THURSDAY, MARCH 14, 1878

THE LOCUST PLAGUE IN AMERICA

The Locust Plague in the United States; being more particularly a Treatise on the Rocky Mountain Locust, or so-called Grasshopper, as it occurs East of the Rocky Mountains, with Practical Recommendations for its Destruction. By Charles V. Riley, M.A., Ph.D., State Entomologist of Missouri, &c. With 45 Illustrations. (Chicago: Rand, McNally, and Co., 1877.)

THE greater part of this treatise has already appeared in the Entomological Reports published annually for some years past by Mr. Riley, as State Entomologist for Missouri, in which the information was given piecemeal from time to time as it was acquired. The whole is now brought together in a connected and systematic form, and we have in it a very complete and valuable treatise on the different kinds of locusts, whether species or varieties, which have proved destructive in North America. Ever since the discovery and colonisation of that continent the new settlements have been from time to time subject more or less to scarcities resulting from the invasions or migrations of these insects. These have gradually, however, become scarcer and scarcer, and confined more and more to the interior as the insects retreated before the advancing wave of civilisation and cultivation, until now their ravages do not extend eastwards beyond the 16th or 17th degree of longitude west of Washington; in other words, the regions lying to the east of the Mississippi are now nearly free from them, and it is only in those lying to the west of that river that their propagation and migrations take place on such a scale as seriously to affect the property and prosperity of the settlers. It is not that the species originally inhabiting the eastern coast have been gradually pushed back to the interior, but that the species peculiar to it have been reduced in number in the cultivated districts, and their *rôle* has been successively taken up by other species lying more inland as civilisation has gradually advanced. The species on which that mission has now devolved are two or three that have their home and permanent breeding-place in the Rocky Mountains—we say *permanent* in contradistinction to temporary breeding-place, because when they make their migrations, they often rest and breed at its furthest limit, the brood returning in the following year to the country from which their parents came, although not necessarily by the same route. The route by which they have hitherto invaded the countries to the east of their proper home in the Rocky Mountains has been from north-west to south-east. That by which the fresh-bred swarms sprung from the invaders have made their way back again next year, has been from south-east to north-west, but not absolutely in the same line by which their parents came, but either parallel to it or slightly divergent. Their course of invasion has been carefully traced for many years by Mr. Riley and others, and the fact of their return on their footsteps in this way is beyond question; but it is also beyond doubt that the new brood does not go back so strong or so numerous as their parents came. Their constitution appears to be sapped by the change of climate or condition of life; they are feeble and infested by parasites, so that a large proportion of them die a natural death—a consideration which doubtless explains why the vast swarms which have passed from one country to another in all ages and in all quarters of the globe, seem never to have made good a permanent footing in the country they have invaded; at all events never in numbers at all corresponding to the force of the intruders. This is no doubt but small consolation to settlers living on the borders of a locust-stricken land, but it is better than none—they would be still worse off if the locusts were to remain as a permanent incubus instead of only coming occasionally as a ravaging horde.

Of the amount of injury done by the invading hosts, especially during the more recent invasions of 1873 and following years, Mr. Riley gives a striking account. Where a territory of hundreds of miles in extent is struck with desolation in a few days or weeks through the ravages of an insect, it is scarcely possible to speak of it without exaggeration, and some qualification will almost certainly have to be made upon any estimate of the amount of damage supposed to have been sustained, especially when, as here, we know how little the data on which the estimates are founded are to be relied on. In Great Britain we have now an elaborate machinery by which reliable agricultural returns are obtained; the land, or most of it, has been measured and mapped out; the best means are taken to obtain true and correct returns, and when obtained they are checked by competent and trustworthy experts; so that no error of any magnitude can well creep in without detection. It is otherwise on the prairies west of Missouri. The admirable United States Surveys, although sufficiently perfect and on a sufficiently large scale to answer all general purposes, have no pretensions to such detail as we have adopted in our Ordnance Survey Maps, and no attempt is made to give the acreage of the different plots in cultivation (which, besides, would be useless, as it is an uncertain quantity, varying every year). At the best, therefore, there are no other means of estimating either the amount in cultivation or the amount of damage inflicted on it than an empirical estimate furnished by the farmers themselves, a mode of calculation open to many objections, and requiring much allowance. Still, giving the widest margin, enough remains behind to satisfy the hungriest appetite for startling results. If actual starvation did not come in the locusts' train, poverty and distress did. In 1874 the loss to three exposed, although thinly-peopled, states, Wyoming, Dakota, and Montana, is said to have been fifty millions of dollars; and in 1875 it was calculated that about three-quarters of a million of people were made sufferers on a strip of about twenty-five miles broad along the banks of the Missouri, from Omaha to Kansas.

Mr. Riley gives many statistics on such points. His information regarding the habits of the locusts and their enemies, and the best way of dealing with them, is also ample; and his scientific descriptions and natural history of the species in all their stages leave nothing to be desired. He even touches upon their value as food either with or without wild honey, and gives the results of his experience as to the best mode of cooking them. During a visit that he paid to this country, some two or three years ago, he brought some dried potted specimen with him; but that was scarcely fair play to the locusts, and we shall not say what we thought of them. Let us still be just. If we are to condemn them, let it only be after a trial when they are fresh and good. We have indeed tried them in their native country, pounded up with acorns and mashed into balls by the digger Indians of California; but then acorns would destroy any dish for civilised food, so that we prefer to leave the question of their culinary merits an open one for some gastronomic jury, stipulating only for the right of challenging Mr. Riley, as one of its members, on the score of undue favour and partiality arising from too intimate an acquaintance and familiarity with the individuals under trial.

A further contribution to the subject treated of by Mr. Riley has reached us in the shape of the first two *Bulletins* of the United States Entomological Commission. ANDREW MURRAY

ABNEY'S TREATISE ON PHOTOGRAPHY

A Treatise on Photography. By W. de Wiveleslie Abney, F.R.S. (London: Longmans and Co., 1878.)

ALL those interested in this most attractive study will welcome Capt. Abney's treatise on photography. Those who wish to become acquainted with the scientific principles on which the practice of photography depends will find in the opening chapters a clear and concise description of the theory of sensitive substances, and of the action of light on various compounds, whilst by studying the closing chapters of the volume they will be able to make themselves acquainted with the present state of our knowledge on the important subjects of actinometry, photo-spectroscopy, and the interesting discoveries made by the author and others on the sensitiveness of different salts, and the methods employed for obtaining pictures of the various portions of the spectrum. On the other hand, the artist photographer will find ample matter for interest in the chapter in which Capt. Abney most successfully lays down the rules which must guide the production of an artistic picture, pointing out the special difficulties under which the photographer lies in the choice of subjects in order to avoid incongruity or inartistic massing of light and shade, and showing the best mode of lighting and arranging the picture by choosing the right point of view for the camera. As an illustration of Capt. Abney's happy style and power of artistic treatment, we may quote the following description of a landscape:—

"In the next picture, we have the distance, or perhaps more strictly speaking, the middle distance as the point of interest. The horizon line is kept in the weakest part, the centre, of the picture. The trees in the foreground are so grouped that they frame the view with dark masses, relieved by the light foliage of some of the nearer bushes and shrubs. The foreground finishes at a distance of about ¼ from the bottom. More of it would take away from the value of the middle distance, as it would place it in the weakest part of the picture—viz., centrally; less of it would have rendered the picture bald, and have cut off part of the deeper shades which are so valuable in giving the effect of distance to the stream beyond. This picture would have been spoilt had the camera been so placed as to give more top foliage, since the bough which now partially crosses the picture at about ⅜ the height, would have caused an ugly division, and also the tops of the distant trees, and the sky would have appeared. This latter, in views such as that under criticism, is objectionable, as patches of white give the eye an inclination to wander off towards it, and it would have been an insufficient precaution to have printed in clouds from another negative, owing to the difficulty that would exist in subduing at the same time the lights on the leaves of the near trees. As it is, the picture is in pictorial focus. By placing the stream to the right or left, the balance would have been wanting, and its general direction would have been altered to such an extent as to have given a feeling that it was a subsidiary part of the picture instead of an essential."

Another important section of the work is devoted to the necessary, but unavoidably dry descriptions of the very numerous photographic processes and manipulations now in vogue, of the construction of apparatus, and a statement of the general laws of geometrical optics so far as concerns the principles on which the construction and use of photographic lenses depend. On all these subjects we find Capt. Abney's statements clear and concise.

Then again no book on photography would be complete without an explanation of the various processes of photo-lithography and photo-engraving, and accordingly we find a short account of the more important of these interesting methods of reproducing photographic effects. To one of these photo-relief printing processes, that discovered by Warnerke, with, we believe, the author's co-operation, we would especially draw attention, the picture being remarkable for the beauty and delicacy, as well as for the force and depth of its tones. The details of this process are not yet published; it cannot, however, be doubted that it is capable of producing the finest effects of a steel or copper-plate engraving.

It is, however, the scientific side of Capt. Abney's book which will especially interest the readers of NATURE. The explanation of the effect of vibration as setting up chemical change in the molecule is clearly set forth in Chapter III. The case in which the atoms are in a stable though verging on an indifferent equilibrium as with the sensitive mixture of chlorine and hydrogen, being well illustrated by the equilibrium of a frustum of a pyramid standing base uppermost on as narrow section of the base as we please. In these cases a very small amount of work is needed to make the systems take up more stable positions. Then "extending our previous illustration, supposing we had a row of such frusta of pyramids, and that it was found that one pellet of a number (all being of equal weight) when striking one frustum with a certain velocity was able to cause it to fall, and also that in every case the accuracy of aim was undoubted, and that in falling one frustum did not strike its neighbour, then at any interval after the commencement of a bombardment the amount of work expended in projecting the pellets could be compared by simply counting the number of frusta which had fallen" (p. 12). The question of the action of vibrations synchronous with the oscillations of the molecule on the stability of the molecule is next discussed, and the explanation rendered clear by a description of Rankine's well-known contrivance of the heavy and light pendulums. The difference between the decomposition of explosives and of bodies employed for photographic purposes in respect to the nature of the disturbing vibrations is thus pointed out. Explosives are affected by long wave rays, photographic actions as a rule being only set up by waves of short length. A description of the remarkable negative or reversing action effected by the red rays on the sensitised plate, first observed by H. Draper, is found in Chapter XXXIV. A partial explanation of this very interesting fact is given by the results of experiments lately made by Capt. Abney (*Phil. Mag.*, January, 1878), which show that the image can be rendered undevelopable by the oxidation of the altered silver compound forming it. Chastaing has also recently announced that he finds rapidity of oxidation promoted by the red rays. It is thus easy to see that the sensitive salt of silver which had been altered in chemical composition by a slight exposure to white light, would become oxidised where the red rays fell upon it, and that, in consequence, where the dark Fraunhofer's lines in the ultra red spectrum fell, the plate would remain unaffected and the presence of these invisible bands would become apparent.

Another subject of great interest, that of the production of coloured photographic images, is being attacked experimentally by Capt. Abney. The results of the experiments in this direction by Becquerel and Niépce de St. Victor are well known, and many of the visitors to the Loan Exhibition will remember the coloured photograph of dolls dressed in coloured clothes shown by the latter chemist. Abney believes that these tints are rather to be ascribed to different stages of oxidation of the film, than, as has hitherto been supposed, to the colours of thin plates. Then, again, on the subject of the recent discoveries by Vogel, Waterhouse, and others, as to the production of a film sensitive to the red rays by the addition of a red dye to the collodion, Capt. Abney has something original to say. He has found that the addition of certain resins, albumin, and other organic bodies, when combined with silver, tends to lower the limit of the impressible spectrum and the place of maximum sensibility; so much so, indeed, that it is possible to obtain an unreversed impression of the thermal spectrum. A beam of light was allowed to pass through ruby glass, and the spectrum was then thrown on a resinised plate in the ordinary manner, and a visible impression of rays in the red was obtained far beyond the limit of the visible spectrum, as is seen by a figure in the volume.

Enough has been said to show the value of Capt. Abney's treatise both from the scientific and artistic points of view. If we are to speak on the part of amateur photographers we would express a hope that the subject of the explanation of defects in negatives and their cure may be more fully treated of in the next edition. It is perhaps difficult for an accomplished photographer like the author to appreciate the difficulties of a beginner in the art, but the mere mention of some of the defects met with in negatives does not always, as the author states, suggest the cure to minds unfamiliar with the niceties of manipulation and procedure which to the expert come as a matter of course. We congratulate Capt. Abney on the appearance of this most useful volume. H. E. R.

OUR BOOK SHELF

Archæological Researches at Carnac, in Britanny. By James Miln. (Edinburgh: David Douglas.)

THIS beautiful book reflects great credit on its author. It would be difficult in the recent literature of archæology to point out a more salient example of the great gain which is sure to accrue to that branch of science from the introduction of the true scientific spirit, and attention to details. Carnac, in most people's minds, is associated with Druidical circles, and it was to see the wonderful alignments there that Mr. Miln visited the place. But while in the region the author was particularly struck with the remains belonging to a very different time, which were pointed out to Mr. Miln by a French archæologist. They are termed the mounds of the Bossenno. With characteristic energy Mr. Miln, who was determined to explore, endeavoured to buy in order that he might explore the better. In this, however, he was foiled, beset by too many difficulties. The permission to explore which he subsequently obtained does not appear to have been a very complete one, and after this big book full of matter our author states that much still remains to be done.

The results of the excavations so carefully carried out by Mr. Miln show that we have here the remains of a Gallo-Roman settlement, and he has reconstructed for us out of its ashes the condition of the people in former times. He has been enabled to give us precise information as to their food and the degree of luxury in which they indulged. Their worship, their ceremonies, and modes of manufacture, and the exact times between which the colony was in a flourishing condition are also fully discussed. He traces the local worship of Venus Genetrix, at the Mont St. Michael, in a most interesting manner. One of the oldest constructions which remains in Britanny is the chapel of St. Agatha. On the vault of the apse a few years ago was discovered one of the most curious frescoes which the Romans have left in Britanny. It represents Venus rising from a blue sea, surrounded by fishes and dolphins. This church, now dedicated to St. Vener, is styled "Ecclesia Sancti Veneris" in a twelfth century charter.

The beautiful illustrations comprise not only almost everything which was found, but large coloured plates of the chief coloured designs rescued here and there.

All antiquaries will do well to lay to heart the remarks on ancient pottery made by Mr. Miln *à propos* of his finds in the excavation which he designates A. He shows abundantly how much caution is requisite in such inquiries and how a careful sifting of facts brings order into what at first sight appears a hopeless jumble of objects. It is curious that some of the pottery he found there is similar to some in the Guildhall Museum, which was found at a depth of forty-two feet, when the ground was excavated for the foundations of the Royal Exchange.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Telephone

IN his interesting paper (NATURE, vol. xvii. p. 283) Mr. F. J. M. Page communicated as the result of his experiment to obtain indication of currents from a telephone by means of a mercury capillary tube, that the motion of the mercury was "always towards the end of the capillary." In the repetition of this experiment before the Physical Society on Saturday, February 16, Mr. Page found, however, that the mercury moved persistently in the opposite direction.

In the December (1876) number of the *Phil. Mag.* I showed that the motion of mercury in contact with dilute acid through which a current passes, is due to rapid circulation of the mercury set up by deoxidation of one part of its surface whilst another part is being oxidised; and that a very slight difference in the degree of oxidation is sufficient to produce an appreciable electromotive force.

When the mercury tube of the so-called electrometer is set up, the two surfaces of the mercury in contact with the acid are, I believe, almost always electrically unequal, that in the capillary being less oxidised than the other, and therefore positive to it. When the circuit is closed, a feeble current passes which, if it were strong enough, would move the mercury forwards. When a telephone is in action in the circuit, its equal and opposite currents combine alternately with the mercury current which strengthens the impulses in one direction and weakens those in the other; so that, whilst the sum of the telephone and mercury currents may be able to move the mercury in one direction, the difference of these currents is not able to move it in the other. Hence, I believe, arise the motions in question.

It of course follows that if, by accident, the potentials of the two mercury surfaces were equal, the telephone currents would produce no movement whatever in the mercury. Moreover if by variation of temperature, or by difference of strength of acid at the contact faces, or otherwise, the mercury surface in the capillary is rendered negative to the other surface, the accidental current set up will be in the opposite direction, and the tendency will be for the mercury to recede in the tube, as was observed in the experiment performed before the Physical Society.

Mr. Page's experiment will, I have no doubt, suggest a means of deducing the potentials of the telephone impulses.

ROBERT SABINE

AFTER reading the experiments of Prof. Forbes on the telephone, in NATURE, vol. xvii. p. 343, it occurred to me, as probably it has done to others, that this instrument might be employed in comparing the electrical resistances of wires. Accordingly, two weak cells were connected with the ordinary form of Wheatstone's bridge, and the telephone placed in the position usually occupied by the galvanometer. The current was rendered intermittent by a small electromagnetic apparatus belonging to an electric bell; the bell itself having been detached, the intermitter was placed in a separate room, and connected by long wires with the battery and bridge. The German silver wire of the bridge, having a resistance of ·2 ohms, was further lengthened at each end by resistance coils of ten ohms, and it was found that with a little practice one could easily compare two resistances of about two ohms within at least 1,000th of the true ratio.

It was found better to attach the sliding piece to the battery rather than the galvanometer, and it was exceedingly curious to notice the effect of moving the sliding piece so as to gradually diminish the difference of potential at the two terminals of the telephone, the sound diminishing until at last there seemed to be only a slight *uneasiness* produced in the ear, which ceased whenever the contact between the sliding piece and the German silver wire was broken. I have no doubt whatever that with a more delicate instrument than the one employed, which was apparently not nearly so sensitive as that used by Prof. Forbes, one could compare with considerable accuracy electrical resistances in this manner. Of course the telephone could also be employed instead of the galvanometer, in comparing the electromotive forces of batteries, and it is my intention to make more experiments in this direction.

By using a tuning-fork made to vibrate by electricity and a Helmholtz's resonator in conjunction with the telephone, the accuracy of testing may no doubt be largely increased.

HERBERT TOMLINSON

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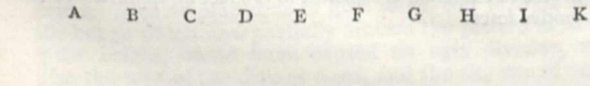
1. IF the cavities above and below the iron disc of an ordinary telephone are filled with wadding, the instrument will transmit and speak with undiminished clearness.

2. On placing a finger on the iron disc opposite the magnet, the instrument will transmit and speak distinctly. It only ceases to act when sufficient pressure is applied to bring plate and magnet into contact.

3. Connecting the centre of the disc by means of a short thread with an extremely sensitive membrane no sound is given out by the latter when a message is transmitted.

4. Ten telephones were connected as represented in the following diagram, on the principle of a battery joined for surface or quantity.

From transmitter—



A, B, C, &c., telephones.

On receiving a message from the transmitter *it could distinctly be heard through any of the ten instruments, although the current had been split up ten times.* (I have no doubt that a greater number of telephones might thus be joined with almost equal effect; from want of instruments I have not been able to find out the limit.)

The following experiments were made with a double telephone, constructed by a battery of horse-shoe magnets with iron cores at their ends. The wires on the bobbins were wound in opposite directions, as on an ordinary electro-magnet.

5. *On connecting the similar poles of the coils (as + and +) and joining the remaining similar poles (as − and −) to line wires the instrument both transmitted and spoke with equal distinctness.*

6. On placing the armature on the horse-shoe magnet no loss of power was perceptible in either transmitting or receiving, nor was there any increase of power on augmenting the number of magnets.

7. If the inner and outer coils of an induction coil are respectively connected with a transmitting and receiving instrument, sound can be distinctly transmitted in either direction.

8. If an ordinary Leyden jar is interposed in the line wire, one end being in contact with the inner, the other with the outer coating, sound can be transmitted, but it is much weakened in strength.

9. Bringing the iron cores of the double telephone in contact with the disc and pressing with the fingers against the plate on the other side, a weak current from a Daniell cell produced a distinct click in the plate, and on drawing a wire from the cell over a file which formed part of the circuit, a rattling noise was produced in the instrument.

Experiments No. 1, 2, 3, and 9 tend to show the absence of mechanical vibration. For the Experiments Nos. 4 and 5 I fail to find a reasonable explanation. No. 6 shows that strength of the magnet has nothing to do with the force of the sound produced, the latter being simply the result of a difference of two opposing forces. Nos. 7 and 8 require no explanation.

The above notes are taken from a paper read by me before the Priestley Club on February 16.

Bradford Grammar School AUREL DE RATTI

IN NATURE, vol. xvii. p. 164, there was a notice of a telephonic alarum in the shape of a tuning-fork. This, however, requires a fixed and special telephone. The following method of attracting attention requires neither. I venture to send it you, as I have seen no notice of any one having tried it; but I can scarcely believe it to be the case, as the thing would suggest itself to any one studying the instrument. It is to include a magneto-electric machine in the circuit, when turning the handle produces a series of taps in the telephone audible at a considerable distance. I have not tried it for any long distance—merely fifty yards. The magneto-electric machine was placed in the observatory, and the telephone, or rather a battery of three telephones, in my study. The noise was heard at the further end of my dining room, the door of which faces that of the study.

Rugby A. PERCY SMITH

EXPERIMENTING with a pair of telephones the other day, I thought I would try if it were possible to utilise underground pipes as conductors. I therefore connected one terminal of each instrument with the gas and the other with the water-pipes, in two houses placed about thirty yards apart, and found that it was possible to carry on conversation by means of the instruments thus connected. The voices were not as distinct as if wire had been used, but singing was very plainly heard. I have not had the opportunity of trying a longer distance; perhaps some of your readers may test the matter further.

Bury, Lancashire WILLIAM STOCKDALE

"Mimicry in Birds"

OWING to the special meaning of late attached to the word "mimicry" by naturalists, the above heading seems liable to mislead when applied to the fact mentioned by Mr. J. Stuart Thomson (page 361). In answer to his inquiry perhaps you will allow me to quote the following from the fourth edition of Yarrell's "British Birds" (vol. ii. p. 229) with respect to the starling.

"Its song is as imitative as that of the vaunted Mocking-bird, and in nothing perhaps is it more grateful than in the reminiscences it brings to our homes of its wilder associates far afield; for Starlings consort with many kinds of birds, learn their notes and frequently mingle them in their own strain."

And then as a foot-note:—

"Thus the well-known wail of the Lapwing, and the piping note of the Ringed Plover may be heard in places wholly unsuited to the habits of those birds. Messrs. Matthews mention Starlings imitating the cry of the Kestrel, Wryneck, Partridge, Moorhen, and Coot among other birds (Zool. p. 2430). Saxby says that in Shetland the notes of the Oyster-catcher, Golden Plover, Redshank, Curlew, Whimbrel, and Herring-Gull, are perfectly mimicked. Mr. Hooper, of Upton near Didcot, informs the editor that Starlings in that neighbourhood will render exactly the characteristic cry of the Quail and the Corn-Crake. The common sounds of the poultry-yard are often copied with more or less accuracy, and a Duck may be heard to quack, a Hen to cackle, and a Cock to crow from the topmost bough of a tall tree."

It follows that if a Starling can so well imitate the notes of the above-named birds, it would have still less difficulty with those of species much more nearly allied to it, as the Blackbird, Chaffinch, and Sparrow. ALFRED NEWTON

Magdalene College, Cambridge, March 9

The "Geographical" and the Public

QUITE accidentally this evening I noticed in NATURE that Capt. Evans was to read a paper on the Magnetism of the Earth, before the Royal Geographical Society at the London University. Having devoted considerable attention to the subject I was desirous of hearing the paper and hurried up to town. I found, however, that I could not obtain admittance without an order. I offered payment but that was useless. I explained to the doorkeeper that I had come a long distance, was most anxious to hear the paper, and did not know until then the terms of admission, otherwise, as many of my friends are Fellows, I would have supplied myself with the necessary order.

I offered my card and suggested that it might be sent in to Sir Henry Rawlinson, to whom I was known, or to the Secretary or some other official, but to all my endeavours there was a curt, not to say pert, reply.

It occurred to me that if I waited a short time some friend might possibly make his appearance and help me in my "pursuit of knowledge under difficulties." I had not waited many moments when I noticed the door-keeper despatch on an errand a lad who supported him. I was weak-minded enough to imagine he had relented, and that some official would come to my aid. An official did certainly come back with the lad—it was a policeman! who gave me a look which I interpreted to mean, "If you don't be off I'll 'run you in.'" A few words in a very low tone passed between the doorkeeper and himself, and as I had no desire to spend the night in Vine Street station, I departed, feeling that this was an *argumentum ad hominem* which I could not resist. X.

Temple, March 11

Hearing and Smell in Insects

ALL that I have observed leads me to believe that any sensitiveness shown by insects to sound is due to a diffused sensibility to vibration rather than to a differentiated sense like our own. This will sufficiently explain the behaviour of J. C.'s moths (NATURE, vol. xvii. p. 45), and my own larvæ (NATURE, vol. xvii. p. 102). In the one case the ringing glass, and in the other the vibrant wood of the feeding-box communicated the alarm. If anyone, an hour after his kitchen has been left in darkness and quiet, will enter it as gently as possible, without shoes or light, and then, having no contact with anything, other than the unavoidable one of his sock-muffled feet with the floor, will speak suddenly and sharply, I believe he will find that not a cockroach shows any signs of alarm. If, on the other hand, he should drop something heavy abruptly, or enter with his usual step in boots, there is a stampede; but even then nothing to compare with the commotion caused by the introduction of light.

As to smell, there can be no doubt, it seems to me, that it is a very finely-differentiated sense; residing, I suspect, to a great extent, in the antennæ, and probably capable of detecting qualities in substances of which our own analogous sense gives us no warning. The ichneumon flies are an example in point. One of the larger of these alighted inside my open window in the sunshine this afternoon, and I noticed, as often before, the incessant play of his antennæ as he hunted restlessly to and fro, apparently in search of larvæ, or pupæ, concealed under the wood. As the prey of some members of this tribe are always so hidden, and the egg is accurately laid therein, by means of the long ovipositor, without the aid of sight, some other sense, in great perfection, must guide them in their quest. But here is a quite conclusive instance.

I saw in Athens, March, 1864, in the collection of Mr. Merlin, then our vice-consul there, placed in juxta-position in one drawer in his cabinet, a wasp and spider, of which he told me that that species of spider is the habitual prey of that species of wasp, and that he hunts him by scent, nose down, precisely like a hound. He witnessed himself the chase from beginning to end in the case of the actual specimens I saw. It occurred in his own house, and was continued for some time, and across, as I understood him, more than one room. The spider, as soon as he found himself marked down, showed the greatest terror, running hither and thither, with many doubles and turns. These the wasp—a long, thin-bodied variety—followed accurately, turn by turn, never quitting the spider's track for an instant, recovering, when at fault, like a dog, until, after an exciting chase, he seized his exhausted prey, and the keenly-interested human observer secured both pursuer and victim. HENRY CECIL

Bregner, Bournemouth, March 2

OUR ASTRONOMICAL COLUMN

THE TOTAL SOLAR ECLIPSE OF JULY 29.—Prof. Newcomb has lately issued empirical corrections to Hansen's Lunar Tables, which he proposes to employ in the American Ephemeris for 1883. The errors of the tables have now attained such magnitude, and exhibit so steady an increase, that it becomes necessary to apply corrections, even though they may be of the otherwise unsatisfactory nature of empirical quantities, and it is probable that Prof. Newcomb may not be the only superintendent of an ephemeris who will adopt this course pending the formation of new lunar tables at, it may be hoped, no distant period.

At the time of the total solar eclipse which traverses the United States in July next, Mr. W. Godward finds the correction of the longitude of the moon deduced from Hansen's tables to be $-9''.5$, and the correction of the latitude $+0''.9$, according to Newcomb. Applying these corrections to the moon's place, and adopting Leverrier's diameter of the sun, with a somewhat reduced diameter of the moon from that given by Hansen's tables, which corresponds well in the calculation of eclipses, the following equations are found, which may be expected to give the times of beginning and ending of the total phase with considerable accuracy for any point not far distant from Denver, Colorado, the most important place traversed by the belt of totality.

$$\text{Cos}\, w = 59.7050 - [1.85211] \sin l + [1.71204] \cos l, \cos (L + 216^\circ\ 48'.2)$$

$$t = 9\text{h. } 54\text{m. } 34.2\text{s.} \mp [1.93963] \sin w - [3.56966] \sin l$$
$$- [3.82402] \cos l, \cos (L + 256^\circ\ 25'.6).$$

Here l is the *geocentric* latitude of the point, L its west longitude from Greenwich, to be used with a *negative* sign, and the quantities within square brackets are logarithms; t is the Greenwich mean time of beginning or ending of totality, according as the upper or lower sign of the second term is used, $[1.93963] \sin w$ representing the semi-duration of the total phase; and applying the longitude of the place for which we are calculating in the usual way, the local mean times result.

As an example of the method of using formulæ of reduction similar to the above, which is frequently a matter of doubt to the uninitiated, we may find from them the local mean times of beginning and ending of the total eclipse in 106° 14′ W., and 40° 23′ N., which, according to the *Nautical Almanac* elements, is the position of the central eclipse at 10h. 28m. Greenwich mean time.

The reduction of the geographical to the geocentric latitude (which may be taken from tables found in many astronomical works—in Loomis's "Practical Astronomy," for instance, or in the *Berliner Jahrbuch* for 1852) is − 11′·4 and consequently l = 40° 11′·6.

W. long.	− 106° 14′	... ...	− 106° 14′
Constant	+ 216° 48′·2	... ...	+ 256° 25′·6
A	+ 110° 34′·2	B ...	+ 150° 11′·6

Constant ...	− 1·85211	Constant ...	+ 1·71204
Log. sin l ...	+ 9·80981	Log. cos l ..	+ 9·88302
		Log. cos A ...	− 9·54574
	− 1·66192		
			− 1·14080
No.	− 45·9111		
	− 13·8293	No.	− 13·8293
	− 59·7404		
Constant ...	+ 59·7050		
Sum	− 0·0354		
Log. cos w ...	− 8·54900		
w	92° 1′·7		

Constant	1·93963	Constant	−3·56966	Constant	−3·82402
Log. sin w	9·99973	Log. sin l	+9·80981	Log. cos l	+9·88302
				Log. cos B	−9·93837
	1·93936		−3·37947		
					+3·64541
No.	$87^s{\cdot}0$	No. ...	$-2395^s{\cdot}9$		
			$+4419^s{\cdot}9$	No. ...	$+4419^s{\cdot}9$
			$+2024{\cdot}0$		

	$+\ 33^m\ 44^s{\cdot}0$
Constant	$9^h\ 54^m\ 34^s{\cdot}2$
G.M.T. of middle of totality	$10^h\ 28^m\ 18^s{\cdot}2$
Long. W. *in time*	$7^h\ 4^m\ 56^s{\cdot}0$
	$3^h\ 23^m\ 22^s{\cdot}2$
Semi-duration	$1^m\ 27^s{\cdot}0$
Totality begins	$3^h\ 21^m\ 55^s{\cdot}2$ } Local M.T.
" ends	$3^h\ 24^m\ 49^s{\cdot}2$ } Local M.T.

The duration of the total eclipse is therefore 2m. 54s. and the middle at 10h. 28m. 18s. G.M.T.; the *Nautical Almanac* has 2m. 55s. and 10h. 28m., so that the corrections which we have introduced into the calculation have had but very insignificant effect. It may be added that when cos w is found greater than unity, and therefore impossible, the place for which the calculation is made is beyond the zone of totality.

THE STAR LALANDE 31266-7.—Mr. J. E. Gore writes with reference to this object, which in the reduced Catalogue of Lalande appears as a *first* magnitude, with position for 1800 (by a mean of the two observations), R.A. 17h. 1m. 22·36s., N.P.D. 45° 57′ 21″·6, and suggests that it may prove to be a remarkable variable, since it is "shown 6m. in Flammarion's edition of Dien's Atlas." The introduction of such a star into the Catalogue is easily explained, and in fact is rather an old story. The two observations on p. 353 of the "Histoire Céleste" were really observations of Capella (*Chèvre*, as Lalande calls it) *sub polo*, and were erroneously reduced to 1800, as though the star had been observed above pole. It is singular that these two observations should have given rise to the introduction of a spurious star, since there are eight other observations of Capella *sub polo* in the same year, 1790, between April 19 and July 24, of which no use has been made by the computers in their reduction of the stars of the "Histoire Céleste." There is no sixth magnitude in the position of the reduced catalogue.

MINOR PLANETS.—There are yet two more members to be added to this group—No. 184, discovered by Herr Palisa at Pola, on February 28, and No. 185, by Prof. Peters, at Clinton, U.S., on the following night. The *Berlin Circular*, No. 86, contains elements of Nos. 181–183.

BIOLOGICAL NOTES

INLAND FISHERIES, AMERICA.—We are indebted to Mr. Theodore Lyman, one of the United States Commissioners on Inland Fisheries, for an early copy of the Twelfth Annual Report to the Commonwealth of Massachusetts. Among other interesting facts we gather from it that there is still a mystery about the young of the Californian salmon (*Salmo quinnat*), for, notwithstanding the hundreds of thousands that have been put into New England waters, no one has been able to say with certainty that a single smolt has been seen. In reference to the true salmon (*S. salar*) it is pleasant to know that the return of mature salmon to the waters of the Merrimac last year (1877) commences a new era in the history of fish-culture in America. From the observations taken many of these mature salmon were from eight to ten pounds weight each, and were from the parr put into the river in 1873; but some were seen from fifteen to eighteen pounds weight, and these were most probably the result of the first parr put into the river in 1872. From 1872 to 1876 upwards of 830,000 parr were put into the river, and hundreds of fine fish were seen passing up in the spring of 1877; and, so says the report, "it will be seen that what we have so long fought for, what the mass of people here have generally considered mere theories, visions of men who suffered from fish on the brain, has been fully substantiated. It is true it took a little longer than was at first thought, but now Massachusetts knows that while she was the first of the States to take an interest in fish-culture, so she has been the first to demonstrate the certainty of a good return, and she can restock those rivers where the fish have been for a long time killed out."

THE DEVELOPMENT OF NERVES.—Dr. A. M. Marshall is continuing his careful researches into the earliest stages of nerves in vertebrate embryos. He has recently published in the *Quarterly Journal of Microscopical Science* some of his latest results, obtained from embryos of the common fowl, treated with picric acid. He describes a distinct neural ridge at the top of the cerebro-spinal tube in the middle cerebral track, before it has even closed in, the embryo being barely two days old in development. This ridge afterwards becomes continuous along the whole brain and great part of the spinal cord, and many of the nerves undoubtedly arise from it. It appears in the highest degree probable that the olfactory nerve originates from the anterior part of this ridge; but Dr. Marshall is quite certain that there is no special olfactory vesicle in the chick. This is directly contrary to the received teaching, which speaks of an olfactory lobe of the brain, and does not compare the olfactory with other nerves. Dr. Marshall believes that the common olfactory nerve is really the nerve of the anterior cranial segment. The third nerve is for the first time developmentally traced by Dr. Marshall, and he finds it to be a strictly segmental nerve. The seventh and eighth nerves (facial and auditory) are shown to have a common origin; the auditory is really a branch of the facial. The history of the vagus nerve (pneumogastric) is regarded as suggesting very strongly that it is equivalent to several spinal nerves, and not merely to one.

FRENCH POLYZOA.—An important contribution to the history of a number of species of marine polyzoa will be found in a memoir on "Les Bryozoaires des Côtes de France," by M. L. Joliet, of the Zoological Laboratory at Roscoff, a spot so well known to every tourist in Britanny.

A *résumé* is given of the remarkable works that have appeared on the structure of the animals of this group in England, Sweden, and Germany, as well as in France. The interesting question of the part played by, as well as of the origin of, the brown bodies (*groddskaplar* of Nitsche) is very fully gone into. The specialist will know what a subject of debate lies here. Hincks, our best English authority, believing them to be special formations elaborated from the substance of the polyp; Claparède, that they are products of secretion; Nitsche that they are only the remains of decaying polyps. With the last of these views our author agrees: "Le corps brun est un résidu, le reste de la matière qui constituait un polypide après que celui-ci a subi la désorganisation." The nature of the nervous colonial system in the polyzoa is also investigated at full length, and M. Joliet feels compelled to doubt if this so-called system merits this name. The arguments for and against are too technical for us to epitomise. The growth and development of several species were specially investigated, and the entire memoir, to which is appended a list of the species collected (74) at Roscoff during the summers of 1876 and 1877, is well worthy of the attention of all interested in the study of these small but interesting polyps. It will be found in the recently-published *Archives de Zoologie Expérimentale* (Tome 6, No. 2).

STRUCTURE OF LINGULA.—Mr. E. Morse, Professor of Zoology in the Imperial University of Tokio, Japan, has discovered many facts quite new to science in the life history of this interesting form of Brachiopods. Perhaps the most important is his discovery of the auditory capsules. In the species of Lingula investigated, their position and general appearance recall those in certain tubicolous annelids as figured by Claparède. He has also cleared up many points in regard to their circulation, and maintains the absence of anything like a pulsatory organ, the circulation being entirely due to ciliary action.[1] In describing the habits of this species he mentions that, while partially buried in the sand, the free border of the pallial membranes join so as to leave but three large oval openings, one in the centre and one on either side; the bristles then arrange themselves so as to form these openings into funnels which arrest the mucous secretion from the animal, and a continuous current is to be seen passing down the side funnels and escaping by the central one. They can bury themselves very quickly in the sand, and the peduncle agglutinates a sand tube. Prof. Morse exhibited specimens in Boston on December 19, 1877, which had been brought living from Japan; the water had been only changed twice since August 19, and yet none had died. Their viability, therefore, seemed to be great. As Prof. Morse is now on his way back to his professorial duties at Japan, he will have the opportunity of still further prosecuting his researches into the structure and habits of these forms so interesting to both the palæontologist and zoologist.

GEOGRAPHICAL NOTES

NEW GUINEA.—A recent number of *Il Movimento* contains a letter from the Italian traveller, D'Albertis, dated from Thursday Island, in Torres Straits, on January 8 last, in which some account is given of his last expedition into New Guinea. Leaving Port Somerset on May 3, 1877, in his steam launch, *Neva*, it was not until the 21st of that month that he succeeded in entering the *embouchure* of the Fly River, where he was well received by the natives. But such was not the case when the *Neva* had advanced a little further up the river, for on June 1 a sudden and unprovoked attack was made on the vessel, and one of the Chinese crew seriously wounded. These attacks were frequently repeated during the further ascent of the river, though always successfully repelled without casualties. In July and August, when far in the interior, the expedition seems to have been unmolested, but on the subsequent descent of the stream the banks were found again beset by daring and hostile parties of warriors, whose efforts to hinder the return of the expedition brought on frequent skirmishes. Signor D'Albertis was also much inconvenienced by the dissensions of his crew, the greater part of whom deserted him, leaving only five to manage the vessel and to repel the attacks of the natives. Two of these also left him on returning to the mouth of the river, leaving him to accomplish the dangerous navigation of Torres Straits with only the engineer and one sailor. Eventually, however, with aid received from the native teachers on some of the islands in Torres Straits, he succeeded in reaching Thursday Island—now the calling-place of the Queensland mail steamers—on January 4 last. As regards the results of the expedition no details are given in this letter, but from certain expressions employed it would appear that gold in some quantity was obtained. Of this we shall, no doubt, be duly informed before long, as also of the zoological discoveries in which Signor D'Albertis has on former occasions been so successful.

[1] Semper has already fully demonstrated this fact.—E. P. W.

NEW AFRICAN EXPEDITION.—It is rumoured that the Council of the Royal Geographical Society are likely soon to send out a new expedition for the exploration of Africa. The region between Mombasa and Mount Kenia and Victoria Nyanza is mentioned as the probable field of this expedition.

AFRICAN EXPLORATION.—Abbé Debaise, who intends to cross Africa from Zanzibar to the Congo, has received a credit of 100,000 francs from the French government. This sum was voted to him on the proposal of M. Perrin, a radical member, who was supported by M. Gambetta, the leader of the Liberal party. The Abbé will leave Paris for Marseilles in a few days, and thence proceed to Zanzibar. He will be supported by the new Geographical Society of Marseilles, and its president, M. Rambaud, the large Zanzibar trader. News has lately been received in Berlin from the African traveller, Dr. G. A. Fischer, who has traversed since last autumn the tropical regions lying opposite the island of Zanzibar. Despite the hostility of the natives, he has succeeded in making a large number of scientific observations, and has gathered a large collection of zoological specimens, which are now on the way to Berlin. During the present month he starts on a journey up the river Tana.

CAPTAIN ELTON.—We have already referred to the great loss sustained by geography, by the death of this energetic traveller in Ugogo; he died of sunstroke. Mr. Cotterill and Captain Elton had reached this place from the north end of Lake Nyassa, the country traversed being described as very interesting and new to geography. They found the sources of the Ruaha, Usanga, and other affluents of the Lufigi, the Myembe tributary being specially worthy of notice. Mr. Cotterill's narrative will be looked for with interest, as well as Capt. Elton's diaries and map, which have been sent home. The latter, at the time of his death, was H.M. Consul in Portuguese East Africa, and had done work in various parts of the world. He had done good service in helping to clear up the history of African Copal, the produce of *Trachylobium Hanemannianum*.

ANCIENT MAPS OF CENTRAL AFRICA.—M. Richard Cortambert, one of the librarians of the National Library in Paris, has discovered in that establishment a gilt globe, dated 1540, and showing apparently that the course of the Congo was known then to have almost the same direction as given to it by Mr. Stanley. There has also been discovered in the public library of Lyons a globe of 1701, on which are traced in detail the geography of the sources of the Nile and Congo. This globe is said to have been executed by the Fathers

Placide, of St. Amour, and Crispinien, of Toulon, and by the two Brothers Bonaventura and Gregory, all of the Order of St. Francis. Father Gregory, it is said, was the celebrated Lyonnaise geographer, Henry Marchand. In speaking of these discoveries at the Paris Geographical Society, M. R. Cortambert showed that there was nothing extraordinary in them. From the fifteenth century most of the maps make the Congo issue from a great mass of water in the interior of the African continent. No doubt all the information in these old maps was furnished by the Portuguese. M. Vivien de St. Martin is also of this opinion. The Portuguese traders were quite *au courant* with the geography of the interior of Africa, and all the maps, even that of Fra Mauro (15th century) represent the Nile issuing from lakes to the south of the equator, and give an idea of the course of the Congo, similar to that made known by Stanley. M. St. Martin reminded the Society, moreover, that Ptolemy himself had indicated three immense lakes in the centre of Africa from which issued the Nile and the Congo; only in his map these lakes are placed much too far south. Father Kircher, in his "Mundus Subterraneus," published at Amsterdam in 1653, gives a map showing four large lakes, from one of which, called Zaire, both the Nile and the Congo are made to issue. Kircher states that he obtained his information from the General Procurator of the Jesuits for these provinces, who lent him a manuscript of Father Païs. This manuscript may possibly be still preserved in the Jesuit College at Rome.

Paris Geographical Society.—Besides the medals to Mr. Stanley and M. St. Martin, the Paris Geographical Society will give medals to Dr. Harmand for his exploration of the Mekong and the coast of Anam, and to M. Ujfalvy for his travels in Turkestan. The *Bulletin* for December contains an important geographical and statistical article on Kashgar, compiled from various sources by M. J. B. Paquier, an itinerary on the Yang-tsze from Shung-shing to Yun-nan-fu, by M. Rocher, and a valuable summary of the geodetic work of the Russian Geographical Society in Asia, by Col. Chanoine.

NOTE ON THE DISCOVERY OF THE LIQUEFACTION OF AIR AND OF THE SO-CALLED PERMANENT GASES

IN the Notes on "Recent Science," in this month's *Nineteenth Century*, the writer, in an account of the results of the researches of M. Pictet and M. Cailletet on the condensation of the so-called permanent gases, draws attention to the long-neglected paper of Mr. Perkins "On the Compressibility of Water, Air, and other Fluids," an abstract of which, and apparently the only one with which the writer is acquainted, appeared in Thomson's *Annals of Philosophy*, *N. S.*, vol. vi., 1823. The paper was intended for the Royal Society, but, being mislaid, was not read at the appointed time. Either it or a second paper was, however, brought before the society on June 15, 1826, and appears in the *Philosophical Transactions* for that year. In this paper, as in the brief record in the *Annals*, Mr. Perkins announces that he had effected the liquefaction of atmospheric air, and other gases, by a pressure of upwards of 1,000 atmospheres, and fully describes the apparatus which he had employed, which is, in principle, very similar to that of M. Cailletet. He thus describes his results in the case of aëriform fluids:—

"In the course of my experiments on the compression of atmospheric air by the same apparatus which had been used for compressing water, I observed a curious fact which induced me to extend the experiment, viz., that of the air beginning to disappear at a pressure of 500 atmospheres, evidently by partial liquefaction, which is indicated by the quicksilver not settling down to a level with its surface. At an increased pressure of 600 atmospheres, the quicksilver was suspended about $\frac{1}{8}$th of the volume up the tube or gasometer; at 800 atmospheres it remained about $\frac{1}{3}$ up the tube; at 1,000 atmospheres, $\frac{2}{3}$ up the tube; and small globules of liquid began to form about the top of it; at 1,200 atmospheres the quicksilver remained $\frac{3}{4}$ up the tube, and a beautiful transparent liquid was seen on the surface of the quicksilver, in quantity about $\frac{1}{2000}$ part of the column of air. On another occasion a second tube was charged with 'carburetted hydrogen' and subjected to pressure; it began to liquefy at about 40 atmospheres, and at 1,200 atmospheres the whole was liquefied."

Mr. Perkins goes on to say: "These instances of apparent condensation of gaseous fluids were first observed in January, 1822, but for want of chemical knowledge requisite to ascertain the exact nature of the liquids produced, I did not pursue the inquiry further; and as the subject has been taken up by those who are eminently qualified for the investigation, I need not regret my inability to make full advantage of the power I had the means of applying."

Mr. Perkins's observations seem to have attracted little attention at the time they were published, and have since been, apparently, almost forgotten. Although they do not in the least detract from the great merit of M. Cailletet's work, they undoubtedly have their place in the history of this subject of the liquefaction of the gases.

It may be worth while to point out that the statement that all the gases known to the chemist have now been liquefied is not strictly true. The most recently-discovered of these—phosphorus pentafluoride—has not yet been seen in the liquid state, although there is not the least reason for believing that it will constitute an exception to the general law.

T. E. Thorpe

HELMHOLTZ'S VOWEL THEORY AND THE PHONOGRAPH

THE following experiments with the phonograph are of interest as throwing light on the nature of vowel sounds:—

Let a set of vowel sounds, as A, E, I, O, U (pronounced in Italian fashion) be spoken to the phonograph in any pitch, and with the barrel of the instrument turned at a definite rate. Then let the phonograph be made to speak them, first at the same rate, and then at a much higher or lower speed. The pitch is, of course, altered, but the vowel sounds retain their quality when the barrel of the phonograph is turned at very different rates. We have made this experiment at speeds varying from about three to one, and we can detect no alteration in the quality of the sounds.

According to Helmholtz, the characteristic quality of each vowel is given by the prominence of a constituent note or notes, of definite or approximately definite absolute pitch, in the sounds uttered. Now obviously, the absolute pitches of the constituents of the vowel-sounds in the above experiment were all altered in the same proportion, so that the absolute pitch of the prominent notes varied greatly; but yet the vowel quality was unchanged. This experiment, therefore, appears to give results in contradiction of Helmholtz's theory as we understand it.

At the same time we have found, in the course of experiments, of which a full account will shortly be communicated to the Royal Society of Edinburgh, that if a scale be sung to the phonograph with one vowel sound, such as O, the wave-form of the marks on the tinfoil does not remain unchanged at all pitches. We have not yet had time to analyse the curves so obtained into their harmonic constituents. Such an analysis will show whether the changes we have observed in the wave-form as the pitch rises, are due to a change in the relation of the amplitudes of the constituents present, or only to a variation of phase.

Fleeming Jenkin
J. A. Ewing

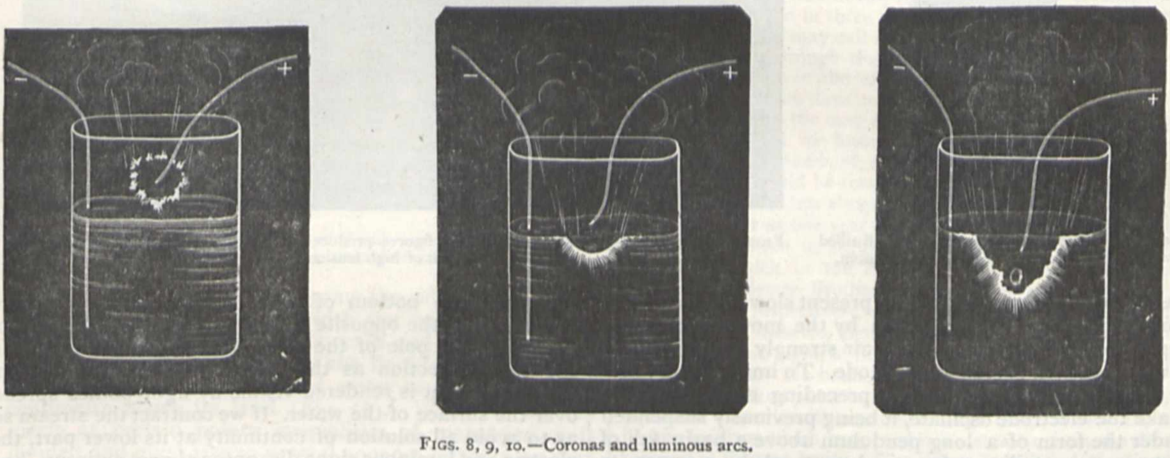
Edinburgh, March 11

ELECTRICAL ANALOGIES WITH NATURAL PHENOMENA [1]

II.

POLAR AURORÆ.—The experiments of De la Rive have already shown the connection of polar auroræ with terrestrial magnetism; but they do not explain all the circumstances which accompany auroræ. In M. Planté's experiments the electric current, in presence of aqueous vapour, yields a series of phenomena altogether analogous to the various phases of polar auroræ.

If the positive electrode of the secondary battery is brought into contact with the sides of a vessel of salt water, we observe, according to the distance of the film from the liquid, either a corona formed of luminous particles arranged in a circle around the electrode (Fig. 8), an arc bordered with a fringe of brilliant rays (Fig. 9), or a sinuous line which rapidly folds and refolds on itself (Fig. 10). This undulatory movement, in particular, forms a complete analogy with what has been compared in auroræ to the undulations of a serpent, or to those of drapery agitated by the wind. The rustling noise accompanying the experiments is analogous to that sometimes accompanying auroræ; it is caused by the luminous electric discharge penetrating the moisture. As in auroræ, magnetic perturbations are produced by bringing a needle near the circuit, the deviation increasing with the development of the arch. Auroræ are produced by positive electricity; the negative electrode produces nothing similar.



FIGS. 8, 9, 10.—Coronas and luminous arcs.

Globular Lightning.—To study the effects produced on distilled water, M. Planté increased the tension of the current, combining twenty secondary batteries, composed each of forty couples, and forming a total of 800 secondary couples, whose current of discharge was nearly equal to that of 1,200 Bunsen elements.

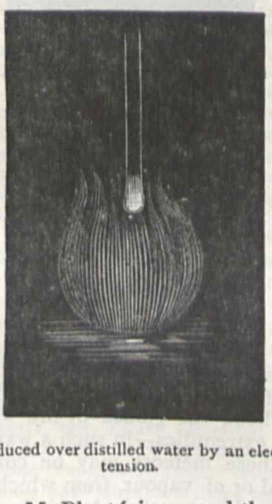


FIG. 11.—Flame produced over distilled water by an electric current of high tension.

When the current of this combination of batteries is made to act on distilled water, he finds, first, in much greater intensity, the effects already observed by Grove, by means of 500 elements of his nitric acid pile. The positive electrode being inserted in the distilled water, he obtains, by approaching the negative platinum wire to the surface of the water, and immediately raising it, a yellow flame, almost spherical, of about two centimetres in diameter (Fig. 11). The platinum wire, two millimetres in diameter, melts; the flame is formed by the rarefied incandescent air, by the vapour of the metal of the electrode, and by the elements of the vapour of water; spectral analysis shows clearly the presence of hydrogen.

If, to avoid the fusion of the metal, we diminish the intensity of the current by interposing a column of water in the circuit, the spark appears under the very compact form of a small globe of fire from eight to ten millimetres in diameter (Fig. 12). On raising the electrode a little more, this globe takes an ovoid form; luminous blue points, whose number varies continually, arranged in concentric circles, appear at the surface of the water (Fig. 13). Rays of the same colour soon issue from the centre and join these points (Fig. 14). At intervals the rays take a gyratory movement, now in one direction, now in another, describing spirals (Figs. 15 and 16). Sometimes the points and the rays disappear all on one side, and varied curves, formed by the movement of those which remain, are figured on the surface of the liquid. Finally, when the speed of the gyratory movement increases, all the rays vanish, and only blue concentric rings are seen (Fig. 17). The rings are found to be the last term of these transformations which are very curious to follow with the naked eye or with a telescope, and constitute a veritable electric kaleidoscope.

The production of these figures is explained by the great mobility of the arcs or luminous threads which compose the ovoid light, formed between the water and the electrode. On examining with care this particular form of spark, he finds that it is, in reality, a sort of voltaic brush discharge, analogous to the brush discharge of static electricity, but more dense on account of the greater quantity of electricity in play. These luminous threads being in a state of continual agitation, the points at which they encounter the surface of the liquid are constantly displaced, and form the rays observed. Their gyratory movement

[1] Continued from p. 229.

proceeds from the reaction due to the flowing of the electric flux. As to the rings, they are formed in a visible manner, under the eye of the observer, by the more and more rapid movement of the blue points, and by the persistence of the impression upon the retina.

When the metallic electrode is positive and the distilled water negative, the spark still assumes externally an ovoid form; but the middle is traversed by a cone of violet light. When we employ two metallic electrodes we obtain a luminous spheroid, the interior of which is traversed by a brilliant line. This appearance corresponds to the spark, and the aureole of the spark seen in the discharges of an induction coil; only here the aureole occupies more space, in consequence still of the greater quantity of electricity. In fact, if we much increase the length of the column of water interposed, we do not obtain more than an arc or a straight line.

M. Planté therefore thinks globular lightning may result from an abundant flow of electricity in the dynamic state, in which quantity is joined to tension. The particular case where globes of lightning present slow movements or times of stoppage, is explained by the movement or the repose of the column of moist air strongly electrified and invisible, which serves as electrode. To imitate this effect it is sufficient, in one of the preceding experiments, to make the electrode oscillate, it being previously suspended under the form of a long pendulum above a basin full of water or a metallic surface, and to mask by a screen its lower extremity. We then see a little ball of fire move above the water or the conducting surface, and thus reproduce all the appearances of the natural phenomenon.

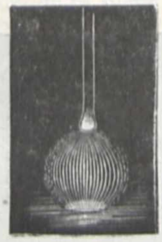
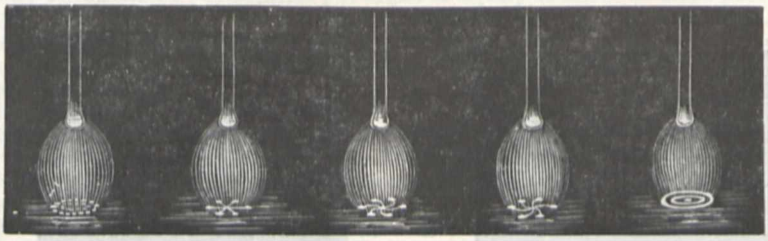


Fig. 12.—Globular spark produced over distilled water by an electric current of high tension.



Figs. 13 to 17.—Ovoid sparks and luminous figures produced over distilled water by an electric current of high tension.

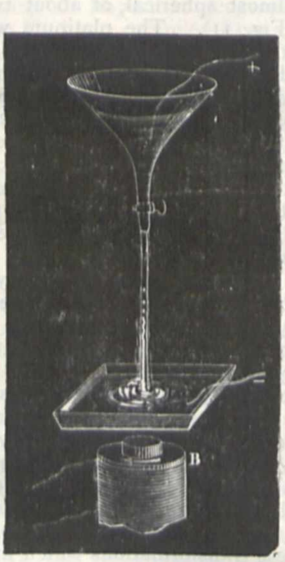


Fig. 18.—Experiment reproducing the effect of waterspouts.

Waterspouts.—Cause a narrow stream of salt-water to flow from a funnel provided with a cock communicating with the positive pole of a battery of 400 secondary couples; the liquid is received in a basin containing the negative wire and below which is an electro-magnet (Fig. 18). As soon as the voltaic circuit is closed the stream appears furrowed with bright lines at its upper part and traversed by a luminous thread at its lower part. Sparks, illuminated aqueous globules, play with a rustling noise at its extremity, vapour is disengaged, and the liquid which surrounds the bottom of the stream takes a gyratory movement in the opposite direction to that of the hands of a watch if the pole of the electro-magnet is north, and in the same direction as the hands if this pole is south. The movement is rendered visible by light bodies spread over the surface of the water. If we contract the stream so as to avoid all solution of continuity at its lower part, the electric and luminous signs disappear almost entirely. The liquid is, nevertheless, heated, as is shown by a light vapour, and the gyratory movement is yet more pronounced and rapid. On extending the stream anew the electric manifestations re-appear as before.

This experiment reproduces the principal effects of waterspouts, the rustling which proceeds from them, the

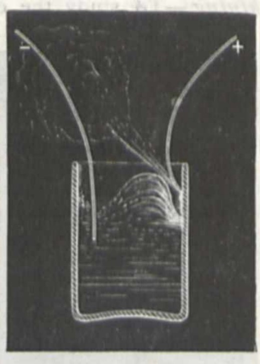


Fig. 19.—Electric bore.

mist which is formed around them, the flashes of light which furrow them, the globes of fire which sometimes appear at their extremities—in such a way that, according to M. Planté, these meteors may be compared to electrodes of liquid or of vapour, from which escape to the earth or the sea the powerful electric currents of storm-clouds; and if no thunder follows it is because the conductor accompanies them to the ground, and there is in this case no proper electric discharge, no more than under the preceding conditions.

The very formation of waterspouts, or the descent of these cloudy appendages towards the ground, has been connected by Brisson and Peltier with an electrostatic attraction between the clouds and the earth. We may add to this very natural attractive force an action of transport, of which dynamic electricity presents numerous examples, and which tends to facilitate the flow of water from an electrified cloud. The agitation of the liquid, the boiling of the waters at the point where these meteors encounter the surface of the sea, are explained not only by the descending movement itself, but also by the action of the electric current, which may repel or raise liquid masses like a breeze or an impetuous wind. If we support, in

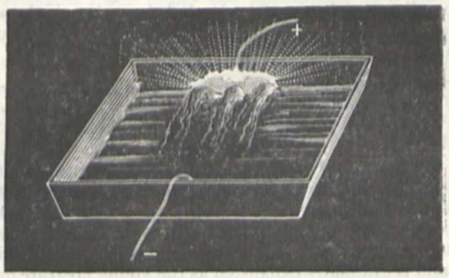


FIG. 20.—Electric bore or formation of liquid waves by the flow of a powerful current of dynamic electricity.

fact, the positive electrode against the sides of the vessel of salt-water communicating with the negative pole, we observe, besides the luminous streaks and jets abounding in vapour, a violent whirling of the liquid forming a sort of electric bore, which raises the water to the height of $1\frac{1}{2}$ centimetre above its level (Fig. 19). When the current meets at certain points inequalities of resistance, it is divided and gives rise to several aqueous hillocks, as seen in Fig. 20.

ON COMPASS ADJUSTMENT IN IRON SHIPS AND ON NAVIGATIONAL SOUNDINGS [1]

IV.—*On a Navigational Sounding Machine.*

THE machine before you is designed for the purpose of obtaining soundings from a ship running at full speed in water of any depth not exceeding 100 or 150 fathoms. The difficulties to be overcome are twofold: first, to get the lead or sinker to the bottom; and, secondly, to get sure evidence as to the depth to which it has gone down. For practical navigation a third difficulty must also be met, and that is to bring the sinker up again; for, although in deep-sea surveys in water of more than 3,000 fathoms' depth it is advisable, even when pianoforte wire is used, to leave the thirty or forty pounds' sinker at the bottom, and bring back only the wire with attached instruments, it would never do in practical navigation to throw away a sinker every time a cast is taken, and the loss of a sinker, whether with or without any portion of the line, ought to be a rare occurrence in many casts. The first and third of these difficulties seem insuperable—at all events they have not hitherto been overcome—with hemp rope for the sounding-line; except for very moderate depths, and for speeds much under the full speed of a modern fast steamer. It may indeed be said to be a practical impossibility to take a sounding in twenty fathoms from a ship running at sixteen knots with the best and best-managed ordinary deep-sea lead. Taking advantage of the great strength and the small and smooth area for resistance to motion through the water, presented by pianoforte wire, I have succeeded in overcoming all these difficulties; and with such a sounding machine as that before you the White Star liner *Britannic* (Messrs. Ismay, Imrie, and Co., Liverpool) now takes soundings regularly, running at sixteen knots over the Banks of Newfoundland and in the English and Irish Channels in depths sometimes as much as 130 fathoms. In this ship, perhaps the fastest ocean-going steamer in existence, the sounding machine was carefully tried for several voyages in the hands of Capt. Thompson, who succeeded perfectly in using it to advantage; and under him it was finally introduced into the service of the White Star Line.

[1] Report of paper read to the Royal United Service Institution, February 4, by Sir Wm. Thomson, LL.D., F.R.S., P.R.S.E., Professor of Natural Philosophy in the University of Glasgow, and Fellow of St. Peter's College, Cambridge. Revised by the Author. [The Council of the R.U.S.I. have kindly permitted us to publish Sir W. Thomson's paper in advance, and have granted us the use of the illustrations.—ED.] Continued from p. 354.

The steel wire which I use weighs nearly $1\frac{1}{4}$ lbs. per 100 fathoms, and bears when fresh, from 230 to 240 lbs. without breaking; its circumference is only ·03 of an inch. By carefully keeping it always, when out of use, under lime water in the galvanised iron tank prepared for the purpose, which you see before you, it is preserved quite free from rust, and, accidents excepted, this sounding line might outlive the iron plates and frames of the ship. If the sinker gets jammed in a cleft of rock at the bottom, or against the side of a boulder, the wire is inevitably lost. Such an accident must obviously be very rare indeed, and there does not seem to be any other kind of accident which is altogether inevitable by care in the use of the instrument. The main care in respect to avoidance of breakage of the wire may be stated in three words—beware of kinks. A certain amount of what I may call internal molecular wear and tear will probably occur through the wire bending round the iron guard rod which you see in the after part of the instrument, when, in hauling in, the wire does not lead fair aft in the plane of the wheel, as is often the case even with very careful steering of the ship, but from all we know of the elastic properties of metals, it seems that thousands of casts might be taken with the same wire before it would be sensibly weakened by internal molecular friction. Practice has altogether confirmed these theoretical anticipations so far as one year of experience can go. My sounding machine has been in regular use in charge of Captains Munro and Hedderwick in the Anchor liners *Anchoria* and *Devonia* (Messrs. Henderson Brothers, Glasgow) for eleven months and seven months respectively, and in neither ship has a fathom o wire been lost hitherto, though soundings have been taken at all hours of day and night, at full speed, in depths sometimes as great as 120 fathoms. No break not explicable by a kink in the wire has hitherto taken place in any ship provided with the sounding machine. That it will bear much rough usage is well illustrated by one incident which happened in a cast taken from the *Devonia* running at thirteen knots. The sinker in falling from the wheel into the water accidentally fell between the rudder chain and the ship, and fifty fathoms or so had gone out before it was noticed that the wire was running down vertically from the wheel instead of nearly horizontally as it ought to have been by that time. The handles were immediately applied to the sounding wheel, and it was turned round to haul in without reducing the speed of the ship. Though the wire was bent almost at right angles round the chain until it was nearly all in, it was all got safely on board, as was also the cod-line with attached depth gauge, and the sinker at the end of it.

When soundings are being taken every hour or more frequently (as in the case of a ship feeling her way up channel from the 100 fathom line when the position is not known with sufficient certainty by sights and chronometers) the sounding wheel should be kept on its bearings in position; with the cod-line, depth gauge, and sinker, all bent on and ready for use. But in all other cases the wheel should be kept in its tank under lime water, and the cod-line with sinker and depth gauge attached should be kept at hand in a convenient place near the stand of the machine, which should be always fixed in position ready for use. With such arrangements, and methodical practice, as part of regular naval drill in the use of the sounding machine, one minute of time should suffice to take the sounding wheel out of its tank, place it on its bearings, adjust the brake cord, bend on the cod-line, and be quite ready for a cast. When the machine is to be shown to an inspecting officer the wheel ought to be in its tank of lime water when he asks to see a cast. It should be carefully noticed that the ring at the end of the wire is securely lashed by small cord to the hole provided for it in the ring of the wheel whenever the cod-line is unbent from the ring. If the wire and ring are allowed at any time to knock about slack on the wheel when the wheel is being moved to be set up for use or to be replaced under the lime-water there is a liability to some part of the wire getting a turn which may be pulled into a kink. One accident, at least, has happened in this way: the sinker dropped off carrying the cod-line and ring with it just as it was being let down from the taffrail for a cast. If the sinker had weighed 400 lbs. [1] it could not have broken the double wire next the ring without a kink.

A description of the machine and rules for its use are given in the accompanying printed paper of instructions, to which I have only now to add a few words regarding the depth gauge. Erichsen's self-registering sounding lead (patented in 1836), depending on the compression of air, might be used with my machine, but the simpler form before you is preferable as being

[1] It weighs 22 lbs.

surer. It too depends on the compression of air, but in it the extent to which the air has been compressed is marked directly on the interior of a straight glass tube by the chemical action of sea-water on a preparation of chromate of silver with which the tube is lined internally. Between the salt of the sea-water and the chromate of silver a double decomposition takes place. The chlorine leaves the sodium of the common salt and combines with the silver, while the chromic acid and oxygen leave the silver and combine with the sodium. Thus chloride of silver, white and insoluble, remains on the glass in place of the orange-coloured chromate of silver lining as far up as the water has been forced into the tube, and the chromate of sodium dissolved in the water is expelled as the air expands when the tube is brought to the surface.

My navigational sounding machine was brought into practical use for the first time in the steamship *Palm*, belonging to Messrs. Charles Horsfall and Co., Liverpool, in a voyage to Odessa and back about a year ago, in command of Capt. E. Leighton. I cannot illustrate the use of the machine better than by reading to you an extract from a letter I received last April from Capt. Leighton, describing his experience of it in this first trial :—

"During the voyage in the *Palm* steamship, which has just come to an end, I took frequent opportunities of testing the sounding machine when I had a chance of cross-bearings to verify the depths as shown by chart, and always found it most accurate. For instance, going up through the Archipelago and just after clearing the Zea Channel, I got a good position by bearings, chart showing seventy-nine and seventy-six fathoms, two casts of your glass gave seventy-eight and seventy-five fathoms. In the Bosphorus also it gave capital results in thirty to forty fathoms water.

"The first real use I made of the machine was in the Black Sea during a fog which obscured everything. Wishing to make sure of my position I put the ship's head for the land and kept the machine at work. After running in to thirty fathoms at full speed I slowed down and went in to twelve fathoms, then hauled out to a convenient depth and put her on the course up the coast. When it became clear I found myself in a proper position, and no time had been lost by stopping to sound.

"How many shipmasters let hours go by without obtaining soundings either because of the delay or on account of the danger of rounding-to in heavy weather to get them, when, if they were provided with your sounding-machine, they could have their minds set at ease by having timely warning of danger, or by knowing that they were in a good position!"

I had myself very satisfactory experience of the usefulness of the sounding machine in coming up Channel running before a gale of south-west wind in thick weather, on the 6th and 7th of last August, on returning from Madeira in my yacht—a small sailing schooner of 126 tons. About 5 A.M. on the 6th I took two casts and found ninety-eight fathoms (sand and red spots) and 101 fathoms (sand and small shells). The mean with a correction of 2½ fathoms to reduce to low water, according to the state of the tide at Ushant at the time, was ninety-seven fathoms. Thenceforward I took a sounding every hour but one till eight in the evening. By writing these soundings on the edge of a piece of paper at distances equal according to the scale of the chart to the distances run in the intervals, with the edge of the paper always parallel to the course, according to the method of Sir James Anderson and Capt. Moriarty, I had fixed accurately the line along which the vessel had sailed, and the point of it which had been reached, with only a verification by a noon latitude. At 6 o'clock next morning, by the soundings and course, with proper allowance for the flood-tide, I must have been about thirteen miles magnetic south of the Start, but nothing of the land was to be seen through the haze and rain; and with the assistance of about ten more casts of the lead (by which I was saved from passing south of St. Catherine's) I made the Needles Lighthouse right ahead, at a distance of about three miles, at 2 P.M., having had just a glimpse of the high cliffs east of Portland, but no other sight of land since leaving Madeira and Porto Santo. In the course of the 280 miles from the point where I struck the 100 fathom line to the Needles, I took about thirty casts in depths of 100 fathoms to nineteen fathoms without once rounding-to or reducing speed; during some of the casts the speed was ten knots, and the average rate of the last 220 miles was a little over nine knots.

It is a pleasure to me to be able to add that the sounding machine has also been successfully used in the Royal Navy, Admiral Beauchamp Seymour and Capt. Lord Walter Kerr having kindly taken it on board H.M.S. *Minotaur* for trial last summer. Lord Walter Kerr wrote, on his return from Vigo, regarding it as follows :—

"The sounding machine is most serviceable. We have been using it constantly when running up Channel, from the time of crossing the line of soundings to the time of reaching Plymouth, and though running before a gale of wind with a heavy sea, at the rate of ten knots, we were able to get soundings as if the ship had been at anchor. We were able to signal to the squadron each sounding as it was obtained; thus, in thick weather, verifying our position by soundings without having to round the ships to."

THE ANALOGIES OF PLANT AND ANIMAL LIFE[1]

LET us begin our inquiry into the analogies of plant and animal life by comparing the egg of an animal with the seed of a plant. Let it be the ripe seed of a common plant, and the egg of a bird. Both seed and egg may be said to consist of the young creature and a supply of food which is stored up for its use, and is gradually exhausted as the young creature develops. Every one who has tried when a boy to blow a late bird's egg must have been painfully alive to the fact of its containing a young animal, and the egg we eat for breakfast may serve to remind us of the store of food which we diverted from its proper course of nourishing a young chicken.

Here is a diagram representing a section through the seed of a poppy, in which the young plant may be seen lying in its store of food containing a supply of carbohydrates and nitrogenous matter, which is consumed as the yolk of the egg is consumed by the young chicken. Other seeds, such as a bean, an acorn, or an almond, seem at first sight to consist of nothing but the young plant, and to have no store of food. The two halves into which a pea split are the two first leaves or cotyledons of the young plant, the embryo stem and root being represented by the little projecting mass lying between the two halves at one end of the seed. Here the store of food is laid up in the body of the young plant just as many young animals carry with them a store of food in the shape of the masses of fat with which they are cushioned; the two leaves which seem so gigantic compared with the rest of the plant are filled with nutriment, and perform the same function of supplying food for the growth of the seedling, which is performed by the mass of nutrient material in which the embryo of the poppy seed is embedded. Recent researches have shown that embryo plants are possessed of powers which even in the present day it seems almost ludicrous to ascribe to them. I mean powers of digestion. Gorup-Besanez,[2] a distinguished German chemist, found that in the germinating seed of a vetch a ferment exists similar to the ferment in the pancreatic secretion of animals—a secretion having the power of reducing both nitrogenous bodies and starch to a condition in which they can be utilised and absorbed by the tissues, so that the embryo plant behaves exactly as if it were a minute animal digesting and absorbing the store of food with which it is supplied. The power of digesting starch possessed by the embryo plant has been brilliantly demonstrated by van Tieghem,[3] who found that the embryo removed from the seed of the Marvel of Peru (*Mirabilis jalapa*) was distinctly nourished if placed in an artificial seed made of starch paste. He found that the starch paste was actually corroded by the young plant, proving that a digestive ferment had been at work.

This wonderful experiment is of special interest as proving that the digestive ferment is a product of the young plant itself, just as the digestive juice of an animal is a secretion from its stomach. It is indeed a striking thought that whether we grind up a grain of wheat to flour and eat it ourselves as bread, or whether we let the seed germinate, in which case the young plant eats it, the process is identically the same.

The power of storing up food in a fixed condition and utilising it when required is a most important function both in animal and plant physiology. And just as this utilisation is seen in the seed to be brought about by a ferment—by a digestive process—so probably wherever the transference or utilisation of food stores occurs it is effected by ferments. If this be so it would seem that the processes of

[1] A Lecture delivered at the London Institution on March 11 by Francis Darwin, M.B.
[2] *Deutsch. chem. Gesellsch.*, 1874; *Botanische Zeitung*, 1875, p. 565.
[3] *An. Sc. Nat.*, 1873, xvii. p. 205.

digestion proper, as they occur in the stomach and intestines of animals and on the leaves of carnivorous plants, I say it is probable that these processes are only a specialisation[1] of a widely spread power, which may exist in the simplest protoplasmic ancestor of animals and plants. In this case we shall have no right to consider the existence of carnivorous plants anything strange or bizarre; we should not consider it, as seems sometimes to be done, an eccentric and unaccountable assumption of animal properties by plants; but rather the appearance of a function which we have quite as much right to expect in plants as in animals. Not that this view makes the fact of vegetable digestion any less wonderful, but rather more interesting as probably binding together by community of descent a wide class of physiological functions. Let us now pass on to consider the analogies of plants and animals in a more advanced stage of life.

Great differences exist among animals as to the degree of development attained before the young ones enter the world. A young kangaroo is born in a comparatively early stage of development, and is merely capable of passive existence in its mother's pouch, while a young calf or lamb soon leads an active existence. Or compare a human child which passes through so prolonged a condition of helplessness, with a young chicken which runs about and picks up grain directly it is out of its shell. As analogous cases among plants, we may take the mangrove and the tobacco plant. The ripe seed of the mangrove is not scattered abroad, but remains attached to the capsule still hanging on the mother plant. In this state the seeds germinate and the roots grow out and down to the sea-level, and the plant is not deserted by its mother until it has got well established in the mud. It is due to the young mangrove to say that the conditions of life against which it has to make a start are very hard on it. The most intrepid seedling might well cling to its parent on finding that it was expected to germinate on soft mud daily flooded by the tide. Perhaps the same excuse may be offered for the helplessness of babies—the more complicated the conditions of life, the greater dependence must there be of offspring on parent.

Now compare a young tobacco plant with the mangrove. All the help the seedling tobacco receives from its parent is a very small supply of food; this it uses up in forming its first pair of leaves; it has then nothing left by way of reserve, but must depend on its own exertions for subsistence. By its own exertions I mean its power of manufacturing starch (which is the great article of food required by plants) from the carbonic acid in the air. In this respect it is like a caterpillar which is formed from the contents of the egg, but has to get its own living as soon as it is born.

In many cases there is a certain degree of independence in young creatures, which are nevertheless largely dependent on their parents' help. Thus, young chickens, though able to feed themselves, depend on their mother for warmth and guidance. A somewhat parallel case may be found among plants. It has been shown that the large store of reserve material in a bean is not all needed for the development of the seedling. It has been proved that well-formed and flourishing seedlings are produced, even when a large part of the cotyledons has been removed. In fact, the store of food in the bean has been said to play a double part in the economy of the plant,[2] first, as giving absolutely necessary formative material, and secondly, as protecting the young plant in the struggle with other plants, by supplying it with food till it is well established and able to make its own food. This view was fully established by my father,[3] who sowed various kinds of seed among grass in order to observe the struggle; he found that peas and beans were able to make a vigorous start in growth, while many other young plants were killed off as soon as they germinated.

The young bean is thus indirectly protected by its mother from death, which the severe competition entails on less fortunate seedlings. This kind of protection can only in a certain general sense be compared with the protection given by parent to offspring. Nevertheless, a more strictly parallel case may be found among animals. Certain fishes retain the yolk bag, still containing a supply of food, and swim about leading an independent life, carrying this store with them. Among plants, a good case of a retention of a store of food occurs[4] in the oak. Young trees possessing woody stems and several leaves may still have an acorn underground with an unexhausted store of food.

In comparing the lives of plants and animals, one is struck with the different relation which the welfare of the race bears to the welfare of the individual. In plants it is far more obvious that the aim and object of existence is the perpetuation of the species. The striking and varied development of the reproductive organs in plants is one factor in this difference. Roughly speaking, plants strike us most by their flowers and seed—that is by organs serving the interest of the race. Animals are most striking on account of their movements, which are chiefly connected with the wants of the individual. If a child wants to know whether a stick *is* a stick or a caterpillar, he touches it, and if it walks off, classes it in the animal kingdom. Of course, I do not mean that the power of movement is a mark of distinction between animals and plants, but it certainly is a power which is well developed in most animals, and badly developed in most plants. It is the absence of locomotive powers (as opposed to the absence of simple movements) that especially characterises most plants. One sees the meaning of this if one inquires into mode of life of stationary and of locomotive animals. Stationary animals either inhabit the water, or else are parasitic in habits, and live on tissues of plants or animals. In either case the absence of locomotion has the same meaning. Many aquatic animals derive their food from the minute organic particles floating in the water, so that even though they lead a stationary life, food will be brought to them by the currents in the water. Parasitic animals obtain their food directly from the juices or sap of their host, so that they do not need to move about as other animals do in search of food. In the same way plants live like parasites on the earth, penetrating it with their roots, and sucking out its juices; and their food—carbonic acid—is brought to them by the currents of the air, so that like both an aquatic and a parasitic animal, they have no need of locomotion as far as concerns the obtaining of food.

In the case of many young animals their powers of locomotion would be useless unless the eggs were deposited by the mother in a proper place; one cannot imagine anything more forlorn than a caterpillar reared from an egg laid anywhere by chance, and expected to find its proper plant. The necessity of finding proper places to lay her eggs implies the necessity of locomotion on the part of the mother. This need of locomotion is, of course, equally a need to the plant, but it is supplied in a distributed way. The seeds themselves become locomotive; they either acquire plumes to fly on the wind like the seeds of dandelions or they become burrs and cling to passing animals, or are distributed in other ways. Various and strange are the means of transportal adopted by seeds; for instance, the acorn seems to distribute itself by deliberately trading on the carelessness of creatures which are usually considered its superiors in intelligence. Good evidence exists that young oaks which grow scattered in large number over a wide extent of wild heathy land have sprung from the acorns accidentally dropped by passing rooks. In all these cases the young plant has to trust to chance as to what kind of soil it will be deposited in, and this of course accounts for the enormous number of seeds produced by plants. Some seeds are more fortunate in possessing a kind of mechanical choice or power of selecting suitable places to grow in. Many years ago my father described a plumed seed which, when damped, poured out a sticky substance capable of gluing the seed firmly to whatever touched it. Imagine such a plant blown by the wind over some sandy waste; nothing tends to stay its course till it happens to pass by a region where the soil is damper; then it sends out its sticky anchors, and thus comes to rest just where it has a chance of germinating favourably. Again, some seeds have a certain amount of locomotive power independent of such external agencies as wind or passing animals. I mean a power of burying themselves in the ground; the seeds of grasses are the best known of these self-burying seeds; and among them the feather-grass, or *Stipa pennata*, is the most conspicuous. These seeds possess a strong, sharp point, armed with a plume or tuft of recurved hairs, which act like the barbs of an arrow and prevent the seed from coming out again when it has once penetrated the soil. This arrow-like point is fixed at the lower end of a strong awn, which has the remarkable property of twisting when dried and untwisting when wetted. Thus the mere alternations of damp nights and dry days cause the arrow-like point to rotate, and by another contrivance, which it would take too long to go into, the point is pressed against the surface of the ground and actually bores its way into it. Fritz Müller

[1] See Morren, "La Digestion Végétale," Gand, 1876; and Pfeffer, "Landwirth. Jahrb.," 1877.

[2] Haberlandt, "Schutzeinrichtungen in der Entwickelungen der Keimpflanzen," 1877, p. 29. The idea is quoted as originally given by Sachs, *Vienna Acad.*, xxxvii., 1859.

[3] See "Origin of Species," 6th edition, p. 60.

[4] Haberlandt, p. 12.

described in a letter to me how these twisting grass seeds bury themselves in the extremely hard and dry soil of Brazil, and are thus no doubt enabled to germinate. Unfortunately these boring grass-seeds do not always confine themselves to penetrating the soil, but exercise their powers on both men and animals. I have received accounts from India and from Italy of the way in which the sharp-pointed seeds work their way through thick trousers into the legs of unfortunate sportsmen. But the most extraordinary case is that of certain grasses which work their way into sheep. They often penetrate the skin deeply and in large numbers, inflicting great tortures and often causing death by emaciation. Mr. Hinde, of Toronto, has given me the details of this plague to sheep-farmers as it occurs in Buenos Ayres. Another observer has described it in Australia.[1] He states that not unfrequently the seeds are found actually piercing the heart, liver, and kidneys of sheep which have died from the effects. I believe that the northern part of Queensland has been actually given up as a sheep country because of the presence of this grass.

Another use to which locomotion is applied by animals is that of finding a mate at the proper season. The curious imitation of the courtship of animals which is found in Vallismeria is well known. The stalk grows with extreme rapidity up through the water till the female flower reaches the surface, and there awaits the approach of the male flower, which breaks loose and floats down the stream to meet her. But most plants have not even this amount of locomotive power, and are therefore compelled to employ either the wind or insects as go-betweens. Fortunately for the beauty and sweetness of our woods and fields, insect fertilisation is the commonest means adopted; and all the bright flowers and sweet smells of flowers are nothing but allurements held out to insects to entice them to carry the fertilising pollen from one flower to another. It is curious to find a plant adopting a new mode of conveying its pollen when the old one fails. Thus, a wild cabbage-like plant which grows in Kerguelen's Land is now fertilised by the wind, that is, it produces dry dust-like pollen, which is easily carried by the wind. Now this cabbage is the only species in the enormous order of the Cruciferæ which is not fertilised by insects; so that we may be certain that a change has taken place for which some sufficient reason must exist. And the reason of the change is no doubt that the insects in Kerguelen's Land are wingless, and are therefore bad distributors of pollen. And to go one step further back, the reason why the insects are wingless is to be found in the prevalent high winds. Those insects which attempt to fly get blown out to sea, and only those are preserved which are gradually giving up the habit of flying. Thus the pollen of the cabbage has to learn to fly, because the insects will not fly for it.

In considering the analogies between plants and animals, one cannot merely compare those functions which are strictly and physiologically similar in the two kingdoms. One rather sets to work and studies the needs which arise in either a plant or an animal, and then discovers in what way the same need is supplied in the other kingdom. There is no connection between a plant having bright flowers and an animal's power of walking about, yet they may, as we have seen, play the same part in the economy of the two lives.

In the life of animals the first needs that arise are supplied by certain instinctive movements. The young chicken only escapes from its egg by some such movements. Mr. W. Marshall has also shown that the chrysalides of certain moths possess instinctive movements by which they escape from the cocoon or outer case. In one case a sharp spike is developed, sticking out from the side of the chrysalis, and as the latter rotates the spike saws the cocoon all round, so that the top lifts off like a lid. Again, in young chickens Spalding has shown the existence of an instinctive power of obtaining food, and instinctive recognition of the hen by sound only. This was proved by a newly-hatched chicken, which had never heard or seen its mother, running towards a cask under which a clucking hen was hidden. The powers of growth which exist in young seedlings would certainly be called instinctive if they existed in animals, and they are quite as indispensable as those just mentioned in supplying the wants which first arise.

These two instincts are the power of directing the growth in relation to the force of gravity, and in relation to light; the first being called geotropism, the second heliotropism. As soon as the young root emerges from the seed-coats, it turns abruptly downwards, perceiving like the chick in what direction the earth, its mother, lies. Thus the young plant fixes itself firmly in the ground as quickly as possible, and is enabled to begin to make arrangements for its water supply. At the same time the young stem grows upwards, and thus raises itself as much as possible over its neighbours. The power of directing itself vertically upwards is also a necessity to the plant, because without it no massive growth like that of a tree would be possible. It would be like a child trying to build a wooden house with bricks that did not stand straight. Thus, both the young stem and the young root have an instinctive knowledge as to where the centre of the earth is—one growing towards the point, the other directly away from it. This fact is so familiar to us, that we fail to think of it as wonderful; it seems a matter of course, like a stone falling or a cork floating on water. Yet we cannot even generalise the fact so far as to say it is the nature of all stems to grow up, and all roots to grow down, for some stems, such as the runner of a strawberry, have a strong wish to grow down instead of up, and side roots that spring from the main ones, though their method of growth is identical with that of the main roots, have no wish to grow downwards. We can find no structural reason at all why a root should grow down and a stem up. But we can see that if a plant took to burying its leaves and rearing its roots into the air, it would have a bad chance in the struggle for life. It is, in fact, the needs of existence which have impressed these modes of growth on the different organs of the plant in accordance with their various requirements. On the other hand, the plant is not absolutely tied down by geotropism, it is not bound to grow *always* in a vertical line, but is ready to be turned from its course if some other direction can be shown to be more advantageous. Thus Sachs[1] planted peas in a little sieve, and as the roots emerged underneath, they were enticed from the vertical by an oblique damp surface. This power of giving up the line of growth for the sake of a more advantageous position, must be of great service to roots, by enabling them to choose out damp places in the earth which a blind adherence to rule would have caused them to pass by.

The other tendency, which may be also compared to an instinct, is the power possessed by the growing parts of plants of perceiving the position of the chief source of light. This tendency of course interferes with the geotropic tendency, for if the tip of a growing shoot bends towards the light it deviates from its vertical course. This contest between two instincts is well shown by placing a pot of seedlings close to a lamp or a window, in which case the heliotropic beats the geotropic tendency and the young plants curve strongly to the light; now if the pot is removed to a dark room the geotropic tendency reasserts itself, and the seedlings become once more upright. One might fancy from this that the darkness of night would be always undoing any good gained by heliotropic growth in the day. An imaginary case in the life of a seedling will show that it is not so. A seedling germinates under a pile of sticks: having few competitors it makes a good start, but in consequence of the darkness it begins to starve as soon as it has exhausted the supply of food given it by its mother plant stored up in the seed from which it sprang. It starves because it is dark under the pile of sticks, and without light it cannot decompose the carbonic acid of the air and make starch; carbonic acid may be said to be the raw material from which a plant makes its food—but without the help of light the plant is powerless to make food—it starves in the midst of plenty. So that the power of knowing where the light is and of moving towards it may be just as necessary to prevent a young plant starving as the power of knowing a grain of corn when it sees one and of snapping it up are to a young chicken. Luckily for our imaginary plant a ray of light streams in between two sticks—if the plant insisted on growing straight up in obedience to the geotropic instinct it would lose its chance of life. Fortunately the other light-seeking instinct wins the day and the plant thrusts its summit between the sticks and reaches the light. And now it is clear that when the plant has once got between the sticks the tendency to straighten again in the night will not be able to undo the advantage gained in the day by heliotropism. Besides the tendency to seek the light, there is in some plants another exactly opposite tendency to grow away from it. Just as in the case of geotropism no reason can be given why two organs should be affected in exactly an opposite manner by the same cause; no difference of structure can be perceived and no difference in manner of growth can be found between a tendril which grows away from the light and one which grows towards it. The convenience of the plant seems to dictate the result. Thus the virginian creeper climbs by forming little sticky feet at

[1] C. Prentice, *Journal of Botany*, 1872, p. 22.

[1] "Text Book of Botany," Eng. Tr. p. 764.

the end of its tendrils, and as it climbs up a support each new tendril is enabled by its power of seeking for darkness rather than light to find out little dark crannies in which to place its feet. On the other hand a bryony climbs by seizing anything it can get hold of, and as each tendril reaches out towards the light the whole plant will tend to be dragged towards the lighter side of the bush or hedge on which it clambers.

It looks as if the case might be put thus: Given the fact that light produces some kind of movement, the convenience of the plant shall decide whether it be towards the light or away from it; or in other words, grant the plant the power of knowing where the centre of the earth is, and grant it the power of knowing where the light comes from, then the plant itself can decide what course of growth is most advantageous.[1]

(*To be continued.*)

NOTES

THE subscription for M. Leverrier's statue is progressing favourably. A sum of 4,200 francs has been already collected. The subscribers up to the present moment number thirty-five, almost all of them belonging to the French Institute. M. Cohen, of Antwerp, sent 1,000 francs. Other large sums are expected soon from different parts.

IT is stated that M. Faye has declined to stand for the direction of the Paris Observatory, unless it is agreed to retain at the observatory the International Meteorological Office. It is very probable that the long spoken of Meteorological Institute will now be established; at all events a solution of the pending question will soon be adopted by the government.

M. DUMAS announced to the Paris Academy of Sciences at its sitting on March 4 that an anonymous donor offers a prize of 6,000 francs to be awarded in 1880 to the person who makes the most useful application of M. Pasteur's researches to the healing art.

A COMMITTEE has been formed at Königsberg to erect a fitting monument upon the grave of the great philosopher Immanuel Kant. The City authorities have headed the list of subscriptions with the sum of 4,000 marks (200*l.*).

IN a report by M. Daubrée to the Paris Academy of Sciences it is strongly recommended that measures should be taken to preserve the many boulders which are scattered over France, and many of which are disappearing under the pick-axe of the builder. The Academy has appointed a commission for the purpose, which will have delegates in the principal districts of the country. Similar measures have been taken in Switzerland since 1866, and our Scotch geologists deserve praise for their zeal on behalf of the preservation of the boulders of their country, and for their excellent periodical reports on the subject.

GEN. DUFF, in a letter to the Earl of Derby, dated Gothenburg, January 4, reports that great shoals of herrings of the large kind which disappeared from this coast in the year 1809 have now made their appearance again north of Gothenburg. The first appearance of the herring took place at Christmas, when whales were seen following the shoals toward the coast. Preparations were made by the merchants of Gothenburg to make good use of this godsend. It would appear from the history and traditions of Sweden that, after an interval of seventy years, there are some grounds for supposing that the shoals of herrings may be expected to visit the coast regularly for fifty or sixty years to come, as has been the case during earlier periods. The Swedish Government have appointed Professors Sars and Smitt to inquire into the various questions raised by this sudden appearance of the herring shoals off this part of the Swedish coast, the more important of these questions being the alleged disappearance of the shoals from the coast of Norway, whither, it is said, they have betaken themselves since 1808, and the bearing of the inquiry on the future of the fishery.

THE first National Entomological Exhibition commenced on Thursday at the Royal Aquarium, Westminster, and is thoroughly creditable to all concerned. There are altogether about 250 exhibitors contributing between eight and nine hundred cases, with an average of at least 300 insects per case; and the whole of the specimens shown, with very few exceptions, have been collected by ladies and gentlemen and artisans, in their leisure hours.

WE regret to learn the death of Joachim Monteiro, at Delagoa Bay. He was an active and enterprising naturalist, whose work on Angola will give him an enduring place in the literature of African travel, no less than his services in procuring and sending to this country a great part of the fine series of specimens from which *Welwitschia* was originally described.

THE death is announced of Sulhiz Kurz, the Curator of the Herbarium of the Calcutta Botanic Garden. Possessed of an extensive knowledge of Indian botany, he had recently completed the preparation of a Flora of British Burma for the Indian Forest Department. He died at Penang on his way to the islands of the Malayan Archipelago, for the purpose of botanical exploration.

A LETTER has been written by the Municipal Council of Paris to the director of the Meteorological Service of the Observatory asking that the publication of weather telegrams and prognostications he made in Paris as well as in provincial towns.

A GREAT prehistoric burial ground has recently been discovered at Cremmen (in the district of East-Havelland, Prussia), not far from Berlin. Numerous urns and ash-jars of varied form, all containing ashes and bones of burnt human remains, have been found. The urns are mostly round in shape, and stood some $2\frac{1}{2}$ to 3 feet below the surface upon a large slab of stone; they were surrounded by round stones, and each was covered with a flat stone lid. The antiquities will all be deposited in the Provincial Museum of Berlin.

AN International Agricultural Exhibition will take place at Hamburg on June 13, and will last 5 days; and another exhibition of this nature will be held at Prague on May 15, 16, and 17.

THE Royal Society for Agriculture and Botany of Ghent, will hold its Horticultural International Exhibition on March 31 next. These exhibitions are quinquennial, and last for seven days. The coming one promises to be unusually brilliant, to judge from the copious list of names of exhibitors.

WE are glad to see that a beginning has been made in the formation of a local museum at Tenby, the proposal for which we referred to some time since. The magnificent geological collection of the late Mr. Smith, of Gumfreston, has been purchased. The Corporation of Tenby has given the old National School-rooms on the Castle Hill, and after some slight alterations have been made they will be admirably well adapted for a museum. In addition to the geological specimens there will be a valuable collection of British shells, and one of Pembrokeshire birds and eggs; also a library of scientific books. It would be idle to speak of the advantage this institution is likely to confer on the town, and on all the residents in South-west Wales, where nothing worthy of the name of a museum at present exists. About 300*l.* is still required before the museum can be opened. The trustees ought to have no difficulty in raising this moderate sum in the district concerned; perhaps some of our readers might like to contribute. The hon. secretary is Mr. Edward Laws, Tenby.

[1] I have spoken as if the existence of positive and negative helio- and geotropism could be simply explained by considering the convenience of the plant. But in details many difficulties arise; for instance, some roots are heliotropic. (Sachs' "Text Book," p. 755.)

THE *Spectator* learns from a private letter that the telephone has been adopted by the Chinese, the telegraph being useless, as they have no alphabet. Five hundred miles, it is stated, have already been spoken over in China. Mr. H. F. Stevens writes from Tabreez, Persia, that conversation and music were transmitted satisfactorily by telephone between that town and Tiflis, along the line of the Indo-European Telegraph Company.

AT a recent meeting of the East Kent Natural History Society, P of. Gulliver exhibited a very extensive series of drawings of raphides and other crystals found in the tissues of plants. Mr. Gulliver considers that sufficient attention has not hitherto been directed to the part played by these deposits of mineral salts in the vital economy of the plant, or, from the soluble condition in which they are presented, in the nutrition of the animals which feed on them.

Apropos of the note in NATURE (vol. xvii. p. 311) relating to a recent attempt to send certain fish to America, Mr. Carrington, of the Westminster Aquarium, writes that there are in the Royal Aquarium, Westminster, at least eighteen species of fish from American waters. In return he has exported a number of sea-water animals, including fish, molluscs, crustaceans, and zoophytes. At first a large proportion of specimens was lost during the voyage, but now there are seldom any lost, either on the homeward or outward voyages. In addition to the constant attention necessary at sea, Mr. Carrington finds the great secret of success is to have the animals subjected to confinement for some weeks before shipment.

MESSRS. LONGMAN have published an abridged edition of Dr. Pole's excellent "Life of Sir W. Fairbairn." The personal narrative has been retained entire, the scientific and technical portions being much abridged. The little work deserves, and no doubt will have, a wide circulation.

WE are pleased to see that the *Natural History Journal*, conducted by the Societies in Friends' Schools, whose appearance we noted a year ago, has reached the beginning of a second volume. Of the 170 contributors sixty-three, we learn, have been boys and girls. The journal is well conducted and, judging from the number before us, its contents are well calculated to interest its young readers in science.

IN NATURE, vol. xii. p. 514, W. W. Wood, writing from Manila, describes a species of Navicula (?) with a gelatinous ciliated envelope, which is there figured. Mr. Wood announced his intention of submitting his specimens to a competent diatomist, but three years have nearly elapsed, and no more has been said on the subject. It is one of such extreme importance as bearing on the ordinary motion of diatoms, that Mr. G. S. Boulger writes asking for an explanation.

MANY of our readers will be sorry to hear of the death, on Monday last, of the old hippopotamus, in the Gardens of the Zoological Society. He was obtained in the White Nile when only a few days old, in 1849, and has been in the Gardens since 1850. Prof. Garrod, F.R.S., will communicate the results of his examination of the body to an early meeting of the Zoological Society.

WITH reference to a note in NATURE (vol. xvii. p. 38) respecting the uninflammability of eucalyptus, Mr. A. Nicols writes that this must be a mistake, as in Australia the wood is extensively used as fuel. Acclimatisation of these really valuable trees, Mr. Nicols thinks, should be strongly supported. They yield timber of immense size and strength, durable alike in dry or wet situations, and more proof against the attacks of *termites* than many other woods, and some work up into beautiful furniture. They would probably thrive wherever the mean annual temperature is not below 60°, or, roughly speaking, over an area of about one-half of the habitable region of the earth.

THE provisional observatory at Meudon is in full operation, as we reported some months ago. Dr. Janssen has done such good work that the ministry will propose to restore the old palace which is now in ruins, and establish a splendid physical observatory in an admirable situation. A credit of 250,000 francs is to be asked for; this will include the purchase of a refractor om. 67 in. diameter.

THE governor of the French island, Reunion, in the Indian Ocean, reports that this colony was visited by a terrible cyclone on January 15, causing great losses of life and property.

UNDER the auspices of the Deutscher Fischerei-Verein, 2,000,000 salmon eggs are hatched annually, and distributed among the various rivers of the empire. Strong efforts are now being made to introduce extensively the grayling, which is comparatively rare in Germany.

IN the February session of the Berliner polytechnische Gesellschaft, Dr. F. Siemens, of Dresden, the inventor of the new compressed hard glass, gave an interesting exhibition of this new invention. The process has been brought to such perfection, that the hard glass is not only more easily, but more cheaply manufactured than the ordinary glass. The power of resistance varies from eight to ten times that of ordinary glass. The serious objection made to hard glass at the time of its discovery, that it often fell to pieces when entirely unexposed to pressure, has been successfully avoided. This property was found to result from over-hardening, and it is now possible to detect all articles which have acquired it, by the use of the polarisator, under which over-hardened glass shows a prevalence of violet tints. This condition is also detected by exposure to water at a certain temperature.

THE working out of the results obtained by the Transit of Venus expeditions sent out by the German Government, were expected to have been far enough advanced for publication in the year 1877. It has been found, however, that this task causes more difficulties and expenses than had been at first anticipated. The Imperial Chancellor's office has therefore demanded from the German Parliament an extra credit of 500*l*. to defray the additional costs.

A USEFUL invention has recently been made by Herr Weber, of Hummel-Radeck, near Lübben (Prussia). This gentleman has contrived to construct a very simple machine for levelling roads, which for working requires only two horses, a driver, and a labourer, and renders it possible to make such improvements in a road, in a short time, as could otherwise be accomplished only by fifty or sixty workmen. The machine works equally well upon gravel or clay soil, and its cost is only forty-five marks (shillings). The whole machine works much in the same way as an ordinary carpenter's plane does upon wood.

ON January 25, shortly after noon, the belfry of Toucy (Yonne) was struck by lightning, and set on fire. According to Dr. Roche (who describes the case), the wind was blowing from the north-west, and a dense, low cloud had begun to cover the ground with large hailstones. A few minutes after a single and prolonged thunder peal was heard, and the cross on the belfry was then seen to be surrounded by a luminous meteor. Persons in the houses near the church saw coming from the base of the belfry two fire-balls of about 0·30m. to 0·40m. diameter, and about 0·50m. apart. They rolled on the steps of the building about 20m. and disappeared. A woman in a room about 15m. from the belfry was carried to the end of the room; a young man who was passing was thrown on the ground, and several other persons were more or less shaken. Immediately after the thunder peal the hail ceased and was replaced by a snow-storm which lasted three-quarters of an hour. It was afterwards found that the belfry was fired at two points—one at the upper part of the north-west side, the other at the lower part of the south-east side, probably the points of entrance and exit of the electric fluid. Toucy stands in the middle of a narrow valley, running north-west, and is rarely visited by thunder-storms, which pass nearly always to the right or left.

SOME researches on the magnetic properties of nickel were recently made by the well-known physicist M. H. Wild, and are now published in the *Bulletin* of the Imperial Academy of Sciences of St. Petersburg. M. Wild arrives at the following conclusions: (1) Pure nickel can become permanently magnetic to a considerable degree, thus differing materially from pure (soft) iron. The maximum qnantity of permanent magnetism which pure nickel can retain is, however, only between one half and one-third of that quantity which hard steel can permanently retain. (2) Magnetism is less permanent in nickel than in well-hardened steel, after the magnetising force has ceased to act; the slow loss of magnetism in course of time, as well as by heating and cooling, is comparatively greater in nickel than in steel; and this is the case even if the nickel has, like hard steel, by repeated heating and cooling, been brought to a certain state of permanent capacity. (3) The temperature coefficient of nickel magnets in the latter state is a little larger than that of properly hardened steel. (4) The temporary magnetism which pure nickel can retain is about double its permanent quantity, or about one half of the temporary magnetism which hard steel, and about one quarter of that which soft iron can retain. In its magnetic properties nickel is, therefore, thoroughly inferior to iron and steel.

THE question with regard to the existence of microscopic organisms in media containing no oxygen has been a fruitful subject of discussion for biologists of late, and some doubts have been thrown on the entire absence of this gas in the experiments cited by Pasteur and others. Prof. von Nägeli, in his work on "Die niederen Pilze," which has just appeared in Munich, presents some interesting figures in this connection. According to his calculations the larger bacteria weigh $\frac{1}{2500000000}$ milligramme. If we assume that they consume the same amount proportionally of oxygen daily as a man, viz., 1 per cent. of his weight, then a million bacteria would require in twenty-four hours $\frac{1}{20000}$ milligramme, or nearly $\frac{1}{30000}$ cubic centimetre of oxygen. These calculations, taken in connection with the well-known difficulties of entirely eliminating gases, will probably render a repetition of the best experiments necessary.

FROM recent experiments on the spread of gases through bodies, Dr. Wroblewsky (*Pogg. Ann.*) arrives at the following conclusion:—When a gas is absorbed it spreads in the absorbent body according to the same laws as those ruling the propagation of heat in a solid bar; and that whether the absorbent body be liquid or solid, or in a transition state between these two extremes." The only exceptions to this law are attributable to the action of gravity. It is known that the excretion of carbonic acid by an animal is increased by a violent muscular action, but it has been uncertain whether the CO_2 is a direct product of muscular action, *i.e.*, belongs to the substances which, through decomposition processes, are formed in greater measure during contraction of the muscles. To clear up this point, M. Sedgwick-Minot recently forced through the vascular system of detached muscles of dogs (the blood having been removed) a quantity of blood-serum saturated with oxygen, and determined the proportion of CO_2 in the serum in a series of cases in which the muscles were at rest, and in another series in which they were repeatedly stimulated to contraction. If the contraction of the muscle caused a greater formation of CO_2, the serum, after passage, must contain more CO_2 than if the muscle remained at rest. The experiments, however, gave equal quantities of CO_2 in the two cases, and the reason of the fact referred to at the outset is not determined.

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus*) from India, presented respectively by Capt. Pole Carew, and Mr. Henry Wright; a Green Monkey (*Cercopithecus callitrichus*), two Common Chameleons (*Chamæleon vulgaris*) from West Africa, presented by Mr. G. H. Garrett; a Herring Gull (*Larus argentatus*), European, presented by Mr. Capstick; two Undulated Grass Parrakeets (*Melopsittacus undulatus*) from Australia, presented by Mr. Hylton Jolliffe; an American Darter (*Plotus anhinga*) from South America, purchased; two Sambur Deer (*Cervus aristotelis*), an Isabelline Bear (*Ursus isabellinus*) from India, a Javan Adjutant (*Leptoptilus javanicus*) from Java, received in exchange.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Mr. J. R. Terry, M.A., Fellow of Magdalen College, who was Fifth Wrangler at Cambridge in 1873, has accepted the senior mathematical mastership in Magdalen College School; and Mr. D. C. Robb, B.A., scholar of Worcester College, has been appointed to a science mastership (in physics) at the same time.

CAMBRIDGE.—The report of the Council of the Senate recommending the appointment of an assistant to Prof. Hughes has been confirmed upon the understanding that the person to be appointed be not permitted to take private pupils.

EDINBURGH.—A movement has originated in the University of Edinburgh to procure a portrait of Prof. Balfour, in recognition of his services to the University in having for thirty years acted as Dean of the Medical Faculty. This movement has been joined in by the Fellows of the Royal Society of Edinburgh, in recognition on their part of the services he has for many years rendered to the Society in the character of Secretary.

BIRKBECK INSTITUTION.—A course of six lectures on Electric Telephony will be delivered by Mr. W. J. Wilson, F.C.S., on Saturday evenings, at eight o'clock, commencing March 23. The entire proceeds will be given to the fund now being raised for the erection of a new building for the institution. The lectures will be very fully illustrated by experiments, diagrams, &c., and will form a complete exposition of the subject.

PARIS.—M. Pierre Picard is proposed as a successor to the late Claude Bernard in the chair of physiology at the Collége de France. He was for a long time assistant to the famous physiologist, and is himself the author of valuable researches on the constitution of the blood corpuscles. At present he is a professor in the Faculty of Medicine at Lyons.

ALGERIA.—M. Bardoux proposes to establish in Algeria three preparatory schools for medical and law students, one in each of the three provinces. At present Algiers alone is provided with a preparatory school of medicine. The means for obtaining superior instruction, which have been very limited up to the present in the colony, will be greatly enlarged.

BERLIN.—On the night of the 8th instant the professors and students of the Berlin University, assisted by civil and military dignitaries, held a grand "Commers," or beer-drinking revelry, in the time-honoured style of German academical life, in honour of the sixtieth anniversary of the birthday of Prof. A. Hofmann, the celebrated chemist. The proceedings began by the secretary of the committee reading a letter from the Chamberlain of the Crown Prince expressing the regret of his Imperial Highness at being prevented from attending the festivity. After this Prof. Helmholtz, the Rector of the Berlin University, formally congratulated Dr. Hofmann, who replied in a speech to the felicitations addressed to him by his Berlin colleagues and friends. Numerous other speakers, among them Privy-Councillor Jacob, Chief of the Patent Office, and Prof. Reuleaux, Rector of the Berlin Polytechnic Academy, then addressed the hero of the day. The official part of the festivity closed at 2 o'clock, after which came the singing of all the obligatory songs and the delivery of student speeches. Not a few congratulatory letters and telegrams reached Prof. Hofmann on the auspicious day from England, America, and France.

PRUSSIA.—The three agricultural institutes of Prussia are attended at present by 270 students, of whom 215 are from Prussia, 20 from other parts of Germany, and 35 from foreign countries.

GERMAN POLYTECHNIC CONGRESS.—At the recent inauguration of the new Polytechnic Institution of Brunswick, the assembled men of science considered the question of a general congress of lecturers at the German polytechnic schools. It is intended to hold the congress at Dresden, and a preliminary meeting of delegates will take place in the beginning of April, in order to fix the programme for the congress. Dresden has also been selected as the meeting-place for a congress of German engineers and architects, and it is supposed that the two meetings will be held simultaneously.

SAXONY.—An interesting example of the comparative sums devoted in Germany to various educational purposes is to be seen in the recently-issued Report of the Minister of Public Instruction for Saxony, a kingdom with 2,550,000 inhabitants. The whole number of educational establishments is 3,900, of scholars and students, 523,000, of instructors, 6,400. The salaries amount to 12,300,000 marks, and the total educational expenses are 18,000,000, of which 5,000,000 are contributed by the Government. The State devotes 766,000 marks to its 76 gymnasia and *Realschulen*, 1,354,000 to the general school system, and nearly as much, viz., 1,048,000 marks to the University of Leipzig with its 161 professors and 3,100 students, besides 893,000 marks for pensions. The total annual cost of the Leipzig University is 1,402,000 marks, or 70,100*l*.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 1, 1878.—The universal compensator, by M. Beetz.—On the electromotive force and the internal resistance of some thermopiles, by M. Beetz.—The theory of stationary currents regarded from a quite general standpoint, by M. v. Bezold.—On a tangent multiplier and the electromotive force of the Grove element, by M. Riecke.—On the influence of density of a body on the amount of light absorbed by it, by M. Glan.—On the theory of the longitudinal-elliptical vibrations in the incompressible ether, by M. Ketteler.—On fluorescence, by M. Lommel.—On metallic reflection, by M. Wernicke.—On the volume-increase of liquids through absorption of gases, by Messrs. MacKenzie and Nichols.—Some observations on Crookes's radiometer, by M. Riecke.—Determination of the resonance-tones of the mouth-cavity by percussion, by M. Auerbach.—On the pitch of a tuning-fork in an incompressible liquid, by M. Auerbach.

Zeitschrift für wissenschaftliche Zoologie, vol. xxx., part 1.—Rhizopod studies, by Emil Buck, 49 pp. 2 plates; dealing with the development of arcella, and a new genus parasitic on rotifers.—Revision of the genus analges (avian parasite), by G. Haller.—Contribution to the anatomy of asteridæ, by Hubert Ludwig, 4 plates, 63 pp., describing the water-vascular system, the blood system, the nervous and the generative apparatus, the body cavity.—Contribution to the natural history of the cestodes, by H. A. Pagenstecher, dealing with *Tænia critica* and *Cœnurus serialis*.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, February 21.—W. Carruthers, F.R.S., vice-president, in the chair.—Mr. Thos. Christy illustrated by diagram and made remarks on M. Ossenkep's new system of plant-propagation; and he also showed the recently imported fresh berries of the Liberian coffee of this year's crop.—Mr. Holmes exhibited a remarkable oak gall of *Aphilothrix sieboldii*, Hart., obtained at Willesboro, Leas, Ashford.—Mr. Thiselton Dyer likewise exhibited and made a few observations on the inflorescence and a drawing of the palm *Pthychosperma rupicola*, Thw., which had flowered for the first time in Europe at Kew.—A paper, notes on the Mahwa tree (*Bassia latifolia*), was read by Mr. E. Lockwood. This tree grows in abundance in India; a hundred thousand may be seen in the plains around Monghyr. Wild animals of all kinds greedily devour the flowers, of which one tree will yield several hundredweights. Besides being highly nutritious to man, it is an excellent fattening agent for cattle, &c. A strong-smelling spirit is obtained by distillation of the corolla, an essential oil from the fruit, and as an agent in soap-making the tree is invaluable. Thus, certain yield, unlimited supply, nourishing and chemical qualities, easy preservation, and its cheapness, all combine to render it a commercial product of no mean importance to our Indian empire.—The gist of a "Synopsis of the Hypoxidaceæ," by Mr. J. G. Baker, was given. This group differs in some respects from the Amaryllidaceæ, and offers a close alliance with the Bellosiceæ. Four genera, and between sixty and seventy species are known. The Cape is their head-quarters, but some are found in Tropical Africa and Angola, a very few in Abyssinia and the Mascarenes. None are found in Europe, Polynesia, North and Central Asia, nor Extra Tropical South America.—The Secretary read an abstract of a technical paper on the Schoepfieæ and Cervantesiiæ, distinct tribes of the Styraceæ, by John Miers, F.R.S.—Then followed a communication by Mr. Arthur G. Butler, on the butterflies in the collection of the British Museum, hitherto referred to the genus Euplœa of Fabricius.—Dr. Hance, of China, Mr. E. Milner, Dr. Geo. Shearer, and the Rev. R. Boog Watson were elected Fellows of the Society.

Chemical Society, February 21.—Dr. Gladstone, president, in the chair.—A lecture entitled "Laboratory Experiences on board the *Challenger*" was delivered by Mr. J. Y. Buchanan. After describing his laboratory, which measured 10 feet by 5 feet 8 inches and 6 feet high, and its fittings, the lecturer gave a detailed account of the means by which, after estimating the compressibilities of water and mercury, he was enabled to determine the depths and temperatures attained by the sounding line. The compressibility of distilled water was found to be 0·000049 per atmosphere, or 0·0009 per 100 fathoms; of sea-water, 0·00077 per 100 fathoms; and of mercury, 0·0000271 per 100 fathoms, or 0·0000015 per atmosphere. He then described the apparatus and methods by means of which the amounts of oxygen, nitrogen, and carbonic acid were determined. The most interesting results obtained were the following:—From the surface down to 300 fathoms the amount of oxygen continuously decreases; from 300 fathoms downwards, whatever be the depth, the amount increases. This anomalous result the lecturer stated to be due to the great abundance of animal life at the depth of 300 fathoms, the increase in the quantity of oxygen at greater depths being caused by its non-consumption, owing to the scarcity of life. The next part of the lecture dealt with the distribution of the sea-water as regards density, in depth and superficially. Two regions of maximum density exist north and south of the equator, corresponding to the tracts frequented by the trade winds. At 350 fathoms deep a great zone of water of low density is found. The densest water is found in the Atlantic. Light water is found in the neighbourhood of ice and in certain regions immediately after the cessation of the monsoons. The maxima of density lie in the north hemisphere to the south-west, in the south to the north-west of the maxima of barometric pressure. A hearty and unanimous vote of thanks was given to Mr. Buchanan for his interesting lecture, which was illustrated by many tables and diagrams.

Physical Society, February 16.—Prof. W. G. Adams, president, in the chair.—The following candidate was elected a Member of the Society: Mr. G. H. West, M.A.—Dr. Lodge read, for Mr. H. F. Morley, M.A., a paper on Grove's gas battery. After referring to the views of M. Gaugain and Mr. Grove himself with regard to the cause of the action of this apparatus, the author proceeded to describe an elaborate series of experiments he has recently made in order to ascertain the circumstances by which it is regulated. It would be impossible to give a clear account of them in a short space, but some of his conclusions are as follows:—The whole of the current is due to dissolved gas, and if n be the distance of the level of the liquid from the top of the plate in the H tube, and $E = \frac{C\,R}{1{,}000}$, C being given in galvanometric readings and R in ohms, he finds that, approximately, $(1 + n\,a)\,C = b + n\,e - (c + n\,d)\,E$, where a, b, c, d, and e are constants. The electromotive force is not constant, but rises with the resistance. The current is greater in proportion as the gas present in the elements is less; and, finally, the current appears to vary directly with the pressure.—Mr. S. C. Tisley then described the harmonograph, specially referring to its use for drawing pairs of curves for the stereoscope. This, the latest forms of his pendulum apparatus, is capable of giving a very great variety of curves, for, in addition to rectangular vibrations, parallel and elliptic motions can be combined by its means. In the older form of apparatus each pendulum moves on the other as a centre, whereas in the instrument described they are independent. One pendulum carries at its upper end a table which can be caused to rotate by clockwork if required. The whole is supported on a kind of gimbal joint formed of two pairs of knife edges at right angles, so arranged that vibration can take place either on one or the other, or the two can be so combined as to give a circular motion; or again, the pendulum can be caused to vibrate in any given plane. The second pendulum vibrates in the plane in which the two hang, and carries at its upper end an arm terminating in a pencil over the table of the other pendulum. A very ingenious adjustment renders it possible to raise or lower the bob of the second-named pendulum during its motion. If two pens be attached, about $2\frac{1}{2}$ inches apart, instead of the single one usually employed, and two curves be traced, they are not precisely similar, and when viewed in a stereoscope they are found to give the well-known appearance of solidity to the figure. It was further shown that by gradually changing the relative motions of the pendulums it is possible to impart to the curve many of the forms observed in biaxial crystals in the polariscope.—Mr. F. J. M. Page then exhibited the action of the telephone on a capillary electrometer. The construction of Lippman's electrometer as modified by Marey was first explained, and the meniscus of the mercury in the capillary tube was thrown on the screen by the electric light. The delicacy of the instrument was shown by passing a current of $\frac{1}{1000}$th of a Daniell, which caused a distinct movement of the mercury. Resistance of 5,000 ohms and $\frac{1}{10}$th ohm gave approximately the same deflection; so that, in practice, the instrument may be considered to be independent of resistance, in addition to which it possesses the great advantage of portability, and its indications are almost instantaneous. To illustrate the use of the electrometer for physiological investigations, a frog's heart was connected by non-polarisable electrodes with the instrument; each beat of the heart caused a considerable movement of the mercury column. A telephone was now connected; on pressing in the iron plate the mercury moved, and on reversing the wires the movement was seen to be in the opposite direction. On singing to the telephone each note produced a movement, but the fundamental note of the plate as well as its octaves and fifths had the greatest effect. On speaking the mercury oscillated continually; some letters of the alphabet had scarcely any effect, and the *w* was especially curious, producing a double movement. Reversing the wires did not alter the character or *direction* of these movements. The same effect was observed when the telephone was in the primary and the electrometer in the secondary coil of a Du Bois Reymond's induction coil. In conclusion, Mr. Page showed the contractions produced in a frog's leg; on inserting under the sciatic nerve two platinum wires coupled with the binding screws of a telephone and talking to this instrument, violent contractions ensued. In the course of the discussion which followed, Prof. Graham Bell expressed himself as highly gratified at the results of Mr. Page's experiments. He has made very many attempts to ascertain the strength of the current produced by the human voice in vain, but considers the present method will in all probability give some most valuable results. He was quite unable to account for the fact that the motion of the mercury took place *from* the opening, but this seems to depend on conditions not yet determined.—Mr. Wilson then exhibited, for Prof. S. P. Thompson, a lantern slide galvanometer for showing the deflections of the needle to an audience. It consists of a coil of insulated copper wire wound on a flat bobbin, within which a needle is balanced on a horizontal axis; this needle carries a long needle of aluminium traversing a semicircular divided photographic scale, and as this is transparent the index can be projected on to the screen. The whole is inclosed between two glass plates.

Geological Society, February 20.—Henry Clifton Sorby, F.R.S., president, in the chair.—James W. Carrall, Tientsin, China, Edward Cleminshaw, Percy John Neate, Arthur Nicols, John Snell, and John Spencer were elected Fellows of the Society.—The following communications were read:—Notes on the physical geology of the Upper Punjàb, by A. B. Wynne, F.G.S. The author stated that crystalline rocks are rare in the accession parts of the Upper Punjàb district, and that when present they consist of syenite and gneiss. The Cambrian and Silurian formations are represented by more or less metamorphosed azoic slates in the Himalayan district, and in the Salt Range by a zone less than 200 feet thick, containing either *Obolus* or *Siphonotreta*, underlain by a thick unfossiliferous sandstone, beneath which is a deposit of gypseous marl and salt. Above the Silurian in the Salt Range, and conformable to it, comes the magnesian sandstone group and a group of unfossiliferous sandstones and clays; in the Himalaya these deposits are probably represented by an unfossiliferous siliceous dolomite, which rests unconformably upon the slates. There are no fossils indicative of rocks of Devonian age. The carboniferous rocks, are also conformably deposited on limestones, sandstones, and shales, the last sometimes carbonaceous. These deposits contain hæmatite in sockets, and the oldest known ammonites have been found in them. An infra-triassic group occurring in Lei Bau mountain consists of red shales, sandstones, and red quartzitic dolomites, overlain by lighter-coloured siliceous dolomites, which in their turn are covered by hæmatite, quartz breccia, sandstones, and shales. The author believes these to have been deposited by the same waters which subsequently laid down the trias, which is largely composed of limestones in the northern Himalayan area, and here and elsewhere includes dolomites, shales, and sandstanes. Numerous fossils occur in some of the beds, such as *Dicerocardium*, *Megalodon*, and *Nerinæa*. In the western part of the Salt Range conglomerates composed of great blocks are regarded by the author as evidence of proximity of land. The Jurassic deposits are local in their distribution, and consist of shales, sandstones, and limestones, containing abundant fossils, such as belemnites, ammonites, and saurians. A dark limestone contains also *Gryphea* and *Trigoniæ*. The cretaceous deposits, when present, are conformable to the carboniferous; they are variable in thickness and fossil contents, and are not recognisable near Attock between the Jurassic and nummulitic groups. Further east a group, supposed to be cretaceous, includes clays with boulders of crystalline rock, which the author regards as derived from land to the south. One of these boulders presented glacial striæ. The eocene rocks are generally limestones, and lie conformably upon the subjacent formations. The nummulitic series of the Salt Range includes gypseous and coaly shales. The salt beds sometimes attain a thickness of over 1,000 feet. The Miocene and Pliocene deposits are of immense thickness, and contain only fossils of terrestrial and fresh-water origin, so that the deposits were formed in lakes and inland seas. The tertiary epoch closed with the elevation of the Himalayas and Salt Range, which was followed by a long period of change, during which various deposits were produced, some including great quantities of erratics, which, however, the author believes were brought to their present position rather by floating ice than by the extension of glaciers.—Description and correlation of the Bournemouth beds; Part I., Upper or Marine Series, by J. Starkie Gardner, F.G.S. The author comes to the conclusion that the whole group is contemporaneous with the Bracklesham beds, and is not of Lower Bagshot age. Similar shore conditions probably extended into the London basin, and the beds mapped by the Survey as Lower Bagshot are probably of the same age as those at Boscombe, in which case nothing more than the Bracklesham is to be met with in the London basin. The similarity of the leaves, &c., from Bovey Tracey to those obtained by the author leads him to infer that the former also are of eocene, and not of miocene age. The author increases the thickness of the London clay at Alum Bay at the expense of the Bagshot beds, and diminishes that of the Bracklesham beds at Whitecliff Bay by transferring part of them to the Lower Bagshot.—Notes on certain modes of occurrence of gold in Australia, by Richard Daintree, F.G.S.—Notes on the geology of the Island of Mauritius and the adjacent islets, by W. H. T. Power, B.A. (Communicated by W. Whitaker, F.G.S.)

Entomological Society, February 6.—H. W. Bates, F.L.S., F.Z.S., president, in the chair.—Prof. J. O. Westwood, Mr. J. W. Douglas, and Mr. F. Smith, were nominated by the president as vice-presidents for the year.—Mr. Rich. S. Standon and Mr. T. W. Wonfor, were elected Members of the Society.—Mr. J. Jenner Weir exhibited the following spiders:—three species identified by Sir Sydney Saunders as *Atypus sulzeri*, taken at Lewes; a remarkable form from Madagascar, and a small species beaten out of trees in the New Forest, which in marking and coloration, resembled lichen.—Mr. McLachlan exhibited a small collection of dragon-flies in illustration of a paper he communicated entitled "Calopterygina collected by Mr. Buckley in Ecuador." The collection contained a fine series of a new species, *Euthore mirabilis*.—Mr. Meldola exhibited a remarkable specimen of *Leucania conigera*. The colour and markings of the fore-wings were reproduced in the lower half of the left hind-wing.—Mr. Meldola read extracts from a letter addressed to Mr. Chas. Darwin from Dr. Fritz Müller, St. Catharina, Brazil, containing some valuable observations on the discrimination exhibited by a number of butterflies for certain colours in flowers. Mr. Müller also described the odoriferous organ of a male sphinx-moth which exhaled a strong musk-like odour, and called attention to a secondary sexual character observable in some species of Callidryas and other Pierinæ, in the serration of the costal margin of the anterior wing. This is confined to the males, though sometimes found in the females of Callidryas Philea, but in a far less degree.—Reference was made to a sphinx-moth, the proboscis of which, measuring 22 centimetres, had been forwarded by Mr. Müller and was exhibited at the meeting.—Mr. A. G. Butler stated that he had measured the probosces of all the Sphingidæ from Madagascar contained in the British Museum, and found that none of them exceeded 5 inches in length. He also stated that the Callidryades in the British Museum with serrated costal margins to the fore-wings, included the males of all the species of the genera Catopsilia, Phœbis, and Callydryas (true), with the addition of one or two other species. The President observed that in the genus Prioneris the serrated costal margin existed in both sexes.—The Secretary, on behalf of Capt. Elwes, exhibited some coloured illustrations of butterflies which had been taken by a new process of nature-printing.—Mr. G. C. Champion exhibited a specimen of the rare British beetle *Anthicus bimaculatus*, taken at New Brighton, and some specimens of the genus Cetonia, from the Mediterranean region.—Mr. J. W. May exhibited a specimen of *Carabus intricatus*, which he described as taken, for the first time, in the neighbourhood of London.—Mr. H. Goss called attention to the occurrence of sexual dimorphism in *Erebia medea*, exhibiting specimens of both forms of the female.—Sir John Lubbock read a paper on the colouring of British caterpillars. Accepting the principle laid down by Mr. Darwin and others, that dull-coloured, green, and smooth-skinned caterpillars are eaten by birds, &c., whilst spiny, hairy, and brightly-coloured species are rejected, the author stated that by the statistical method it was shown that no hairy caterpillars are green, whilst, on the other hand, a large majority of black and brightly-coloured species are hairy or otherwise protected.—Mr. Meldola read extracts from a recent communication by Dr. Fritz Müller in *Kosmos* on the subject.—The following papers were communicated by Mr. C. O. Waterhouse:—"Description of a new Dragon-fly (Gynacantha) from Borneo," "Description of a new Species of Chernetidæ (Pseudoscorpionidæ) from Spain," "On the Different Forms occurring in the Coleopterous Family *Lycidæ*, with Descriptions of New Genera and Species."

PARIS

Academy of Sciences, March 4.—M. Fizeau in the chair.—The following papers were read:—On the theory of the telephone, by M. Du Moncel. The theory of speech being transmitted by electro-magnetic action causing the plate of the receiving telephone to repeat the vibrations of the sending one, is, he thinks, untenable. The plate in the receiving instrument merely strengthens by reaction the magnetic vibrations of the bar, which seem to be due to contractions and dilatations of the magnetic molecules, through being successively magnetised and demagnetised. Induced currents probably owe their advantage for this work to their *instantaneity*. Their greater or less intensity is of small account.—The vibrations of matter and the waves of the ether in photo-chemical combinations, by M. Favé.—Report of Committee on the importance of preservation of certain erratic blocks situated on French territory, and on the work of MM. Falsan and Chautre, on ancient glaciers and the erratic region of the middle part of the Rhône valley, by M. Daubrée.—On the telluric etiology of cholera, by M. Decaisne. Cholera appears on all geological formations, but its development and propagation depend largely on the physical aggregation of the ground, its permeability for water and air, and the variable quantity of water it contains. The partisans of the telluric doctrine always suppose a specific infectious substance or cholera germ, which is propagated from place to place by human communications, not by the atmosphere.—Study of the resistance of the air in the torsion-balance, by MM. Cornu and Baille. Eliminating accidental perturbations, they have established these two laws: (1) The amplitudes or distances of two successive elongations decrease in geometrical progression; (2) The epochs of the elongations are in arithmetical progression. One theoretical consequence is that the resistance of the surrounding air to the movement of the lever is proportional to the first power of the angular velocity of the lever.—Influence of electricity on evaporation, by M. Mascart. Small basins containing water or moistened earth were placed under conductors (having the form of circular gratings), which were electrified by a Holtz machine driven by a water-motor, and were kept in a constant electric state. The evaporation was thus constantly increased, sometimes even doubled. Inequalities of temperature, however, veil the influence of electricity; the basins were inclosed in a large case, the air in which was regularly dried, and in winter the operation was performed in a kind of subsoil.—Observations on gallium, by MM. Lecoq de Boisbaudran and Jungfleisch. *Inter alia*, the authors exhibited anhydrous chloride, bromide, and iodide of the metal.—Discovery of a small planet at Clinton, New York, by Mr. Peters.—Theory of Vesta, by M. Perrotin.—On the employment of particular solutions of a differential equation of the first order and the first degree, in the investigation of the general integral, by M. Darboux.—On the fundamental points of the group of plane curves defined by a differential equation of the first algebraic order, by M. Fouret.—On the sumnatory formula of Maclaurin, by M. Callandreau.—On the elastic forces of vapours emitted by a mixture of two liquids, by M. Duclaux. A mode is indicated of calculating beforehand the boiling temperature of a liquid of known constitution.—Theory of the new direct-vision spectroscope, by M. Thollon.—On the combustion of gases, by M. Schützenberger. This relates to the propagation of combustion in eudiometers. The chief conditions affecting the phenomenon are: pressure of the gas, length of the gaseous column, composition of the mixture, and diameter of the tube.—On two allotropic varieties of magnetic oxide of iron, by M. Moissan. Sesquioxide of iron heated in an atmosphere of hydrogen or carbonic oxide to 350° or 440°, is transformed in a few hours into magnetic oxide; but this is very different in properties from the magnetic oxide got at a high temperature, by decomposing water with iron at a red heat or burning iron in oxygen, or decomposing sesquioxide at a lively red.—On the action of fluoride of boron on anethol; study of fluorhydrate of fluoride of boron, by M. Landolph.—New carbonated cupric liquor for determination of glucose, by M. Pellet.—On lactic fermentation, by M. Boutroux. He describes the form of the organism present and its mode of action.—Researches on the chemical composition and the functions of the leaves of plants, by M. Corenwinder. The predominance of azotised substances in young leaves indicates that it is these substances which exercise the respiratory function (absorbing oxygen and exhaling carbonic acid). Phosphorus too is in much less quantity in the older leaves, which again are rich in calcareous salts, and the chlorophyll in them retains and decomposes the CO_2 emanating from respiration.—Researches on the maturation of olives, by M. Roussile.—On the mineral water of Challes, in Savoy, by M. Willm.—On the frequency of glaucoma on the north coast of Africa, by M. Gayal.

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