊤ form, inverted, having the cross well rolled into a U shape, thus forming gutters in each side of the vertical part of the bar, for carrying off any moisture or condensation. The iron is coated with a good anti-corrosive paint, or a bituminous substance, if desired, after which it is enveloped in sheet lead or other soft ductile metal or alloy.

The composite bars are fixed at convenient distances apart, the glass is laid upon the soft metal, which acts as a cushion and prevents breakage through shocks or vibrations. Channels are provided in the bar for carrying away the moisture, and the sectional strength of the bar is increased by giving the cross web an arch form. The work can be done in any weather, and no periodical outlay for putty and paint is necessary. There are other advantages claimed for what seems to be a decidedly improved system of glazing.

A HYDRAULIC DOOR-SPRING.

The shutting of doors is, in many cases, a matter of some importance, and one that, doubtless, should be as nearly as possible automatic. Messrs. Archibald Smith & Stevens, of the Janus Works, Queen's-road, Battersea, London, S.W., furnish some interesting particulars of what is known as Stevens & Major's patent hydraulic spring and check for swing doors, and for regulating the closing of doors so as to prevent banging. The spring is made to fix flush with the floor, and can be even covered with a carpet, and acts as a hinge also. Assuming that this invention does efficiently what it professes, it should prove very useful. The patentees give the following general description of the principle of action:—"The spring is placed within a small pump barrel. On opening the door, a charge of oil is drawn from the containing-box into the pump. The spring, while closing the door, has to expel this charge of oil through a small aperture, the size of which is adjustable, and the rate of closing is controlled by the speed at which the oil is allowed to escape. All parts are of metal, and, as oil is constantly passed through, every part is always perfectly lubricated." Simple means of regulating the action for faster or slower closing are provided.

Colliers and their Lamps.—It is stated that at Walker Colliery, near Newcastle, the miners have been asked to take down Marsaut lamps instead of the old Clanny and Davy lamps, but have objected, and have struck to the number of 300, leaving the colliery idle

Our Whist Column.

By Five of Clubs.

HERE is the preface of the new treatise on Whist, by "Five of Clubs," called "How to Play Whist," now in the press :—

Preface.

The following chapters on the Theory and Practice of Whist originally appeared in Knowledge, and there had the advantage of the criticisms and suggestions of some of the finest exponents of the game. These criticisms have in many cases led to important modifications and improvements. The treatise has no claim to novelty as regards Whist principles; in fact, outside the modern signalling system and the absolute rejection of the singleton lead, there is very little difference between the Whist of to-day and the Whist of Hoyle and Matthews.

The method of presenting the leads here adopted is much more easily followed than that usually employed. Learners are deterred by the multitudinous rules for leading from such and such hands, but grasp at once the rules for leading such and such cards. The gain in simplicity is great. For instance, there are hundreds of hands from which the Ace is "the correct card" to play, while there are only two conditions under which Ace should be lead originally; moreover, when these two conditions have been noted, the meaning of an Ace lead is recognised at once. So it is with the two original King leads, the one original Queen lead, and so forth. In less than half an hour, by the method supplied here, the right card to lead and the right meaning of the each lead, can be fully learned. I have extended the same method, as far as possible, to play second hand and third hand.

As regards the general conduct of the game the chief point of novelty in this work is that I have been careful to correct the common error that, because scientific Whist involves the long suit system at starting, therefore the whole play of each hand should proceed on that system. Many of the rules which beginners learn are suitable only for the long suit method; yet there is scarcely one hand in ten in which one side or the other has not to give up (sometimes quite early) all idea of bringing in a long suit. If I were asked what I regarded as the most valuable working quality in a partner, I should answer—Readiness in determining whether an aggressive game, aiming at the introduction of a long suit, should be entered on, or a defensive policy pursued. The original discard tells your partner which line you are taking.

With regard to the system of signalling, I sympathise with the objections which have been urged against it by many fine players; but the system *must* be learned by all who wish to play Whist successfully. It must be learned for defence if not for attack. A player is not much worse off than his fellows if he determines *and lets his partner know he has determined*, never to *use* the Trump signal, the Echo, or the Penultimate. He may even safely determine never to *respond to* the Signal,—indeed with too many partners this is a most necessary precaution. Yet he can never escape the duty of *noticing* the signals. If he fails to do so, he will ere long find himself forcing the enemy's weak Trump hand and omitting to force the strong (mistaking a response to the signal for an original Trump lead) or committing some other Whist enormity. But I incline to judge from the objections of Pembridge, Mogul, and other strong players, to the signalling system, that they have not noticed its full meaning. For they speak of the Echo and Penultimate as if these signals were seldom available, instead of coming in—either in their positive or negative form—far oftener than the Signal for Trumps itself. Especially is the Penultimate Signal of frequent use. Scarcely a hand is played without it. If my partner always leads the lowest but one from a five-card suit (not headed by cards requiring a high card lead) then if he leads a Two, or a card which is shown by the play of the others or by my own hand to be the lowest of his suit, I know that he has not more than three cards left in the suit; and if the lead is not a forced one, I can infer pretty safely that he has just three left. This may prove most important knowledge, not only by showing the limits of his long suit, but by guiding me as to forcing the enemy in that suit. If the Penultimate is not played in this negative way by my partner, it will probably be so played (or played in the positive form) by the adversaries. I put myself and my partner at a disadvantage, then, if I fail to observe this signal.

The full importance of the signalling system can only be understood when we recognise *six* signals—thus :—

1. If
2. Unless
} you have commanding strength in Trumps, and at least one long and strong suit { *signal* / do *not* signal } for trumps.

3. If
4. Unless
} you have at least four Trumps { *echo* / do *not* echo } in response either to the signal or to your partner's Trump lead.

5. If
6. Unless
} you have at least five cards in a suit play the { lowest but one / lowest card } except where the leading cards are such that a high card has to be played.

So understood, signalling goes on in almost every game. But I cannot too carefully warn the learner to be most chary of displaying the Trump signal; and especially to reject, as altogether unsuitable for *him*, Pole's rule, that you should always signal from five Trumps.

My own experience has been that the various signals, so far from taxing the memory, serve greatly to help it. This had been already noticed in the case of the customary rules for leading, discarding, returning leads, and the like. Every act of attention to a rule helps to record the play in the mind. I cannot, indeed, understand why there should be any more effect in noticing signals than in trying to ascertain *in other ways* (as by examining your hand at starting) your prospects of success or failure.

The learner will soon find that at times he must go counter to the customary rules if he would win or save a game. Hand XXVII., p. 158, is a remarkable case in point. Here Mr. Lewis neither led Trumps from five, nor Ace from Ace four others in his long plain suit; because to have followed either rule would have been running counter to the only rule of play which is absolutely general—Play to Win.

The forty illustrative games are nearly all from actual play. They are chiefly intended to illustrate Whist principles, the way of forming inferences at Whist, and so forth. Several are fine examples of Whist strategy. A few have been selected as examples of bad play. They differ from any such series hitherto published in being fully annotated,* and in having the full hand of each player displayed (with score, trump card, &c.), as if set round the Whist Table itself. The games (contributed to Knowledge originally) by Mr. Lewis are particularly valuable.

The Whist Whittlings include Whist stories, maxims, notes, curiosities, and problems.

To make the work complete, the Laws and Etiquette of Whist are added, and a Glossary of Whist Terms in more or less common use.

"Five of Clubs."

* Of the five games given by Prof. Pole, two are unsound, the play approved being bad; two are merely examples of play from overwhelming strength, and the fifth (and last) is merely a Whist curiosity.

As an instance of rapid telegraphy, says the *Japan Mail*, the following item from the record of the Yokohama telegraph office is not without interest:—A telegram was handed in at Yokohama at 3.10 p.m., and was received in London at 8.27 a.m. (time of transmission, two hours thirty-seven minutes). An inquiry arising from the message was given in at London at 10.43 a.m., and received in Yokohama at 8.40 p.m. (time of transmission, thirty-seven minutes, deducting nine hours twenty minutes, the difference in time between London and Yokohama). The reply was forwarded from Yokohama at 9.50 p.m., and reached London at 3.21 p.m. (time of transmission, two hours fifty-one minutes). Thus the whole transaction—forwarding the telegrams, the receiver in London making further inquiry, the examination at this end before replying, and the delay occasioned by the messages having to wait their turn for transmission—occupied as nearly as possible the time of the sun's passage between the two places.

Alisanders, or Alexanders.—It is commonly believed that this old pot-herb has long been extinct; but in many Midland districts, especially where mining is a leading industry, it will be found in the cottage gardens, and is regularly employed in the flavouring of soups. Amongst a similar class on the Continent the plant is in equal favour, and, in fact, it takes the place of celery where this better plant is not grown. It is a British plant that may often be met with on waste ground near the sea, and seems partial to ruins. It is the *Smyrnium olusatrum* of the books, a plant of ancient renown for its mild aromatic flavour. When in vigorous growth the leaves reach a height of two to three feet, the stems are stout and deeply furrowed, the leaves alternate, a vivid green colour, the whole plant very closely resembling celery. It does not flower the first year, but in the second puts up a head of yellowish-green umbels, which are followed by black seeds or nuts. Although belonging to the suspicious umbelliferous order, every part, root included, is perfectly wholesome, and when put into soup communicates a flavour similar to that of celery.—*Amateur Gardening.*

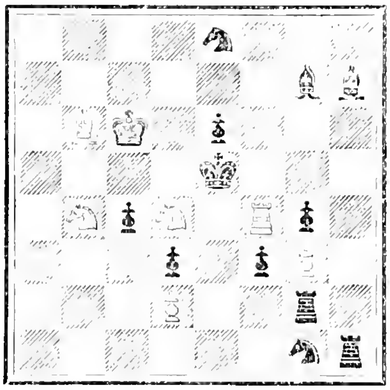
Our Chess Column.

By Mephisto.

PROBLEM No. 140.

By B. G. Laws.

Black.



White.

White to play and mate in four moves.

SOLUTIONS.

Problem No. 137, p. 454.

1. P to Q6.

1. P to K4. 2. Q to QR7, K to K3, Kt3, B5. 3. Q to Q7, R7, B2, mate.

1. K to K4. 2. Q to B sq., K to Q5, B4. 3. Q to B3 or Kt5 mate.

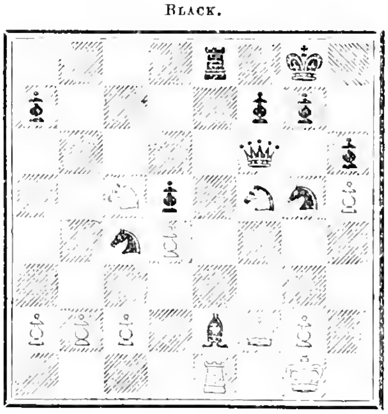
1. K to B5. 2. Q to B5, K to B6. 3. Q to B2 mate.

Problem No. 138.

1. B to R8 !		K to R2
2. Q to QR sq.		K to Kt2
3. Q to Kt7 (ch)		Mate.
1.	if	K to B2
2. Q to B2 (ch)		Any
3. Q mates.		

ENDING FROM ACTUAL PLAY.

Black.



White.

Black played—

	Kt to B6 (ch) ?
Q × Kt !	B × Q
R × R (ch)	K to R2
Kt to Q7 !	Q to B3
Kt to B8 (ch)	K to Kt sq.
Kt to K7 (ch)	K to R sq.
Kt (B8) to Kt6 (ch)	K to R2
R to R8 (ch)	Mate.

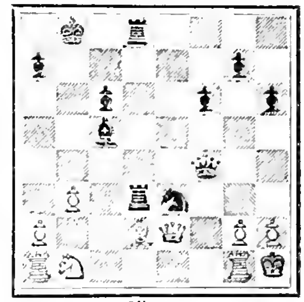
Game played at Bradford between Mephisto and a member of the Bradford Club :—

Two Knight's Defence.

White. Amateur.	Black. Mephisto.
1. P to K4	P to K4
2. Kt to KB3	Kt to QB3
3. B to B4	Kt to B3
4. Kt to Kt5	P to Q4
5. P × P	Kt to QR4
6. B to Kt5 (ch)	P to B3
7. P × P	P × P
8. B to K2	P to KR3
9. Kt to KB3	P to K5
10. Kt to K5	B to Q3
11. P to Q4 (a)	P × P (en pas)
12. Kt × P	Q to B2
13. P to KB4	B to R3
14. Castles	Castles (QR)
15. B to Kt4 (ch) (b)	K to Kt sq.
16. Q to B3 (c)	Kt × B
17. Q × Kt	B × Kt
18. P × B	B to B4 (ch)
19. K to R sq.	R × P
20. B to Q2 (d)	Kt to B5
21. B to B3	P to B3
22. Q to K2	KR to Q sq.
23. P to QKt3	Kt to K6

White. Amateur.	Black. Mephisto.
24. R to Kt sq.	Q × P (e)
25. B to Q2	

Black.



White.

	R (Q sq.) to Q5 (f)
26. R to Q sq. (g)	Q × P (ch)
27. K × Q	R to R5 (ch)
28. K to Kt sq.	Kt × R (ch)
Resigns.	

NOTES.

(a) Here the book recommends 11. P to KB4.

(b) Results in loss of time and weakness; White ought to have tried to bring out his pieces by Kt to B3.

(c) This breaks up his position, having given a useless check. The best he could do was either to retire his B to B3 or play K to R sq.

(d) White thought it was inadvisable to capture the KtP, and tried to make up for lost time by bringing out his pieces.

(e) Black is playing for something big, as he might have won at least an exchange by Kt to Q8.

(f) Q to K4 would have resulted in a substantial gain, but this move possessed more attraction.

(g) A necessary precaution, although of little avail. R to K sq. was better than this. The likely-looking move of 26. Q to B3 would also lose by Q × P (ch). 27. K × Q. R to R5 (ch). 28. The Q must interpose, then Kt to Kt5 (ch), &c.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W.—You are quite right; the position is analogous to Pearson's Problem, but it is altogether impossible, which upsets the whole "apple-cart," as the White B could not possibly be on K8.

H. A. L. S.—We did not publish the above as a Problem.

A. W. Orr.—There is no harm in 2. P to QB4. You need take no notice of it, but play B to B4 or Kt to B3 as usual.

Contents of No. 162.

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CONTENTS OF No. 164.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XLIX.—THE MODERN THEORY OF FOOD.

In my last I summarised Liebig's theory of the source of vital power, and its supposed refutation by modern experiments, but had not space to state the substituted theory. I will now endeavour to do so, though not without difficulty, nor with satisfactory result, seeing that the recent theorists are vague and self-contradictory. All agree that vital power or liberated force is obtained at the expense of some kind of chemical action of a destructive or oxidising character, and is, therefore, theoretically analogous to the source of power in a steam-engine; but when they come to the practical question of the demand for working fuel or food, they abandon this analogy.

Pavy says (Treatise on Food and Dietetics, page 6):—"In the liberation of actual force, a complete analogy may be traced between the animal system and a steam-engine. Both are media for the conversion of latent into actual force. In the animal system, combustible material is supplied under the form of the various kinds of food, and oxygen is taken in for the process of respiration. From the chemical energy due to the combination of these, force is liberated in an active state; and besides manifesting itself as heat, and in other ways peculiar to the animal system, is capable of performing mechanical work." In another place (page 59 of same work), after describing Liebig's view, Dr. Pavy says, "The facts which have been already adduced (those described in my last paper) suffice to refute this doctrine. Indeed, it may be considered as abundantly proved that food does not require to become organised tissue before it can be rendered available for force-production." On page 81 he says:—"While nitrogenous matter may be regarded as forming the essential basis of structures possessing active or living properties, *the non-nitrogenous principles may be looked upon as supplying the source of power.* The one may be spoken of as holding the position of the instrument of action, while the other supplies the motive power. Nitrogenous alimentary matter may, it is true, by oxidation, contribute to the generation of the moving force, but, as has been explained, in fulfilling this office there is evidence before us to show that it is split up into two distinct portions, one containing *the nitrogen which is eliminated as useless, and a residuary non-nitrogenous portion which is retained and utilised in force-production.*"

The italics are mine, for reasons presently to be explained. The following pages of Pavy's work contain repetitions and illustrations of this attribution of the origin of force to the non-nitrogenous elements of food.

Then we have a statement of the experiments of Joule on the mechanical equivalent of heat, connected with experiments of Frankland with the apparatus that is used for determining the calorific value of coal, &c.—viz., a little tubular furnace charged with a mixture of the combustible to be tested, and chlorate of potash (better a mixture of chlorate and nitrate). This being placed in a tube, open below, and thrust under water, is fired, and gives out all its heat to the surrounding liquid, the rise of temperature of which measures the calorific value of the substance.

From this result is calculated the mechanical work obtainable from a given quantity of different food materials. That from a gramme is given as follows:—

Beef fat	27,778	Units of work, or number of pounds lifted one foot.
Starch (arrowroot)	11,983	
Lump sugar	10,254	
Grape sugar	10,038	

In Dr. Edward Smith's treatise on "Food," the foot pound equivalent of each kind of food is specifically stated in such a manner as to lead the student to conclude that this represents its actual working efficiency *as food.* Other modern writers represent it in like manner.

Here, then, comes the bearing of these theories on my subject. A practical dietary or menu is demanded, say, for navvies or for athletes in full work; another for sedentary people doing little work of any kind.

According to the new theory, the best possible food for the first class is fat, butter being superior to lean beef in the proportion of 14,421 to 2,829 (Smith), beef fat having nearly eight times the value of lean beef. Ten grains of rice gives 7,454 foot pounds of working power, while the same quantity of lean beef only 2,829; according to which 1 lb. of rice should supply as much support to hard workers as 2½ lb. of beef-steak. None of the modern theorists dare to be consistent when dealing with such direct practical applications.

I might quote a multitude of other palpable inconsistences of the theory, which is so slippery that it cannot be firmly grasped. Thus, Dr. Pavy (page 403), immediately after describing bacon fat as "the most efficient kind of force-producing material," and stating that "the *non-nitrogenous* alimentary principles appear to possess a higher dietetic value than the *nitrogenous*," tells us that "the performance of work may be looked upon as necessitating a proportionate supply of *nitrogenous* alimentary matter," and his reason for this admission being that such nitrogenous material is required for the nutrition of the muscles themselves.

A pretty tissue of inconsistences is thus supplied! Non-nitrogenous food is the best force-producer—it corresponds to the fuel of the steam-engine; the nitrogenous is necessary only to repair the machine. Nevertheless, when force-production is specially demanded, the food required is not the force-producer, but the special builder of muscles, the which muscles are not used up and renewed in doing the work.

It must be remembered that the whole of this modern theoretical fabric is built upon the experiments which are supposed to show that there is no more elimination of nitrogenous matter during hard work than during rest.

Yet we are told that "the performance of work may be looked upon as necessitating a proportionate supply of nitrogenous alimentary matter," and that such material "is split up into two distinct portions, one containing the nitrogen, which is eliminated as useless." This thesis is proved by experiments showing (as asserted) that such elimination is not so proportioned.

In short, the modern theory presents us with the following pretty paradox:—The consumption of nitrogenous food is proportionate to work done. The elimination of nitrogen is *not* proportionate to work done. The elimination of nitrogen is proportionate to the consumption of nitrogenous food.

I have tried hard to obtain a rational physiological view of the modern theory. When its advocates compare our food to the fuel of an engine, and maintain that its combustion *directly* supplies the moving power, what do they mean?

They cannot suppose that the food is thus oxidised as food; yet such is implied. The work cannot be done in the stomach, nor in the intestinal canal, nor in the mesenteric glands or their outlet, the thoracic duct. After leaving this, the food becomes organised living material, the blood being such. The question, therefore, as between the new theory and that of Liebig must be whether work is effected by *the combustion of the blood itself* or the degradation of the working tissues, which are fed and renewed by the blood. Although this is so obviously the true physiological question, I have not found it thus stated.

Such being the case, the supposed analogy to the steam-engine breaks down altogether; in either case, the food is assimilated, is converted into the living material of the animal itself before it does any work, and therefore it must be the wear and tear of the machine itself which supplies the working power, and not that of the food as mere fuel material shovelled directly into the animal furnace.

I therefore agree with Playfair, who says that the modern theory involves a "false analogy of the animal body to a steam-engine," and that "incessant transformation of the acting parts of the animal machine forms the condition for its action, while in the case of the steam-engine it is the transformation of fuel external to the machine which causes it to move." Pavy says that "Dr. Playfair, in these utterances, must be regarded as writing behind the time." He may be behind as regards the fashion, but I think he is in advance as regards the truth.

My readers, therefore, need not be ashamed of clinging to the old-fashioned belief that their own bodies are alive throughout, and perform all the operations of working, feeling, thinking, &c., by virtue of their own inherent self-contained vitality, and that in doing this they consume their own substance, which has to be perpetually replaced by new material, the quality of which depends upon the manner of working, and the matter and manner of replacement. We may thus, according to our own daily conduct, be building up a better body and a better mind, or one that shall be worse than the fair promise of the original germ. The course of our own evolution depends upon ourselves, and primarily upon the knowledge of our own physical and moral constitution, and their relations to the external world. Of such knowledge even the humble element supplied by "The Chemistry of Cookery" is one that cannot be safely neglected.

Intimately connected with the preparation of the materials that internally sustain and renew our bodies, is that of protecting them externally. I have accordingly arranged with Mr. Proctor to follow this series (which I hope to conclude in my next) with another—necessarily shorter—on "The Philosophy of Clothing."

CHATS ON GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

(*Continued from p. 458.*)

THE CONIC SECTIONS.

A. I have been thinking over the method of treating areas which we considered in our last conversation. It seems to me that while the method is sound enough, it is in some degree artificial. Take for instance the example you gave, that of the cycloidal area;—by a certain arrangement you were able to compare the area with that of the generating circle. But, in any case, taken at random, how can you tell that this or that particular method of slicing up your area will avail to make the several parts of it comparable with the several parts of some known area?

M. Well; how can you tell that any particular method of dealing with a complicated algebraical or trigonometrical expression, will result in simplifying it? In geometry, as in other matters (even in business matters), we can but try such methods as seem likely to help us.

A. But I am told that analytical methods are sure, in these cases.

M. That is far from being the case. When you deal with an area by analytical methods, you get an algebraical or trigonometrical expression,—let us say,—for one of the minute elements into which you have sliced up your area, and you very often see at once from this expression that the area can be obtained by the process known as integration. But often enough the expression you obtain is not one you can deal with as it stands. Then you have to apply tentative processes, which may or may not lead to a solution. Of course, the more you know about the analytical treatment of various expressions, the more likely you are to succeed quickly by the analytical methods: but a similar truth holds in regard to geometrical work also. Moreover, you will find that there is no surer help to success with analytical methods, than a knowledge of the various geometrical methods, and practice in their application. These underlie, in reality, the analytical methods, and later on in your studies you will find great interest in taking your analytical work and seeking the geometrical interpretation of every process, nay of every line in it. However, let us resume our subject.

A. You promised to take the area of a parabolic segment next.

M. I did. But on consideration, we had better begin with the more familiar curve, the ellipse.

A. Can we afterwards go on to the hyperbola?

M. Hyperbolic areas are not to be dealt with geometrically quite so easily as the ellipse and parabola. In fact, it is impossible to make any exact geometrical statement about the area of a hyperbolic segment. It has been suggested—but, perhaps, mistakenly—that Shakespeare had been working on some hyperbolic area when he wrote the impatient words, "Out hyperbolical fiend! why vexest thou this man?"

A. It seems not unlikely. But had we not better turn to the ellipse?

M. Let $AbA'b'$ (Fig. 1) be an ellipse, axes AA', bb', and let circles be described having these axes as diameters. Now, if any radius as CqQ is drawn to these concentric circles, then, by a well-known property, QM and qm (produced) meet at P, a point on the ellipse. We may conveniently take this property for use in dealing with the area of the ellipse. Complete the diagram, and mark in letters, as in the figure. Now, PM bears to QM the same ratio that Cq bears to CQ, or Cb to CB. Hence, if we regard P M as a strip of the semi-ellipse A b A′, and Q M as a strip of the semi-circle A B A′, we have

$$\text{Strip P M : strip Q M :: C}b \text{ : C B},$$

and the like with all such strips into which the areas A b A′ and A B A′ may be divided by a multitude of parallels to B B′, indefinitely near each other. Hence, since each strip in A b A′ bears a constant ratio to the corresponding strip in A B A′, all the strips in A b A′ together, bear that same ratio to all the strips in A B A′ together: that is to say,

$$\tfrac{1}{2} \text{ ellipse A } b \text{ A}' : \tfrac{1}{2} \text{ circle A B A}' :: b\text{C : B C},$$

or ellipse $\text{A } b \text{ A}' b' = \frac{b\text{ C}}{\text{B C}}$. circle A B A′ B′.

In like manner, beginning with the ratio

$$\text{P}m : q\,m :: \text{Q C} : q\text{ C},$$

we can prove that ellipse $\text{A } b \text{ A}' b' = \frac{\text{B C}}{b\text{ C}}$. circle $a\ b\ a'\ b'$.

It is also evident that area $\text{P A P}' = \frac{b\text{ C}}{\text{B C}}$ area Q A Q′;

area $\text{P A}' \text{P}' = \frac{b\text{ C}}{\text{B C}}$ area Q A′ Q′; area $\text{P } b\, p' = \frac{\text{B C}}{b\text{ C}}\ q\ b\ q'$;

and area $\text{P } b'\, p' = \frac{\text{B C}}{b\text{ C}}$ area $q\ b'\ q'$.

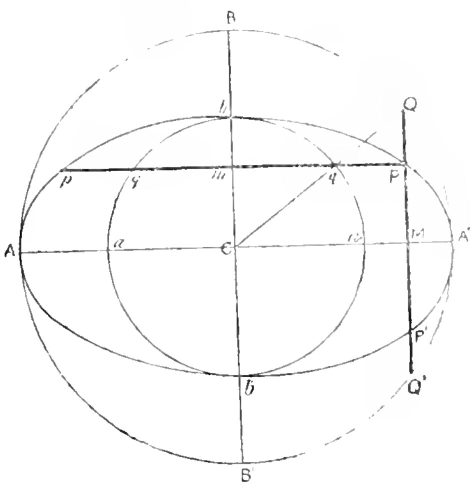


Fig. 1.

A. I see that you have here taken the *lines* P P′, Q Q′, P p', and $q\,q'$ to represent elementary *strips* of the areas you are dealing with. Can you always do this?

M. You can do it in all such cases as this, where you know that the strips in one area are of the same breadth as the corresponding strips in the other. Here they are so by the nature of the construction itself. But in other cases—in dealing with the parabola, for example—they are not so. In such cases you must consider the breadth as well as the length, and therefore you cannot use the lines as in the last case—for a line represents length, not breadth.

A. The ellipse seems easy enough to deal with. I wonder why there should be more trouble with the hyperbola, which resembles the ellipse in so many properties. How is this?

M. You say the ellipse is easy to deal with. Have you satisfied yourself on this point?

A. Why, have we not just determined its area?

M. We have shown that its area bears a certain proportion to the area of certain circles. But is the determination of the area of a circle so easy a matter? I imagine that the quadrature of the circle has been considered a problem of some difficulty.

A. Still it has been dealt with so thoroughly that we know the area of a circle of given radius as closely as we can ever want to know it.

M. Quite so. And if we had as familiar a knowledge of the curve which bears the same relation to a hyperbola that the circle bears to the ellipse, we should be able to deal as easily with the hyperbola as with the circle.

A. What curve is that?

M. What else but the rectangular hyperbola? The circle is an ellipse with equal axes, the rectangular hyperbola is a hyperbola with equal axes.

A. Then, in point of fact, all we have done with the ellipse has been to show what relation the quadrature of the ellipse bears to the quadrature of the circle.

M. Precisely. And it is just as easy, as a moment's consideration will show you, to see what relation the quadrature of a hyperbola with unequal axes bears to the quadrature of a rectangular hyperbola.

A. Will you take a moment's consideration for me, and show me this?

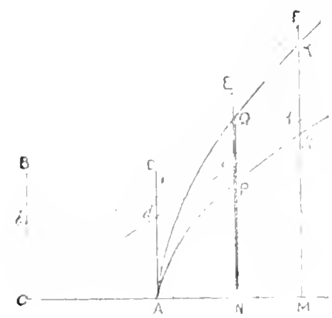


Fig. 2.

M. Suppose in Fig 2, C A and C B are the ½ axes of a rectangular hyperbola A Q K; C A and C b those of the non-rectangular hyperbola A P k; C D E F, C $d\ e\ f$, asymptotes; D A, E Q P N, F K k M perp. to C M. Then we know that

$$\text{P N} : \text{Q N} :: k\,\text{M} : \text{K M} :: \text{C B} : \text{C}\,b.$$

Hence, as in the case of the ellipse,

$$\text{Area A } k \text{ M} : \text{area A K M} :: \text{C B} : \text{C}\,b;$$

and if we had dealt as freely with such areas as A K M, (that is the areas of the segments of rectangular hyperbolas) as we have with the areas of circular segments, this would solve as completely the problem of hyperbolic quadrature as the preceding investigation solved the problem of elliptic quadrature.

A. That is far from satisfying. Allow me to say with Shakespeare, "Out hyperbolical fiend." Let us turn to the parabola.

(To be continued.)

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

ABOVE THE SURFACE (*continued*).

In a former paper a small family of moths was referred to as having aquatic caterpillars; these will form the subject of the present paper. They are called the Hydrocampidæ, or China Marks, and are common adornments of weedy ponds. They are but a feeble band, the British species being only five in number, distributed amongst almost as many genera. The largest is but an inch in expanse of wings, and the smallest little more than half that size. The wings are rather narrow, and often most elegantly adorned with a delicate tracery of brown or black on a satiny white or creamy ground. Like most of the Pyrales—the section to which they belong—they have long slender legs and a narrow body, extending considerably beyond the hind wings. To find these beautiful little beings, seek out a pond where tall plants, such as the Burr-reed, the Arrow-head, the Flowering Rush, and the Water Plantain rise in stately columns straight out of the water, and where the water itself is well stocked with pond-weeds; watch the luxuriant growth for a time, and you will see at any rate some of the Hydrocampidæ playing "hide-and-seek," as it were, amongst the forest of stalks and leaves. Some of their delicate forms are sure to be seen floating on the water in a more or less disintegrated condition—the corpses of such as have either been accidentally drowned, or have perished in the ordinary course of nature, and fallen into the water on their decease. Good specimens of the living insects may easily be secured by sweeping amongst their hiding-places, or by netting them as they dart out from amongst the herbage.

When at rest, the fore-wings are placed nearly horizontally, just covering the hind wings, and giving the whole insect an outline resembling that of an isosceles triangle. The attitude of rest is a matter of importance to the systematic Lepidopterist, for often special attitudes are characteristic of special families. Thus we find that some moths spread out all four wings horizontally, closely applying them to the object on which they are resting; some turn them up over their back, as butterflies do; others wrap them alongside the body so as to give themselves a cylindrical appearance; some rest with head close to the ground and tail in the air, others in just the reverse position, while, as regards the slope of the wings, there is every conceivable degree of inclination between horizontal and perpendicular, and, as a consequence, an infinite variety of triangular outline. But, to return to our China Marks. The prettiest of the family is *Hydrocampa stagnalis*, the "Beautiful China Mark" (Fig. 1). The

Fig. 1.—Hydrocampa stagnalis.

ground colour of the wings is satiny-white, and the markings consist of double, twisted lines of a rich brown colour. Beautiful to the naked eye, it is simply exquisite when viewed by reflected light with a low power of the compound microscope; the satiny scales lying row upon row on the wings, and standing erect on the head like regal plumes, glisten with dazzling brightness, tempered only by the warm brown tints of the wavy lines that form the pattern. Sloping back at the sides of the thorax, and concealing the junction of wings with body, are two plume-covered tippets, found in all Lepidoptera, but of unusually large proportions in this group. The antennæ are most elegant. To the naked eye, they are but fine threads; but under the microscope (Fig. 2) each is seen to be

Fig. 2.—Portion of antenna of Hydrocampa stagnalis, highly magnified.

composed of a series of joints carrying on their outer side a little tuft of scales similar to those on the wing, and on the inner side a number of fine short hairs standing erect like velvet pile.

But it is not in their perfect state that the principal interest attaches to the Hydrocampidæ; they are remarkable as being the only family of the Lepidoptera that are aquatic in the larval condition. Their caterpillars feed on water-plants and form cases, not like caddis-worms, of vegetable débris, but of the fresh leaves of the plants on which they feed, and within these they constantly remain beneath the surface of the water. That a caterpillar should construct a case for itself out of the leaves of its food-plant is nothing extraordinary, there being numerous instances of it amongst the Lepidoptera; indeed, one large family of minute moths, the Coleophoridæ, or "case-bearers," have been so named from their indulgence in this habit; but that a Lepidopterous caterpillar should habitually live in water is an altogether anomalous fact, as submergence is generally very fatal to these insects. Like those of the Lepidoptera generally, these caterpillars are worm-like beings, with a hard head armed with powerful jaws, and with six short legs in front, and claspers, or false legs, on the hinder segments. The eggs are laid on the leaves of pond-weeds, and in some cases, at any rate, the young grubs, when first hatched, instead of at once making cases, mine their way into the substance of the plant, and thus protect themselves while devouring its interior. The duration of this internal life seems to vary with the season; those that are hatched late in the year remain in their burrows all through the winter and do not form cases till the next spring, when the freshly-growing plants afford them suitable materials. But others have been observed to mine for only a few days, and then to emerge and begin to construct cases. The case is made of two pieces of leaf joined at the edges. In order to construct it the caterpillar, by means of its claspers, first seizes a leaf firmly near its edge, and then bites a narrow, curved channel through the leaf, beginning at the edge, and working its way round by bending its head to one side. Having then gone over the same ground again, but in the reverse direction, widening the channel, it shifts its claspers to the fixed part of the leaf, and continues the curve almost to the edge again, repeating *this* operation also a second time. The strip of leaf is now attached only by a narrow isthmus. The caterpillar next transfers itself to this almost detached portion, severs the connecting bridge, and floats away as on a raft. In this way half the case is made; then, seizing some fixed leaf in its forelegs, and guiding itself thereby, it crawls about in search of a suitable leaf from which to cut a piece for the other half. Having found one to its taste, it hauls itself and raft under the chosen leaf and makes the detached piece fast to the underside by fixing it with silk at intervals along the edge, all the time keeping itself snugly ensconced between the two. Having thus laid the foundation, as it were, it uses the lower piece as a tracing model, cuts out the upper by biting round the edges of the lower, and thus finishes the dwelling, no doubt satisfied enough with the economy of its arrangements, which have combined in the most pleasurable way the taking of a meal and the building of a domicile.

From the open end of this case it can easily feed on the plants around without unduly exposing its defenceless body. But even the best-made cases will grow old, and caterpillars, too, will grow stout, so that there is constant need for the manifestation of constructive genius. The larvæ are by no means fastidious as to the kind of leaf used for the case, and sometimes the two halves even will be of different materials. Sometimes only half the case is changed at a time, a new roof or floor being put on as occasion may require; but care is always taken that the new piece shall be a trifle larger than the old, and in this way the case itself gradually grows and keeps pace with the requirements of its owner. Sometimes, however, especially after a moult, the caterpillar literally "turns over a new leaf," discarding the old case, and starting afresh with an entirely new outfit. Inside the rejected abode may be found the cast skin, stretched out at full length along the floor, and attached by some silken threads. The chrysalis is formed inside the case, and when about to assume this state the larva is obliged to moor its dwelling to some plant, for it would be far too dangerous to leave it floating about with its precious freight, the sport of winds and waters. Most of the above particulars apply specially to the larva of *Hydrocampa nymphealis*, a species rather larger and of a browner colour than *H. stagnalis*, but in other respects very similar to it.

(*To be continued.*)

POLITICAL LIFE IN AMERICA.

By Richard A. Proctor.

I HAVE had an opportunity of noting what Americans have described to me as absolutely essential to a right understanding of the dignity of freedom in America—the progress of a Presidential election. Let me try to record the impression which this event has produced on an Englishman who certainly views American institutions with no unfriendly feelings—nay, recognises as in progress here the most hopeful attempt at self-government in which any great nation has ever been engaged.

In the first place, the fact is forced upon one most emphatically at such a time that the best Americans keep out of politics, so that the nation is obliged to select her chief officers from an inferior class. The very name "politician" has long been akin here to a term of reproach. I have even heard men described as "mere politicians and scallawags" as if one term were about as contemptuous as the other. For this the persons responsible are those "best men in America" who avowedly avoid the political arena for more or less selfish reasons. They could, if they would, keep the inferior men out.

Secondly, one cannot but notice that while in the heat of a Presidential contest, the most virulent abuse is poured on the rival candidates, while every offence in their political or private career is displayed and exaggerated; and while words of the foulest sort are applied to them, there is a disposition (scarcely less unworthy) to forget altogether after election the known defects or evil proclivities of the men selected for high offices. I have before me as I write a paper in which the offences of one of the Presidential candidates have been abused for months in terms implying that a gaol rather than the White House at Washington would be his proper place. But the election being now over, this very paper speaks of the contest as a friendly and fraternal one. Again, consider the election of 1880. Few names are now *professedly* held in higher honour in America than that of President Garfield. His career from Log Cabin to White House is followed by young Americans with nearly as much admiration as the career of a Washington or a Franklin. Doubtless, something of this is due to the circumstances of his death, which were such as to excite the sympathy of the whole nation, and so to disarm adverse criticism. But ask any truthful American—Democrat or Republican—what was really Garfield's record before he became President, and you find it that of a man with whom no honest statesman in England would have associated. He had accepted for 5,000 dollars the duty of attorney in an important matter brought before a committee at Washington, *of which he was himself chairman*, and the decision of the committee had been set aside *for this cause* by a court of justice, no appeal being made, or indeed possible, against a decision which in England would have been utterly fatal to his reputation. It was clearly proved, again, that on another occasion he had received a bribe of 326 dollars—so clearly that his friends could find no other defence than that "he did not know better." All this and more was brought against Garfield while the election was pending, with customary exaggerations and intensifications, and abuse such as we in England can hardly imagine. This was an extreme fault on one side, but surely it was an extreme fault on the other side that his election to the Presidency (imagine its being *possible*) should cause men to forget all this, and a still more serious fault that because his death chanced to have been brought about in a most tragic and painful way, his career should be held up as an example to young Americans. Neither exaggerated abuse nor misapplied applause is worthy of a great nation of grown men.—*Newcastle Weekly Chronicle.*

A MARVELLOUS LITTLE STREAM.

AT a distance of thirty miles south of the River Diamante our route passed by a natural object of considerable interest—a stream, or rather rill, of yellowish white fluid like petroleum issuing from the mountain side at a considerable height, and trickling down the slope till lost in the porous soil of the valley below. The source from which it flowed was at the junction where a hard metamorphic rock, interspersed with small crystals of augite, overlay a stratum of volcanic tufa. It was formed like a crater of a volcano, and full of black bituminous matter, hot and sticky, which could be stirred up to the depth of about eighteen inches.

Floundering in it was a polecat or skunk (*Mephitis varians*), having been enticed to its fate by the desire of securing a bird caught in the natural bird lime, till a bullet from the revolver of one of the party terminated the skunk's struggle to extricate himself from the warm and adhesive bath in which it was helplessly held captive. The overflow from this fountain was, as described, like a stream of petroleum two or three feet wide, trickling over a bed of pitch or some such substance, which extended to a much greater width along the edge of the running stream at its contact with it. The material was of a very sticky nature, becoming gradually harder as it spread further out, assuming the appearance of asphalt when it became mingled with the loose sand of the adjoining soil.

While engaged in examining this natural curiosity, we came upon two small birds, caught in the sticky substance at the edge of the stream; they were still alive, but upon releasing them both the feathers and the skin came off where they had come in contact with the bituminous matter, so that we had to kill them to put an end to their sufferings. No doubt they had been taken in by the appearance of water which the stream presented and had alighted to drink, when they discovered their mistake too late. Their fate suggested the idea that in a district so devoid of water others of the feathery tribes must constantly become victim to the same delusion in a similar manner, and upon a close inspection of the margin of the stream the correctness of this inference was established by the discovery of numerous skeletons of birds imbedded in it; nor were those of small quadrupeds unrepresented, among which we recognised the remains of a fox.—*South American Traveller.*

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER VI.—THE EARTH'S REVOLUTION ROUND THE SUN.

Although the fact that the earth rotates upon her axis is one of the most striking revealed to us by astronomical researches, it is far surpassed in interest by the circumstance that the earth speeds with inconceivable velocity on a widely-extended orbit around the sun. Once we have become convinced that the earth is a globe, freely suspended in space, we are prepared to learn that this globe may rotate upon its axis. But nothing save long familiarity with the idea can render the theory of the earth's revolution round the sun otherwise than surprising. That this earth on which "we live and move, and have our being," this globe which we are accustomed to regard as the very emblem of stability and fixedness, is rushing through space with a velocity far exceeding that of the swiftest motions know to us, is an amazing fact, and one which men can only be forced to believe by the clearest and most convincing evidence. Our swiftest express trains travel with about one-thousandth part of the velocity that astronomers assign to the earth's revolution around the sun; the velocity with which sound travels is but as rest compared with that of the onward rushing earth; light itself, though its velocity is so enormous that it courses in a single second over a space that would eight times circle the earth, yet does not travel so many times faster than the earth but that her motion bears to that tremendous velocity an appreciable proportion.

To establish the fact of the earth's revolution, then, we must have irresistible evidence, for the probabilities against that theory seem irresistible.

We must for a while forget that the earth's rotation has been established, in order that the more imposing fact of her revolution may be grounded on independent evidence.

The main proof of the earth's revolution is derived from the motions of the sun, moon, and planets, upon the celestial sphere. Regarding this sphere as marked with a number of index-points—the fixed stars—for our guidance, we have to consider what the motions of the sun, moon, and planets upon that sphere actually are. Let the student remember that many of the facts now to be mentioned are such as he can abundantly verify for himself. Whatever opinion men may form about the explanation of these facts, there the facts are; and no theory can be accepted which does not give a satisfactory account of them.*

Let P E P' E' (Fig. 1), represent the celestial concave; P O P' the polar axis about which it appears to rotate. Then the sun appears to circle once in a year round a circle, E E' obliquely situated. His motion in this circle is not absolutely uniform, being faster in one part as near E, and slower in the opposite part as near E'. But year after year his motion is repeated in the most regular manner, the velocity in any part of the circle E E' being always the same, as, year after year, he returns to that part of his course. Again, as his apparent magnitude is not appreciably altered to ordinary vision, we conclude that throughout his course he is always at about the same distance from the earth. Carefully measured with telescopic appliances, however, he is found to be slightly larger when near E than when near E'. Hence we conclude that he is slightly nearer at the former than at the latter part of his path.

Now, here at once we have an important fact to deal with. We know this at any rate for certain, that either the sun goes once in a year round the earth, or the earth goes once in a year round the sun. One or other *must* move. Observed appearances can also be accounted for, it is true, by making both bodies move round a common centre, but this is an hypothesis that has nothing in it to invite our attention.

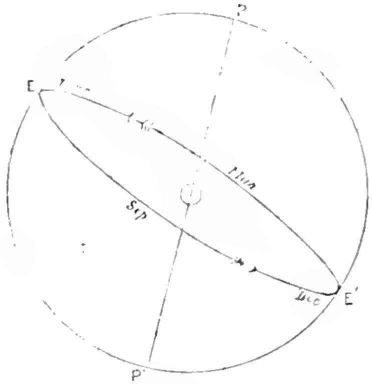


Fig. 1.

If we knew the distance separating us from the sun we could tell at once whether he or our earth were the larger body, and therefore which was most probably at rest. The estimate of the sun's distance involves considerations of too great complexity to be conveniently available here. I may mention, however, that it is rather in appearance than in reality that the proof of the sun's distance is mixed up with the theory of the earth's revolution; so that even on the Ptolemaic theory the facts dealt with in discussing transits of Venus can only be interpreted by accepting it as a demonstrated fact that the sun is upwards of 90,000,000 miles from us. Those of our readers who have given that subject the thoughtful attention it so well merits, will see that the estimate of the distance of Venus depends simply on the fact that, viewed from the ends of a measured base-line, the planet was seen in positions differing by such and such an angle. So that *her* distance comes out from the simplest trigonometrical considerations at so many millions of miles, whether the sun or the earth be in motion. Again, the proportion between the distance of Venus and that of the sun from us, though deduced by astronomers from Kepler's laws, yet follows immediately from the range of her apparent motion on either side of the sun.

We might, then, at once proceed to consider the enormous improbability that the sun, whose deduced magnitude exceeds that of our earth more than a million times, should be circling round an orb relatively so minute. For the present, however, I prefer to confine myself simply to the question of observed motions and their interpretation.

The moon, the second body we have to consider, travels also round and round the celestial sphere in a continuous manner, and with a velocity only slightly variable. But here the resemblance between her motions and the sun's ceases. He follows always the same path; the moon—travelling much more swiftly, so as to completed a circuit in a month instead of a year—travels on a path continually changing. In any single circuit her path appears to resemble the sun's, being apparently a circle inclined about five degrees to the circle E E'. But in reality it does not

* Singularly enough, the most striking of all these facts, the peculiar paths of the planets, have been left wholly undealt with by the paradoxists. Whether those people are, in truth, altogether unaware of the difficult problem presented by the apparent motions of the planets, or whether they cautiously and wisely eschew a difficulty which is too great for them, I cannot say. It is to be feared that many of the paradoxists know much more than it is convenient for them to admit; but, on the other hand, we must, in all fairness, concede to most of them an enormous—nay, a portentous ignorance on the subjects they are so eager to instruct the world about.

re-enter. The circle is continually shifting in position, though always inclined at about the same angle to the circle E E′ (Fig. 1). The mode of shifting is very complex. It may be thus generally described :—

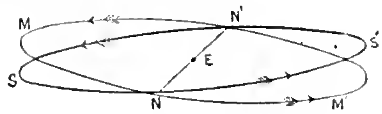


Fig. 2.

Suppose S N S′ N′ (Fig. 2) the sun's path on the celestial sphere, M N M′ N′ the moon's path at any moment—by which I mean the path she would follow if she performed a complete circuit without any shifting of her plane of motion. Now the two paths intersect in a line N E N′, and this line it is which is continually shifting. Sometimes the end N travels towards S, sometimes towards S′ ; but on the whole a motion in the former (or retrograde) direction prevails ; and in the course of about nineteen years the line N E N′ has shifted completely round in the plane S N S′ until it has the same position as at first.

Here, then, we have another set of facts to explain. Either the moon travels round the earth, or the earth travels round the moon.

In considering which view is the more probable, we may fairly take into account the estimates which have been formed respecting the moon's distance and magnitude ; because at a very early epoch astronomers obtained reliable information on this point. It has been proved that the moon is somewhat less than a quarter of a million miles from the earth, and that consequently her apparent magnitude indicates a real magnitude falling far short of the earth's. Her diameter is, in fact, little more than a quarter of the earth's, and her volume rather more than one-fourteenth.

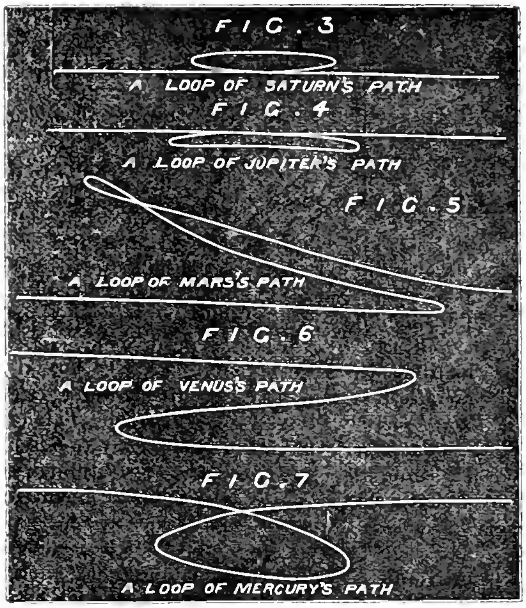
So far as the evidence goes, therefore, we are led to recognise a real motion of the moon round the earth as a more satisfactory interpretation of her apparent motion, than a real motion of the earth around the moon. And as we have as yet decided nothing about the sun's motion, we are led to infer that probably the sun also goes round the earth ; because it seems more reasonable to assume that where two out of three bodies are certainly in motion, the body at rest is the centre of *both* motions. I think it not unlikely that it was from being able to show that the earth is probably the centre of the moon's motion, that the ancients were led to believe that she is in all probability the centre of the sun's motion also. At any rate, until we get further evidence, this is the view suggested by the observed facts.

It remains to be seen how far the motions of the planets confirm this view. If we had only the sun and moon to deal with, the astronomy of Ptolemy would have no unsatisfactory basis to rest upon, setting aside, of course, the more delicate modes of modern observation, and the facts revealed by them.

The planets also go round and round the celestial sphere, each in its proper period. If they only travelled round in circles, they would confirm the impression that the earth is the centre of their motion. But from the very commencement of astronomical observation, it was observed that the planets follow very peculiar paths.

Every planet moves, speaking generally, in this wise :— It travels along as if it were about to describe such a circle as the sun or moon describes. But gradually it moves more and more slowly, until at length it stops altogether. Then it retraces its path, first with continually increasing, and then with continually diminishing velocity, until it again stops. Then it advances again ; and so on continually. The backward motion covering a smaller range than the forward motion, the planet advances on the whole—that is, travels in the same direction as the sun. And again, the backward motion not being exactly on the same track as the advancing motion, the path of the planet forms a succession of loops or convolutions. And not only has each planet its own general way of forming loops, but each loop of a planet's path has its own peculiar character.

Saturn, for instance, forms nearly 30 loops in going once round the celestial sphere, the space between the loops being about equal to the loop itself. Jupiter makes about 11 loops in going once round, the loops being larger than Saturn's, and the space between them larger yet. Mars makes a loop, and one much larger than Jupiter's, then sweeps more than once round the heavens and makes another loop, and so on continually. Venus goes more than once and a half round the heavens between successive loops. Mercury, however, travels along a looped path more resembling that of the outer planets, making about three loops in going round his circuit. Figs. 3 to 7 show how these loops vary in shape and size.



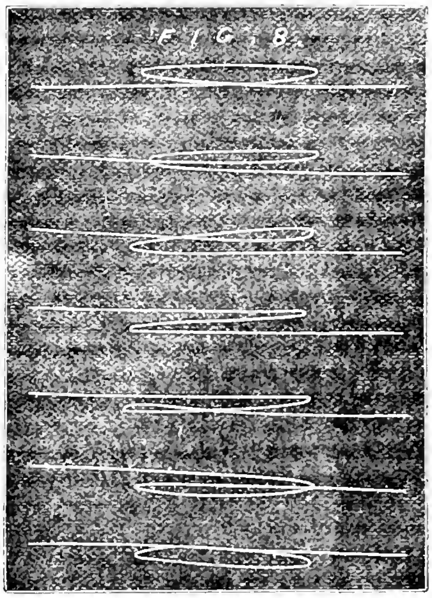
But the successive loops made by the same planet, though exhibiting about the same range, yet vary singularly in figure. The seven figures (Fig. 8, next page), for example, exhibit a set of loops traversed by Jupiter in about half a complete revolution.

It will easily be seen how, in the other half revolution, the loops change back into the first figure.

We have in these peculiar motions a problem which *must* be solved by any theory pretending to exhibit the true character of the scheme formed by the earth, the moon, the sun, and the planets. The ancient astronomers, in forming their theories, recognised this fact in full ; and we must by no means compare the thoughtful and careful way in which they tried to master the problem, imperfect as their results were, with the egregious folly of the modern charlatan, who puts forward theories not in themselves much more imperfect, but differing altogether in this, that they are not constructed with even the vaguest reference to the observed celestial motions.

Let us inquire whether all the complicated loops and convolutions above described admit of being disentangled.

It will be granted that a theory which leaves no loop or part of a loop without an explanation at once complete and simple, well deserves all the admiration which men have so



long awarded to the labours of Copernicus, Kepler, and Newton.

(*To be continued.*)

ELECTRO-PLATING.

By W. Slingo.

XV.—PREPARING THE BATH, &c.

German silver articles having been subjected to the cleansing processes, require yet another operation prior to immersion in the depositing bath. This consists in dipping them into a solution of nitrate or cyanide of mercury. The former is more generally adopted, and is prepared by dissolving an ounce of mercury in nitric acid, diluted with three times its volume of distilled water. The quantity of acid required varies with its quality. As it is desirable that there should not be either too much metal or too much acid, the best plan, perhaps, is to place the mercury in a vessel, and then pour the dilute acid over it until the whole of the metal is dissolved and converted thereby into nitrate of mercury. When this is accomplished, water is added until the bulk is increased to one gallon, when a little additional nitric acid may be poured in. The immersion of the German silver articles in this solution results in a film of mercury, of a greyish or blackish colour, being deposited upon them. The characteristic brightness is produced by brushing the film softly. As mercury oxidises somewhat readily, it is essential that the article should be immediately transferred to the depositing bath. In the event of the parts of an article being soldered or leaded together, yet another process is necessary. By simply subjecting the solder, &c., to the abovementioned operation it remains obdurate, and will rarely take a deposit of silver. If, however, a stronger mercury solution is applied to the solder or other joint, the necessary metallic film is deposited; but a better way, perhaps, is that recommended by Watt. The edge or joint is immersed in a solution of sulphate of copper, and one end of a rod of iron being held in the hand, the other end is made to touch in succession the various parts of the joint. By so doing, electrolytic action is set up, the sulphate of copper is decomposed, and a bright metallic copper film is deposited upon the solder. After well rinsing, it is ready for the silvering bath. Another plan which answers well, more particularly if we have a joint other than an edge to deal with, is to attach one or two thin iron wires to the handle of a camel-hair brush, and moistening the latter with a weak solution of sulphate of copper, pass it slowly over the joint. The iron wires should be so arranged that, travelling with the brush, they come into contact with the successive parts of the soldering immediately after they have been wetted by the brush. The same action then takes place as would result from immersion in the sulphate of copper, a copper film being deposited on the solder.

To coat brass or copper with a deposit of silver, the same series of operations should be gone through as in the case of German silver.

Turning now to the electrolytic cell, the presence of the cyanide prevents the use of that form recommended for the sulphate of copper solution, and it would be the best economy to procure an earthenware bath. However, as has been previously pointed out, the adoption of the orthodox rectangular form is not in any way obligatory, and vessels of other shapes may be more cheaply purchased. They will, in all probability, require a somewhat larger quantity of solution, but that is of no great moment, seeing that it does not materially deteriorate. The relative dimensions of the bath must to some extent be determined by the shape of the object to be plated, so that it would be well for the student to make up his mind as to the kind of work he contemplates turning out before he provides himself with his bath. For some objects he would require a tall, long, and narrow bath, for others a short, wide one, while others, again, might as well be suited by a circular bath as by any other.

Having determined the kind of work to be done, and procured the bath, the next thing is to procure a couple, or, if necessary, more, bright brass or copper rods, about two inches longer than the bath and a quarter of an inch in diameter. To one end of each rod should be attached a binding-screw, for the purpose of making connection, by means of copper wire, with the terminals of the battery. If the student has the facilities, he may accomplish this object by tapping one end of each rod, and then making a screw to fit. The wire may then be clamped between the screw-head and the end of the rod.

These rods then become the terminals of the battery. From one of them—that is, from the one in connection with the copper, or positive, pole of the battery—must be suspended the silver plate or plates intended to form the anode of the electrolytic bath. Only fine silver should be used, as impurities may impair the deposit, and they will certainly injure the solution. The number and form of the silver plates must depend upon the shape of the article to be plated. They should, however, be of considerable thickness, for it must be borne in mind that for every atom of silver deposited upon the object, a corresponding atom should be dissolved from the plate connected with the battery. If this does not take place, then the atom deposited is withdrawn from the solution, and, no compensating action taking place, the solution cannot fail to be proportionately weakened. In fact, were this to continue, we should soon find hydrogen or some other metal accumulating over the surface of the object instead of silver. In the case of a flat bath, used for plating medallions or suchlike objects, flat plates of silver answer best. When the bath is long as well as narrow, it may be advantageous to use a number of such plates, but all should obviously be suspended from the same rod. It is hardly necessary to intimate that so far as the proper circulation of the current is concerned, the number of plates is of no moment. The student must not forget, as it is known many are apt to, that the shape of the plate, or its divisions into any number of parts (all of which are metalically connected) is immaterial. What really governs the strength of the current is the amount of surface exposed; the larger the surface, the stronger the current, the more silver will there be dissolved, and the more deposited. It is, nevertheless, not always advisable to have a large surface exposed; this must be governed by the size of the object, and by its composition. There is one point to be observed in connection with the suspension of the silver plate from the brass rod. The contact must not only be sure, but the greatest precaution must be taken to guard against the solution becoming impurified by means of the wires used to suspend the silver. If copper-wire is used, its connection with the plate should be at a point well out of reach of the liquid. Lead and other metals are used for this purpose, but perhaps the best method is to have one or more *lugs* or extensions from the silver plate which shall be long enough to bend over the brass rod, and so allow the silver plate to hang down and make the necesary contact in virtue of its own weight. When the silver plates are cast, this method may be easily adopted; but if sheet-silver is used, the adoption is still possible. In this case the plate should, instead of being cut square or rectangular, have one or two lugs or extensions left on of the necessary length. When the metal is too thick to bend, it may be attached to the rod by means of a stout clamp, or binding-screw. If it is wished to plate two sides of an object simultaneously, it may be done, if the current is strong enough, by using three parallel rods instead of two, and suspending silver plates from the two outer ones. These two rods should be placed in connection one with the other. If a round object is to be plated, it may be more advantageous to use a cylindrical silver plate. However, in such cases the student must be guided and controlled by the exigences of circumstances. The objects themselves must be suspended from the rod in connection with the zinc or negative pole of the battery. They may be suspended by copper wires, which should, however, be only just thick or stout enough to support the objects in the solution. If thick wires are used, there is great probability that an unpleasantly-striking dark line will be left round the part of the object covered by the wire. The object to be coated should manifestly be entirely immersed, otherwise only a portion of it will receive the deposit. That part of the wire which envelopes the object and is immersed in the solution receives also a deposit of silver, but this is rather advantageous than otherwise.

Great care should be taken to prevent pieces of foreign metal falling into the solution. Should, for example, a piece of copper wire fall in, it would enter into chemical action with the liquid, precipitate a quantity of silver, and be itself dissolved. This would probably cause a deal of trouble. Nor should the objects be immersed before the other portion of the circuit is completed, otherwise considerable trouble may ensue. If a copper object were immersed and left hanging without a current being sent through, a portion of it would be dissolved, and a corresponding quantity of silver would be deposited, which, however, would be of a non-adhering nature, and consequently it would be found that the subsequently properly deposited coating of silver would peel or strip off. Even with this precaution, however, the "stripping" will sometimes occur, due generally to a want of proper care in regulating the strength of the current. It is advisable, more especially in early experiments, to remove the object from the bath, and apply the scratch-brush to it. If it is inclined to strip, this operation will show it. This, though, is a little anticipatory. Another precaution worthy of notice is to avoid placing a fresh object in a bath in which a partly finished object is being deposited upon. Should this be done, there is a chance of local action being set up between the fresh and the partly-finished objects, as we should have two different metals immersed in a liquid and connected externally by a metallic rod (all the conditions necessary to set up a current of electricity between the metals).

On first placing the objects in the bath, the silver plate should be lowered gradually until a thin film of silver covers the whole of the object, when the plate, otherwise known as the anode, may be lowered to its full extent. The amount of surface then exposed should not, however, exceed approximately the surface of the object. If the first film of silver is deposited very rapidly, the current is demonstrated to be too strong, and, in that case, there is great danger of the deposit stripping, whence the necessity for gradually introducing the anode; that is to say, gradually increasing the strength of the current from the minimum until the requisite strength is obtained. When a considerable thickness of silver is required, as is the case with objects likely to be subjected to considerable wear and tear, the articles are taken out after a few hours' working, and their surfaces scratch-brushed, by which means a more or less crystalline deposit, is, to a great extent, if not entirely, prevented. Were the object allowed to remain in the solution continuously until a very strong deposit had accumulated, it would most likely be of a crystalline character. The occasional scratch-brushing and subsequent immersion may prevent this.

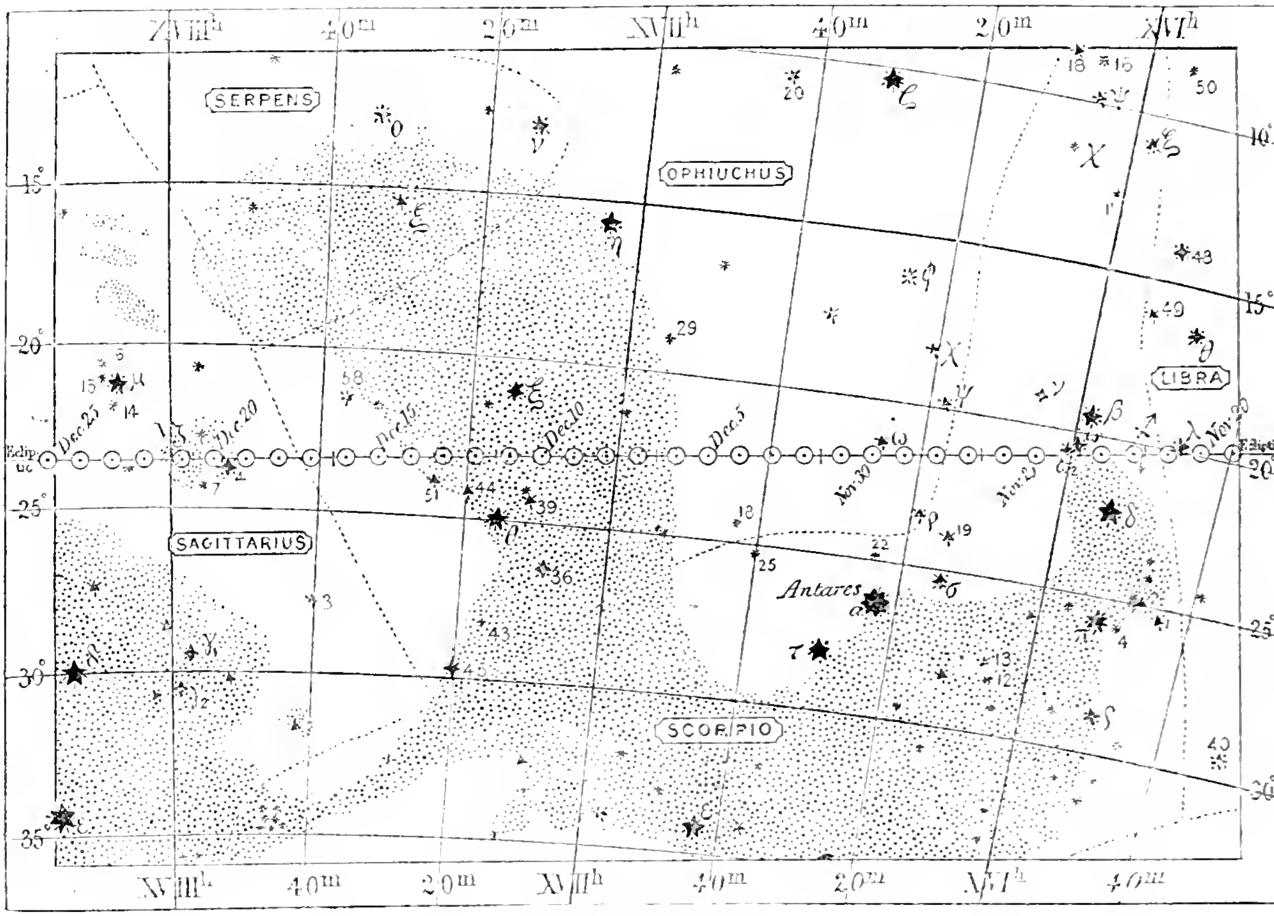
It is, of course, easy to ascertain how much silver is being deposited by first weighing the unsilvered article, and then weighing at each removal from the solution, until the requisite quantity of silver is recorded as having been added.

(*To be continued.*)

AUTOMATIC ARCTIC EXPLORATION.

THE Chicago *Current* says :—Probably the most wonderful thing in connection with the whole sad history of Arctic exploration is the recent discovery of an ice-floe in the waters of Davis' Strait—west of Greenland—which had drifted from a point in the Arctic Ocean north-east of the Lena delta—where the crew of the *Jeannette* divided into three parties and took to the open waters—to the southernmost point of Greenland, and north again to Baffin's Bay. Upon this floe were a corpse and many indubitable relics of the expedition, including an article of wearing apparel marked with the name of Seaman Noros, who, it will be remembered, in company with Seaman Nindermann went a few miles ahead of poor De Long, and lived to write the most extraordinary experience ever penned by a human hand. Had these two simple seamen been able to tell, in the Siberian tongue, that their comrades were only eleven miles back, the whole De Long party would have lived to join Melville and Danenhower.

Now, the floe discovered by the Greenlanders has, perhaps, crossed directly over the North Pole. From the *Jeannette* floe to the southern point of Greenland, in a direct line across the Pole, is 3,500 miles, but by way of the northern shore of Asia and Europe—past Cape Northeast, Nova Zembla, Spitzbergen, and Iceland, and north again into Baffin's Bay—would be a distance of at least 6,000 miles. Scientifically, the life of a moving ice-floe for so many years, and its migration from one side of the world to the other,



Day Sign of the Month.

ought to furnish suggestions and data more valuable than all the other fruits of Polar research combined. Self-registering meteorological apparatus, and possible gauges of the miles travelled, may in the future reveal to the investigators what the sacrifice of thousands of lives has otherwise failed to discover.

ZODIACAL MAPS.

By Richard A. Proctor.

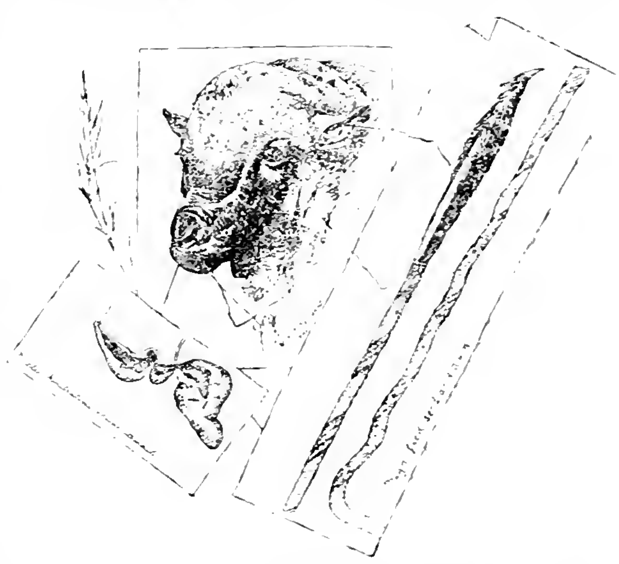
We give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

A SHEEP-DESTROYER.

By John R. Coryell

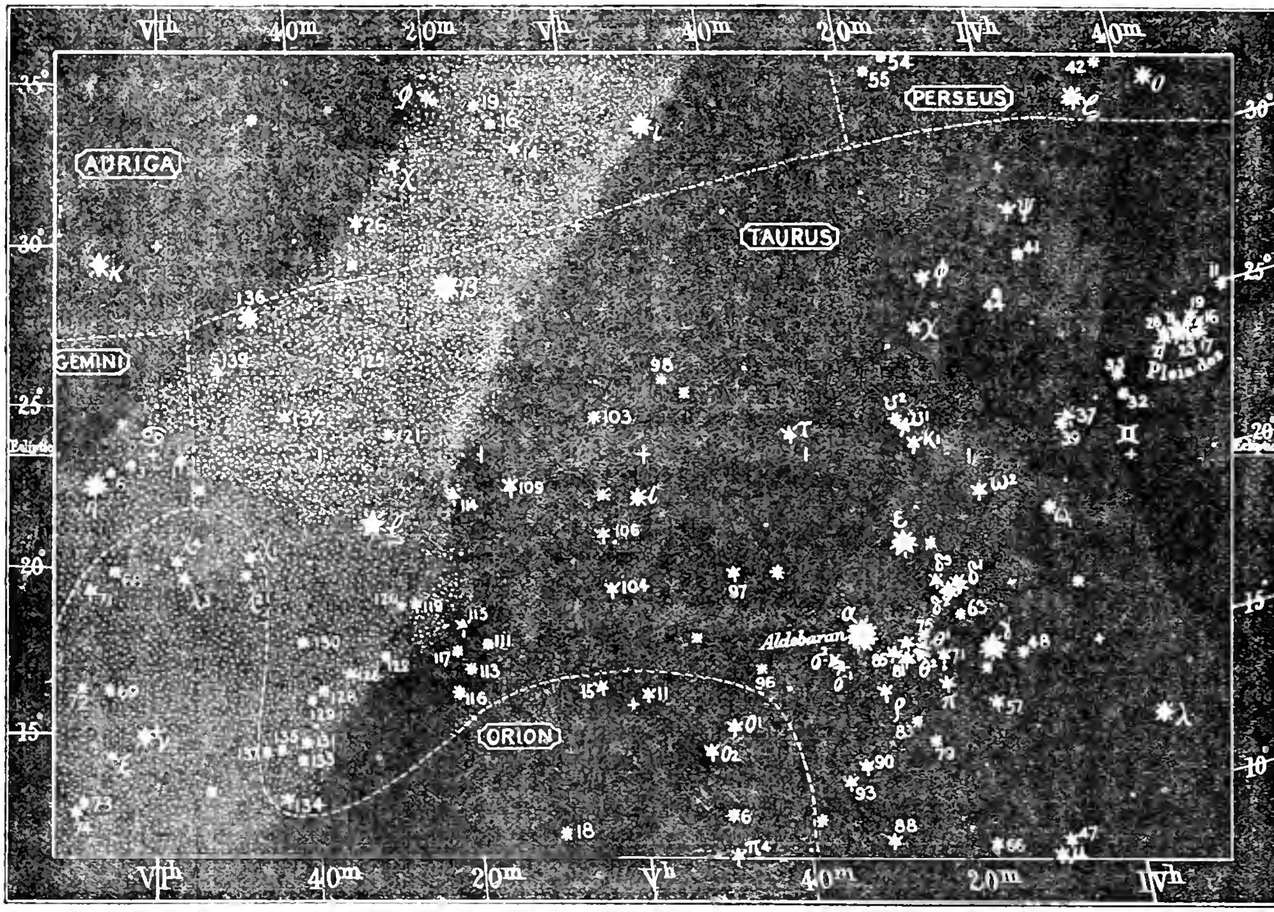
Growing on our Western plains is a pretty-looking kind of grass, resembling oats, and which is called, popularly, weather grass or needle grass—botanically, *Stipa spartea*. What may be its special sphere of usefulness to man or in the economy of nature, granting that it has such a sphere, is hardly worth considering in the light of its evil works.

Looked at casually, while in its growing state, it might be mistaken for immature or bastard oats, although a moment's inspection would reveal its true character. The seed, particularly, would serve to emphasise its unlikeness



to its useful cousin, and it is this seed which, as a seemingly insignificant but really potent agent of destruction, claims our attention.

The seed in general conformation, but not otherwise, is like the oat. Its base is tipped with a tiny point as sharp



Night Sign of the Month.

and hard as that of a pin. Almost hiding this tip, and extending upward to nearly half the length of the seed, is a soft, silky, hair-like growth. The remainder of the seed, which has a total length of about three-quarters of an inch, is bare, smooth, and flinty. A minute depression, made by the unfolding of the edges of the case, runs the entire length of the seed.

From the upper end of the seed runs a long awn or beard, varying in length from four to seven inches. This awn is a simple but beautiful piece of mechanism, designed apparently for the sole purpose of enabling the seed to sow itself. It is tightly twisted, screw-like for two-thirds of its length, and then turns abruptly into a right angle, the remaining one-third being untwisted. They who are acquainted with the so-called animated oats or the wild oats will be familiar with the action of the twisted awn under the influence of wet or dry weather. The awn unloosens or tightens its twist according as it comes under the influence of wet or dry conditions, and the untwisted, right-angled end remaining quiescent enables the seed to writhe and turn and burrow deeper and deeper into the earth.

This application of its mechanical powers to the proper end of saving its life is both beautiful and pleasing; but, unfortunately, those powers, being mechanical, act with equal vigour to an improper end. Caught in the seemingly impenetrable wool of the sheep, and there subjected to the influence of alternate moisture and dryness, the awns do their work, and, incredible as it may seem, propel the seed so far as to cause the needle to penetrate the hide of the animal. The awns break off, and the needles penetrate the vital parts of the sheep, causing painful death. The harmless-looking silky growth on the needle, tending backward from the point as it does, acts as a barb to prevent any retrograde movement of the intruding needle.

The points, too, not only enter the body of the sheep in this way, but also stick in the nostrils, nose, and lips, where, however, they do less harm than when eaten and swallowed into the stomach, in which event death must follow.

The tendency to underrate the work of weak agents may lead to the thought that no material damage can be done by means of the *Stipa spartea* to sheep. How erroneous such a conclusion would be will be seen from a statement of Mr. Henry Stewart, who, in his work, "The Shepherd's Manual," says, referring to sheep in the North-Western district, that "the most frequent losses are caused by a native grass, which bears exceedingly sharp awn or beards, and called popularly 'needle grass.'"

Sheep-men guard against loss from this cause by frequent examination of the sheep during the period when *Stipa spartea* is ripe, and by burning the pasture in June, at which time the deadly grass has just commenced its growth. Prevention in this instance, as in others, is better than cure, for it is no easy matter to examine every sheep of a large herd so carefully that all the needles can be detected and withdrawn.—*Scientific American.*

CHAPTERS ON MODERN DOMESTIC ECONOMY.

VII.—THE FRAMEWORK OF THE DWELLING-HOUSE (*continued*).

GENERAL PRINCIPLES OF CONSTRUCTION.

We have hitherto taken it for granted that the entire household arrangements are included within the principal shell or framework of the building, and such may possibly happen to obtain within the more centrally situated portions of this metropolis; they may also be found in the larger suburban tenements, and in a few country mansions. In this respect, however, the two last-named types compare unfavourably, and yet favourably, with their humbler neighbours. Unfavourably, because the most unwholesome refuse of the abode may be said to be included within the building, whereas in the smaller houses it is consigned to the garden or back yard. Favourably, because the form of apparatus used is more expensive and, *ergo*, in most cases, more efficient than that provided in the aforesaid backyard; in other words, what is gained in location by the latter is lost in practical utility through a cutting down of expenditure. It may therefore be allowed that, provided all other things are equal, the out-house system, although not quite so convenient, is undeniably the healthiest and best.

In rural districts, and even in moderately large-sized towns, out-houses are almost universally the rule; this may be said more with regard to the midland and northern counties of England than elsewhere. Unfortunately, however, it is the sewage system that is applied, in most of these cases, to the removal of excrementitious waste products from the house. There are, however, a few noteworthy exceptions to this rule, and to them we shall refer in the course of our remarks upon this all-important subject.

The principles to be observed in the erection of out-houses, may be briefly formulated thus:—1°. The water-closets ought to be situated in as convenient a situation as possible; freed from damp by a suitable floor of concrete, asphalte, or other impervious material, raised somewhat above the level of the ground, and sheltered from the wind, rain, or open-air discharge water-pipes. The water-supply ought to be conducted thereto, by pipes from a specially-isolated cistern, and the entire arrangements so disposed as to prevent the escape of deleterious products, and especially of sewer-gas. 2°. Receptacles for other waste products ought to admit of a rational sub-division; *e.g.*, house-sweepings, ashes, and garbage may be placed in one, and such things as broken glass and crockery-ware, old tins, &c., in another compartment of the dust-bin. The dust-bin itself ought to be of moderate size, and of such a shape as to permit of being readily cleared. The best kind of bin is one which can be emptied about once a week, and that by being simply turned over into the dustman's collecting-pan. A non-corrodible metal bin may be used with advantage. One caution of importance is here necessary, and that is with regard to the kind of dust-bin now most generally employed. It is usually furnished by the builder, and consists of an immovable structure after the shape of an imperfect dog's kennel, with a lid above, and a small door at one side, below. It is very often made to fit into the corner of a building, presumably to save the trifling cost of extra wooden boards for one or two of its sides. Its size is comparatively enormous, as if intended to store the offal of a large community rather than that of a single household. What, indeed, would kitchen-midden-hunting geologists of a future age say of such heaps as these! From a sanitary point of view such a dust-bin ought to be condemned, because it gives rise to what we might aptly term contaminated damp of the adjacent wall of the house, and to a mass of putrefying filth which is both disagreeable and harmful.

This leads us naturally to a question of amendment. There can be no doubt that the sewage system of London, and other similarly-constructed towns, coupled with the prevalent and very defective provisions for the removal of household rubbish, is one of the problems of the present day which calls most urgently for attention. It has been repeatedly stated that the evil has become so widespread that extensive reformation cannot be effected without an immense outlay. In its earlier days London suffered even more than it does now from an unwholesome condition of things; the house refuse was allowed to collect and fester in cesspools, and, indeed, anywhere, or rather everywhere, so that at length it became a question in which the authorities of the nation itself were obliged to interfere and to act with promptitude. Irrespective of expense, they sought to remedy the evil, and their efforts were crowned with partial success in 1871—the year of the completion of the present hydraulic system of sewerage, at a cost of from four to five million of pounds sterling. It has been shown that 12,000 lives have been annually saved through this provision. The marked mitigation of evil which followed directly upon the innovation, naturally tended to satisfy the promoters of the sewage scheme, and they little expected to find that the disinterested advance they had made for the welfare of the people was not only far from perfect, but, in reality, very defective, and but transitorily beneficial. The bulk of the sewage—about 150 million gallons—is daily discharged into the river Thames from large reservoirs, twelve miles below London. Not only does this seething mass of pollution move onwards to the sea, but, in virtue of the tides, it flows backwards towards the city itself, where the water is further contaminated from sundry minor outlets. The danger that is liable to arise from the persistence of such a state of affairs, more particularly during the warmer periods of the year, has been commented upon by almost all of our daily contemporaries. Commissions, even, have been appointed to inquire into the actual condition of things, and, if possible, to institute adequate and speedy remedies.

So far as we are able to judge, there is but one practicable way out of the difficulty; it is founded on the surest and best principle, viz., prevention. In a former number* we pointed out how the sewage question might be solved satisfactorily. The well-known proverb of the "old man and the bundle of sticks" is peculiarly applicable here. If the entrusted committee wish to attain to a happy and speedy issue without being forced to seek extraneous aid from the public funds, and a consequent increase of the rates, why do they not begin at once by taking the initiative step in the promotion of the "dry earth" and "ash" systems? Whilst they recognise the efficacy of the last-named processes, no progress whatever in relation to those systems has been made, on the score of the overwhelming introductory expense that would be incurred by its universal application. It has been estimated that 10,000 carts, horses, and dustmen would about suffice to carry out the details of such a plan for London alone. We observed before, and, by way of emphasis, we repeat again, that it is quite possible to substitute the reform we have alluded to in the course of time. New suburban houses ought to be erected with the necessary fittings; and, as the resources of each parish stand, old ones may be cut off from the existing sewage ducts. We have reason to believe that, on this

* See this journal, Oct. 31, 1884, p. 363.

limited scale, the necessary labour for the removal of refuse would not be increased; in fact, if judiciously applied, there is in reality naught to prevent its decrease. Then, again, the utilisation of house-refuse would add to the local funds and afford provision for similar extensions city-wards. In the meantime, preventive measures, such as those now being carried out, would at first be negatively advanced through the suppression of the outflow from growing neighbourhoods, and afterwards positively aided by the natural growth of the reform, until the whole system has been completed, and London, like Manchester, would be sewageless.

In our next communication we shall give an outline of the principles upon which outhouses, in conformity with the requirements of the earth and ash systems, ought to be constructed, and show how they may add most materially to a domestic economy of the highest possible standard.

THE TRICYCLE IN 1884.

By John Browning,

Chairman of the London Tricycle Club.

VULCANIZED RUBBER TYRES.

THE possibility of tricycling on our, in many districts, imperfect roads depends on the application of vulcanized rubber as tyres for the wheels.

Dr. Richardson has stated that the most important consideration in tricycling is the reduction to the utmost of vibration. There is no method of doing this known to me so simple and efficacious as the adoption of large vulcanized rubber tyres.

Everything that tends to the reduction of the size of the tyres is likely, therefore, to prove injurious to tricyclists, and to the spread of tricycling.

A short time since I saw a statement in a cycling paper that vulcanized rubber tyres of large diameter are prejudicial to the speed of tricycles. In proof of this statement, some particulars were given of an experiment made by the elder Starley, from which it appears that he rode two tricycles of similar make, one having large tyres and the other small, down the same hill, and that the machine with small tyres ran the quicker of the two.

I would not lightly impugn the accuracy of any result arrived at by Starley; but he was, of course, not infallible. For instance, in his well-known machine, the Salvo, which was the progenitor of all front-steering, double-driving tricycles, he used a small front-steering wheel, and placed it as close as possible to the driver. It has been abundantly proved by those who have experimented in this direction, that by using a large front wheel and throwing it one foot, or even more, further forward, that vibration is much decreased, and the going of the machine improved.

Unfortunately, the makers, who are aware of this fact, cannot make their machines on the improved plan, for fear the public should decline to purchase them, as they raise what they consider the fatal objection "that a machine with a larger front-steering wheel thrown further forward does not look so nice!"

Probably a similar reason will prevent larger vulcanized rubber tires from being used, though anyone who tries them will find they possess great advantages.

Paradoxical as it may seem, they are more advantageous on light machines than on heavy ones, for the machine may be made much lighter in the frame if the wheels are provided with large rubber tyres.

The Surrey Machinists Company were the first to take advantage of this, and by making their Invincible machines on this plan they have reduced their weight from one-quarter to one-third, without impairing their durability. For instance, when they first introduced their Invincible Sociable, the lowest weight of any front steering Sociable in the market was from about 140 to 150 lb., and this with ¾-inch rubber tyres, while the weight of the Invincible Sociable with one-inch rubber tyres did not exceed 100 lb.

Mr. Smith, the manager of the company, told me nearly two years since that he had had considerable experience in riding machines with large rubber tyres, and that, the weight being equal, he considered machines with large rubber tyres the fastest. This is also Mr. Grace's conclusion, and it is mine.

Now, it is easy to make the weight of two such machines equal, because what is added to the weight of the wheels may easily be taken out of the frame.

The machine of Mr. Grace's, which I recently described as being one of the fastest machines I have ever ridden, has rubber tyres ⅞ths diameter on the driving-wheels, and 1 in. on the front wheel.

My experience is that small tyres are the fastest on very good roads, but on rough roads the large tyres have a great advantage. But it is just on rough roads, where the machines run heavy, that we long to be eased of some of the work, and should, consequently, prefer the large tyres. I think it will be generally agreed that it is a good machine which goes well on a rough road.

But, besides this excellent quality of travelling easily under the most unfavourable conditions, large rubber tyres possess many other important advantages.

They do not come off the rims of the wheels nearly so frequently as small tyres do.

They increase the durability of the machine.

They reduce, most materially, the vibration to the rider, and they wear infinitely longer.

I speak within bounds when I say that a tyre one inch in diameter will last twenty times as long as a tyre half an inch in diameter with the same work.

A great number of the readers of Knowledge are tricyclists, and I shall feel much indebted to them if they will write stating how far their experience agrees with my own on these points.

The Electric-Lighting Act.—The suggestion made by the President of the Board of Trade to the deputation which recently waited upon him, that clauses should be submitted to the Board of Trade embodying the desired modifications of the Electric Lighting Act and Provisional Orders, is to be acted upon, and a committee consisting of representatives of the various electric lighting interests is being constituted to draw up such clauses.

Some rich mineral discoveries in the Illawarra district, New South Wales, have just been reported by Mr. Hardy, mining engineer, who has been prospecting for coal in the Calderwood Mountains, about three miles and a half from Dapto. The prospectors have found no less than five seams of first-class coal, which range from 4 ft. to 17 ft., together with an excellent sha'e seam. The coal and kerosene shale will, it is estimated, last upwards of 200 years. Besides the above-mentioned, Mr. Hardy has discovered a large seam of ironstone about 20 ft. in thickness.

A loud chorus of complaint is at present going up of the physical and mental injury and disquietude inflicted on dwellers near railway stations by the incessant shrieking of the engine-whistles. So far as we know, however, no one has so far pointed out the even more serious evil, that whistling by the drivers of locomotives has become so common as to have practically ceased to be regarded as any indication of *danger*. No one who has ever visited powder-mills can fail to have been struck with the fact that all conversation is carried on there in so low a tone as to approximate almost to a whisper. A shout or a loud call is but too well understood to mean imminent peril; and all whose ears it reaches at once look out for their own safety. If a cognate principle were only acted on in the daily routine of railways, the life of many of their most valuable servants might be annually saved.

Reviews.

CUSTOM AND MYTH.*

By Edward Clodd.

[first notice.]

THIS is a book, or, to define it more accurately, collection of papers, of remarkable value and interest. Mr. Lang's numerous contributions, both in vigorous prose and "aërylight" verse, to current literature are well-known, and the daintiest essay from his pen wears easily that grace of scholarship of which his Homeric translations, as well as the original poem, "Helen of Troy," are such solid, and withal delightful, credentials. His articles on the Family and on Mythology in the new edition of the "Encyclopædia Britannica," charged as they are with the true historic spirit, led us to expect that independent and masterly analysis of the generally-accepted method of comparative mythology known as the "solar," which the volume before us, and, in a lesser degree, his introduction to the new version of Grimm's stories ("Kinder und Hausmärchen") supply. But although controversial matter, therefore, enters largely, and of necessity, into the present work, it obscures neither the constructive material in it, the foundation of which is well and truly laid, nor the illustrations thrown freely and felicitously on every page. Specimens of the varied range and scope of these will be given presently, meanwhile the prominence which Mr. Lang assigns to adverse criticism of the solar theory requires that the measure of success or failure attending that criticism be first discussed. Remembering what a veil hung over our knowledge of the movements of races in times geologically recent, but historically remote, and especially concerning the ancestors of the European nations, we cannot easily over-estimate the value of the results which Bopp, Grimm, Schleicher, and later scholars (working on Schlegel's early hypothesis), obtained by the comparison of the languages grouped under the general term Indo-European or Aryan. The descent of the languages spoken by our composite English race, and other leading European peoples, also by Hindus, Persians, and some smaller peoples in Asia, from an ancestral tongue; one key to the earlier form of which is supplied in the Vedic Sanskrit, being demonstrated, philologists were enabled to pass from words to the things which they connoted, and to construct a vivid sketch of old Aryan life at a time when the congeries of tribes were scattered over the uplands of Central Asia, or the plains of Central Europe, for the exact site remains undetermined.

Although the vivid picture of their mode of life thus constructed out of the immaterial relics of speech is now generally admitted to have been over-coloured, chiefly from the tendency to read modern meanings into the ancient words, the importance of the discovery remains undiminished. It led to the extension of the method to the comparison of the leading mythologies of the Indo-European family, whereby common elements were traceable within them, and some semblance of order imported into what had been confused, disconnected, and misunderstood. An additional motive for inquiry was furnished by the incongruous, often coarse and disgusting features of these mythologies, explanation of which appeared to be supplied in the analysis of the proper names composing the *dramatis personæ* of the myth. The meaning of these names once determined, the key to the meaning of the story was clear, because, it is contended, they were the germs, the oldest surviving part of the story. Mr. Lang and other authorities contend, on the other hand, that the meanings are not determined, and that the names are much younger than the stories; but upon this more presently.

The analysis of the names, the solar mythologists say, proves that they were originally "appellations," applied to the powers of nature, chiefly and extensively to the sun, the dawn, and the other ever-varying phases incident to his daily path across the sky. In the early stages of language the same object would be called by different names, and the same name given to different objects, according to the onlooker's mood or standpoint; the most strikingly descriptive names becoming the most permanent. Although the primitive meaning in the course of time faded away, the words remained with changed meaning, no longer figurative, but literal; no longer fluent, but crystallised. The sun, the dawn, the cloud, came to be regarded as gods, "the *nomina* became *numina*, and out of the inextricable confusion of thought which followed, the belief in cannibal, bestial, adulterous, and incestuous gods was evolved." This is due, Professor Max Müller (the ablest exponent of the theory in this country) says, to a disease of language—*i.e.*, to the confusion arising from forgotten meanings, and with that explanation most of us have long remained content.

But the mythologists who regard the comparison of groups of allied languages as the only key to the intellectual condition of men in the past, shut their eyes, and, as with Professor Max Müller, wilfully, to every other kind of evidence. If the Aryans were a primitive race, there would be good reasons for trusting the Vedas as the record of men's earliest thought, for picturing them as passing each day in shuddering anxiety as they watched the varying fortunes of the sun—now strangling the cloud-serpent, now running his course like a giant, now plunging into the leaden sea; and for refusing to compare the myths of barbaric, and therefore degraded races, with such refined products of the human mind as Aryan myths. But the Aryans were very far from being primitive men; relatively to these they are but of yesterday, and their myths are the more or less polished survivals of a remote ancestral fancy spelling out the meaning of the ancient heavens, and working on the crudest, most confused knowledge of the earth. Moreover, although the method of the comparative philologist is uniform, the outcome varies much. Even where there is agreement as to the etymology there is difference as to the meaning of the word. This would not matter greatly if the general principle which makes the essential feature of a myth depend on the appellation was surrendered. But where this is retained the dissidence is fatal.

Professor Max Müller has contended that the irrational element in mythology can be accounted for only in one of two ways, either by taking it as a matter of fact, as an actual occurrence, or by referring it to the influence of language on thought, "so that many of the legends of gods and heroes may be rendered intelligible if only we can discover the original meaning of their proper names."

According to the *first* method, the myth of Daphne changed into a laurel tree by the gods when nearly overtaken by Phœbus is a poetic version of the flight of a girl from the wooer she dislikes, and her concealment behind a laurel-tree.

This is the Euhemeristic method, so named after Euhemerus, who degraded the myths to commonplace history, contending that the gods were originally men who had distinguished themselves as warriors, culture-heroes, and the like, or who were ignoble drovers or freebooters. Mr. Spencer's theory of mythology, under which every form of

* "Custom and Myth." By Andrew Lang, M.A. (Longmans. 1884.)

it and of religion is based on ancestor-worship, is a purified Euhemerism.

According to the *second* method, Daphne the laurel-tree was an old name for the dawn, and Phœbus one of the many names for the sun, who pursued the dawn till she vanished before his rays.

Mr. Lang shows a *third* and "more excellent way." His method, recognising the light which the many-sided science of anthropology throws on the operations of the human mind at low stages of culture, is, in his own words, "to place the myth which is unintelligible when found among a civilised race beside the similar myth which is intelligible enough when it is found among savages. . . . The conclusion will usually be that the fact which puzzles us by its presence in civilisation is a relic surviving from the time when the ancestors of a civilised race were in the state of savagery. By this method it is not necessary that some sort of genealogy should be established between the Australian and the Greek narrators of a similar myth; the hypothesis will be that the myth is common to both races, not because of original community of stock, not because of contact and borrowing, but because the ancestors of the Greeks passed through the savage intellectual condition in which we find the Australians" (pp. 25, 26).

In this view, the name is not the earliest feature, but often the latest; it is accidental and local; the idea being essential, universal; witnessing to like explanations of like surroundings at corresponding levels of culture.

In reviewing the several methods, it seems surprising that there should be any divided opinion about the matter among those who recognise the myth-making stage as a necessary attitude of man's early thought. Where the theory of primitive purity and complete mental equipment at the outset is held, such a fall from grace as decay or disease of language assumes is logical, but, the ascent of man from a lower to a higher once granted, no evidence as to the ideas of savage races extant, and as to any corresponding idea traceable in civilised races should be unwelcome. Yet it is this evidence which the solar mythologists, for the most part, refuse to take into account; evidence preserving for them, like fly in amber, the coarse and ludicrous which are enwrapped within the purer element of myth. In this "Aryan heresy," as the late Mr. Crawfurd, on other grounds than the present, humorously termed it, the doctrine of continuity is denied. So much the worse for the heretics; their doctrine is doomed, and they had better recognise it, lest they find "no place of repentance though they seek it carefully with tears."

The anthropological method exhibits no such discordant results as the philological. In the series of chapters following an introductory explanation of grounds of dissent from Max Müller, Kuhn, and others of the same school, Mr. Lang selects typical illustrations showing survival of savage customs (therefore beliefs of which they are the outward and visible signs) in classic mysteries; of savage ideas about the heavens and earth corresponding to those in Greek myth; of savage beliefs in descent from animals surviving in Greek and other religions, and generally of the numerous analogues between the lower and the higher culture. Under this wise extension of the comparative method the myth of Cronus supplies excellent material, as our next paper will show.

SOME BOOKS ON OUR TABLE.

Economical Cookery for the Middle Classes. By Mrs. Addison. Third Edition. (London: Hodder & Stoughton, 1884.)—Mrs. Addison's little book is not only what it professes to be, a large collection of formulæ for cooking fish, meat, and *entrées*, and making soups and sweets at a small cost, but it possesses the not very common merit in cookery books of furnishing a considerable number of entirely new recipes. Our authoress would seem to have spent the greater part of her life abroad; hence Spanish, Portuguese, and even Cape dishes figure among them, for whose preparation she gives explicit directions. All seeking for some new thing in the shape of a flavour should lose no time in expending the extremely modest sum at which Mrs. Addison has appraised her very practical volume.

Shakespeare and Shorthand. By Matthias Levy. (London: Jas. Wade. 1884.)—This is an attempt to show that the corruptions of the text in the earliest copies of Shakespeare's Plays had their origin in the fact that such plays were produced from shorthand notes taken down from the mouths of the actors. Incidentally, a quantity of information is conveyed with reference to the history of stenography in England from the Tudor times downwards.

Wheeling Annual. (London: Harry Etherington. 1885)—Verily the "wheelman," be he bi-, tri-, quadri-, or omni cyclist, gets his money's-worth for his money in this "Annual." A historical *résumé* of cycling in 1884, and tables of amateur bicycling and tricycling records; similar ones of professional achievements; jokes, essays, conundrums, tales (thrilling and otherwise), acrostics, poems, and narratives of tours, are a few subjects selected absolutely at random from the bulky book lying before us. Presumably every cyclist in the kingdom will furnish himself with a copy.

Elementary Text Book of Zoology. General Part and Special Part. Protozoa to Insecta. By Dr. C. Claus. Translated and edited by Adam Sedgwick, M.A. and F. G. Heathcote, B.A. (London: W. Swan Sonnenschein & Co., 1884.)—It is not often that a work so entirely fulfils its expressed object as does that whose title heads this notice; for it would be hard to find a better introduction to practical zoology than it affords. The volume before us is the first of the two into which Dr. Claus's excellent treatise is divided. Should the second one, which has yet to appear in its English dress, only equal this instalment, the biological student will be furnished with a concise zoological cyclopædia which will leave but little to be desired indeed. The first 179 pages are devoted to an exposition of the nature of organised (and notably animal) life generally. It begins by explaining the difference between organised and unorganised substances; goes on to point out the salient distinctive features of plants and animals; and then, beginning with the individual cell, explains how by its aggregation every particle of the animal frame is built up. The correlation and connection of organs, and the structure and functions of compound ones are treated of in succession. Anatomical and physiological details are given with regard to the special organs of sense: the nature of Intelligence and Instinct discussed, and Reproduction, Development, the Alternation of Generation, Polymorphism, and Heterogamy dealt with. After this a historic *précis* of the various systems which have been devised from the time of Aristotle to that of Darwin and Lyell serves as an introduction to the modern system of classification, and the masterly and philosophical way in which the doctrine of descent is subsequently applied to it, must be read to be appreciated. Following the Introduction comes the special or descriptive part of the work; and this ranges from the Protozoa to the Insecta; from the amorphous lump of sarcode which constitutes the entire animal in some of the Rhizopoda, to the comparatively complicated anatomy of the hive-bee. Numerous typical examples in succession of the Protozoa, the Cœlenterata, the Echinodermata, the

Vermes, and the Arthropoda are described and illustrated with a mass of beautiful and artistic woodcuts, of which no less than 491 adorn the present instalment of the work. This volume is alike creditable to its author, translator, and publisher, who seem to have vied with each other in rendering it not only valuable but attractive.

A Bibliography, Guide, and Index to Climate. By Alexander Ramsay, F.G.S. (London: W. Swan Sonnenschein & Co. 1884.)—To the meteorologist who may wish to learn what has been written on the subject of climate, Mr. Ramsey's thick volume will be found to possess value, containing, as it does, a good deal of information. With reference to what has been denominated "Sunspottery," however, its author seems to have confined his search for authorities to a great extent to our contemporary *Nature*, and to have avoided or ignored any and every scientific periodical which has shown the fallacy of a hypothesis that has been vigorously advocated form merely interested and pecuniary motives. Any one confined to the list of the literature of this subject in the volume before us, might well conceive that the connection between sunspots and the weather has been irrefragably established, instead of being repudiated by the very Meteorological Department itself!

Scientific Romances. No. 1: What is the Fourth Dimension? By C. H. Hinton, B.A. (London: W. Swan Sonnenschein & Co. 1884.)—It was only on p. 449 that we reviewed the romance of "Flatland," and here, by a "coincidence" as odd as the majority of those which have recently appeared in our Correspondence columns, we have Mr. Hinton essaying a reply to the question, What is the Fourth Dimension? Prior to the perusal of his excellent little tract we should hardly have fancied it possible for the discussion of so purely an abstract geometrical question as this to have been made so really interesting as our author has contrived to make it. So far from being (as might, *à priori*, have been anticipated) dry or dull reading, Mr. Hinton's small pamphlet wili arrest the reader's attention at once, and we venture to predict that any one who, being impressed with the idea that space can only possibly possess the attributes of length, breadth, and height or thickness, will take that pamphlet up, will scarcely lay it down until he has read it to the last page.

First Lessons in English Grammar. By S. E. Guerini. (London: Wyman & Sons. 1884.)—If it be possible to make grammar pleasing and attractive to children, Mr. Guerini has certainly succeeded in doing so. The elementary rules are stated in a plain and simple manner, and the examples are precisely of the kind to arrest the learner's attention. Our author shows his wisdom in asking his pupils to parse such sentences as "this pig went to market," or "he put in his thumb, and pulled out a plum, and said what a good boy am I," rather than the long-winded phrases by which small incipient grammarians are usually scared from their subject.

We have, too, on our table, from Messrs. Cassell & Co., the *Book of Health*, to Part VIII. of which we would invite especial attention, containing, as it does, the beginning of a series of papers by Dr. Crichton Browne on "Education and the Nervous System." Some recent revelations in the matter of over-pressure in Board Schools confer notable interest upon Dr. Browne's essay just now. *Cassell's Popular Gardening*, *Cassell's Household Guide*, the *Countries of the World*, the *Franco-German War*, the *Library of English Literature*, and *European Butterflies and Moths.* Also the *American Naturalist*, *Ciel et Terre*, *Bradstreet's*, the *Journal of Botany* (with a life-like photograph and biography of the late George Bentham, F.R.S.), *Society*, the *Tricyclist*, and *Night and Morning*.

THE FACE OF THE SKY.

From December 19th, 1884, to January 2nd, 1885.

By F.R.A.S.

Low down as the Sun now is, and struggling through the haze of the winter horizon, he may yet be examined whenever it is sufficiently clear for spots and faculæ. The night sky will be found delineated in Map XII. of the "Stars in their Seasons." Mercury is an evening star, but is much too low down, even when on the meridian, to be fairly visible. Venus, slowly diminishing in lustre and getting into a worse and worse position for the observer, continues to be a morning star. Mars is invisible. Jupiter rises a little before 9h. 40m. to-night, and about 8h. 43m. p.m. on the 2nd of next January. Hence he is becoming visible during all the later part of the working hours of the night. He is almost due east of ρ Leonis. To-night, 12m. after midnight, his 1st Satellite will reappear from occultation, as will Satellite II., at 12h. 29m. p.m. On the 22nd the shadow of Satellite IV. will enter on to his disc at 11h. 40m. p.m. It will not pass off until half-past four o'clock the next morning. The next phenomenon happening at a convenient hour for the amateur is the eclipse of Satellite II. at 9h. 50m. 27s. p.m. on the 26th; but Jupiter will be very near the horizon. Later on the same night Satellite I. will be eclipsed at 10h. 39m. 8s. On the 27th the shadow of Satellite I. will leave Jupiter's disc at 10h. 10m.; the satellite casting it following it at 11h. 14m. p.m. On the 28th the egress of Satellite II. will happen at 9h. 34m. p.m.; but again Jupiter will be very low down. Afterwards Satellite III. will emerge from behind the body of the planet at 11h. 26m. p.m. Satellite IV. will reappear from occultation 29 minutes after midnight on the 31st. Finally, on the night of Jan. 2, 1885, Satellite II. will be eclipsed at 12h. 26m. 34s., and Satellite I. a little later, at 12h. 32m. 10s. Saturn is now visible all night long, and affords an all-repaying spectacle, alike to the observer with the moderate telescope and to the possessor of the largest and most powerful instrument. He continues to travel in a westerly direction away from ζ Tauri. Uranus is invisible. Neptune may be fished for in the blank region to the south-east of δ and ζ Arietis. The Moon enters her first quarter at 1h. 21m. 2s. in the afternoon of the 25th, and will be full at 26·3 minutes past 5 o'clock in the early morning of Jan. 1, 1885. Five occultations of stars will occur at convenient hours during the next fortnight. On the 23rd, B.A.C. 7986, a star of the 6th magnitude, will disappear at the Moon's dark limb at 7h. 52m. p.m., at a vertical angle of 131°; reappearing at her bright limb at 8h. 58m. p.m., at an angle from her vertex of 339°. On the 29th, 63 Tauri, a 6th mag. star, will disappear at the dark limb of the Moon at 8h. 34m. p.m., at an angle of 77° from her vertex. It will reappear from behind her bright limb at 9h. 15m. p.m., at a vertical angle of 287°. A little later the 6½th mag. star B.A.C. 1351 will disappear at the dark limb at 8h. 40m., at an angle of 46° from the vertex of the Moon, reappearing at her bright limb at 9h. 36m. p.m., at a vertical angle of 317°. On the 30th, 115 Tauri, of the 6th mag., will disappear at 8h. 27m. p.m., at the Moon's dark limb, at a vertical angle of 77°. It will reappear at her bright limb at 9h. 34m. p.m. at an angle of 245° from her vertex. Lastly, on January 2, 1885, B.A.C. 2872, a 6th mag. star, will disappear at the bright limb at 7h. 10m. p.m., at an angle from her vertex of 341°; reappearing at 7h. 36m. p.m. at her dark limb at a vertical angle of 283°. The Moon, which is in Sagittarius when our notes begin, passes into Capricornus at 8 o'clock to-morrow morning. This she quits at 4h. a.m. on the 21st for Aquarius, across which she is travelling until 6h. a.m. on the 24th, when she enters Pisces. It is 8h. a.m. on the 27th, when, having traversed this great constellation, she crosses into Aries, which she quits at 10 o'clock the next night for Taurus. Travelling through Taurus, she arrives at 6h. 30m. a.m. on the 31st, on the confines of the northern strip of Orion. She traverses this in between 10 and 11 hours, and emerges in Gemini. At 6h. a.m., on January 6, she leaves Gemini for Cancer, through which constellation she is still passing when our notes terminate.

We have received a copy of Messrs. King, Mendham, & Co.'s new and reduced price-list of electric apparatus, which is the largest, and probably the best, list ever published, treating exclusively of electric apparatus. In it will be found descriptions of batteries used, all kinds of experimental apparatus, including an improved pattern of the Wimshurst Influence Machine, and the firm's new and useful Standard Ohm Coil. Parts of apparatus for amateurs' use, and a revised wire table, giving the resistance and weight of copper and German silver wires, form special features of the Catalogue, as well as a section at the end giving information as to electrical terms, proper arrangement of batteries, and formulæ for winding bobbins, &c.

Miscellanea.

The Société Internationale des Electriciens has decided that an exhibition shall be held in January, 1885, on the occasion of its first general assembly, not only to bring into prominent notice new appliances up to date, but also to sum up the progress made by means of lectures given by eminent electricians.

Mr. Carpentier is reported to have stated, in a lecture delivered at the Victoria Coffee Hall, in the beginning of this month, that "Sun-spot maxima . . . . are accompanied by a maximum rainfall all over the world." He can hardly have read the report of the Astronomer Royal to the Board of Visitors of the Royal Observatory on June 12, 1884, before making so very questionable—not to say baseless—an assertion.

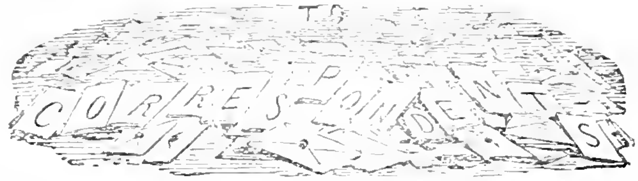
The organisation of the whole of the Paris pneumatic postal service is now completed. This great work, costing more than a million francs, and involving over 60,000 mètres length of pipes, was inaugurated by M. de Cochery. The charge for carrying a letter to any place within the fortifications has been fixed at 3d. The two extreme points in the service are about 11,000 mètres apart, and the time required for the delivery of a letter to the remotest place in the most unfavourable circumstances, and including its conveyance from the nearest station, will be within one hour.

Overhead Wires.—Sir Charles Dilke attended last week's meeting of the Chelsea Vestry, of which he is a member, and authorised a statement to be made with reference to overhead wires. The vestry of St. George's (Hanover-square) had addressed to the Local Government Board a memorial urging that Board to bring the erection and maintenance of overhead wires under due control by some adequate local authority, and expressed the hope that Chelsea would concur with them in the matter and adopt a similar course. Sir Charles gave the Hon. Conrad Dillon permission to mention that the Local Government Board were pledged to move for a committee on the subject of overhead wires, and it was hoped that on the report of that committee a bill would be brought in by the Government early next session.

Criminal Plumbing.—The trial of Thomas C. Holland, plumber, of this city (New York), for criminally negligent work, was held before Special Sessions, November 6, and resulted in the imposition of a fine of 250 dols. In default of payment Holland was sent to prison. Dummy vent-pipes from washbasin traps had been run into partitions and there terminated. The ends of these vents had been roughly battered together, but were, of course, not tight, and allowed foul air to escape into the partitions. The whole arrangement was designed simply to deceive the Board of Health inspectors; and, to assist in carrying out the deception, a dummy terminal-pipe, supposed to be the end of a ventilating pipe, was fastened to the roof. The dummy had no connection with any *bonâ-fide* pipes inside the house.—*Scientific American.*

International Inventions Exhibition.—It is stated that the applications for space have now all been examined by sub-committees of the Council, and a selection has been made of the most promising. The number of applications has been so great that it has been decided to limit very strictly the admissions in those classes which may be considered to have been fully represented in the Exhibitions of the present and past year. The Council will, therefore, be obliged to refuse many valuable exhibits in such classes as those relating to food, clothing, and building construction. It will even be a difficult matter to accommodate those which have been selected, and it is feared that the list will have to be still further reduced. As soon as possible information will be sent to those who have applied for space; but the enormous number of applications, far in excess of what was expected, have made it impossible to do this up to the present. The guarantee fund now amounts to £48,280, a sum considerably in excess of that subscribed for the Health Exhibition, or for the Fisheries, the amount for the former being £26,518, and that for the latter £26,656.

Mr. A. Tylor read a paper before the Linnæan Society on Dec. 4, "On the Growth of Trees and Protoplasmic Continuity," his chief object being to show the principles that underlie the individuality of plants, and to prove that plants have a dim sort of intelligence, and are not merely an aggregation of tissues responsive to the direct influence of light. Not only this, but that the tree as a whole knows more than its branches, just as the species knows more than the individual, and the community than the unit. The result of Mr. Tylor's experiments, which have extended over many years, has been to show that many plants and trees can adapt themselves to unfamiliar circumstances, such as avoiding obstacles artificially placed in their way, by bending aside before touching, or by altering the leaf arrangement so that, at least, as much voluntary power must be accorded to such plants as to certain lowly-organised animals. Finally, Mr. Tylor contends that a connecting system, by means of which combined movements take place, is to be found in the threads of protoplasm which unite the various cells, and that this connecting system is found even in the new wood of trees. He has observed that most new wood points upwards, but year after year it changes its position, showing great mobility even in old wood.



"Let Knowledge grow from more to more."—Alfred Tennyson.

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.

IS TEA INJURIOUS?

[1537]—Instead of three weeks only, as suggested by Professor Williams (for which I beg to tender him thanks), I have abstained three months. Without filling up your valuable space with details, suffice it to say that I find myself so much better without this beverage, that I have resolved never again to return to my "first love;" this in spite of my former strong attachment.

Mr. Liddle's [1524] facts are hardly convincing, for who has not heard of old folks who have been habitual "tipplers" all their lives? Cocoa, when only taken occasionally, has a tendency to cause biliousness, but soon loses this effect when used frequently.

A. Gaubert.

WINE, TEA, &c.

[1538]—Doubtless your correspondent's grandmother ("J. Liddle," p. 471) and millions of other people's grandmothers, as well as ten times the number of healthy men and women all over the world, have, during the greater part of their lives, consumed tea and coffee and wine and beer with impunity—and with advantage. But nowadays, because there is, here and there, a wretched being who has no command over his own appetite, who never knows when he has had enough, all these millions are to discontinue—forsooth! the use of everything that is pleasant to the taste, as if the human body was a mere machine, to be kept going with the smallest possible quantity of the cheapest fuel that can be found. It is not as if excess and drunkenness were on the increase—the reverse is the fact; our forefathers undoubtedly drank to excess; but such a thing as a gentleman the worse for liquor is a sight almost unknown at the present time, and those who assert that drunkenness is on the increase among the lower orders forget that this impression is probably produced by the facilities afforded by the telegraph and cheap newspapers of knowing things which, forty years since, were unheard of beyond their immediate localities. I have often been struck with this fact in noticing the large number of deaths from lightning that we read of in late years. It is not that lightning has now a habit of striking people more frequently than formerly, but, in old times, the news of such occurrences never reached us.

In Australia especially, the common drink of the settlers is tea, of which they consume immense quantities, and in the most objectionable form (*i.e.*, without milk), yet we never hear of any ill-effects of tea-drinking among the colonists.

Now if the faddists—who, for some inscrutable reason, prefer water which has generally come through miles of pipes, and is loaded with all sorts of impurities—would blow off their superfluous steam in endeavouring to get the adulteration laws properly carried out, they would do some good to their kind. Our forefathers, who survived their hard drinking, did so because they had pure liquor. There is the great secret. There is one comforting reflection, that these people, who wish to regulate our diet on the principle of the fox who had lost his tail, disagree among themselves to that extent that sane people may safely take the average of their ideas as their guide, and they will find that the best thing to do is to eat and drink what they like, without taking too much of anything. Cornaro, who is the model of moderate people, consumed as much as he felt he wanted of soup, bread, eggs, &c., and fourteen ounces of wine daily. We can't do better than follow his example, especially with regard to the &c. A friend of mine not long since entertained for a day or two a couple of gentlemen of the total abstinence persuasion. They were lecturing in an adjacent town. At dinner my friend, who was not a teetotaller, consumed one glass of claret with water; the total abstainers put within them during that meal—one, six large cups of strong coffee, the other, seven of tea! ! ! Let me ask Mr. Mattieu Williams which of these would (*cæteris paribus*) be considered the healthiest lives if they applied at a life assurance office, my friend of the glass of claret or the abstainers with the tea and coffee? Mr. M. Williams deserves our thanks for instructing us in the art of detecting adulterations, but in the matter of cutting off one by one every article of food or drink that is pleasant to the palate, I do—and I am sure also will many of your readers—implore him to "draw it mild." B. M., F.R.C.S.

VEGETABLES v. MEAT.

[1539]—In the September number of Knowledge, Mr. W. Mattieu Williams alludes to a retired colonel, aged eighty-two, who dwelt fifty-two years consecutively in India, and was a vegetarian. Now, I want to know where—oh, where did the aforesaid gentleman live, that he was able to procure vegetables all the year round? Not in Nagpur, surely! unless he was content to subsist on Irish peasant diet, and partake of potatoes and milk.

And such potatoes! Why one would be ashamed to offer them to pigs in Ireland.

During the six hottest months of this year our pretty wooded station here, so far as thermometer readings went, kept ahead of the rest of India, except on a few occasions when Jacobabad in Sind shot in front of us with a rash spurt, and wildly registered (if I remember rightly) from 113° to 117° in the shade. Now while this hot weather lasted, the members of our household ate meat three times a day, had ravenous appetites and enjoyed glorious health. We had no vegetables, barring the afore-mentioned apology for the potato, and, honestly, we were none the worse for the want though occasionally, I must admit, we had hungry longings for something green, and moist, and cooling, such as a fresh salad from Covent Garden Market, or a dish of marrowfat peas—nay, even a cabbage from a coster's barrow in the New Cut would not have been despised; but it was Hobson's choice with us, and we had to go without.

Granting, as we all must, the wholesome and refreshing qualities of vegetables as *part* of our daily dietary, might I suggest to Mr. Williams the possibility of there being persons, even in a tropical clime, who are all the better for partaking of a fair share of meat at their meals?

Short as has been my stay in this country—a little over nine months—I could not help noticing how much the Hindoos—a pulse, grain, and vegetable-eating race—seem wanting in backbone in comparison with the flesh-eating Mohammedans.

When Mr. Williams spoke so slightingly of "condiments," surely he must have had his memory or his palate full of the delicious nutty flavour of a roast shoulder of Southdown mutton, or of the succulent juices of a prime piece of Scotch beef—luxuries, alas! quite unknown to us benighted Nagpurites. What would he say to mutton tasting like the flesh of a sick goat, and beef with no more sap in it than mahogany chips!

I, for one, though no craver after spices or condiments, am grateful to our clever Indian cooks, who by their aid (in moderation, be it said) can make palatable and inviting dishes out of food that would be otherwise all but uneatable.

L. O'Shea Dillon.

Nagpur, Central Provinces, India, Nov. 19, 1884.

NOAH'S RAINBOW.

[1540]—The negroes whom I remembered as ignorant of this meteor were in or near Spanish-town, the tenth year from emancipation, and all were ex-slaves, and some (perhaps all) of African birth. Soon after writing, I found that Sir Hans Sloane, in his account of Jamaica, considered it a country rather more favourable than others to rainbow production. Of course, they are common in that latitude at sea (not, indeed, at hours like 2.15, wherein most rain-squalls break, but with any exceptionally early or late daylight ones), and Port Royal may practically be called a sea islet, being never approached along the eight or ten miles of narrow sandspit that alone connects it with land.

The whole matter was shown, in your number of June 27, to have no bearing on Noah's story whatever; as we see there are readers to whom (as to H. Rowntree) Genesis never suggested the idea of the rainbow having been new to either the world or Noah. Our teachers in childhood made us think it so; but might, with just as much, or as little, ground, have said thorns have only grown since Cain's sentence, or donkeys have only had a cross on their back (as some Catholics have been taught) since the crucifixion, or that the ram Abraham found in the thicket was the first he ever saw. My negroes, who knew not what a "bow in the cloud" meant, supposed some sort of lightning; and, of course, a "token of the covenant" might have been made of that, or of anything accompanying storms, however familiar before.

The point I argued was the entire naturalness and correspondence of Noah's story with extant facts; and should have proceeded to another, if allowed—the manifold incompatibility of the Lyellian pseudo-geology with them, both when hatched forty years ago and ever increasingly since. E. L. Garbett.

[What Mr. Garbett patronisingly calls "the Lyellian pseudo-geology" will have to be attacked by much stronger and more philosophical arguments than ever Mr. G. has himself employed, if it is to be shaken in the least.—Ed.]

RETINAL IMAGES—THE DUALITY OF THE BRAIN.

[1541]—Will you, or some of your correspondents, kindly furnish me with an explanation of the following peculiar sensations, which I have often experienced?

When I first awake in a morning it often happens that on opening my eyes I see very vividly a network of black lines, something like the branches of a river, or thus:—

By shutting my eyes again, and re-opening them, I am enabled to see the figure six or seven times. Undoubtedly it has something to do with the fibres of the optic nerve, but why I am able to see it at certain times I cannot imagine.

I should mention that I sleep facing the windows, and with the blinds usually drawn up.

Anent your articles on "Our Two Brains," I may mention a curious example of what I consider to be the separate workings of the two brains. Sitting in an easy chair before the fire on Thursday last, I fell asleep, and, as is my custom when asleep, I dreamed. The scene of the dream lay near a wood, and I perfectly remember a footbridge over a stream which I was about to cross. Awakening, I gradually approached consciousness—and, indeed, was so far conscious as to say to myself, "It is a dream," and still I saw the footbridge before me, and at the very same time, and apparently for a few seconds, I knew that I was sitting in my chair, and had the fire before me. The two scenes were present together, my eyes were still shut, the bridge was there, and yet I knew the fire was there also. I struggled to awake, which I soon did, but could not forget the curious sensation. It seemed as though the two brains for the time being refused to coalesce.

The "sentiment of pre-existence" I have often experienced from my earliest days, and used in vain to strive to recollect where the event had really happened to me before; and I endorse what you say, that the scenes are often those which could not have appeared to us at any previous time. W. W. S.

[What our correspondent sees is *not* the fibres of the optic nerve, but the shadows of the blood-vessels of the retina ("Purkinje's figures," as they are called), *vide* p. 189 of the current volume of Knowledge.—Ed.]

LETTERS RECEIVED AND SHORT ANSWERS.

James Cram. Very many thanks; but, as far as an overwhelming majority of our readers are concerned, the interest of the subject is exhausted.—Naturalist. An instant's reflection will show you that if we compare the aspect of any celestial body viewed at the Cape, it must appear inverted as seen from a British station. At Greenwich, the "Metropolitan crater" of the moon, Tycho, appears at the bottom of the moon; at Cape Town, it is seen at the *top*. Hence your difficulty.—J. Farrar. A girdle: the belly-band of a saddle.—R. McMillan. The "professor's" astro-meteorological system is utter, hopeless rubbish, and any time spent in reading his exposition of it merely wasted. The gentleman to whom you refer does own a place in Missouri.—R. A. Peacock. "Saturated Electric Steam" a little beyond us.—Anonymous (H. J. Browne?). These columns are not a refuge for destitute essays; nor can Knowledge print papers which have been refused by learned societies, either here or at the Antipodes.—T. J. Barnardo. "Night and Day" are only dealt with in their astronomical relations in these columns.—F. G. As far as I can comprehend your requirements, Goodeve's "Principles of Mechanics," and his "Elements of Mechanism," and Sir J. Anderson's "Strength of Materials and Structures"—all published in Longmans' "Text-books of Science," —might to suit you. In fiction, read all Dickens's works, and those of Charlotte Brontë, and "George Eliot."—M.D. I have not read the work from which you quote, but, quite obviously, we can simultaneously experience many sensations. A reply to the second part of your query will best take the form of an illustration. I am conscious of the optical sensation of a flickering light, of the tactile one of warmth, of the aural one of a slight roaring sound, and the sum of these states of consciousness make up my concept of a fire burning in the grate by my side.—P. Macleod Yearsley. I myself literally no more believe in the existence of ghosts than I do in that of the phœnix, or the hippogriff. Whether any of our readers may have reason (good, bad, or indifferent) for being more credulous I do not know. Several (second or third-hand) ghostly experiences have already been recorded in these columns.—W. A. Cooper. A map of the Moon appears on p. 223 of Vol. III. of Knowledge.—F. W. Bellamy. England is not a bran-new country in process of colonisation; and I am firmly convinced that the plan you advocate would be attended with the worst results. *If* all men were secured absolutely against want, and *if* every one possessed a cultivated intellect of the highest order, a Republic might quite conceivably exist without the glaring and deplorable abuses which at present appear inseparable (in practice) from that form of Government. It will be time enough "to solve your problem" when "the highest state of civilisation" has been attained.—J. Murray. You must not be angry with me if I fail to grasp the idea that bodies "would move from the up to the down by the only motion Nature has, and that is Time." Nor, if I fail to form a definite conception of your notion, "If our earth is passing through the deluge of solar time, how easy it is to understand if it were passed through the rest of the way in a sudden sort of way." I am in the same predicament, too, in connection with your hypothesis concerning "the Earth's motion towards the Sun, which it reduces every lap of its orbit itself and every other thing by the gain of one-quarter day every year, which is the cause of such a winter now, and such winters about ten thousand years ago, when temperature was about ten times as strong." You see, when I come across such passages as these, I am myself apt to "pass through the rest of" a letter "in a sudden sort of way."—Istoria. The earth rotates on her axis, in twenty-four hours, from west to east. Suppose that the mean sun is on the meridian of Greenwich; then it will have been due south at every place 15°, or one hour, east of the prime meridian one hour previously; in other words, it will be 1 p.m. at all such places. Similarly, one hour west of Greenwich it will be 11 a.m. Mark the result. It is noon on Dec. 19 at Greenwich. Now let us travel eastward. It is 1 p.m. (or thereabouts) at Stettin, 2 p.m. at St. Petersburg, 3 p.m. at Aden, 4 p.m. in the Aral Sea, 5 p.m. at Baikul, and so on, to 12 p.m., or midnight, of Dec. 19, in the Friendly Islands, through which the 180th meridian passes. Let us now, though, travel round the earth in a westerly direction. One hour west of Greenwich it is 11 a.m.; two hours, 10 a.m., at Cape Breton, 8 a.m.; at Philadelphia, 7 a.m.; at New Orleans, 6 a.m. (all be it noted in the early morning of the 19th), so that by the time we reach our 180th meridian in this direction it is midnight on *Dec.* 18. Hence the navigator's change of date. In answer to your second query, No. Only torpid.—Curious. Purely a medical question, to be decided by personal examination.—H. S. Dove. A 6-inch reflecting telescope would be very much more effective than a 3-inch refractor; but the reflector would cost about £30, and the achromatic £15.—Edward Brown. I regret my inability to present you with the works you ask for. Mechanics' Institutions, Workmen's Clubs, and now, in your case, a Bible-class, from time to time appeal for gifts of books by the conductor of this journal. Such have hitherto invariably been refused, and I regret that no exception can be made in your case.—T. Hurtley & Son. Delayed through being addressed to the Editor instead of to the Publishers.—F. S. Donaldson. I know nothing of the date of Charles Wesley's birth, beyond the fact of its having occurred in the year 1708.—Science Teacher asks for the address of Professor David Hughes, the inventor of the microphone, &c.—Dr. E. W. Prevost. Thanks, but its length excludes your contribution in the present crowded state of our columns.—A. M. Trübner & Co., London.—C. B. Arding and D. Pitcairn. Was unfortunately unable to avail myself of it.—T. May. I can only feel gratified at your appreciation of it.

The *Engineer* notes that about 1 per cent. of all the gas used in New York, or about 55 millions of cubic feet annually, is used in thirty of the largest theatres. This, at 8s. per thousand, ought to offer electricity a fine field.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

SANITARY TRAPS.

"Traps," as is well known, are often insanitary in a very serious sense indeed. Mr. William Henman, of 38, Bennett's Hill, Birmingham, has invented what seem to be decided improvements in sanitary traps. In this invention the outer arm of the trap is elongated, funnel-shaped, and made in one piece, with, or attached to, a length of vertical pipe, so that no "lodgment" is allowed for sewer-gas. There are, moreover, no "made" joints, and thence great security is obtained against the admission of sewer-gas into a building. The traps may be of any suitable size, and be made of iron, earthenware, or any suitable material.

LACTO-GLYCOSE.

Mr. G. Mellin, of the Marlborough Works, Stafford-street, Peckham, London, S.E., is the inventor and manufacturer of what is claimed to be a very remarkable milk food for infants and children. One of the features of this preparation appears to be the entire absence of all farinaceous properties which do not conduce, contrary to some popular teaching, to infants' health. Starchy foods, indeed, are not good for children, and the closer the approximation to milk itself the better. Mellin's Lacto-Glycose, may be, indeed, looked upon, when dissolved in water, as a solution of Mellin's food in cow's milk, with this difference—that the peculiar organisation of the caseine in the cow's milk has been destroyed simply by mechanical means, viz., by the prolonged stirring and trituration of the cow's milk with Mellin's food during the process of evaporation at a low temperature. The milk is obtained from the best country sources, and as large quantities are always manipulated, a certain average milk is obtained, which is, no doubt, more stable in composition than milk from one cow, so often recommended. It can easily be inferred how well adapted this form of food must be for hot climates, where milk is generally more or less in a state of decomposition, or on board ship, where good milk cannot be obtained for the feeding of infants.

AN AUTOMATIC BOLT AND AN UNPICKABLE DOOR-LOCK.

What is known as Hancock's Patent Invisible Automatic Bolt and Unpickable Door-lock is an invention having for its object improvements in fastenings for street and other doors and windows, and other similar openings. In this invention there are three long bolts, radiating from the centre to the circumference of the door. One of these bolts, which may be called the main bolt, is placed in a horizontal line with the lock of the door, and the other two bolts are placed perpendicularly—one fastening into the centre of the frame at the top, and the other into the plate beneath. The handle is fixed in the centre of the door, from which the bolts are worked by means of a cog-wheel placed upon the spindle of the handle, and acting upon a rack upon each of the several bolts. A slot cut into each bolt, and which works backwards or forwards upon a stud, holds the bolt firmly in gear against the cog-wheel. The mechanism being inside the panels of the door, is out of sight, and the handle itself, which is secured to a disc, can, if necessary (together with the spindle and cog-wheel), easily be removed.

Should it be considered desirable to retain the usual lock in addition to Hancock's invention, an important feature in this appliance consists of a slotted plate upon the main horizontal bolt, which plate, being shot over the ordinary keyhole, renders the lock unpickable. By turning a small key in the disc of the handle, all the bolts can be thrown into or out of gear with the central cog-wheel, which in turn forms also a rachet-wheel, to which a catch, held in position by a spring, is attached, thereby holding the bolts rigidly in position until released by means of a proper key.

For asylums and other public institutions, theatres, banks, strong-rooms, offices and warehouses, as well as the doors of private houses, the cabins of ships and yachts, and, indeed, for all purposes where absolute security and safety are required, this invention is obviously of the highest consequence, and will doubtless command the attention its importance deserves. It is also applicable to existing doors, and being exceedingly simple in construction is not likely, we think, to get easily out of order.

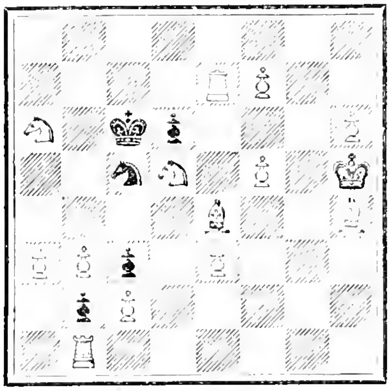
Our Chess Column.

By Mephisto.

PROBLEM No. 141.

By C. Planck.

Black.



White.

White to play and mate in three moves.

SOLUTION.

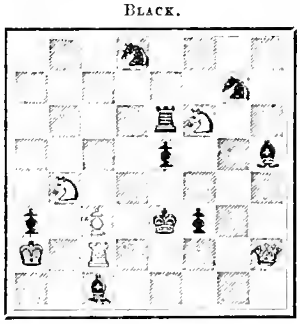
Puzzle No. 140.

Black's last move might have been P (Q2) to Q4. White plays 1. P × P en passant, discovering check, and mate next move.

Whitby, December 7, 1884.

Dear Sir,—My problem referred to by your correspondent in this week's Knowledge was originally published in the *Illustrated London News* for Dec. 30, 1854. It was, as far as I know, and as your correspondent says, the first problem in which the R makes way for the Q. In my problem the R is moved twice before the ch with the Q takes place. Four move problems were more in vogue thirty years ago than they are at the present time. The problem, unfortunately, admitted of another solution, in four moves. Mr. Staunton, who was at that time Chess Editor of the *Illustrated London News*, and who frequently took the law into his own hands with regard to young composers, preferred the "cook" to the original solution, and published it instead of mine. I remember about that time Mr. S. writing to me and also to J. B., of Bridport, stating that the proprietors of the *Illustrated London News* objected to our sending problems to what Mr. S. called the "small fry," alluding to "Cassell's Penny Illustrated Paper," "Home Circle," &c. Although our names did not appear in those journals, for some time after that we used to contribute for some time under the nom-de-plume of "Domino," J. B., and "Modestus" myself.

Black.



White.

(Corrected as a three mover).

I was always a great admirer of Mr. Healy's clever and world-famed Bristol problem, but it appears that as far as ideas in Chess problems are concerned, there is "nothing new under the sun.

N. Grimshaw.

THE EVANS GAMBIT.

We have firstly shown that, by declining the Evans, Black has a safe game. Then we have given Black's reply of 5. B to B4, although in the after-play White has an attack, Black ought to be able to defend his game, and he has a Pawn more. There would, therefore, really be no necessity of going into Black's reply of 5. B to R4, as we think it is of more importance to master the principle of the *best* lines of play in each opening, than to know every principal variation in an opening.

But having given a few specimens of the Compromised Defence, we shall give a few more variations arising from 5. B to R4. 1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. B to B4. B to B4. 4. P to QKt4, B × P. 5. P to B3, B to R4. White can avoid the Compromised Defence by playing

6. Castles	P to Q3
7. P to Q4	P × P
8. P × P	B to Kt3

and we have the same position treated before, and arising from the defence of 5. B to B4. Instead of 8. P × P; White may also play

8. Q to Kt3	Q to B3

which gives White a good attack by either P × P or P to K5, but Black would have done better to play 8. Kt to R4 instead of Q to B3

9. P to K5	P × P
10. R to K sq.	

and White has a strong game, for if now 10. KKt to K2, then 11. B to KKt5, Q to Kt3. 12. B × Kt, Kt × B. 13. Kt × P and White ought to win; or

	Kt to R3
11. B to Kt5	Q to B4
12. Q to R3	

with a fine game. It is, therefore, best to avoid this attacking variation when playing on the defensive.

The following is also an interesting variation in the Opening, when in reply to 6. Castles, Black plays

6. Castles	Kt to B3
7. P to Q4	Castles
8. Kt × P	Kt × Kt *(a)*
9. P × Kt	Kt × P
10. Q to Q5	B × P
11. Kt × B	Kt × Kt
12. Q to B3	

and White will have a good game by playing B to R3.

(*a*) If, instead of 8. Kt × Kt, Black plays 8. Kt × P then follows:

8.	Kt × KP
9. B to Q5	Kt × QBP
10. Kt × BP!	R × Kt

(If Q to K2. 11. Kt × Kt followed on B × Kt by 12. B to KKt5.)

11. B × R (ch)	K × B

12. Q to Kt3 (ch) with the better game.

Contents of No. 163.

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CONTENTS OF No. 165.

COMETS AND METEORS.

By RICHARD A. PROCTOR.

THERE is a marked contrast between our present knowledge respecting meteors and that which astronomers possessed before 1866, when Professor Newton, of Yale College, announced that the earth would pass through a rich part of a certain meteor-system on the night of the 13th-14th November, 1866. I am not here referring to the recognition of the nature of meteors as extra-terrestrial bodies. Too often the credit of this recognition is assigned to the astronomers who, during the last quarter of a century, have done so much to advance our knowledge beyond that point. But, in reality, Professor Olmsted, of Newhaven, Conn., had proved conclusively that meteors are non-telluric bodies, long before the modern school of meteoric astronomers had entered on their labours, and to him the whole credit of that part of the work of research must be assigned. His reasoning was perfectly demonstrative, though he did not succeed in convincing many of his contemporaries, or even in attracting their attention in any marked degree. Many in his day followed a custom which is common enough now, and regarded as suggestive of eminent caution and scientific prudence. Carefully avoiding any real expression of opinion, they remarked safely that "Prof. Olmsted's reasoning was worthy of careful consideration, though we are far from admitting that the startling theory to which his reasoning seems to point is a sound one: possibly the facts on which he insists may be explained in some other way." That theory had, however, been in reality demonstrated; and it now forms part of the basis on which meteoric astronomy stands.

An outline of his reasoning can be easily and briefly presented:—The 10th-11th of August and the 13th-14th of November are days on which meteor-showers may be looked for. But a particular day in the year is the time when the earth reaches a particular part of her orbit. Therefore certain parts of our earth's track are, as it were, infested by meteors. Now there is no possible way in which this can be brought about but by the passage of meteors, in flights or systems, across the track of the earth at those particular places. In the striking words of Alexander Humboldt, who (though he was never much of an astronomer) was keen-sighted enough to see the force of Olmsted's reasoning, which many astronomers overlooked, "the meteors before their encounter with our earth may be described as 'pocket planets.'"

The argument needed no clinching, but Olmsted clinched it. He gave another demonstration as perfect as the one he had already supplied:—The falling stars seen during a great display seem to radiate at any given time from a fixed point; just as parallel lines are foreshortened in perspective to a series of lines radiating from a point. Therefore the tracks of the meteors are parallel. But the point from which the tracks of shooting stars seem to radiate shifts its position from hour to hour with respect to the horizon and the cardinal points. It *moves with the stars* and remains stationary *among them.* Therefore the meteors had been travelling on parallel paths before reaching our atmosphere, and the fiery tracks left by them as they rush through the air form a set of parallel lines differently situated in the air as the earth rotates into different positions, but directed always to the same point on the remote concave of the celestial sphere.

As a piece of pure reasoning, educing from observed facts their full and true significance, nothing can be more perfect than Olmsted's argument; the credit of the achievement should not be lightly assigned to others because many careless professional astronomers of Olmsted's day failed to realise the force of his reasoning, or even to pay any attention to it.

Professor Newton's prediction of the display of November 13-14, 1866, started a new series of inquiries. It has always struck me that that prediction was one of the boldest ever made, and (considering the uncertainty which still hangs over all the problems of meteoric astronomy) one of the most fortunate. We know now that the meteors about which he spoke had been $33\frac{1}{4}$ years on their course, which carries them far outside the orbit of Uranus, or twenty times our distance from the sun: but in 1866 not even this was known. Professor Newton had a choice of no less than five paths to account for what was then known about the November meteors; and of all the five the true path seemed to him the least probable. Yet he ventured to predict the time of the earth's transit through the meteor-cloud for the morning hours of November 14, 1866, in the Eastern States of America, and he was not wrong by more than about a quarter of a day, the actual display of falling stars occurring in the morning hours of the 14th in Europe, and being over by the time that the eastern seaboard of America had swung round to the side on which the meteors had been falling. American observers were disappointed so far as the expected shower of falling stars was concerned; but American astronomers had every reason to be proud of the success of their calculations.

Science owes to Professor Adams, of Cambridge, the demonstration of the real path of the Leonids, as the November meteors are called (because they seem to radiate from a point in the constellation Leo). By as pretty a piece of mathematical work as has ever been done, he showed that the slight change of position which has been observed during the last few centuries in the crossing-place of the earth and meteors, can only be reconciled with a long oval orbit, $33\frac{1}{4}$ years in period, which carries the meteors within the disturbing influences of Jupiter, Saturn, and Uranus. Thus the average interval of rather more than 33 years between the great displays of November meteors, is to be explained by the existence of a rich portion—the "gem of the meteor-ring" it has been prettily called—which returns to the neighbourhood of the earth's orbit once in rather more than 33 years, or about thrice in a century. Then came the singular coincidence by which a comet—discovered in that very year 1866—was found to travel in precisely the same orbit which had thus been assigned to the meteor-system. Already astronomers had suspected the existence of a connection of some sort between comets and meteors. Schiaparelli had shown that if the August meteors follow in the track of the conspicuous comet of 1862, which passed very near the part of her orbit traversed by the earth on Aug. 10, their paths would seem to radiate, as they actually do, from a point in the constellation Perseus. But this might have been a mere coincidence. The agreement between the *paths* of the November meteor-system and Tempel's comet (Comet I., 1866) was a very different matter. If the garrison in a beleaguered city found several cannon-balls falling on the same place and from the same direction, they might guess that these had all come from the same gun—but they could not be certain. If, however, they could determine the exact trajectories of two of these bodies, and found them exactly alike, they could no longer doubt that the same cannon had projected them. Now the exact paths of the November meteor-system and of Tempel's comet have been determined, and are found to be the same (within the narrow limits of errors of observation): no doubt then can exist that the meteors and the comet have had the same origin. The same has since been shown in the case of other comets and other meteor-systems.

It has been customary to repeat Schiaparelli's explanation of this peculiarity,—that a flight of meteoric bodies approaching the solar system after a journey from interstellar space, had chanced to approach so near one of the giant planets as to be diverted from its original course to an elliptical path around the sun, the path always thereafter intersecting the orbit of the disturbing planet. Slight differences in the velocities thus assigned to the meteors would account, said Schiaparelli, for the gradual trailing of many of the meteors behind the main body. This main body would be the comet, the laggards would be the meteoric train (this train being entirely distinct it will be understood from the comet's tail, indeed Tempel's comet had no tail worth mentioning). Schiaparelli's theory was accepted by some astronomers well able to have examined it effectively, without sufficient inquiry. For it is in truth altogether untenable. It can be shown in the first place that a meteor-flight would have to approach a planet much more closely than is at all likely, to have its path changed in the necessary degree. But what is more important, it can be shown that if a meteor-flight did approach a planet thus closely its various members would be very differently affected, and so would be spread into a scattered, widely-ranging flight altogether unlike the existent meteor-streams. There is curious evidence, I may remark in passing, of the carelessness with which Schiaparelli's explanation was accepted. Even astronomers of repute have repeated the statement that those meteors which were most delayed as the flight passed the disturbing planet would lag behind the rest. As a matter of fact those which were least delayed would be the laggards, paradoxical though it may sound to say so. If our earth were checked in her course so as to lose a considerable part of her velocity she would complete her next circuit round the sun in a much shorter period (it would of course be much diminished in extent), *i.e.*, she would return ahead of time: but if she were hastened in her course she would be much longer in completing her next circuit. Nay, if the earth's actual velocity of about 18 miles per second were increased to 25½ miles per second she would never complete another circuit, the range of her path being increased *infinitely*. So with the meteors of Schiaperelli's imagined flights, those most delayed would come back soonest to the place where they had been disturbed, and be ahead of their fellows.

But we need not consider minor flaws in a theory which is in truth entirely untenable.

To replace this unquestionably erroneous theory respecting the common origin of comets and meteors by a true one, would not be easy. The probability is that we have to look back into depths of time so remote that we can hope for no clear view of the processes by which comets and meteors came into existence. I must confess I see little hope in that outlook into interstellar space to which Schiaparelli, Hoek, and others have invited us. It seems to me far more likely that comets and meteors have, for the most part, belonged to our system since it began to be, than that they have been gathered in from that vast unknown region which separates our sun from his fellows. I imagine that comets and meteors are either the "fragments that remain" from the vast mass of nebulous matter or cosmic dust out of which the solar system was gradually formed,—or else they had their origin from the various orbs forming that system when as yet those orbs were in the sunlike state. Only one member of the solar system is now in that state—the sun himself; though the giant planets retain more sunlike characteristics than many imagine. Now the sun does unquestionably eject matter from his interior from time to time, with velocities sufficing to carry such matter for ever away from him: he has been caught in the act. Again, the microscopic examination and the chemical analysis of certain meteors have agreed in showing that these bodies were once aggregations of liquid globules in a hydrogen atmosphere of considerable density—or, as Sorby the mineralogist and Graham the chemist agree in putting the matter these bodies once existed under conditions such as belong only to sunlike bodies. If the sun still gives birth to meteor-flights, one can see no reason why the giant planets, *when they were suns*, should not have done likewise: but, on the contrary, strong reason to believe they would have done so. The comet families of the giant families travel on orbits indicating such an origin, and a flight of meteoric bodies ejected from Uranus millions of years ago, would travel on precisely such an orbit as that of the November meteors. Such seems to me the most reasonable interpretation of the facts, and the one most consonant with all the evidence we have.

RAMBLES WITH A HAMMER.

OVER CHARNWOOD FOREST.

By W. Jerome Harrison, F.G.S.

CHARNWOOD FOREST! How many of my readers know the place? Perhaps there are some who do not even recognise the name. And yet Charnwood occupies thirty square miles in the very heart of England. Look for it in the north-west corner of Leicestershire. There lies the craggy region of old rocks—between Leicester and Loughborough on the east and Ashby-de-la-Zouch on the west, with the Trent running along its northern base—which it is my purpose now to describe. The very name tells us of the nature of the district—"Quern-wood," the wood whence hard stones suitable for the querns or old hand-mills in which corn was ground could be obtained. The hard stone is there still, but the trees are nearly all gone. In Bradgate Park the picturesque, stunted, bossy oaks still flourish, but, as for the rest of the "forest," the fatal Enclosure Act, which came into operation in 1829, has destroyed much of its wildness and beauty. Attempts have almost everywhere been made to cultivate the poor, thin, stony soil, with the result that, while nature has been spoiled, man has gathered but a scanty reward for his toil.

It is probable that, if our grandfathers could have foreseen that spread of a love for the study of nature among all classes which now exists, together with the great increase in the wealth and population of this country, instead of "enclosing" and "disafforesting" Charnwood, they would have retained it as a national park, have planted it and cared for it, and preserved it as a safe refuge for all that is wild and free in the native fauna and flora of our country. Charnwood is encircled by railways. On the east the Midland main-line runs from Trent to Leicester; and, by getting out at either Sileby (six miles north of Leicester), Barrow-on-Soar (noted for its lower lias limestone), or Loughborough, we shall find ourselves within a moderate walk (two or three miles) of the area in which the old rocks rise to the surface. (Fig. I.)

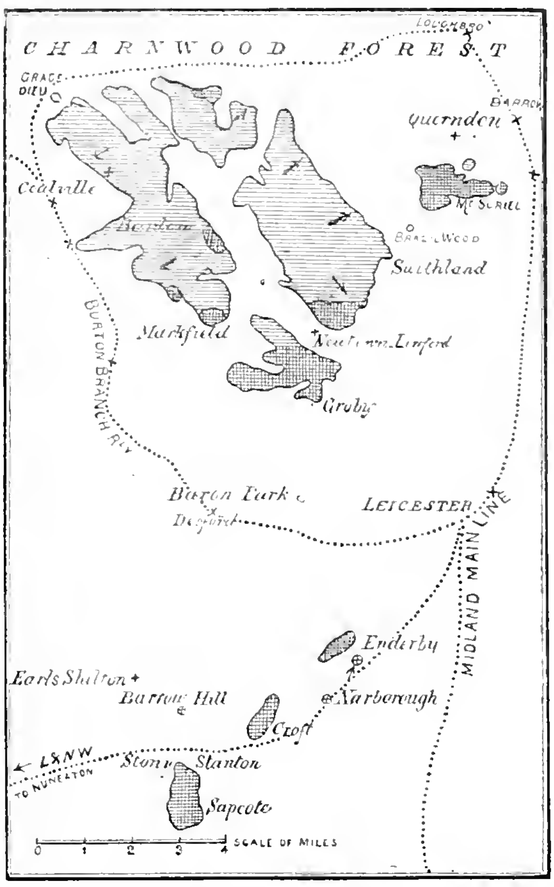


Fig. 1.—Map of Charnwood Forest, with the Narborough Distrist. Horizontal shading = slatey rocks; cross shading = igneous rocks; dotted lines = railways.

On the west side of the forest there is the Midland branch line from Leicester to Burton, which actually touches the forest at Bardon Hill station; while the circuit is completed by the little railway lately opened between Coalville (the next station to Bardon) and Loughborough, which skirts the northern and north-western edges.

There are two very pleasant villages in Charnwood where the tourist will find good accommodation, Woodhouse Eaves on the eastern side, and Newtown Linford (beloved of artists) on the south. At the Forest Rock Hotel (in the north-west corner, near Bardon Hill) I have found good quarters, either for the crowd to lunch (and the onslaught of the parties of geologists whom I have led from time to time requires some preparation), or for the solitary knight of the hammer who is belated while puzzling over the intricate rocks of Peldar Tor and High Towers.

The maps required will be 63 N.E. and 63 N.W., published by the Geological Survey; but let the student remember that these maps were made twenty-five years ago, and that we have "learned much since then." As a corrective to the map, nothing can be better than the admirable papers by Messrs. Hill and Bonney.* During the eight years for which I was curator of the Leicester Museum, I devoted some time to the investigation of the Charnwood rocks, and the results of my work are embodied in a "Geology of Leicestershire," which is published by Messrs. J. & T. Spencer, of the Market-place, Leicester. The Leicester Museum contains—or did contain, for I have not visited it lately—a very fine series of Charnwood rocks and minerals; but I was also able to send typical sets to the British Museum (South Kensington), the Jermyn-street Geological Museum, and most of the provincial museums, and I should advise those who mean to visit Charnwood to previously inspect these collections if possible.

To most travellers who study scenery, the Charnwood Hills come as a pleasant surprise. Rising to heights of four hundred or five hundred feet above the surrounding plain, they have all the aspect of a miniature mountain-range, such as one little expects to find planted among the soft clays and sandstones of the Midlands. The highest points are Bardon Hill on the west, 902 ft. above sea-level; and Beacon Hill on the east, 840 ft.

Nor is the surprise of the geologist abated when he walks over the ground, and minutely examines the rocks in the quarries and on the hill-sides. In the first place, there are coarse slates, and finer workable slates, with volcanic ashes and agglomerates of a most remarkable nature and appearance. Apparently breaking through these sedimentary rocks are great bosses of syenite and granite, yet the junction between the two sets of rocks—the stratified or slaty, and the unstratified or syenitic—is hardly anywhere visible, so that it has been argued by a certain school of geologists that the latter rock (the syenite) is really only the same thing as the coarse slate, but that it is slate which has been so greatly altered by heat and other agencies (metamorphosed) that it has become a crystalline rock. By careful search I have, however, been able to find sections which entirely disprove this view, and which show that the syenites are truly igneous rocks which have come up from below in a melted state, and have forced themselves through the slaty beds. From this it follows that the slates are the *older* of the two. But what is the age of the Charnwood slates? That is a very difficult question, and one which has hitherto been little more than a matter of conjecture. Quite recently, however, discoveries have been made, not in the Forest region itself, but at some little distance from it, which throw much light upon the question.

When Professor Sedgwick examined Charnwood in 1833, he considered the strata to be of "Cambrian" age, and he was followed in this by Professor Hull (of the Geological Survey), who mapped the country in 1860.

From the remarkable similarity of the rocks to the "Green Slates and Porphyries" of the Lake district, Professor Bonney was at one time led to assign the Charnwood beds to the Lower Silurian period, but he has since acknowledged that the discovery—by Dr. Hicks—of a great series

* "Quarterly Journal of the Geological Society," vol. 33, p. 754; vol. 34, p. 199; and vol. 36, p. 337.

of rocks of volcanic origin underlying all the other rocks of Wales, and therefore of *Pre-Cambrian* age, has led him to consider that the Charnwood rocks, too, may be of this enormous antiquity. From the study of the Silurian rocks of the Lake district, I, too, once believed them to be identical with our Leicestershire strata, but I now feel certain that the latter are of Pre Cambrian age. Is it possible that any mistake can have been made in mapping the strata in Cumberland and Westmorland, and that they, also, are of this high antiquity?

(*To be continued.*)

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE FOURTH EVENING (*continued*).

"After Mercury comes the sun; but there is no possibility of peopling it, nor no room left for a wherefore. By the earth which is inhabited, we judge that other bodies of the same nature may be likewise inhabited: but the sun is a body not like the earth, or any of the planets; the sun is the source or fountain of light; which, tho' it is sent from one planet to another, and receives several alterations by the way, yet all originally proceeds from the sun: he draws from himself that precious substance which he emits from all sides, and which reflects when it meets with a solid body, and spreads from one planet to another those long and vast trains of light which cross, strike thro', and intermingle in a thousand different fashions, and make (if I may so say) the richest tissues in the world.

"The sun likewise is placed in the center, from whence, with most convenience, he may equally distribute, and animate by his heat. It is then a particular body, but what sort of body, has often puzzled better heads than mine. It was thought formerly a body of pure fire; and that opinion passed current till the beginning of this age: when they perceiv'd several spots on its surface. A little after they had discover'd new planets (of which hereafter), which some say were those spots; for those planets moving round the sun, when they turn'd their dark half to us, must necessarily hide part of it: and had not the learned, with these pretended planets, made their court before to most of the princes in Europe, giving the name of this prince to one, and of that prince to another planet, I believe they would have quarrell'd who should be master of these spots, that they might have nam'd them as they pleas'd."*

"'Twas but t'other day," says the lady, "you were describing the moon, and call'd several places by the names of the most famous astronomers. I was pleas'd with the fancy: for since the princes have seiz'd on the earth, 'tis fit the philosophers (who are as proud as the best of 'em) should reserve the heavens for themselves without any competitors."

"Oh! trouble not yourself," said I, "the philosophers make the best advantage of their territories; and if they part with the least star, 'tis on very good terms: but the spots on the sun are fallen to nothing. 'Tis now discover'd that they are not planets, but clouds, streams, or dross, which rise upon the sun, sometimes in a great quantity, sometimes in a less; sometimes they are dark, sometimes clear; sometimes they continue a great while, and sometimes they disappear as long.

* They called them the Bourbonian stars.—R. P.

"It seems the sun is a liquid matter; some think, of melted gold (!), which boils over as it were continually and by the force of its motion calls the scum or dross on its surface, where it is consum'd, and others arise. Imagine then what strange bodies these are, when some of them are as big as the earth. What a vast quantity must there be of this melted gold! and what must be the extent of this great sea of light and fire which they call the sun?

"Others say, the sun appears thro' their telescopes full of mountains, which vomit fire continually, and are joined together like millions of Etna's. Yet there are those that say, these burning mountains are pure vision, caus'd by a fault in the spectacles; but what shall we trust, if we must distrust our telescopes, to which we owe the knowledge of so many new objects? But let the sun be what it will, it cannot be at all proper for habitation; and what pity that is! for how pleasant would it be! You might then be at the center of the universe, where you would see all the planets turn regularly about you; but now we know nothing but extravagant fancies, because we do not stand in the proper place. There is but one place in the world, where the study or knowledge of the stars is easily obtain'd, and what pity 'tis there is nobody there!"

"You forget yourself, sure," says she; "were you in the sun you would see nothing, neither planets nor fixed stars: doth not the sun efface all? So that could there be any inhabitants there, they might justly think themselves the only people in Nature."

"I own," said I, "my mistake: I was thinking of the situation of the sun, and not of the effect of its light: I thank you for your correction; but must take the boldness to tell you, that you are in an error as well as myself: for were there inhabitants in the sun, they would not see at all; either they could not bear the strength of its light, or for want of a due distance, they could not receive it; so that things well consider'd, all the people there must be stark blind, which is another reason why the sun cannot be inhabited. But let us pursue our voyage."

(*To be continued.*)

PLEASANT HOURS WITH THE MICROSCOPE.

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

In holiday times it is well to make experiments and observations which are sure to interest the young folks. One of the best that can be suggested is to form a so-called lead-tree, portions of which make very pretty objects for the microscope. The proceeding is very easy. Get a clear, round, glass bottle, holding six ounces. Take two drachms of acetate of lead, and dissolve in six ounces of distilled water. If the water is pure, it will dissolve the salt without milkiness; but it is seldom pure enough for this. The solution, if not quite clear, should be allowed to stand until a deposit settles to the bottom, and the clear part may then be poured off for use. Take a thin strip of zinc, about a quarter of an inch wide, which should be made bright by rubbing with a little sand or Flanders brick-dust, or by wiping with a rag moistened with dilute hydrochloric acid. Make one end of the zinc sharp, and force it into a cork that fits the bottle. The strip of zinc should be long enough for one inch of the metal to be immersed in the fluid. The acetic acid of the lead salt immediately attacks the zinc, forming a soluble acetate of that metal. The lead is precipitated in a beautiful feathery form. As soon as an elegant little tuft is seen, withdraw the cork, and scrape off the lead on to a piece of blotting-paper. As soon as it is dry, select a pretty piece to view with an inch or lower power under the microscope. When a piece worth preserving is obtained, mount it in Canada balsam, which will keep it from tarnishing.

The cork with the zinc attached to it should be quickly replaced in the bottle, which must be left quite free from shaking for a day or two. It is very interesting to watch the gradual formation of the lead tree with a magnifying glass. The tree will last for some time if not disturbed, and when it falls to pieces the smaller crystalline leaves should be placed under the microscope. If melted lead is slowly cooled, it forms octohedral crystals. In the experiment just described the forms are arborescent, like the frost figures with which a cold winter adorns our window-panes. The exact character of the lead tree figures varies according to the strength of the solution. The proportions mentioned give the prettiest effect—that of large metallic leaves composed of smaller feathery deposits. All the soluble salts of lead are extremely poisonous, including the acetate. It must therefore be used with care, and not placed where inquisitive children may be tempted to taste it.

A still more beautiful experiment may be made with the formation of a silver tree. This metal crystallises in arborescent forms as native silver, and sometimes in cubes or octohedra. For our present purpose, get a solution of five grains of crystallised nitrate of silver in one dram of distilled water. If the water is quite free from chlorides and certain other impurities, the solution will be clear, and will keep for any length of time in a *stoppered* bottle. Neither cork nor any other organic matter should be allowed to come into contact with it. It is highly poisonous. Melted and cast in sticks, nitrate of silver is the lunar caustic of the doctors. It is also the active ingredient in marking-inks, and stains the skin black, besides destroying it, unless it is very dilute. A slate-blue man is still occasionally seen, bearing for life that sad tint, the evidence of having been doctored with this salt.

To obtain a silver tree, take up a drop of the solution on a glass rod, and transfer it to the centre of an ordinary glass slide, placed on the stage of the microscope, which for this purpose should be *horizontal*, to prevent the drop running. Focus the drop with an inch power, and then put in the middle of it a piece of copper the size of a small pin's head, which can be cut from a bit of bell wire. Instantly the nitric acid will attack the copper, setting free the silver, which forms numerous branches, something like a Selaginella, and exquisitely brilliant in reflected light. A dram of the solution will enable the experiment to be repeated scores of times, and there are few that are more striking. A fresh and bright particle of copper should be used on each occasion. I do not give a figure of the silver tree, because its beauty depends very much upon the fine colour of the pure metal, which no engraving could repro duce. When quite dry the piece of copper should be removed, and the tree can then be mounted in Canada balsam; but, unless the covering-glass is very gently superposed, the crystals are scattered and the beauty lost.

THE GAMBLING SPIRIT IN AMERICA.

By Richard A. Proctor.

At Monte Carlo the gambling spirit has shown itself during the past few years in such a way as to startle even those who have not been accustomed to regard gambling with special horror. France, which encourages a national system of gambling; and Britain, whose betting ways have long put her among the very foremost of the gambling races, look on with pain and sorrow at a system of gambling which seems dwarf-like compared with the system of lotteries in France and British betting on races. So easy is it to see the mote in another's eye while a beam in our own is overlooked! But, much as all European nations are given to gambling in various forms, Americans seem to have gone altogether beyond them. In America boys of ten or twelve bet as resolutely as bookmakers at a British race. Everything seems to afford fit subject for wagering in America, insomuch that betting expressions have become part of the language. A man can hardly express agreement with another in America save by saying, "You bet," or "you may go your pile," or "bet your bottom dollar," or the like, "on that." The progress of the Presidential election brought out the betting element in a marked way throughout the length and breadth of America. In every State of the Union, north and south, east and west, betting men—by which one may be said to mean nine out of ten of all the men and boys in America—backed their favourite candidate at the current odds. These were published in the papers as systematically, though not as exactly, as the betting on races in England. A fabulous amount of money changed hands over the results of the election, and preposterous though it may seem, it is nevertheless true, that a large part of the energy with which the results of the New York election were canvassed had its origin simply in the anxieties of betting men to get a good chance of hedging.

I can imagine no worse sign in a community than the general prevalence of the gambling spirit. It is so rife in my own country that I am making no attack specially on America, or any vaunt respecting England, in saying this. The gambling spirit is evidence of an immoral, unprincipled nature. Those who find themselves possessed by it should be as anxious about so evil a symptom as a man would be who should find himself spitting blood or giving other evidence of a disease affecting his whole physical nature. A nation in which the gambling spirit is seen to be prevalent is in a dangerous way, though it may well be that the difference between one nation and another in this respect is only apparent, and due to the circumstance that in one nation gambling folk take a more prominent position than in another. Just as one who had travelled much in America might be disposed—if in England he belonged to the classes which take no part in trade—to imagine that a much larger portion of the American population are engaged in business than in England, so may the opinion be quite as mistaken that betting is very much more prevalent among Americans than among ourselves. We know that business men and tradesmen take a better position and mix more in society in America than at home, so that they are much oftener met. May it not well be that the real fault in America (for serious fault there must be somewhere) in regard to betting lies not in the much greater prevalence of betting-folk, but in the circumstance that they are suffered to intrude in America into circles whence in England they are excluded (unless they happen to be titled or wealthy persons, when they are too easily admitted into the company of the better - principled portion of the community). American political life is not only open to immoral and unprincipled men, but, as has been only too strikingly shown of late years, honest men are withdrawing themselves more and more carefully from it. Among the various office-holders and dependents on office-holders in America, an immense proportion are of just the class from which the betting community is formed. Nay, political life in America is itself a lottery, and a man must be very strongly imbued with the gambling spirit to become a politician in the

United States. After entering on political life in America, a man's best chance of becoming rich lies in the judicious application of his political influence to furthering, at a price, such financial schemes as come in his way. Politicians in America see nothing wrong in this employment of their influence. I have no doubt Mr. Blaine was quite in earnest in saying that he had no reason to be ashamed of anything which came out respecting his correspondence with Mr. Fisher, though an English statesman (if one could conceive anything of the kind happening in England) could never have raised his head again after such a disclosure. Nor do most other American politicians appear to have been much surprised or ashamed at anything which appeared in those Mulligan letters.

It seems tolerably manifest that we can make no comparison between American and English morality in matters political, until we have an opportunity of observing how matters proceed when the best classes in America take to politics, and thrust to their deserved position in the background the adventurers who now disgrace the nation. It may well be that then the gambling spirit will be found to be no more widely prevalent in America than in our own country. At present, it unquestionably is much more obtrusive.—*Newcastle Weekly Chronicle.*

AN INTERESTING FAMILY.

By David Houston, F.L.S.

Not at all uncommonly in the still, clear water of open drains or sheltered ditches may be found a floating, elongated, ragged, or sac-like net of green, buoyed one end uppermost by a mesh-entangled bubble of gas evolved by the living moieties of the singularly complex organism. The net, as will be readily observed, varies considerably in size; but three or four inches long and one to one and a-half inches deep may be taken as a typical full-growth measurement.

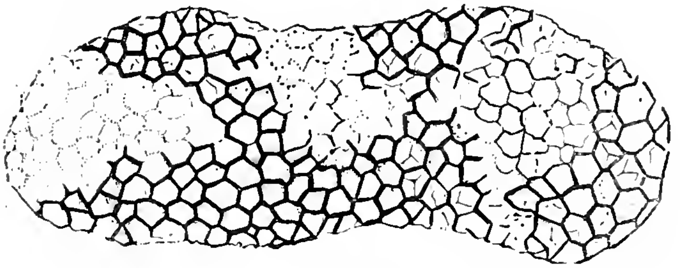


Fig. 1.—"Water-Net" (*Hydrodictyon*), natural size. (After Cooke.

This peculiar vegetable growth (Fig. 1) is an algal family of very many individuals, each individual simply consisting of an elongated or oblong cylindrical rod (Fig. 2) about a

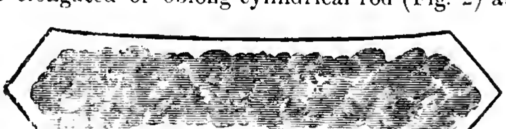


Fig. 2. A single cell or individual (very much enlarged) from the Water-net colony.

line or so in length, brightened in the season of active growth with a light or vivid green colour. Structurally, each rod is made up of a mass of protoplasm enclosed in an exceedingly thin cellulose wall forming a single histological element or cell. The green pigment or chlorophyll is confined to the protoplasm, and to that part of the protoplasm that lies immediately within the cell-wall, leaving a slender, colourless portion in the central region of the tiny plant.

Instead of living a life of comparative isolation, like a great many unicellular and other simple algæ, these interesting organisms elect to form special groups, or families, and share together the seasonal ups and downs of quiet vegetable life in the drainage-water of an unpolluted ditch. In the formation of a colony, either end of any individual cell meets one of the ends of each of two other cells, and, as a geometrical result, meshes averaging about one-sixth of an inch are constructed, each space being bounded by

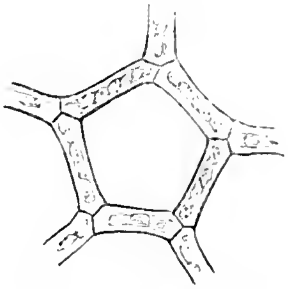


Fig. 3.—One of the "Meshes" of Water-Net (magnified). After Cohn.

five cells (Fig. 3). The presence of a gelatinous substance adhering to the outside of the cell walls—and, perhaps, arising from a slow disintegration of the material of the wall itself—is of very common occurrence among members of the class of algæ. It is by virtue of the existence of this jelly-like matter that the individuals of this family can remain closely, although not organically, attached, and form a net-like floating community, or sisterhood.

The plant, or rather the assemblage of plants, is known "vulgarly" as the "water-net," while its scientific, generic name of Hydrodictyon (Gr., *hudor*, water; *diktuon*, a fishing-net) expresses exactly the same idea as the common or simple one. There is—so far as is at present known—only one species of Hydrodictyon (*Hydrodictyon utriculatum*). It is distributed throughout the pure fresh waters of Europe and North America, never, it seems, attaining in any locality a size beyond a length of twelve inches, with meshes of a third of an inch in diameter. Like all chlorophyll-bearing plants, the water-net is able to manufacture starch under the influence of solar light and heat out of the chemical elements of carbonic acid gas and water; but, as there is more oxygen proportionately present in the dioxide of carbon and monoxide of hydrogen than in the molecules of starch, a considerable quantity of pure oxygen is liberated during the hours of sunshine, and it is from this source that the gaseous body above referred to is kept in existence day by day throughout the plant's active period of vegetative growth. The manufactured starch may be discovered in the form of minute grains lying in the peripheral or greenish region of the protoplasm; but their presence can be rendered clearly visible by treatment with solution of iodine, under the action of which the grains will assume a dark blue colouration. It is, of course, from this starch and from protinaceous substances formed through the vital activity of the plant, together with certain ever-essential inorganic salts obtained from the drainage water, that the protoplasm derives its constructive material or food, and out of which it is able to build up new protoplasmic substance, enabling it to increase itself in size, and, in due time, to attain an adult condition.

After a course of purely vegetative growth, during which all the energies of the plant are directed to its nutrition and general self-interest, the different individuals in the net-like colony enter into a reproductive stage, whereby the preservation of the race will be secured after the death of the now-existing family. The changes about to take place within the cell at this period are preceded by a loss of the bright green colour so characteristic of the organism, the starch also disappears, while a vast number of little clear specks arise throughout the now quickly modifying cell-contents. In a short time the protoplasmic mass is broken up into a very great number (7,000 to 20,000) of roundish grains (*gonidia*), which for a space of half-an-hour or so move with a tremulous motion within

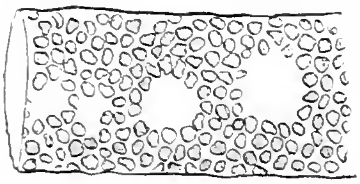


Fig. 4.—Portion of a cell of Water-net (magnified 400 times), showing the formation of *Micro-gonidia*. (Cohn.)

the cell (Fig. 4). When they come to rest, they arrange themselves by force of heredity, after the usual plan of cell-grouping observable in the adult colony; then when the old wall of the mother cell is finally absorbed, or otherwise destroyed, a brood of cohering sister Hydrodictyon plantlets escape to lead an independent existence in the surrounding water. The individuals rapidly elongate, and, still continuing to remain attached by their ends, the group soon assumes the appearance of a miniature water-net. After this, cell enlargement proceeds most actively; and, at the end of three or four weeks, the colony will have attained full size and maturity.

Fig. 5.—Single *Macro-gonidia* (magnified 600 times).

There is another, but less usual, way by which the Hydrodictyon plant multiplies itself. Each individual cell, instead of breaking up its contents into the comparatively large gonidia (hence known as *macro-gonidia*), above referred to, resolves its protoplasmic mass into an enormous

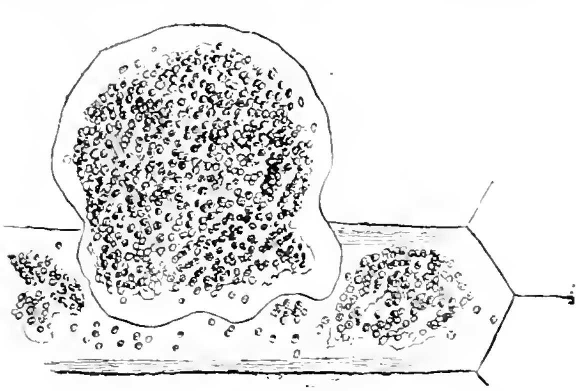


Fig. 6.—Portion of cell (magnified 300 times), showing escaping *Micro-gonidia*. (Cohn.)

number (30,000 to 100,000) of inconceivably small gonidia (*micro-gonidia*), which, instead of cohering among themselves, remain perfectly free from one another and eventually escape (Fig. 6), as unwalled and ciliate spores (Fig. 7), by the rupture of the old mother-wall. By the agency of their cilia they are able to move hither and thither throughout the water and mix with similar spores, set free from the cells of other water-nets. It would seem that these motile bodies (generally described as *zoospores*) are of sexual phy-

Fig. 7.—Single *Micro-gonidia* (magnified 600 times).

siological importance, and that they conjugate with one another during their brief period of activity. The conditions under which the act of conjugation is effected are, of course, entirely against the chances of self-fertilisation, and thus the well-known benefits of a "cross" are fully secured to the next succeeding algal generation. Immediately upon conjugation being completed the dual mass draws in its cilia, rounds itself off, forms for itself a resisting cell-wall, and falls to the mud at the bottom of the ditch, within or on the surface of which it lies in a still or dormant condition for a period of three or four months. On the approach of spring vital activity is again resumed, and for the next few months growth and development are strictly confined to an enlargement of the cell. When the cell has attained its maximum size, its contained protoplasm breaks up into three, four, or five large ovate zoospores that generally escape and move freely through the surrounding water. But they soon become motionless, and develop into single, many-sided cells, from the angles of which long, horn-like processes invariably grow. Finally, the contents of each polyhedron resolves itself into a group of two or three hundred gonidia enclosed in an extremely delicate sac that protrudes itself from the burst side of the containing cell, and these, after about half-an-hour's tremulous motion, come to rest and arrange themselves into a miniature net-like structure which, eventually bursting the womb, escape, and, still remaining attached to one another, gradually increase in size and grow into a mature Hydrodictyon, only differing from a non-sexually produced "net" in having a fewer number of cells. But such cells or individuals as these that are the resulting offspring of a sexual act have had their vital energies as it were renewed; their constitutional vigour and reproductive powers have been considerably increased, and they have acquired a potential of growth and multiplication that will enable them to run through several non-sexual generations before they have exhausted the present stock of available hereditary energy.

Tabulating, then, by way of a summary, the entire possible life-history of Hydrodictyon, or water-net, we have:—

Non sexual generation multiplying by the formation of macro-gonidia repeated for many generations.

Sexual generation multiplying by formation of micro-gonidia or zoospores.

Conjugation.

Resting spore.

Renewal of growth and enlargement of cell.

Conversion of entire cell-contents into 3—5 large zoospores.

Development of these into "polyhedra."

Formation of numerons gonidia within the polyhedra.

Arrangement of gonidia into an ordinary net colony.

Non-sexual generation multiplying by macro-gonidia repeated for many generations.

We are asked to state that Mr. Higgins's book, "Museums of Natural History," which was reviewed on p. 488, is published by D. Marples & Co., of Liverpool.

OUR TWO BRAINS.

By Richard A. Proctor.

(*Continued from p. 479.*)

The case of dual consciousness now to be considered is a remarkable one. The original narrative of M. Azam is somewhat prolix,—the following account is from an article by Mr. H. J. Slack, in which the account has been skilfully abridged.

The subject of the disorder, Felida X , was born in Bordeaux in 1843. Until the age of thirteen she differed in no respect from other girls. But about that time symptoms of hysterical disorder presented themselves, and although she was free from lung-disease, she was troubled with frequent spitting of blood. After this had continued about a year, she for the first time manifested the phenomena of double consciousness. Sharp pains attacked both temples, and in a few moments she became unconscious. This lasted ten minutes, after which she opened her eyes, and entered into what M. Azam calls her second state, in which she remained for an hour or two, after which the pains and unconsciousness came on again, and she returned to her ordinary condition. At intervals of about five or six days, such attacks were repeated; and her relations noticed that her character and conduct during her abnormal state were changed. Finding also that in her usual condition she remembered nothing which had passed when she was in the other state, they thought she was becoming idiotic; and presently called in M. Azam, who was connected with a lunatic asylum. Fortunately, he was not so enthusiastic a student of mental aberration as to recognise a case for the lunatic asylum in every instance of phenomenal mental action. He found Felida intelligent, but melancholy, morose, and taciturn, very industrious, and with a strong will. She was very anxious about her bodily health. At this time the mental changes occurred more frequently than before. Nearly every day, as she sat with her work on her knees, a violent pain shot suddenly through her temples, her head dropped upon her breast, her arms fell by her sides, and she passed into a sort of sleep, from which neither noises, pinches, nor pricks could awaken her. This condition lasted now only two or three minutes. "She woke up in quite another state, smiling gaily, speaking briskly, and trilling (*fredonnant*) over her work, which she recommenced at the point where she left it. She would get up, walk actively, and scarcely complained of any of the pains she had suffered from so severely a few minutes before. She busied herself about the house, paid calls, and behaved like a healthy young girl of her age. In this state she remembered perfectly all that had happened in her two conditions." (In this respect her case is distinct from both the former, and is quite exceptional. In fact, the inclusion of the consciousness of both conditions during the continuance of one condition only, renders her case not strictly speaking one of double consciousness, the two conditions not being perfectly distinct from each other.) "In this second life, as in the other, her moral and intellectual faculties, though different, were incontestably sound. After a time (which in 1858 lasted three or four hours), her gaiety disappeared, the torpor suddenly ensued, and in two or three minutes she opened her eyes and re-entered her ordinary life, resuming any work she was engaged in just where she left off. In this state she bemoaned her condition, and was quite unconscious of what had passed in the previous state. If asked to continue a ballad she had been singing, she knew nothing about it, and, if she had received a visitor, she believed she had seen no one. The forgetfulness extended to everything which happened during her second state, and not to any ideas or information acquired before her illness." Thus her early life was held in remembrance during both her conditions, her consciousness in these two conditions being in this respect single; in her second or less usual condition she remembered also all the events of her life, including what had passed since these seizures began; and it was only in her more usual condition that a portion of her life was lost to her—that, namely, which had passed during her second condition. In 1858 a new phenomenon was noticed as occasionally occurring—she would sometimes wake from her second condition in a fit of terror, recognising no one but her husband. The terror did not last long, however; and during sixteen years of her married life her husband only noticed this terror on thirty occasions.

A painful circumstance preceding her marriage somewhat forcibly exhibited the distinction between her two states of consciousness. Rigid in morality during her usual condition, she was shocked by the insults of a brutal neighbour, who told her of a confession made to M. Azam during her second condition, and accused her of shamming innocence. The attack—unfortunately but too well founded as far as facts were concerned—brought on violent convulsions, which required medical attendance during two or three hours. It is important to notice the difference thus indicated between the character of the personalities corresponding to her two conditions. "Her moral faculties," says M. Azam, "were incontestably sound in her second life, though different,"—by which, be it understood, he means simply that her sense of right and wrong was just during her second condition, not, of course, that her conduct was irreproachable. She was in this condition, as in the other, altogether responsible for her actions. But her power of self-control, or rather perhaps the relative power of her will as compared with tendencies to wrong-doing, was manifestly weaker during her second condition. In fact, in one condition she was oppressed and saddened by pain and anxiety, whereas in the other she was almost free from pain, gay, light-hearted, and hopeful. Now I cannot altogether agree with Mr. Slack's remark, that if, during her second state, "she had committed a robbery or an assassination, no moral responsibility could have been assumed to rest upon her with any certainty, by any one acquainted with her history," for her moral faculties in her second condition being incontestably sound, she was clearly responsible for her actions while in that condition. But certainly, the question of punishment for such an offence would be not a little complicated by her twofold personality. To the woman in her ordinary condition, remembering nothing of the crime committed (on the supposition we are dealing with), in her abnormal condition, punishment for that crime would certainly seem unjust, seeing that her liability to enter into that condition had not in any degree depended on her own will. The drunkard who, waking in the morning with no recollection of the events of the past night, finds himself in gaol for some crime committed during that time, although he may think the punishment he has to endure severe measure for a crime of which in his ordinary condition he is incapable, knows at least that he is responsible for placing himself under that influence which made the crime possible. Supposing even he had not had sufficient experience of his own character when under the influence of liquor, to have reason to fear he might be guilty of the offence, he yet perceives that to make intoxication under any circumstances an excuse for crime would be most dangerous to the community, and that he suffers punishment justly. But the case of dual consciousness is altogether different, and certainly where responsibility exists under both conditions, while yet impulse and the restraining power of will are differently related in one and the other condition, the problem of satisfying justice is a most perplexing one. Here are in effect two different persons residing in one body, and it is impossible to punish one without punishing the other also. Supposing justice waited until the abnormal condition was resumed, then the offender would probably recognise the justice of punishment; but if the effects of the punishment continued until the usual condition returned, a person would suffer who was conscious of no crime. If the offence were murder, and if capital punishment were inflicted, the ordinary individuality, innocent entirely of murder, would be extinguished along with the first, a manifest injustice. As Huxley says of a similar case, "the problem of responsibility is here as complicated as that of the prince-bishop, who swore as a prince and not as a bishop. 'But, your highness, if the prince is damned, what will become of the bishop?' said the peasant."*

(To be continued.)

CHAPTERS ON MODERN DOMESTIC ECONOMY.

VIII.—THE FRAMEWORK OF THE DWELLING-HOUSE (*continued*).

GENERAL PRINCIPLES OF CONSTRUCTION.

A MODEL outhouse, designed to work in conjunction with the dry-earth or ash system, or a combination of both, ought to be constructed in such a way as to provide an arrangement which shall be wholesome and economical. Its mechanical parts should embrace:—(i) An apparatus for separating the ashes from the cinders in such a manner that the former shall find its way into a hopper-box, from which it can be discharged in suitable quantities over the fæcal matters by means of a crank and pull-handle, whilst the cinders are entirely and automatically thrown into a compartment, from whence they can be readily removed for future use. (ii) The waste soil ought to be received into a pail of such a shape and size, and so placed, that the earth or ashes shall completely cover its contents; an intervening mechanical partition, made to screen the soil, is desirable, though not indispensable. Of course, the pail ought to be capable of being easily removed: or, if a vault be used, it should admit of being thoroughly cleared with the utmost facility. (iii) A separate receptacle or bin ought to adjoin the outhouse for the reception of house-sweepings, garbage, &c.

Experimental researches have shown that the water system of sewage is not only defective, because of its baneful influences over our water-supply and the general health of the public, but that it is wasteful, almost to an alarming degree. The soil becomes impoverished of those ingredients which nature seeks to restore through an equalised balance of plant and animal life, but it is in a great measure thwarted by this intervention of man. Most of the valuable constituents of the soil are practically lost; they only help to induce contamination of the atmosphere, instead of re-taking their part in the enrichment of the earth. When the process of mechanical separation is applied, the sludge that remains behind is almost valueless, because it is deprived of many essential components which cannot be replaced except by artificial means. Fortunately, there are chemical processes which deal adequately with sewage, and these ought always to be called into use where they can be conveniently applied. In former issues we drew the attention of our readers to the A B C process of the Native Guano Company; we are glad to be able to record that their efforts to utilise sewage have been duly recognised and rewarded by the Councils of both the "Fisheries" and the "Health" Exhibitions with the highest possible awards.

What we desire to point out now, however, is, the way in which the waste matters of a household can be best converted into valuable material, in a thoroughly wholesome way. Those who possess moderately large sized gardens would do well to adopt the earth and ash systems of treatment without delay, and without applying to the necessarily tardy local authorities for any assistance. They will find, by the use of Moule's "Patent Earth System" or Morrell's "Patent Self-acting Cinder-sifting Ash-closet System," that they will be able to secure an adequate supply of mould of the very best manurial quality for their own grounds, and at the same time completely cut themselves off from foul sewers, with their innumerable disadvantages, necessitating costly trapped drains with inspection pipes and orifices, which, if we may be allowed to speak figuratively, have a kind of predisposition to get out of order periodically. Moreover, they can secure all these advantages at but a moderate outlay for new out-houses and special earth-closets. In our descriptive notes, to follow hereafter, we shall give a few specific examples of the best forms of apparatus already introduced.

The dry-earth system is undoubtedly the best from a sanitary aspect. Earth of a loamy nature, perfectly dry (yet not so dry as to fly into a dust when used), and finely sifted, ought to be employed; if these precautions are taken, not only will it act as a perfect deodoriser and disinfectant, but, in combining with the waste soil, form a particularly rich manure, which can be used to the greatest advantage in the garden, and when produced in excess, can always be sold for a good price. Sand should never be used, as it is neither absorbent, deodorising, nor disinfectant. We have no doubt that if a large body of householders in each suburb of this city were to decide to use the earth system, the local authorities would very soon commence to send their collecting carts round frequently and regularly; or, if they do not do so, they would not be at a loss to find capitalists to collect and to pay for house refuse of such good quality.

It may be urged by some persons that finely-sifted and dried loam cannot be readily procured, but we have no hesitation in stating that the authorities or other collectors would find it worth their while to supply the required earth in place of the valuable manure. Then, there is another very weighty argument in its favour. Let us suppose that suitable earth cannot really be obtained; an unfailing supply of ashes are to be found in every household, and will, under Morrell's ash-system, be found amply adequate to the requirements of the case. By that process the ashes are carefully separated from the cinders; the former is substituted, either wholly or in part, for the earth, whilst the latter, which are undesirable in a manure, are stored for reburning. There is no waste, whilst the refuse is doubly utilised in this application of the one to the other; the sum total being an actual diminution in quantity of house refuse, with the manufacture of a valuable and saleable product.

Ashes mixed with the manure have been repeatedly

* Should any doubt whether these conditions of dual existence are a reality (a doubt, however, which the next case dealt with in the text should remove), we would remind them that a similar difficulty unmistakably existed in the case of Eng and Chang, the Siamese twins. It would have been almost impossible to inflict any punishment on one by which the other would not have suffered, and capital punishment inflicted on one would have involved the death of the other.

condemned by agriculturists; but we think that most of such observations are founded upon an imperfect knowledge of the process, and its slovenly application in experiment. Thus, the ashes must be deprived of their associated particles of cinders, for the latter favour decomposition and are injurious to plants in a manure. The analyses of various samples of coal-ash, on the contrary, show that they are of great value in the enrichment of the soil. Dr. Stockhardt, in his address on the "Chemistry of Agriculture," says:—"Notwithstanding that this ash is frequently so little valued as to be thrown away, it deserves to be made use of in agriculture, in the first place because it contains, besides small quantities of alkalies, *lime* and *sulphuric acid* (gypsum), consequently direct sustenance for plants; in the second place, because from the same circumstance, as also from the clay it contains, it has the power to deprive putrefying substances of their odour, and to fix their ammonia, so that it cannot evaporate." This is practically substantiated by the evidence given some time ago in the *Quarterly Review*, as follows:—

A correspondent of the *Paris Journal of Agriculture*, seeing the amount of ashes thrown away annually, and considering that Sir Humphrey Davy and other chemists have found by analysis that ashes contain many substances which contribute to vegetable life —such as sulphate of potash and lime, alumina, and silica—has made some interesting experiments. In the autumn, he filled three flower-pots with coal-ashes, without any admixture with any other substance; in the one pot he sowed wheat, in the other oats, and in the third strawberry-seeds. The pots were then placed in a garden, and left to themselves. In the month of March the plants were in a very thriving condition; and in April were luxuriant. The wheat and oats ripened perfectly, the grains being large and heavy, and the straw, in the case of the wheat, fifty-five inches, and that of the oats forty-three inches high. The strawberry-plants continued to flourish until October, when it was necessary to transplant them, and, after being planted out on the open ground, they succeeded so well that the writer says they surpassed all other seedlings.

Thus we find that there are methods open to us whereby, with a decreased aggregate expenditure, we are enabled to free our houses from their greatest source of evil, the sewers, and, in doing so prevent the pollution of rivers and other water-supplies, upon which the health of the community so largely depends; and the best of all this is, that it can be accomplished by the *utilisation* of refuse products In the instance of new houses, not already provided with the water-closet system, we would strongly recommend the builder to adopt the provisions we have described, and thus to save himself a heavy outlay, and at the same time help to commute the sufferings of the people from an already too-polluted condition of things.

"The Fern Portfolio" Volume.—The Society for Promoting Christian Knowledge will publish, as a Christmas-book, the completed volume of Mr. Francis George Heath's "Fern Portfolio," which will include upwards of sixty figures, life size, coloured from nature, and comprising all the species of ferns found in the British Islands.

The Anti-Vivisectionists.—It is hardly necessary for us to say that the anti-vivisectionists and anti-vaccinationists do not stop at equivocation, or even at deliberate lying, in their desire to influence public opinion. Two of them have, we are glad to see, been brought to book. One Ernst Weber has recently been sentenced to eight weeks' imprisonment for having, in the journal of which he is editor, published, under the heading "Vivisection of a Man," a statement that about eight years ago a Jewish physician had made a post-mortem examination of a man while only apparently dead, and therefore had performed vivisection on him. Dr. Pelz, who had performed the post-mortem in question, summoned him before a court of justice with the above result. A clergyman of Münster also, who was the author of the article, was sentenced to six weeks' imprisonment.—*Medical Press and Circular.*

FIRST STAR LESSONS.

By Richard A. Proctor.

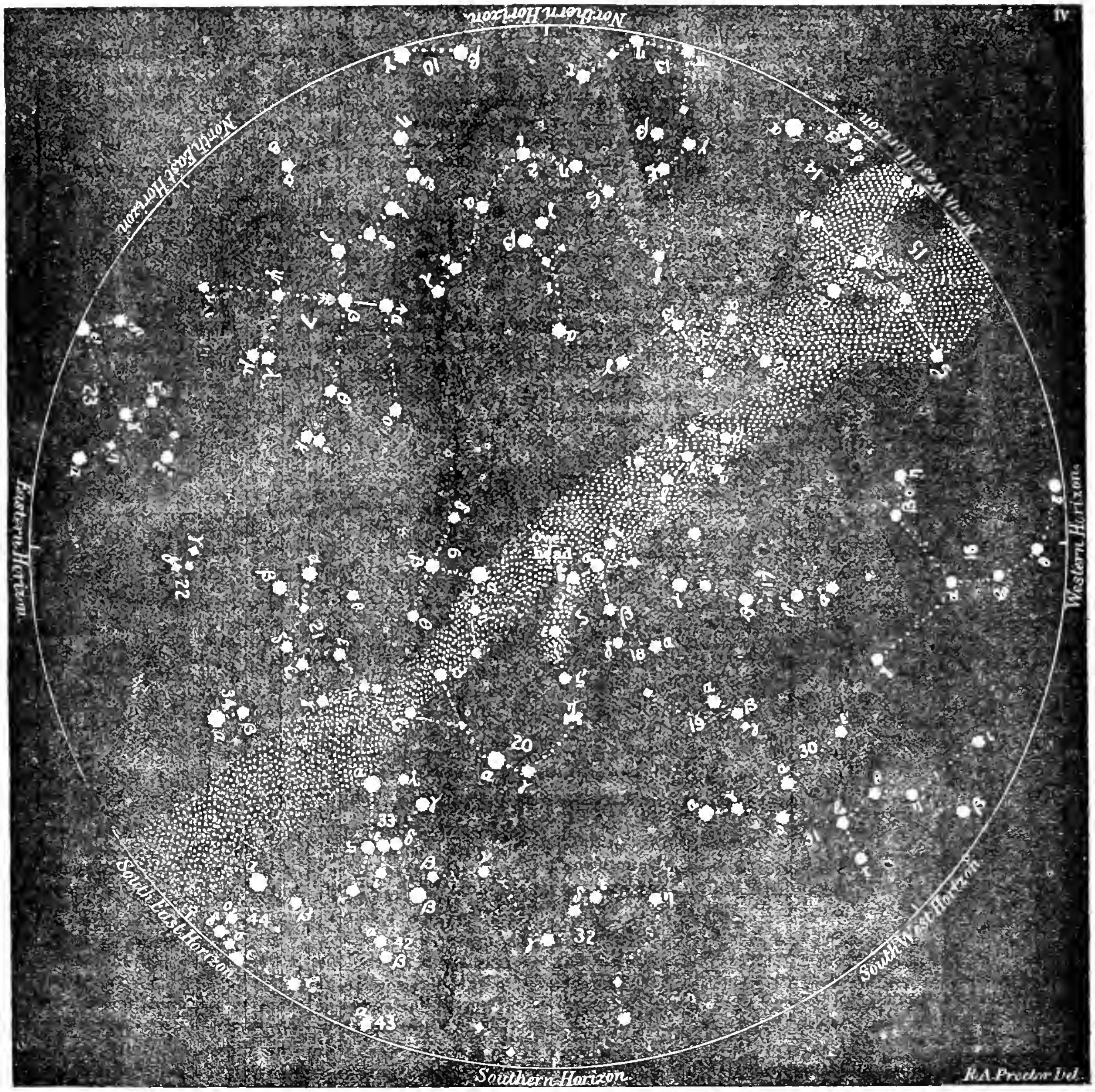
The constellations included in the set of maps are numbered throughout as follows:—

1. *Ursa Minor*, the *Little Bear* (*α*, the *Pole Star*).
2. *Draco*, the *Dragon* (*α*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*α*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*α*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*α*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*α*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*α*, *Vega*).
15. *Cygnus*, the *Swan* (*α*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*α*, *Aldebaran*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*α*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*α*, *Regulus*).
24. *Virgo*, the *Virgin* (*α*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*α*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*. remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*α*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*α*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*α*, *Alphard*).
36. *Crater*, the *Cup* (*α*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*α*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*α*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*α*, *Sirius*).
45. *Argo*, the *Ship*.

THE RACERS OF THE SEA.

Whether or not there shall be such rapid strides in the improvement of navigation on the ocean in the next three hundred years as there has been since 1543, when Captain Blasco de Garry, of the Spanish navy, tried a vessel of 209 tons at Barcelona, Spain, the motive-power of which consisted of a cauldron of boiling water and a movable wheel suspended on each side of the vessel, remains to be answered by future generations. It does, however, seem that it can hardly be possible that as great improvements can be made in the next sixty-five years as there have been since the rudely-constructed American steamship Savannah made the passage from Savannah to Liverpool, in 1819, in twenty-six days with the aid of sails and steam. Since the Guion Steamship Line put under its flag the palatial and fleet steamship Arizona, which was the first of the seven-days ships to be run in the New York and Liverpool trade, those interested in the transatlantic steamship traffic have put forth their energies to exceed the first efforts by building a little larger and faster vessels than their neighbours. This interest is not alone confined to builders and owners, but extends to the difference in models and tonnage of these fast vessels. Many inquiries are made as to the quickest trips across the Atlantic; the fastest average trips; the greatest distance in twenty-four hours, and so forth.

Since the Arizona made a revolution in ocean speed, there have been the following large and fast vessels built for the transatlantic trade:—The Alaska and Oregon for the Guion Line, the latter since transferred to the Cunard; the America for the National Line; the Austral and City



NIGHT SKY FOR DECEMBER (Second Map of Pair),

Showing the heavens as they appear at the following hours:—

December 23 at 10 o'clock.	January 3 at 9¼ o'clock.	January 14 at 8½ o'clock.
December 26 at 9¾ o'clock.	January 7 at 9 o'clock.	January 18 at 8¼ o'clock.
December 30 at 9½ o'clock.	January 10 at 8¾ o'clock.	January 22 at 8 o'clock.

of Rome for the Anchor Line; the Gallia, Servia, Aurania, and Umbria for the Cunard Line; the Elbe, Ems, Fulda, Werra, and Eider for the North German Lloyd; the Hammonia for the Hamburg-American Line; the Normandie for the French Transatlantic; the Westernland and Noordland for the Red Star Line; and the Chateau Yquem and the Chateau Margaux for the Bordeaux Line. The Britannic and Germanic, of the White Star, and the City of Berlin, though not included in the list of those built since the Arizona, may be included among the fast vessels, as they have made remarkably quick passages. For the purpose of comparison the time made between New York and Southampton of the North German Lloyd, the distance being 3,100 miles; and the time made between New York and Plymouth, and New York and Havre, of the Hamburg-American steamers, a distance of 2,980 and 3,150 miles (maritime miles) are given herewith.

As to the fastest average passages made in the past three years, the Arizona is entitled to claim the pennant, while the Oregon has made the fastest average trips of the past twelve months. The Oregon has also made the quickest time, 6 days 10 hours and 10 minutes, from Sandy Hook to Queenstown. This is with four hours and twenty-two minutes difference of time between the two points added. The distance made was 2,861 miles, an average speed of 18½ (maritime) miles an hour. The

Oregon has also made the best day's run on record, on April 19 last covering 472 miles in twenty-four hours, an average of $19\frac{2}{3}$ maritime miles, or $22\frac{6}{10}$ land miles, an hour. A sea mile is 6,080 running feet, and a land mile 5,280 feet.

The following table will show at a glance a comparison of speed of each vessel, and also the quickest trip which each vessel has made both ways:—

Steamers.	Line.	New York to Queenstown. d.	h.	m.	Queenstown to New York. d.	h.	m.	Speed per hour.
Oregon	Cunard	6	10	10	6	12	54	18·5
America	National	6	14	18	6	15	41	18·0
Alaska	Guion	6	18	37	6	21	40	17·5
Aurania	Cunard	6	22	50	6	21	55	17·1
Servia	Cunard	7	00	55	7	2	27	16·9
City of Rome	Anchor	7	1	00	7	2	00	16·9
Arizona	Guion	7	3	38	7	6	7	16·6
Britannic	White Star	7	12	41	7	7	11	16·4
Austral	Anchor	7	9	00	7	6	00	16·1
Umbria	Cunard	—			7	11	00	15·9
Germanic	White Star	7	15	17	7	11	37	15·8
City of Berlin	Inman	7	15	48	7	14	12	15·6
Gallia	Cunard	7	18	32	7	16	32	15·5
		New York to Southampton.			Southampton to New York.			
Eider	N. G. Lloyd	7	16	30	7	16	32	16·8
Ems	N. G. Lloyd	7	18	25	7	23	40	16·6
Werra	N. G. Lloyd	7	21	15	7	23	00	16·4
Fulda	N. G. Lloyd	7	23	00	8	00	00	16·2
Elbe	N. G. Lloyd	8	2	30	8	2	45	16·1
		New York to Plymouth.			Havre to New York.			
Hammonia	Ham-Amer	8	17	00	8	19	00	14·9
		New York to Antwerp.			Antwerp to New York.			
Westernland	Red Star	9	10	50	10	3	00	13·9
		New York to Havre.			Havre to New York.			
Normandie	French	8	15	00	8	4	00	16·0

The average distance made to and from Queenstown and New York is 2,850 miles; to and from Southampton, 3,100 miles; to and from Plymouth, 2,980 miles; to and from Havre, 3,150 miles; to and from Antwerp, 3,250 miles.

In Norway and Sweden accumulations of moss, often more than a foot thick, and half decomposed, serve to make paper and millboard, as hard as wood, blocks of which, formed by the hydraulic press, may even be turned in the lathe and polished. This substance is said to possess the good qualities of wood without the defects, such as warping and splitting, so that it is suitable for making doors and windows. Plant has, it is said, been laid down in Sweden for working up these deposits of a hitherto waste substance into a useful material.

Telephone Subscriptions.—According to *L'Électricité*, the following are the rates of subscription to the telephone exchanges in the following European cities and countries:—London, £20; Paris, £24; Riga and Odessa, £25; Austria, £9 to £15; Germany, from £10, with an increase of £2. 2s. for every kilomètre (1·24 mile) over two; Italy, varying from £4. 12s. to £7, with the towns; Norway, £4 to £8, according to distance; Sweden, £6. 8s. to £10. 16s.; Holland, £10; Portugal, £15 for traders and £7 for private individuals; Switzerland, £1 to £10.

International Inventions Exhibition.—With a view to giving further protection to the inventions of exhibitors, a new certificate has been granted by the Board of Trade to the effect that "The International Inventions Exhibition, proposed to be held at South Kensington, S.W., in the county of Middlesex, from March 1, 1885, is an international exhibition," and by this means all the protection accorded from May 1 to inventions under original certificate (dated August 15) will be secured in addition from March 1 till May 1, *i.e.*, during the time in which the exhibits will be received and arranged. A printed copy of the extracts from the Patents, Designs, and Trade Marks Act, 1883, bearing on this subject, may be obtained on application to the secretary, International Inventions Exhibition.

Reviews.

CUSTOM AND MYTH.*

By Edward Clodd.

[second notice.]

Heaven (Uranus) and Earth (Gæa) were husband and wife, and their many children all hated their father for concealing them between the hollows of their mother's breasts, so that they were shut out from light. Gæa sided with them and provided Cronus, the youngest, with an iron sickle, wherewith he unmanned Uranus and separated him from Gæa. Cronus married his sister Rhea, and, at the advice of his parents, swallowed his children one by one as they were born, lest they grew up and usurped his place among the immortals. But when Zeus was born and he asked for the child, Rhea deceived him by giving him a stone wrapped in swaddling bands. When Zeus grew up he gave his father an emetic, whereupon the children were all disgorged and with them the stone, which became a sacred object at Delphi. There is no such being as Cronus in Sanskrit, but what may be called the Vedic variant of the myth is that in which Dyaus (Heaven) and Prithivi (Earth) were once joined and subsequently separated.

In New Zealand myth Rangi (Heaven) and Papa (Earth) are the parents of all things, and as Heaven lay on the Earth all was darkness, so that their unhappy children could not see.

These took counsel together, and all—one excepted—strove to rend their parents apart. They toiled in vain, save Intenganahan, who, despite the entreaties of Rangi and Papa, severed the sinews which united them. Then the children abode in light, only one of them, the Storm-god, remaining faithful to his father—as in the Greek myth did Oceanus.

In China we find a legend of "a person called Puang-Ku, who is said to have separated the Heaven and the Earth, they formerly being pressed down close together"; and, as one might expect, such a transparent nature-myth of the rending asunder of the world and sky is wide-spread.

The solar mythologists were perplexed at its presence among the refined and cultured Greeks. "How can we imagine that a few generations before the time of Solon the highest notions of the godhead among the Greeks were adequately expressed by the story of Uranus maimed by Cronus, of Cronus eating his own children, swallowing a stone, and vomiting out alive his own progeny. Among the lowest tribes of Africa and America we hardly find anything more hideous and revolting. So the moral character of the Greeks and the exclusive comparative method of Professor Max Müller and his adherents were vindicated by the discovery that, as Cronus means time, the apparently repulsive myth simply means that time swallows up the days which spring from it; "and," remarks Sir G. W. Cox, in his "Manual of Mythology," "the old phrase meant simply this and nothing more, although before the people came to Greece they had forgotten its meaning."†

Cronus is a more than usually troublesome *crux* to the etymologists. Max Müller, Kuhn, Preller, and Brown each have their theories, the details of which not even Mr. Lang can make attractive. And, happily, we may leave the scholars to settle their differences, since they do not affect the fundamental idea resident in the myth. The

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* "Custom and Myth." By Andrew Lang, M.A. (Longmans, 1884.)

† P. xvi.

savage, in the presence of recurring light and darkness, of the clouds lifting and dispersing before the sunrise, has his legend of a time when this was not so, but when heaven and earth were closed in, one upon the other, till some hero thrust them apart. And, to his rude intelligence, the conception of night as a devouring monster might easily "start the notion of other swallowing and disgorging beings." This is, however, subordinate to the explanation which Mr. Lang's method gives. "Just as the New Zealander had conceived of heaven and earth as at one time united, to the prejudice of their children, so the ancestors of the Greeks had believed in an ancient union of heaven and earth. Both by Greeks and Maoris, heaven and earth were thought of as living persons, with human parts and passions. Their union was prejudicial to their children, and so the children violently separated their parents.*

Ex uno disce omnes. Such rational explanation of the irrational element in the myth of Cronus is equally applicable and conclusive in regard to myth all the world over, nor to myth alone, but to the old theologies in which the gods are associated with animals and worshipped under their forms. Of this Mr. Lang finds pertinent illustrations in Apollo, among whose many names is *Smintheus*, which may be rendered "Mouse Apollo," or "Apollo, Lord of Mice." Some of the Greek gods were sculptured with animal heads, although more often the images of the animals consecrated to them were placed in their hands, or the creatures themselves were kept in the inner sanctuary. So striking was the contrast between the insignificant mice, and the glorious, powerful sun-god Apollo, that the connection of the two puzzled the Greeks, and was accounted for in divers ways. The mouse was said to be endowed with the gift of prophecy, and was in consequence associated with the god who possessed wisdom as great as that of Zeus himself. Or, as Welbeck suggests, Apollo, as prototype of the Pied Piper of Hamelin, had freed the land from a plague of vermin, for deliverance from whose ravages the German peasants crowd their churches to this day. Of course, the solar theorist's, "darkening counsel by words without knowledge," see in the presence of the mouse in ancient shrines of the sun-god a further proof of polyonomy. But space must not be wasted on more than this bare reference, since the explanation which Mr. Lang suggests, although only as conjectural, seems conclusive. Seeking for parallel illustrations in both the Old and New World, their value increasing with the square of the distance, he finds the most striking one in the ancient Peruvian religion. The dynasty of the Incas boasted of descent from the sun, and the worship of that orb became the State religion, but, like Christianity with Paganism, it so far tolerated the older animal-worship which it supplanted as to collect the tribal animal gods into its temples, so that side by side with the Master of Life and the Sun were creatures small and great. "Just as in Peru the tribes adored 'vile and filthy' animals; just as the solar worship of the Incas subordinated these; just as the *huacas* of the beasts remained in the temples of the Peruvian Sun; so, we believe, the tribes along the Mediterranean coast had at some very remote pre historic period their animal *pacarissas*. These were subordinated to the religion (to some extent solar) of Apollo, and the *huacas*, or animal idols, survived in Apollo's temples."† That is to say, Apollo as mouse-god is totemic. The barbarous ancestors of the Greeks believed, as do barbarous races still, in their descent from animals or plants, known as their *totem*—a belief which profoundly affects their social relations and customs, preventing unions between sexes of the same totem-name, and the eating of the creature from which descent is claimed. Of the belief in their mouse-ancestry among primitive Greek tribes, proofs occur both in place-names and badges, and although there is an alternative explanation of the consecration of mice to Apollo as votive offerings, it can scarcely be entertained in face of the corroborative evidence of like survivals in remote religions, and among different races. Of these survivals another and very curious example is the use of the same instrument in the Bacchic customs attending the worship of Dionysus, and in barbaric ritual. This instrument consists of a piece of wood sharpened at both ends, to one of which string is fastened. Twisted about the finger and whirled round and round, it makes a booming din dear to the noise-loving boys, by whom it was known as the "bull-roarer." But among both ancient and modern barbarians it acquired a sacred and magic character. It is found in use at this day among barbaric tribes in both hemispheres as a signal summoning the men together for performance of certain mysterious and secret celebrations, and at the same time waving off the women under pain of death. Mr. Lang cites evidence of its use in the Dionysiac mysteries from classic and patristic authorities, and draws the conclusions which the anthropologist must endorse—that, if we find so easily-invented an instrument as the "bull-roarer" in the mysteries of the most civilised of ancient peoples, the most probable explanation is, that the Greeks retained both the mysteries, the bull-roarer, the habit of bedaubing the initiate, the torturing of boys, the sacred absurdities, the antics with serpents, the dances and the like, from the time when their ancestors were in the savage condition.* Space does not allow other than meagre reference to the chapters on "Star Myths," the "Divining Rod," and the "Moly and Mandragora." In the first of these the names of stars (the finding of which was to the old lady a greater marvel than the ascertainment of their constitutions and distances), both singly and in groups, retained on our celestial charts and globes, constellations in which we can see no likeness of anything in heaven above or earth beneath, are shown to be the survivals of savage conceptions of the heavenly bodies as living beings. In the latter of these chapters the lingering superstitions in virtue, and even consciousness, residing in sticks and grotesque-looking objects, are illustrated with abundance of apposite fact.

The chapter entitled "A Far-Travelled Tale" should be read in conjunction with Mr. Long's introduction to "Grimm's Stories,"† as dealing with the intricate and interesting subject of the mode of diffusion of tales widespread as the myth of Jason. For behind that subject lies the larger question of the movements and intermixture of races, upon which the possession of legends common to them all may throw light.

SOME BOOKS ON OUR TABLE.

Tables and Memoranda for Mechanics, Engineers, Architects, &c. By Francis Smith. (London: Crosby Lockwood & Co. 1885.)—Into a tiny volume $2\frac{3}{4}$ in. long, $1\frac{7}{8}$ in. wide, and $\frac{3}{8}$ in. thick, Mr. Smith has contrived to pack an enormous amount of information, of daily and even hourly use among those for whom it is intended. Weights, measures, "quantities" of all descriptions, surveying, trigonometry, agricultural memoranda, rules and memoranda in connection with steam-engines and boilers, knots and splices, and even "useful suggestions in cases of accident or illness," are a few of the multifarious subjects

* Pp. 49, 50. † Page 107.

* P. 77.
† *Vid.* "Grimm's Household Stories." 2 vols. Bell & Sons.

dealt with in a book which may be easily carried in the waistcoat pocket.

Dental Caries. By Henry Sewill, M.R.C.S. and L.D.S. (London: Baillière, Tindall, & Cox. 1884.)—We have heard a dentist declare that, fifty years hence, there will not be a man, woman, or child in the kingdom with a sound set of teeth in his or her head. Even if we regard this as a species of professional hyperbole, the fact remains that caries (or decay) of the teeth is becoming most alarmingly common, and hence the interest of Mr. Sewill's book, not only to the members of his own profession, but to millions in every rank of life. He deals in great detail with the whole subject, explaining the causes, symptoms, and effects of caries in a very intelligible manner. Probably, though, the chapter on "The Prevention of Dental Caries" is that which is of the more immediate importance to the non-professional reader, to whose perusal we commend it.

Methods and Results. Report of a Conference on Gravity Determinations. (Washington: Government Printing-office. 1883.)—In consequence of a letter addressed by Lieut.-Colonel Herschel, R.E., to the Superintendent of the United States Coast and Geodetic Survey, relative to the best method of prosecuting pendulum observations, and their scientific value, a conference met at the Coast Survey Office in May, 1882, the report of which lies before us. Of the great importance of the results of accurately-conducted pendulum experiments to the Geodesist, the Physicist, and even the Geologist, it is needless to insist here; and the very practical suggestions in this Report can scarcely fail to be of the highest value to all who are either personally engaged in such experiments, or may afterwards have to employ their results either for study or calculation.

Destiny; or Man's Will-means and Will-ends. By Arthur Young. (London: Houlston & Sons.)—This astonishing work consists of thirty-one diagrams, with accompanying (we hardly like to call it descriptive) letter-press. Diagram 1 looks like the Union Jack reposing on a circular diatom; on each of the eight arms of which is written the name of some axis—"spirit," or the like. Then, after the repetition of this arrangement in diagram 2, we have a series of black crosses, studded with discs, containing eight armed crosses, each arm, or rather each opposite pair of arms, being inscribed with the name of some science, art, mode of feeling, &c. As a specimen of the extremely intelligible character of the explanation (?) of these marvellous hieroglyphics given by their author, we quote, absolutely at random, from the bottom of page 7:—"6. The Deductive-Explications of Man's Intellect means-of-space, as Positive Pole of his Will-Necessity-Means, conclude this reading, and give us the Generalisations and Classifications of the Will-Means of Analogy as Concomitant of his Trinity (Father, Mother, Child) of Collectivity's Vocations of Aspiration,"— Need we quote further?

The Assay and Analysis of Iron and Steel. By Thomas Bayley. (London: E. & F. N. Spon. 1884.)—In a volume so compact and portable that it may be easily carried in the pocket, Mr. Bayley has furnished the metallurgist and assayer with a most valuable little manual on the analysis of iron and steel. No one possessing a moderate acquaintance with practical chemistry need be at a loss for a single instant with this work in his hands. The directions are as plain and perspicuous as they can be, and are supplemented by woodcuts of all the apparatus employed, tables of atomic weights, &c. Mr. Bayley has produced an extremely useful book.

Origin of Cultivated Plants, by Alphonse de Candolle, International Scientific Series. (London: Kegan, Paul, Trench, & Co., 1884.)—Indispensable to the professed botanist. M. de Candolle's exhaustive work must commend itself to a wide circle of more general readers from the mass of information it contains on a subject in which we have all so direct a personal interest. No less than 247 species of plants are traced to their origin in the volume before us, which displays an amount of erudition, to say nothing of painstaking labour, which cannot fail to impress the reader, and give him confidence in the conclusions of the author. Many of his results are sufficiently striking. We learn, for example, that while wheat, beans, lentils, the fig, millet, the olive, and rice have been in cultivation for many thousands of years, the potato, the Jerusalem artichoke, tobacco, the capsicum, the pineapple, and the tomato have only been cultivated within a comparatively recent period; while many of our ordinary vegetables occupy intermediate positions in the chronology of the subject. The study of a book so worthily sustaining the reputation of its predecessors in the same series cannot fail to indue economic botany with a new and additional interest; and to all who wish to learn the origin and history of many of their most familiar forms of food, clothing, medicine, &c., derived from the vegetable world, we can commend M. de Candolle's book. His discussion of the history of flax (pp. 119 to 130) will serve as an example of the thoroughness of his research.

Madness and Crime. By Clark Bell. Reprinted from the *Medico-Legal Journal*, New York, 1884.—The mad doctors (we humbly apologise, we mean the "Professors of Psychological Medicine") seem to be making a strenuous effort, at the present moment, to interfere with the administration of criminal justice in a fashion which we venture to think is opposed to some of the most rudimentary principles of our jurisprudence. These gentry appear to hold a tacit theory that no man ever commits a murder when he is sane; that their dictum is to settle the question of the amount of insanity which, so to speak, absolves a prisoner from responsibility, and, in fact, that a judge and jury are rather incumbrances and hindrances than otherwise, when the question of punishing a more than usually savage murderer is concerned. Of course, they do not say this, *totidem verbis.* Their utterances are much more euphemistic; but they are certainly putting forth claims in the direction at which we have hinted, the recognition of which can scarcely fail to do serious mischief. If it goes forth that eccentricity is an excuse for murder, no man's life will be safe. The sole object of capital punishment is the protection of society; and if hanging one murderer suffering under a delusion (always supposing that he knows that he is committing a crime) will save the lives of half a dozen peaceable citizens only, then should he be hanged straightway and without compunction.

Brickwork. By F. Walker. (Weale's Series.) (London: Crosby, Lockwood, & Co. 1885.)—This is an admirable practical manual for the bricklayer; one of its distinctive recommendations residing in the fact that it not only gives explicit directions for the merely manual operations of bricklaying, but explains the theory of them as well. The advantage to the artificer of not merely knowing how to do a thing, but why to do it, is inestimable. The chapter on Geometry as applied to the art cannot fail to be useful to the workman who aspires to excel in it. Nor is this little volume without its value for every one about to build either on a large or small scale; as the explanations given of the mode of getting out foundations, of the various forms of "bond," &c., may enable the owner to detect scamping, and the improper use of the material employed.

A Synopsis of Elementary Results in Pure and Applied Mathematics. By G. S. Carr, M.A. (London: F. Hodgson. 1884.)—Sections X., XI., and XII., of Mr. Carr's first volume lie before us, and include a mass of examples in the Calculus of Variations, Differential Equations, &c., &c.; comprising propositions, formulæ, and methods of analysis, with abridged demonstration. The mathematical student will derive real assistance from this synopsis, which is the outcome of an obviously enormous amount of honest work.

Evolution in History, Language, and Science. Four addresses delivered at the commencement of the Twenty-fifth Session (1884–85) of the Crystal Palace Company's School of Art, Science, and Literature. (London: Crystal Palace Company. 1884.)—The addresses collected under the above title were delivered by Dr. Zerffi, the Rev. W. Hales, Mr. H. E. Malden, and the Rev. R. Thornton, and deal respectively with the study of general history, the scientific study of geography, hereditary tendencies as exhibited in history, and vicissitudes of the English language. Those who have the interests of education at heart, as contradistinguished from the detestable system of cram now in vogue, may profit by the perusal of these lectures. If they afford anything like a faithful reflex of the system and character of the instruction in the schools whence they issue, then may the Crystal Palace Company congratulate itself on worthily ministering to the educational wants of the country.

Christmas Gleams. Edited by W. E. Hodgson. (Glasgow: David Bryce & Son. 1884.)—Poems, ghost stories (satisfactorily cleared up), and other tales, by such contributors as Mr. W. H. Mallock, Mrs. Lynn Linton, Lord Rosslyn, &c., make up this Christmas number.

Romance and Reality. By Francis Neale. (London: J. W. Palmer & Co.)—This is the biography of a man who, beginning as a child by selling for sixpence a blue Cape triangular postage-stamp, which he picked up in the street in Hackney, has become one of the largest stamp-dealers in the world.

The Compendious Calculator. By Daniel O'Gorman, corrected and extended by J. R. Young. 26th Edition. Revised by C. Norris. (London: Crosby Lockwood & Co. 1885).—This is the twenty-sixth edition of that well-known work, O'Gorman's "Intuitive Calculations," a fact testifying, perhaps, as strongly to its value as any that could be adduced. It would be difficult to exaggerate the usefulness of a book like this to every one engaged in commerce, or manufacturing industry. Crammed full as it is with rules and formulæ for shortening and employing calculations in money, weights, and measures of every sort and description. Without selecting an example from either of the divisions devoted to a special trade, we will pick one out at random from what we may term the more general part of the work. To multiply by any number of nines. Rule: Add as many ciphers to the right-hand of the multiplicand as there are nines in the multiplier, and from the result subtract the original multiplicand, the remainder will be the product. Multiply 2368 by 999.

$$\begin{array}{lr} & 2368000 \\ & 2368 \\ \text{Product} & \underline{2365632} \end{array}$$

The whole work is full of similar "dodges" for shortening and simplifying calculation.

Before I Began to Speak. By a Baby. (London: Fleet Printing Works.)—The particularly precocious infant who relates his prelocutory experiences in this little tract, gives numerous hints as to the management of babies generally, which may be studied with profit by all to whose charge they are committed.

We have also on our table, *In the Watches of the Night*, Vol. 5 (Remington & Co.), *Our Monthly* (Rangoon), *The Tricyclist*, and the *Medical Press and Circular.*

Miscellanea.

A New Process of Photographic Printing.—The idea of coating paper with a gelatino-bromide of silver followed obviously enough on the successful employment of the same compound for the production of negatives, and many attempts have been made to produce in this manner a paper which might give results equal to those of the process which is always known as silver printing, and at the same time be so sensitive to light as to allow the image to be impressed on it in a few seconds, instead of requiring an exposure often of hours. . . . . . The difficulty of procuring warmth of tone and consequent brilliancy in the picture seems now to have been overcome in a new material which Messrs. Marion, the photographic dealers of Soho-square, have produced and are about to supply commercially. . . . . . The paper is obviously coated with a gelatine emulsion of some sort, and in all probability rival experiments will before long find out its precise nature. As regards the results producible by its means, their value does not seem to admit of much doubt. No industrial process can properly be termed successful till it has stood the test of regular commercial work; but it is at all events safe to say that no improvement of such promise has been introduced into photography since the advent of gelatine plates. . . . The whole process of producing a couple of dozen prints need not take an hour. Allowing time for washing, mounting, and finishing, an energetic man can, if required, supply his customers with their likenesses the next day after the portraits are taken. In these dark, short, winter days, it may be weeks before a photographer gets light enough to print a batch of pictures; but by Messrs. Marion's invention the whole thing can be done by gaslight. The process of working the paper is quite simple. As may be supposed, the image has to be "developed"—that is, no visible image is produced by the exposure to light. Consequently, the exposure has to be estimated, as it has in taking a portrait or a view. The development is effected in very much the same way as if an ordinary gelatine plate were under treatment, the developer being a weak solution of ferrous oxalate. After development the image is of a rich purple; but as this would change in the final, or "fixing" bath, it is necessary to "tone" the picture, as is done with an ordinary silver print, in a solution containing gold. After this the picture is "fixed" in the usual manner. Considerable variety of tone can be produced, the tints ranging from a warm red brown to a purple or even black.—Abridged from the *Times* of Nov. 24.

Anti-Vaccination Curiosities.—The anti-vaccination craze is by itself one of the most instructive and at the same time amusing developments of nineteenth-century sentimentalism; but it also affords an unpleasant study in the sordid relations it is forced into by those who promote it as a means of livelihood. Could we entirely separate it from this connection, and regard it solely as the possession of well-meaning but uninformed enthusiasts, it would be possible to tolerate it without any very great feeling of disgust; but since the movement has been adopted, like its companion delusion anti-vivisection, for merely trade purposes of advertisement, it has necessarily become degraded from the level it might easily occupy as a phase of eccentric mental activity. We have recently been deluged with the literature of subscription-loving agitators in reference to this subject, but the most recent of these productions is so startling in its intention, and so decidedly original in conception, that it almost deserves to be rescued from the oblivion which is the usual fate of such emanations. The communication is illustrated with the heading, "The Government Censured;" but adherents of the Ministry will recover from the momentary shiver induced by these ominous words when they discover that the censuring body is the "London Society for the Abolition," &c., which, it appears, recently assembled to pass the following resolution:—"That the conduct of the Medical Department in encouraging the profession to ignore vaccination as a cause of death in certificates and at inquests; and in their creation of unnecessary panic during the slight prevalence of small-pox, with the view thereby of inducing weak-minded persons to submit to vaccination and revaccination, merits severe condemnation by the Government." Accustomed though we are to the absurdities of conduct necessarily imposed on agitators who have to appeal for support to the unthinking and ignorant classes of the population, still this precious idea of "censuring" the Government strikes us as a master-stroke of policy. There are hundreds, nay, probably thousands, of deluded parents who will accept it as a vital blow to vaccination, and, in consequence, will submit themselves, their children, and their neighbours to the risk of infection, in the mistaken belief that their "rights" are being defended with success by the Society which receives their pennies. But its most vicious effect will be found in the false feeling of security encouraged by the insinuation that small-pox is a bogey, and the further explicit declaration that pro-vaccinators are "weak-minded." If there is anything the foolish among mankind dread more than another, it is the very charge of possessing a "weak" mind, and the "Society" has shown a most crafty wisdom in selecting it as a weapon with which to wound its wavering adherents and compel them to submission.—*Medical Press and Circular.*

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

A SELF-LIGHTING GAS-BURNER AND TAP.

Many, and, sometimes—as in the present instance—almost magical, are the domestically-directed inventions of the day. Prominent among these must be numbered the 'Patent Self-Lighting Gas-Burner and Tap, recently invented by Mr. Kinnear. This appliance obviates the necessity of relighting the gas, the turning of the tap at once effecting the purpose. The invention consists in the employment of a lighter or auxiliary burner for automatically lighting the main burner when the tap is turned on. By this operation the auxiliary burner, which allows only a mere pin-head jet of gas to burn, is shut off, while, when the tap is turned on, the main light is extinguished and the tiny flame of the auxiliary burner again lighted. The appliance consists of a double-way tap having a main way direct through the plug, and leading to the main burner, and also an auxiliary way round the surface of the plug leading to the lighter or auxiliary burner. When the main way is fully opened, by turning on the tap, and the main burner fully alight, the auxiliary way is entirely closed, and the lighter extinguished. When the main way is entirely closed the auxiliary way is open, allowing sufficient gas to pass through to keep a small pin-head jet only burning, which forms the lighter. As the plug is being turned on to open the main way to the burner, it automatically opens the auxiliary way to the full extent (by means of the way connecting the main with the auxiliary ways), whereupon the lighter flares up and ignites the gas, which is then slightly on at the main burner, and as the plug is turned on to the full extent, the main way is gradually opened, and at the same time the auxiliary way is automatically closed until when the main is full on and the burner fully alight, the auxiliary way is shut off, and the lighter is entirely extinguished. On the plug being again turned off the reverse operation takes place, and the lighter is again left with the pin-head jet burning. This useful appliance can be fixed to all existing fittings, by any inexperienced person, and will fit all makes of fittings, while the selling-price of well-finished taps and burners is at 4s. each, and even less.

AN APPARATUS FOR PRODUCING STEAM OR VAPOUR.

The ready and economic production of steam is a desideratum to many. Mr. Johan Millén, of Queen Victoria-street, London, has invented an apparatus which, it is claimed, produces, easily and cheaply, steam or vapour, alone, or mixed, if desired, with hot air. According to a modified arrangement, the steam or vapour jet is caused to enter a hot air jacket by preference at or near the top, and into a kind of cock or thimble or valve which admits the cold air to the jacket, or to a passage provided on it and communicating therewith by a row of holes. The required heat for evaporating or vaporising the water and heating the air is produced by a burner arranged underneath the water vessel and made to burn the vapour of petroleum, or other hydrocarbon or spirits.

AN IMPROVED FIRE-GRATE.

There seems no end of inventions designed to evolve at last the perfect fire-grate. One of the latest endeavours in this direction is the invention of Mr. James Smith, Pine-street, Liverpool, and has for its object to provide a fire-place and grate constructed in such a manner that bituminous coal, or similar carbonaceous fuel, will burn so as to produce a clear, bright fire emitting little or no smoke. The invention consists in constructing a combined fireplace and grate in a novel manner, so that coking and combustion of the fuel are effected in separate parts of the grate, and the air required for combustion is heated and admitted to the fuel as is necessary. The fireplace consists of a chamber or recess partly separated from the flue by an abutment or partition. The grate consists of firebars and sides of suitable construction, the bottom and back have each an air opening (or several) and valves or dampers. Below the lowest bar of the grate there is a coking-chamber, and when the grate is fitted into its place an air-space is left below and at the back, through which air passes past the valves or dampers through the bottom and back of the fireplace to support combustion. The grate is moreover provided with a movable or detachable front, which enables the same to be readily cleaned.

ORNAMENTAL WALLS, CEILINGS, &c.

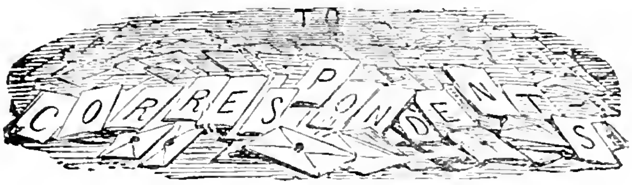
One of the happiest and most encouraging signs of the day is the increasing attention paid to interior ornamentation. There is really no longer reason why decorated walls, ceilings, and pavements should belong only to the very rich, and it is quite certain that the advance of domestic decoration among the majority must *pari passu* include a corresponding advance in national culture. We are glad, therefore, to note that Mr. John Baker Gainsby, of Lower Temple-street, Birmingham, has patented some notable improvements in constructing ornamental walls, ceilings, pavements, and other surfaces. The invention referred to consists of certain improvements in connecting pieces or plates of glass, enamel, or other ornamental material of which the ornament is made, and of methods of attaching the plates to the surface to be ornamented. As an illustration, the construction of a wall ornamented by a design composed of pieces or plates of enamel will be described. In order to connect the several pieces, strips of brass or other ductile material are used. Their shape in cross section is that of a T, or plain narrow strips with pins on the underside may be used. These strips are soldered together in lengths, so as to form a frame into which the pieces of enamel may be inserted from the back, the head of the T strips being in front and bearing upon the edges of the pieces of enamel. At the back the strips may have pins, studs, or projections, allowing the same to be fixed on the wall. The pins may be made to enter the plaster or cement on the wall before it has set. The frame containing the enamel plates may, however, be made with a backing of cement, and thus be formed into solid slabs, which are then used in the same manner as other slabs; or a back-plate of wood may be secured on the wall by screws or the like, and the ornamental slab be fixed thereon.

DOOR-LOCK FURNITURE, &c.

There is ample scope for inventive ingenuity, as we have already observed, for improvement in door and window furniture generally, to employ the builders' phraseology. Messrs. Jelley, Son, & Jones, the manufacturing ironmongers of Blackfriars-road, are now introducing a useful, and, as it certainly seems, a commendable invention known as Jones & Cunningham's patent self-adjusting door-lock furniture, which embodies a very excellent, though simple, improvement. It can be adjusted to any thickness of door, being provided with a tooth spindle, into which a rocking lever is pushed and secured by a sliding rose. Another invention is Jones & Cunningham's patented guarded-lever sash-fastener, which is provided on the hook-plate with a slide or shield for the protection of the arm or bar of the fastening.

A NEW COFFEE-MAKING APPARATUS.

Coffee in England is rarely what it should be, and the fault lies mostly in the manner of making. A well-known Professor has recently been devoting some thought to the subject of coffee-making, and this is, after all, more generally useful than transcendental philosophy; and as the net and satisfactory results, a new coffee-making apparatus (the "Criterion" Cafétière, Arndt's patent) has been constructed, after three years of experiment. It has been established as a fact that the exact time necessary to filter boiling water through coffee so as to completely extract its wholesome constituents is eight minutes, the quantity of coffee-beans and water being always fixed in certain proportions. On this period of filtration the makers base the sizes of their machines, which are made with mathematical accuracy to five different capacities, calculated to give from two to twelve cups of coffee. In these machines, the receptacle for ground coffee being closed at the top by a movable gauze lid, the water is obliged to pass through the immovable layer of coffee, and to extract its essence uniformly, at the same time making up the most valuable volatile constituents, thereby preventing the escape of the same. The wholesale agent for the "Criterion" Cafétière is Mr. Thomas P. Cook, 34, Snow-hill, London.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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EUCLID'S THEORY OF PARALLELS.

[1542]—In letter 1,495, Mr. C. L. Dodgson seems to imply that a proposition is not truly the converse of another unless it follows immediately from that other. This is by no means the case. The proposition that "all animals are men" is the converse of the proposition that "all men are animals;" yet one is true the other false. With regard to my comparison, at p. 337, between Euclid I., 17, and the 12th axiom, the point to be noticed is that the two propositions are equally far from being axiomatic: or if there is any difference Prop. 17 is the more nearly axiomatic; for it is only a general proposition, whereas Axiom 12 is exact, implying as it does that no matter how minute the deficiency of the two angles from two right angles, the two lines will meet. The best proof that Prop. 17 is the simpler of the two is found by comparing the results when the method of superposition is applied. The truth of Axiom 12 is only proved—even in mere sketch I presented—by a rather long process; but here is the proof for Prop. 17:—

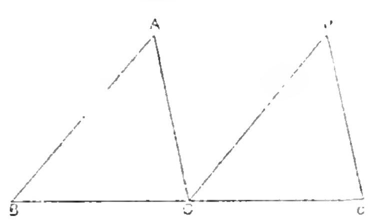


Fig. 1.

Produce the side B C of the triangle A B C (Fig. 1) to *c*, so that C *c* is equal to B C. Apply the triangle A B C to C *c* so that B C coincides with C *c*. We may suppose this done by sliding the whole triangle A B C along B C *c*. Then obviously the line B A will fall into such a position as C *a*, wholly on the right of A B. Hence the two angles A B C, A C B together are equal to the angles *a* C *c*, A C B together,—or fall short of two right angles by the angle A C *a*.

In like manner Prop. 16 may be proved,—or made obvious.

As to Mr. Dodgson's second objection, he does not show that K L is *not* obviously equal to C H. This is obvious from a consideration of the method of superposition employed. He goes on to a proof depending on the proposition that if two triangles have the three sides of the one equal respectively to the three sides of the other, they are equal in all respects. But I wished to use only considerations based on the effect of superposition. Of course Prop. 32 can easily be proved by a simple method of superposition. Indeed Prop. 32 has almost as good a right as Prop. 16 or Prop. 17 to be regarded as axiomatic. If we adopt the idea of an angle as produced by the turning of a straight line round a point, the line moving in one plane, Prop. 32 comes out from very simple considerations, thus:—

1. Suppose A B (Fig. 2) to represent two coincident straight lines, and one of these to turn round the point C, moving in one plane, to the position D C E: then B C D is the angle thus swept out.

2. It matters nothing so far as the angle between the two lines is concerned whether the turning be round the point C or another point as F (to position G F H), so that the amount of turning is the

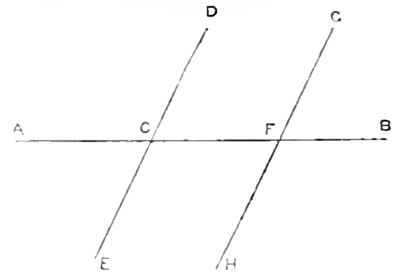


Fig. 2.

same,—that is, the angle G F B (tested by superposition) equal to the angle D C B.

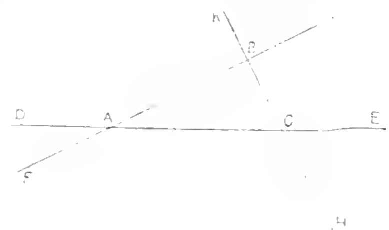


Fig. 3.

3. Now let A B C be any triangle, and let its sides be all produced both ways, as in Fig. 3, the line D A C E so formed being supposed double. Let one of these lines turn around the point A to the position F A B G, sweeping out the angle B A C. F A B G is now double. Let our component of this double line turn around the point B to the position H C B K, sweeping out the angle A B C. H C B K is now double. Let one of its components be turned around the point C to the position E C A D, sweeping out the angle B C A. Then a straight line originally coinciding with D A C E has been so turned as to measure in succession the three angles of the triangle A B C, and is found at the end of the process to coincide again with the line D A C E, but so that the ends which had been towards D and E are now towards E and D respectively. In other words, it has made half a rotation, or has swept out two right angles. Hence the angles of the triangle A B C are together equal to three right angles.

The third objection in Mr. Dodgson's letter is apparently based on the idea that Simson's axiom, "There cannot be two parallels, through a given point, to the same straight line," refers to parallels as negatively defined by Euclid. If this had been the case, Simson's axiom would be less axiomatic even than Axiom 12. It would, in fact, be simply another form of Axiom 12, only without the definite statement which at least enables the student to grasp the meaning of the statement. My definition of parallels includes, as a consequence, the property which Euclid assigns to parallels, and since I prove that not more than one line fulfilling the positive property I assign to parallels can be drawn through a point, so as to be parallel to a given line, I in effect prove that not more than one parallel as defined by Euclid (*i.e.*, negatively) can be so drawn. RICHARD A. PROCTOR.

New York, Nov. 27, 1884.

MATTER.

[1543]—In Letter 1,534 your correspondent F. W. H. gives an extract from Haeckel's "Pedigree of Man," in which it is said that "we must hold that atoms are the smallest particles of masses, *having an unalterable nature*, separated from one another by hypothetical ether." On reading this passage the question will naturally occur to every thoughtful person, What basis can there be for that part of the statement which I have underlined? What claim has it, even if uttered by the highest authority, upon our acceptance? The answer seems to me to be contained in some sentences written by the late Professor Clifford in his "Ethics of Belief." There he says:—"He [referring to a person making a statement similar to the one just quoted] may quite honestly believe that this statement is a fair inference from his experiments but in that case his judgment is at fault." "I have no right to believe this on his authority, for it is a thing which he cannot know without ceasing to be man." "No eminence of character and genius can give a man authority enough to justify us in believing him when he makes statements implying exact or universal knowledge."

Further on, in the quotation from Haeckel, we have: "Every atom has an inherent sum of force, and is, in this sense, gifted with a soul." Though we may not question the first part of this statement, is there any reason for our concluding that this "sum of force" is a sort of "soul," and can be expressed in terms of consciousness and will? Very probably, as Haeckel says, without a notion of attraction and repulsion, the phenomena of chemistry are inexplicable; but what warrant is there for making "pleasure" and "desire" concomitants of attraction, and "displeasure" and "loathing" concomitants of repulsion? *Is it for a moment conceivable that atoms are, or can be, conscious of their own movement?* To assert that two atoms of hydrogen and one of oxygen, or one of carbon and two of oxygen, *desire* to come into contact with each other appears to me to be not much different from a re-establishment of the polytheistic ideas of our rude forefathers.

J. T. ROUTLEDGE.

WHAT SHOULD THE EARTH CONSIST OF THEORETICALLY, IF LAPLACE'S "NEBULAR THEORY" IS CORRECT?

[1541]—A strong argument advanced in favour of the nebular theory of Kant, Laplace, and Herschel, is that the specific gravity of the planets varies inversely with their distance from the sun. The argument being that each planet possesses an average specific gravity which is equivalent to that possessed by the outer layer of the sun at the moment of that planet's separation from it. This theory appears to be approximately true, but it has yet to be shown why the earth, whose specific gravity is about 3, should be composed of many elements whose specific gravities differ widely from this figure. Surely the layer of the sun from which a planet was formed, being in a molten state, would contain elements whose specific gravities were the same as the average specific gravity of that layer, and, if these elements were in a liquid condition, still this would not explain the great differences in the specific gravities of terrestrial elements. The only way to account for the presence of elements in the earth—like platinum sp. gr. 22, or potassium, or lithium, at the other extreme—appears to be to assume that the heat caused by the rupture of each planetary ring would raise the temperature of the resulting planet to such a point as would cause the dissociation of the contained elements, which, on subsequent cooling, would form elements of higher specific gravity by condensation. GILES DAUBENEY.

[Whatever weight may attach to Mr. Daubeney's inferences, his numerical data are, to say the least, vague. To begin with, the specific gravity of the earth, instead of being 3·0, is really 5·67. It is true that that of Mercury is 7·0; but, while Saturn's is only 0·68, the specific gravity of Uranus is 0·99, and that of Neptune 0·96; which accords but indifferently with the notion of variation "inversely with their distance" from the sun.—ED.]

CURIOUS SUNSET.

[1545]—This evening, about 4 p.m., walking along the East Cliffs towards the town, I witnessed a remarkakle and somewhat unusual, sunset. The western sky, above the sun (which was hidden, as also a great part of the western horizon by the ridges of Kinkell Braes), seemed to be covered by a light-grey vapour—almost white, which shaded into the clear sky above without perceptible edge or break, as in ordinary clouds. Through rifts in this vapour, were clearly discerned bands of prismatic colours, as distinct as in the rainbow, but perhaps softer in tint, also the bands were broader. From the shape of the visible bands of colour it seemed as if they radiated from the setting sun in the same way as the fan-shaped pencils of light often seen on grey clouds in the west. They were all about the same height—rather less, I should think, than 45° above the horizon. The loose clouds floating in the clear sky above were deep purple-black, with a coppery tinge. I do not know if anything of the same kind has been observed in other places, or what the cause of this phenomenon could be.

25, South-street, St. Andrews, N.B. A. WERNER.

POWER OF PERCEPTION.

[1546]—To how many objects can we attend at once? Locke, Brown, Stewart, Reid say only one; but this assertion has been completely reduced to absurdity by Leibnitz, Hamilton, and others. Charles Bonnet and Bestutt-Tracey both say that six objects are the maximum, and Hamilton agrees with them. Tucker says four. I have just been testing the matter myself, though without arriving at any very distinct conclusions. I found, to begin with, that I could easily "concentrate my consciousness" on two objects—a matchbox and an inkpot. I added a knife, then a book, then a watch, and sixthly a bottle. I found that I could be still conscious of each and all of these objects without any noticeable mental confusion. I added three new objects simultaneously, and at first did not feel that the result was affected. But as I endeavoured to realise that, individually and collectively, *nine* objects were lying before me, I seemed to experience a mental check. I felt that, were those nine objects animated beings, I could not grasp all and the phenomena of all simultaneously. After trying other variations, I have come somewhat dubiously to the conclusion that six is the number nearest to correctness. If six is not right, seven is more right than five. What do readers of KNOWLEDGE think about it, may I ask? FRED. W. CLEWORTH.

[This is largely a matter of education. The incipient observer with the Transit Instrument is at first terribly puzzled at having to count the seconds ticked by the pendulum of his clock, to watch the star as it crosses the spider lines in succession; to estimate the second and tenth of a second at which it is actually on each "wire," and to write down his results all simultaneously; although, after sufficient practice, he does all this automatically. See, too, the account of the way in which the famous French conjurer, Robert Houdin, prepared for some of his tricks, as related by Dr. Carpenter on pp. 205 and 206 of his "Mental Physiology" (Fourth Edition).—ED.]

LETTERS RECEIVED AND SHORT ANSWERS.

F.R.C.P. To append prices, as you suggest, would be to convert descriptive articles into advertisements pure and simple; which is wholly foreign to our purpose.—AN ANONYMOUS CORRESPONDENT (whose letter bears the Chesterfield postmark) sends a leaf of the *English Mechanic* for Dec. 19, 1873. Why, I have not the smallest conception.—J. B. LIBBY. See KNOWLEDGE for Nov. 21, p. 431, column 2. My own impression is, though, that your object-glass is faulty.—J. W. ALEXANDER. Do you seriously suppose that the æther is *not* matter? !—ARCHITECT. No doubt, the people you name would understand the misapplied marks; but I am wholly in accord with the reviewer that this does not render their use less (scientifically) indefensible.—F. W. H. You wander too near the confines of forbidden ground to allow of the insertion of your letter.—SEPTUAGENARIUS. Your kindly letter is most gratifying. The only paper at all answering the description of that to which your query relates is *The Inquirer*, a Unitarian organ.—P. J. L. You apparently admit Swedenborg's assumptions. I regard him simply as a monomaniac, suffering under hallucinations; who was as much—or as little—inspired as "General" Booth. Hence I can recognise no validity whatever in your arguments.—J. T. ROUTLEDGE. To append the prices of books would be to make reviews merely publishers' advertisements. The work to which your question relates costs half-a-crown. In writing matter which is to be printed, please do so upon one side of the paper only.—W. S. C. Religion is a matter of fact; theology one of opinion. It would be utterly foreign to our purpose to pretend for an instant here to prescribe the limits of belief to yourself or anyone else. All that need be said is that scientific investigation must be conducted strictly by the scientific methods of observation and experiment, and that no craven fear of the consequences must be suffered to daunt the earnest and sincere seeker after Truth.—GEORGE LACY. I must refuse to be entrapped into a purely theological discussion. Would all the conventionalisms you yourself employ bear an absolutely rigid interpretation? You would probably speak of the Sun as he, the Moon as she, of "His Grace" the Duke of Puddledock, and so on, without any serious intention of imputing sex and personality to either of those luminaries, or graciousness to a man who may have figured in the Divorce Court.—WILLIAM JOHNSTON. Pray buy a shilling elementary book on mechanics. Its perusal may save you from such exhibitions as you make on your ninth page, and show you how utterly impossible it is that comets of long period can revolve round two separate suns! Apropos of your fourteenth page, would you be surprised to hear that the density of Mercury is 1·24 times that of the earth: that of Saturn only 0·12 of ours?—H. M. P. I imagine (but am not certain) that the preface is actually in type. I could not communicate the substance of your letter to its writer in time to insure any alteration—always supposing that *he* considered it necessary.—ST. J. H. Many thanks for all the trouble you have kindly taken, but the subject has already been thrashed out in these columns.—A. B. (Glasgow). I am very sorry to be compelled to decline to furnish the name of the manufacturer. You surely do not wish me to advertise what I denounced as a species of fraud—

J. W. P. I always regard the burning brandy which covers the pudding as "the Spirit of Christmas" myself.—George Willamson. (1) The position angle of a double star (never of a planet) is the angle made with the meridian by a line joining the two stars, the larger one of the pair being supposed to occupy the centre of the circle round which the angles are measured from north through east, south, and west to north again. (2) What we need to know is the direction in which the sun is moving, not the absolute distance of the stars. Star groups that appear to open we must be approaching, and receding from those that are closing up. (3) Each star (according to the experiments of Zöllner with his polarisation photometer) in the common scale of magnitudes emits 0·363 of the light of that preceding it.—J. W. Alexander. Rather too vague to print.—Constant Reader. How can I possibly advise you, unless I know what use you wish to make of your discovery?—Alfred Pagan suggests that the passage in Job xxxviii. 31 (which is translated from the Septuagint), "Canst thou . . . . loose the bands of Orion?" should rather be, "Canst thou loose the bands (or rings) of Saturn?" He founds this interpretation on the meaning of the word Kesil (which signifies, in Arabic, inactivity, cold, or torpor), since Saturn was called "the slow mover" by the Hindus. This is ingenious enough; but the interpretation of Aben Ezra strikes me as being more feasible: "Kimah" (the Pleiades) were the harbingers of spring; while Kesil, the great Toledan held, signified the Scorpion—or rather Antares, the chief star in that constellation—which heralded the advent of winter. This antithesis is very striking and poetical.—M. E. Mavrogordato. Your hint shall receive attention.—James Simson. The social emancipation of the gipsies is a question of far too limited interest to justify me in occupying space with it here. Great Queen-street doesn't exactly swarm with that interesting (if, perhaps, scarcely rigidly honest) race.

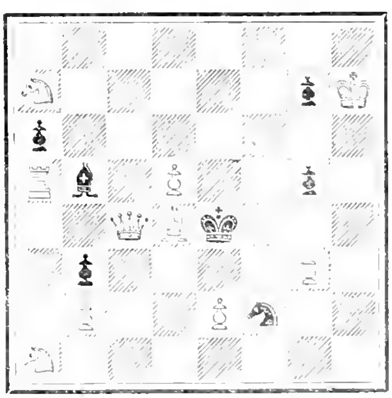
Our Chess Column.

By Mephisto.

PROBLEM No. 143.

By H. W. Sherrard.

Black.



White.

White to play and mate in three moves.

Is there a misprint in Problem 140? I find the following solution, which I presume is *not* the author's:—1. Because no use whatever is made of the W B on QKt6. 2. Because in the only four move line of play there is a "dual" at White's third move.

1. K to B5

Threatening "*either* Kt to B6 mate." Black cannot guard this square nor move his K. His only defences are R × P (giving the K *a square to move to*) and B to KB sq. (ch).

First Defence.

	R × P
2. Kt (Kt4) to B6 (ch)	K × R
3. Kt × KP *mate.*	

Second Defence.

	B to B sq. (ch)
2. R × B	
(Threatening the same mate with either Kt.)	
	R × B (best)
3. *Either* Kt to B6 (ch)	K to K5
4. R to KB4 mate	

W.

[We hope Mr. Laws will give a good account of himself, but we rather believe in W.—Ch. Ed.]

AN ILLUSTRATIVE GAME IN EVANS GAMBIT (COMPROMISED DEFENCE).

Played at Gatti's, November, 1884.

White. H. E. Bird.	Black. W. Seymour.	White. H. E. Bird.	Black. W. Seymour.
1. P to K4	P to K4	18. B to Kt sq.	Kt to K2
2. Kt to KB3	Kt to QB3	19. Q to B2	Kt to Kt3
3. B to B4	B to B4	20. Kt to R4	B to Kt2
4. P to QKt4	B × P	21. Kt to B5	KR to K sq. (*a*)
5. P to QB3	B to R4	22. Q to Q3 (*b*)	QR to Q sq. (*c*)
6. P to Q4	P × P	23. B to Kt3	P to R3
7. Q to Kt3	Q to B3	24. P to KR4	Kt to B sq. (*d*)
8. Castles	P × P	25. K to R2	B to B3
9. P to K5	Q to Kt3	26. Q to Q2	P to KR4 (*e*)
10. Kt × P	KKt to K2	27. Q to KKt5	P to KKt3 (*f*)
11. QKt to K2	P to Kt4	28. R × B (*g*)	Q × R
12. B to Q3	Q to K3	29. Kt to R6 (ch)	K to Kt2
13. Q to Kt2	Kt to Kt3	30. R to Q6 (*h*)	P × R
14. Kt to B4	Kt × Kt	31. Q to B6 (ch)	K × Kt (*i*)
15. B × Kt	P to KR3	32. Q to R8 (ch)	Kt to R2
16. QR to B sq.	Castles	33. B to B4 (ch)	P to Kt4
17. KR to Q sq.	B to Kt3	34. Q × Kt mate	

NOTES.

(*a*) Black dare not play Kt × B, on account of Kt to K7 (ch) and mates on R7.

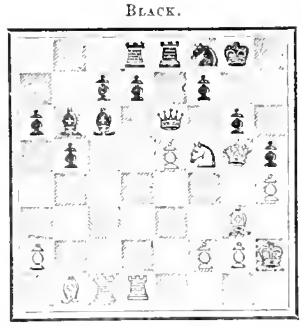
(*b*) An oversight.

(*c*) Overlooking that he can now play Kt × B, for if 23. Kt to K7 (ch), K to B sq., winning a piece.

(*d*) Weak. He should have played Kt × KP, thereby greatly reducing the pressure of the attack. If in reply to Kt × P White plays 25. B × Kt, Q × B. 26. R to K sq., Q to B3, or if 26. Kt × P (ch), P × Kt, in both cases Black has a valid defence.

Position after Black's 27th move.

Black.



White.

(*e*) This exposes his position still more to White's tempestuous attack.

(*f*) This move makes Black's position almost hopeless. White now proceeds in his well-known forcible style. (*See* Diagram.)

(*g*) Well calculated, but if now P × R. 29. R × R, R × R. 30. Kt to K7 (ch), K to R sq. (best). 31. Kt × P (ch), P × Kt, and Black has not a lost game. If 30. Q × R, P × Kt, and we fail to see Black's great disadvantage.

(*h*) An elegant device. White now secures a brilliant victory.

(*i*) If K to R2. 32. Q × P wins.

In the eighth of his series of lectures on "The World before Man," delivered at the Ipswich Museum, Dr. J. E. Taylor told an amusing story of the agates being "abundant in the neighbourhood of Aberystwith." They were imported from Saxony, and during the night scattered on the beach. Visitors picked them up, and the local lapidaries were then employed to polish them.

A New Brush Armature.—In order to obtain more lightness, coolness, and efficiency from the armature of the Brush dynamo, the American makers have introduced a core built up of iron riband instead of the old solid cast-iron core. A long band or riband of iron ·0625 in. thick is wound round a circular frame, and at intervals between each turn cross-pieces of the same thickness are inserted to separate the convolutions admitting air, and at the same time projecting on each side so as to form the V-shaped projections which hold the coils in place, and separate them from each other. About forty-five turns of the band are laid on. The new form is said to enable the machine to supply fifty arcs instead of the forty obtained from the older form at the same speed, namely, 750 revolutions per minute.—*Engineering.*

Our Whist Column.

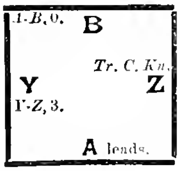
By Five of Clubs.

The following singular game was played recently in America. It is hardly necessary to say that *A-B* only win because of *Y-Z*'s very bad play. A case is on record, which we may present in our next, where Mr. Clay saved a game in a similar way. But he only got two leads, through the enemy's trump strength, here three had to be obtained:—

The Hands.

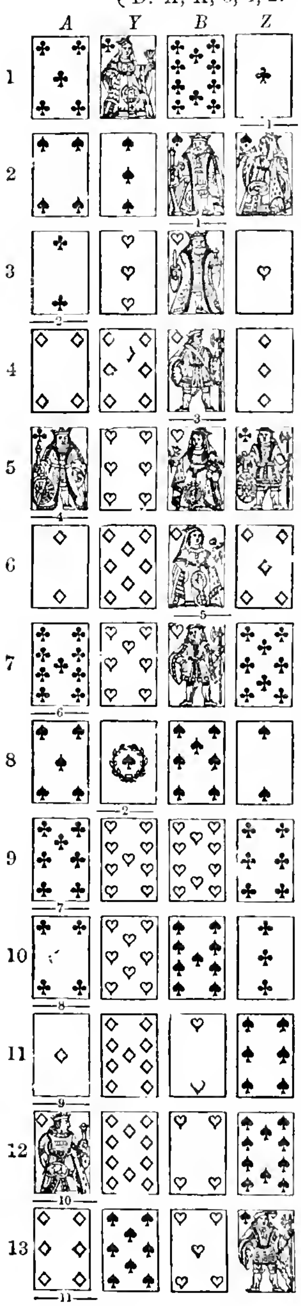
B { C. 10. D. Q, Kn. H. K, Q, Kn, 10, 5, 4, 2. S. K, 9, 7. }

Y { C. Q. D. 10, 9, 8, 7. S. A, 8, 3. H. 9, 8, 7, 6, 3. }



Z { 3, 6, 8, Kn, A. C. 3, 5. D. 2, 6, 10, Kn, Q. S. A. H. }

A { C. K, 9, 7, 5, 4, 2. D. A, K, 6, 4, 2. H. None. S. 5, 4. }



THE PLAY.

Card underlined wins trick.

1. *A* leads lowest but two, the ante-penultimate, to show he holds six. The fall of the cards shows that *Y* and *B* (observe trump card) have no more. *Y-Z* are two by honours, and *A-B* must make five by tricks to save the game. The case looks hopeless; and indeed only bad play on the part of *Y-Z* can give *A-B* a chance. Observe that *A* after this round holds best 3rd, 5th, 7th, and an odd trump, *Z* holding 2nd best, 4th, 6th, and 8th. This both *A* and *Z* knows.

2. *Z* holds Spade Knave and Ten, a rock ahead in *that* suit.

3. Of course *A* ruffs.

4. It is *almost* certain that *A-B* lose if *A* leads in the usual way from his long and strong Diamond suit. Suppose the 4th and 5th suits to fall to him, and the 6th to *B*'s Queen (*Y* holding two and *Z* three), and that then the 7th trick fell as the 5th in the actual play, *A* must then lead a Spade, or give Z a ruff. Now even if *B* holds the Space Ace, and leads a winning Heart, through *Z*'s trumps (making trick 9 like trick 7 in the actual game), *A* must then either lead from his tenace in trumps, in which case *Z* must make two tricks (whether best or lowest trump is led) or a Diamond, which *Z* would ruff, forcing *A* with Spade Knave, but making no more tricks. In this last case *alone* **A-B** would make their five tricks. All the chances are against this happening, and as the cards actually lay *Y-Z* would not only have made the necessary three tricks but four certain, and five if *Z* had declined the force. Without going through all this process of reasoning, *A* feels that the only good chance he and *B* have of making five by cards is by forcing Z with winning cards of *B*'s. If *B* does not hold Diam Qn the game is lost anyway. Therefore *A* leads a small Diam.

5. *B* leads his winning Heart, which *Z* unwisely ruffs. *B* rightly leads the Queen instead of the Ten, the usual card as second lead from that suit; for his object is to tempt Z to ruff, and Z would probably have passed the Ten.

6. *A* again leads a small Diamond, and

7. *B* leads the winning Heart, which *Z* again unwisely ruffs.

8. *A* knows that the lead must go to *Y* or *B*; either way, the Spade lead is safer than the Diamond, which *Z* would probably ruff, leading then a Spade and making the third trick.

9. *Y* plays very badly here,—in fact atrociously. He can count (or he could count if he had played with any attention) every suit. He ought to know his partner has no Diamonds, and therefore would ruff that suit and win. He ought to know his partner has the winning Spades, and that a Spade lead would force *A* and give *Y-Z* the third trick wanted for victory. But "because *A* had the winning Diamond," and "because *A* could trump Spades," (these were the reasons he gave afterwards) he leads from his head sequence in Hearts ("I expected one of them would make"). But even now, by letting the Ten make, *Z* would have saved the game. Whether *B* led a Heart or a Spade, *A* must have ruffed, and the one trick necessary to win the game would have been made by *Y-Z*.

10, 11, 12, 13. The rest of the game plays itself; *A-B* make five by cards and win.

A Little Whist Problem.—I have seen reference made of late to a whist problem examined by Mr. Pole, whose book on short whist is known to all whist players. (It is an excellent work except for the pestilent doctrine that the learner should always signal for trumps if he holds five—whereas the *learner* ought never to signal at all, and no good player would think of signalling *merely* because he held five trumps.) The problem is, what is the chance when you hold originally four of a suit that the suit will go round three times? I have examined the problem (in fact I had done so several years ago) with the following result; the numbers mentioned in which will probably surprise those who notice the matter for the first time. When you hold four of a suit you may have obtained those four cards in any one of 423,314,340,020 different ways; and in 66,905,856,160 of those, the three other players will each have received three cards of those suits. The chances, then, that the suit will go round thrice, are about 6,690 in 42,331, or say 67 in 424, not far from 3 in 19. The odds are 16 to 3, or more than 5 to 1, against the suit proving "honest."—*R. A. Proctor in "Newcastle Weekly Chronicle."*

From the *Iron Trade Circular* of Messrs. Bolling & Lowe we learn that the total quantity and value of exports of British iron and steel were, during the first eleven months of 1882, 4,062,215 tons (£29,301,039); of 1883, 3,765,192 tons (£26,517,163); of 1884, 3,267,490 tons (£22,707,708).

Contents of No. 164.

NOTICES.

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