THURSDAY, FEBRUARY 19, 1874

PHYSIOLOGY AT CAMBRIDGE

WE are not of those who believe that the *quality* of the scientific work produced by any country as a whole, is dependent to any great extent on the facilities afforded for special study, though the *amount* yielded in any special direction varies directly as the opportunities and encouragement which are offered. All experience goes to show that the ability of the individual is a constant quantity, and that whatever direction his mind takes, as the result of the circumstances in which he is situated, he is sure to rise to a certain standard of excellence in the quality of his productions, and no higher; in other words, the same facts put before two men of different mental powers will be employed in producing results of different quality, dependent on those powers. The backward state of physiology, and it may be said, of biology generally in comparison with the more exact sciences, has recently become so conspicuous, that attempts are being made by many of the leading scientific men to attract into these comparatively untrodden paths some of those able minds which would otherwise have devoted their best energies to the mastery and further elucidation of points in a subject such as mathematics, which may be almost said to have reached the limit of human mental power, as far as the methods at present at its disposal are concerned. In biology and physiology, however, the case is very different; their students may be said to be suffering from a glut of facts and disconnected minor theories, which want the assistance of some master minds to weed and connect them, so that the road may be made more easy for other less gifted workers. That such is the case is rendered evident by the undecided and tentative way in which most biological problems are on all sides discussed. Opinions the most opposite are held on fundamental points by partisans of different schools, and discussion becomes more a question of which side can be most subtle in its language or most dogmatic in its statements, rather than which is the true exponent of the subject under consideration. In such cases the precise statement of the problem by a master-mind would set the question at rest once and for all.

There are, however, many difficulties in the way of getting men suitable for this higher work, and for more than one reason. One of these is that there are very few who can be made to undertake the thorough training in more than a single subject, that is necessary for it. A student of ability at the University of Cambridge, for instance, takes up mathematics, and too soon finds that he has every reason to expect considerable pecuniary reward if he devotes the whole of his period of studentship to working for his tripos; he cannot but devote the whole of his time to the single subject, for otherwise those of equal powers who did so would beat him in the race and prevent his appearing in the tripos list in that position which insures him a fellowship, and therefore a competency. He keeps to his subject and reaps the reward; but by that time other duties, generally of a social nature, together with the narrowing effect of his one-sided education, have removed all his inclination to strike out a fresh line of thought, and he commences the routine of life, acquiring by every-day experience those facts which so many others of equal ability have learned before, and which he cannot therefore turn to any good account. The great defect of the Cambridge mathematical tripos is that it is too ultimate, and too complete in itself. The day on which the list comes out is that on which most think that mathematics has done as much good to them as it can do, and on that day most throw over for ever that genuine method of working which has occupied so much of their time and thought during the three or more previous years, never to return to it.

Things being so, all must have felt intense satisfaction at the establishment at last of laboratories in Cambridge, such as that for Practical Physiology by Trinity College, under the able superintendence of Dr. Michael Foster, and that for Practical Physics by the Chancellor, under Prof. Clerk-Maxwell, whose return to Cambridge has itself been a great stimulus to the advance of the subject in which he so greatly and so justly shines.

The first instalment of original papers from the former of these newly-founded institutions has recently been published. From the manner in which the researches have been conducted, from the thoroughly scientific and careful method of work adopted, the great discretion and experience of the Professors, as well as the excellent quality of the minds, with the assistance of which he has to deal, are evident. No teacher can help having a feeling of satisfaction at such work as that of Mr. Balfour and Mr. Liversidge, which shows signs of excellent mental training as well as a thorough love of the subject. Dr. Foster's standard is evidently a high one, and from the papers before us it is certain that on future occasions only thorough work, based on well-verified facts, arrived at by the most approved modern methods, and checked by the researches of previous authors, are to be expected from his laboratory.

Besides the papers on the development of the blastoderm and blood-vessels of the chick, and on the amyloid ferment of the pancreas, by the two above-mentioned authors, Dr. Martin gives some short notes on the structure of the olfactory mucous membrane in connection with the observations of Max Schultze and Exner. Mr. Dew-Smith records the results of observations—made with the assistance of that beautiful instrument the pendulum myographion—on double nerve stimulation, or the simultaneous stimulation, by two pairs of electrodes, of a single nerve, with well-marked and very instructive results. Mr. Yule also has a paper on the mechanism of opening and closing the Eustachian tube, in which, besides clearing up some points connected with their physiological function, he throws fresh light on the correct anatomy of their pharyngeal orifices.

In one of the papers, that by Dr. Foster himself, which is referred to by Mr. Lewes in this Journal (NATURE, vol. ix. p. 83), Mr. T. O. Harding, senior wrangler in 1872, is mentioned as one of those who have been working in the laboratory. This is a most promising sign; for, as previously remarked, nothing is more wanted than the assistance of such men, in order to show the bearing and value of the various facts laid stress on by pure physiologists. We hope that

Dr. Foster will be successful in attracting other advanced mathematicians to the study of his subject; and better still, that he will be able to persuade those who are in the beginning of their undergraduate mathematical education to devote some of their spare time—quite a recreation as it would be—to learning the first principles and the methods of physiological research, under his able supervision.

Truly Dr. Foster and Dr. Clerk-Maxwell have a noble work before them, and we may hope that by their example and precept Cambridge may after a lapse of thirty or forty years, in the matter of physical and physiological research, be on a level with a second-rate German University.

ATHENIAN TEXT-BOOKS OF SCIENCE

Εγχειριδιον της Χημειας, κατα τας νεωτατας της επιστημης προοδους. (Υπο Αναστ. Κ Χρηστομανου. Εν Αθηναις. 1871.)

Επιστημονικα Παραδοξα. (Υπο Δ. Σ. Στρουμπος. . . . Αθηνησι, 1864.)

Περι Αερος και των Ενεργειων Αυτου. (Υπο Δ. Σ. Στρουμπος, 1869.)

Περι των Γνωσεων και των Δοξασιων των τε ἀρχαιων και των νεωτερων ὡς προς τα φυσικα φαινομενα εν γενει, και των μεθοδων τον ερευναν αυτα. (Υπο Δ. Σ. Στρουμπος, 1858.)

THE University of Athens has existed for no more than thirty-seven years. Two of its four Faculties,—the Faculty of Medicine and the Faculty of Philosophy, require a knowledge of natural philosophy and chemistry. It is difficult to understand how these subjects could have been taught at first, for the students by no means often understand French, and no Greek books on science then existed. No doubt the professors taught as Plato and Aristotle taught; and the note-book of the student had to be his text-book. But matters have changed since then: the demand for text-books in Greek has caused them to appear; slowly indeed, for we have seen but few books on science, but we may hope that the original text-books which are now beginning to appear are the first of a continuous series. Do not let it be imagined that the works whose titles are given above are the only works on science we could find in all Athens. There is a big book on Physics by M. Damaskenos, who has also written on trigonometry and meteorology; there are various memoirs by M. Stroumpos on the refraction of light; on the internal constitution of flame; on the fundamental principles of hydrostatics, &c. The University is tolerably well supplied with physical and chemical apparatus, and in good time, we hope, some good student-work will be done there.

Many of the professors have studied in Paris, and we see evidence in the text-books of French science and of French thought. Prof. Chrestomanos appears, however, in the compilation of his Chemistry, to have consulted most of the recent books and memoirs. We are glad to see Canizzaro often quoted as an authority. The work does not present any specially noteworthy features, but it is sound and eminently clear. The phraseology is at times somewhat strange to a western student; thus we do not employ such words as "Physiography" and "Phutology." . . . After some prefatory remarks concerning the division of the sciences, we have a few pages given to the history of chemistry. The period of Alchemy is wrongly stated to extend from 400 to 1500 A.D. Then Iatrochemistry from 1500 to 1650; Phlogistic chemistry from 1650 to 1783; the new chemistry of Lavoisier and Davy, and so on to the chemistry of Kekulé and Canizzaro. This is followed by a short account of physical chemistry; then an account of crystallography with good figures of crystals. Although many of the names of our elements are derived from the Greek, the table of elements looks rather puzzling: lead is of course *μόλυβδος*, while molybdenum becomes *μολυβδαίνιον*; platinum is *λευκοχρυσος*; tungsten (or Wolfram) is *βολφραμιον*; nitrogen is at the beginning of the alphabetical list; copper near the end. Again, as to compounds the names of the oxides of nitrogen read as *ὑποξείδιον ’Αζώτου*; *ὀξείδιον ’Αζωτου*; *νιτρῶδες ὀξὺ*; *ὑπονιτρικὸν οξὺ*; *νιτρικον ὀξύ*. The theory of atomicities is well developed: niobium and tantalum are the only pentatomic elements; while molybdenum and tungsten are the only hexads. The peculiar atomicities of nitrogen and iron are not noticed. The building up of compounds on the type respectively of one, two, and three molecules of water is fully discussed (*μόριον* is the term used in place of our low-Latin *molecula*). Full tables of grouped elements appear; and the naming of compounds is considered. After this considerable and important introduction the work begins with hydrogen in the usual manner, and the account of the other element follows in due course.

The "Scientific Paradoxes" of Prof. Stroumpos is a volume of essays on physics and physiology; including magnetism, electricity, illusions, alchemy. Here too we find paradoxes of another kind; would Mr. Glaisher recognise his name as *ὁ Γλαισχερὸς*, or Mr. Coxwell as *ὁ Κοξουέλλος*? The treatise on the Air, by the same author, is a tolerably complete treatise on pneumatics, illustrated by very crude, but original and sufficient woodcuts. The discourse on the history of Science is very interesting, and full of excerpts from Plato, Aristotle, and other ancient writers. For them we think Prof. Stroumpos has claimed too much; we cannot with any degree of certainty assert that Aristotle discovered that the air possesses weight. His experiment at the outset is altogether faulty, for he tells us that an inflated skin (*ὁ πεφυσημένος ἀσκὸς*) weighs more when filled with air than when empty, that is, not inflated. This of course we know from the law of Archimedes is false; a bladder full of air weighed in air can weigh no more than the uninflated bladder.

These works constitute the commencement of Athenian science. The city, while its art, and literature, and philosophy, have unhappily long passed their culminating point, is more scientific than it has ever been before. Not far from the place in which the Peripatetic made his experiment with a crude statera and an empty wine skin with Theophrastus as demonstrator, Stroumpos now weighs his really vacuous vessel, and Chrestomanos explodes oxygen and hydrogen. Thirty years of science in a remote city, out of the highways of European intelligence, cannot effect much; but we hope in the course of the century original workers will multiply in Athens, and as much will be done to promote chemistry and physics, as has been done by Dr. Schmidt in the service of astronomy on the Hill of the Nymphs, over against the Acropolis.

G. F. RODWELL

THE ACRIDIDÆ OF NORTH AMERICA

Synopsis of the Acrididæ of North America. By Cyrus Thomas, Ph.D. Published in Vol. v. of Report of the United States Geological Survey of the Territories. Pp. 1-262. (Washington, 1873.)

IN a prefatory note to this volume the United States Geologist, F. V. Hayden, tells us that Prof. Thomas's work on the Acrididæ of North America is published "in the belief that it is a substantial contribution to natural history;" and certainly it is impossible, on a perusal of the work, not to share in this belief; it is, moreover, another proof of the great boon conferred upon natural science by public surveys and Government expeditions. Serious and extended works on natural history (except, perhaps, those relating to some few very popular branches of it) would seldom be produced, or in many cases their materials be collected, if it were not for the assistance of natural history societies, public surveys, and expeditions; organisations of these kinds can afford to disregard the commercial aspect of the question, and are able to bestow upon the public, works which private enterprise would seldom venture upon. Among insects, the Orthoptera (of which order the Acrididæ are a well-defined family group) are certainly not the most popular among entomologists, though, for many reasons, of great interest to others. Few persons but have some cherished association with, for instance, the persistent chirp of the cricket on the hearth, or the shrill stridulations of some of the grasshoppers; there are, again, few more wonderful sights in the insect world than a flight of locusts; and few natural scourges are more terrible than those inflicted by the devastations of these rapacious creatures; the walking-leaf and stick insects (Mantidæ and Phasmidæ) are also very popular objects for sightseers in natural history museums. The lack of general popularity among collectors and students arises probably in great measure from the Orthoptera being commonly less sightly as cabinet objects than some other orders of the Insecta, though perhaps it arises as much or more from the paucity of works combining both a general and special treatment of the whole, or of well-defined groups, of the order under consideration. Dr. Thomas's work is undoubtedly calculated to encourage the study of the large group included under the *Acrididæ*, and to be peculiarly acceptable to American entomologists, for it not only describes a large number of North American species (both known species as well as new ones), but it gives, in an "Introduction," pp. 9-45, a concise view of the general classification of the Orthoptera, with the relation of the Acrididæ to the other sub-ordinal groups, their structure, internal and external, and the distribution of genera and species over North America. This introductory part of the work is illustrated by two remarkably clear and good woodcuts, showing all the different portions of external structure, with the name of each part.

The remarks of Prof. Thomas, in the chapter on Classification, bring strongly before us the difficulties and imperfections involved in a linear arrangement of any portion of the animal kingdom; but if a real genealogical relationship be that which exists between all living creatures, then it is apparent at once how comparatively unimportant is (generally speaking) the mere linear arrangement of the series; it is, indeed, the only possible one on paper, but in reality some of the most important relationships do not run in one unbroken line, but in lines diverging at many different angles, and in many different planes. Dr. Thomas considers the Orthoptera as arising from the *Crustacea*, and, after reviewing the various extant arrangements of their families, divides that under consideration—ACRIDIDÆ (*i.e.* the saltatorial Orthoptera, or Grasshoppers with comparatively short antennæ), into two *sub-families*—ACRIDINÆ and TETTIGINÆ; the former of these is sub-divided into three divisions:—CONOCEPHALIDES, ORTHOCERIDES, and XIPHOCERIDES, forming (in the order in which these are here given) seven groups:—1. PROSCOPINI; 2. TRYXALINI; 3. TRIGONOPTERYGINI; 4. ŒDIPODINI; 3. ACRIDINI; 6. XIPHOCERINI; 7. PHYMATINI (?). The three first of these groups belong to the *Conocephalides*, the two next to the *Orthocerides*, and the two last to the *Xiphocerides*.

The sub-family TETTIGINÆ is undivided, and consists of a single group, TETTIGINI.

A useful and concise Synoptical Table gives the leading characters of the author's sub-families and subordinate groups; and another Synoptical Table of the United States genera (p. 49), as well as an excellent plate containing seventeen figures, will give great assistance to the student of the American species. Pp. 55—245 are wholly occupied by scientific descriptions of species, genera, and other larger groups. This portion of the work is divided into two parts, the first treating of the Acrididæ of the United States (pp. 55—190); the second (pp. 195—245) of those of North America, not found in the United States. The number of genera characterised as North American is 45; that of species 227. In the United States (exclusive of *Tettiginæ*, which contain 3 genera and 12 species) are, at present known, 125 species of 25 genera; of the former, *forty*, and of the latter, *four* are described as new; and six others also are described as not hitherto known to be represented in that more restricted locality. At pp. 3—6 will be found a boon to the American orthopterologist in the shape of a list of those authorities which contain descriptions of the genera and species of Acrididæ belonging to the North American fauna. Another exceedingly useful feature of Dr. Thomas's work is a glossary at the end explaining the technical terms (to the number of upwards of 200) used in the scientific descriptions; the utility of this glossary will, no doubt, be felt far beyond the circle of students and collectors of the Acrididæ.

OUR BOOK SHELF

Daily Bulletin of Weather Reports, Signal Service, United States Army, taken at 7.35 A.M., 4.35 P.M., *and* 11 P.M. *Washington Mean Time, with the Synopses, Probabilities, and Facts for the Month of September* 1872. (Washington, Government Printing Office, 1873.)

THIS is a quarto volume of upwards of 180 pp., containing besides 90 weather-charts—three for each day of the month of September 1872. The volume is published for the purpose of showing the method of working of this division of the U.S. Signal Service, the "Division of Telegrams and Reports for the benefit of Commerce and Agriculture." The system appears to us to be thorough and careful, and calculated to lead to valuable scientific results in the department of meteorology. For each of the three daily times mentioned in the title, there is first a tabulated meteorological record from 72 stations in the United States and British N. America, showing the state of the barometer, thermometer, humidity, wind, clouds, rainfall, weather. This is followed by a weather-map constructed on the preceding record, on which, by clearly distinguishable marks, the state of the weather at all the stations is shown, whether clear, cloudy, snow, rain, &c., the direction and velocity of the wind, and the average elevation of the locations. Following this is a synopsis of the record, in which the general results of a comparison of the particular observations are briefly stated. This synopsis is succeeded by a statement of "probabilities," which are the deductions made from the conditions exhibited in the chart, considered in their sequence, as to the meteoric changes probably to follow within the twenty-four hours next ensuing. Then come the "facts" by which the "probabilities" may be tested, these facts being a classified statement of the state of the weather at the various stations at the next succeeding time of observation, with "general remarks" showing how far the probabilities have been realised. This is done, as we have said, three times every day of the month for which this Bulletin is published, and the value of the publication to students of meteorology is evident. "As a contribution of data, at least, to meteoric science," the introductory statement justly says, "and a demonstration that it needs only that governments should will and act through proper organisation to make meteoric knowledge of daily and practical use to the people, the publication must have its value." The Government of the United States deserves the highest credit for the wisdom it displays in perceiving what the true interests of the country are, and for its liberality in supporting a scientific department such as the one from which this Bulletin issues, whose business it is, by publishing the result of scientific research, to "benefit commerce and agriculture." By a patient pursuit of the system exhibited in this Bulletin, and by adopting what improvements may from time to time suggest themselves, we have no doubt that results of great value to science will follow.

The Treasury of Botany: a Popular Dictionary of the Vegetable Kingdom, with which is incorporated a Glossary of Botanical Terms. Edited by J. Lindley, M.D., and Thos. Moore; assisted by numerous contributors. New and revised edition, with Supplement. (London: Longmans, Green, and Co., 1874.)

THERE is no more difficult task than that of editing re-issues of scientific works published some years since. The progress of science is so rapid, the number of new facts accumulated year by year so enormous, that the most satisfactory and exhaustive treatise on any subject written by a specialist in that subject, becomes to a certain extent obsolete or imperfect in ten years. And yet, where can our scientific men be found with leisure to write or edit new dictionaries of science every ten years? The re-editing of old dictionaries seems, therefore, the inevitable alternative, though one attended with many disadvantages, which disadvantages are greatly increased when the objectionable plan has been adopted, as in the present case, of stereotyping the plates of the original work. The new facts can then only be placed before the reader in the form of a supplement, which may often seem at variance with the work itself, while errors or imperfect descriptions cannot fail to be reproduced. Lindley and Moore's "Treasury of Botany" was so admirable a work in its day, containing such an enormous mass of information, that a new edition must necessarily be welcome, although botanical science has made such rapid strides since its first publication in 1866; and the welcome will be more hearty when it is found that the new matter has been entrusted to such competent authorities as Dr. Masters, Prof. Thiselton-Dyer, Mr. Britten of the British Museum, Mr. Jackson of the Kew Museum, and the surviving editor. The only fault we have to find with the supplement is that it occupies five times too little space; under 100 pages out of 1,350 is clearly entirely insufficient for even a brief account of the main additions to botanical knowledge made during the last eight years. Had the new contributors been allowed a larger space, the book would have been a far more satisfactory one. It is to be regretted that at a time when so much attention is being paid to vegetable histology, a description of the vegetable cell should be republished without comment, not only so inadequate, but so misleading in our present state of knowledge, as the following:—"Cavities in the interior of a plant; the cells of tissue are those which form the interior of the elementary vesicles;" or that no description whatever should be given of the structure or mode of formation of starch-grains. As a dictionary of botanical nomenclature and classification the work is most ample; and on this ground only the "Treasury of Botany" is one which no botanical student can afford to be without.

A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Simultaneous Meteorological Observations

IT is doubtless familiar to most of your readers that at the Meteorological Congress at Vienna a proposal was adopted which was made by the War Department of the United States regarding the institution of a system of simultaneous daily observations all over the globe.

I have recently received the subjoined letter from the chief signal officer at Washington on the subject.

It may be of interest to your readers to know that invitations have been issued by this Office to a large number of observing meteorologists in the United Kingdom, on whose co-operation I considered I might count, and that I have received returns from sixty-one stations for the first fortnight of the year, and from sixty-four for the second, so that we may consider that the plan has met with general acceptance with the public.

I am ready to receive the names of any gentlemen who are willing to assist in the scheme, and who possess properly verified instruments, and shall be very happy to answer inquiries on the subject.

ROBERT H. SCOTT, Director

Meteorological Office, London, Feb. 17

"War Department, Washington, D.C.,
"Jan. 20, 1874

"Sir,—At the recent Meteorological Congress at Vienna a proposition was adopted to the effect that it is desirable that, with a view to their exchange, at least one uniform observation of such character as to be suitable for the preparation of synoptic charts be taken and recorded daily and simultaneously at as many stations as practicable throughout the world.

"The United States has an especial interest in reports and exchanges of this character, for the uses of the particular work in which it is engaged. It is hoped that when they are sufficiently extended, satisfactory solutions of many questions from time to time presenting themselves to this Office, and which now cannot be answered, will be arrived at.

"I have the honour, therefore, to request the establishment of a regular exchange between the Meteorological Office of which you are Director, and the Office of the Chief Signal Officer at

Washington, of uniform reports made from simultaneous observations taken daily at as many of the stations under your charge as it may be practicable for you to instruct or request to furnish such reports, or from other stations from which they may be voluntarily tendered, and of similar reports to be taken at the established stations of this Office throughout the United States. The reports to embrace, at least, pressure (reduced), temperature, wind, rain, relative humidity, and clouds, and to be made at 12.43 P.M., Greenwich mean time. The records to be printed or in manuscript, as you prefer, and to be mailed (as many of them as may be ready for exchange on the dates) in packages, on the 15th and last days of each month. Should circumstances render it inconvenient for your Office to furnish such reports without blanks for days on which they will necessarily fail to be taken, the records will be none the less gratefully received. Self-registered records will be very acceptable. In return exchange it is proposed to mail to your Office on the 15th and last days of each month the record of the simultaneous report prepared for that purpose in the form of which the enclosure herewith is a specimen for a single day.

"The data so to be exchanged are intended for any use either Office may wish to make of them.

"As an acknowledgment to those who may, upon your invitation, assist in a work so much wished for on the part of this Office, it is proposed to send to you monthly copies of the 'Official Monthly Weather Review,' with its Maps, for distribution to each of those so assisting, or other papers published by this Office, if so requested.

"In requesting this exchange as a part of a system to which it is hoped a very wide extension can be given, the Chief Signal Officer recurs with pleasure to the prompt encouragement received at your hands at the earlier steps for its adoption, and is gratified to announce that co-operation for similar exchanges of records, commencing on January 1, 1874, has been requested or is in progress with Prof. H. Wild, Director, Imperial Observatory, St. Petersburg; Prof. A. Coumbary, Director, Imperial Observatory, Constantinople, Turkey; Prof. Carl Jelinek, Director, Imperial Observatory, Vienna, Austria; Prof. Quetelet, Director, Meteorological Observatory, Brussels, Belgium; Prof. Buys Ballot, Director, Meteorological Institute of the Netherlands, Utrecht, Holland; and Prof. H. Mohn, Director, Meteorological Institute of Norway, Christiana, Norway. As time and its faculties will permit, this Office will seek additional aid. The advantages to accrue to the service in the United States are certain, and the hope is not unfounded that as the co-operation sought will be world-wide, so also will be the benefits resulting.—I am, &c.,

"ALBERT J. MYER
"Brigadier-General, U.S.A.

"R. H. Scott, Esq."

Remuneration of the Contributors to Milne-Edwards' "Mission Scientifique au Mexique"

EN vous remerciant de l'envoi d'un article (vol. ix. p. 260) relatif aux singulières assertions contenus dans une note de M. Gray, je vous demanderai la permission d'ajouter que ni M. Duméril ni aucun des autres naturalistes qui prennent une part, soit directe, soit indirecte à la publication de l'ouvrage sur la Zoologie du Mexique ne recoivent pour ce travail une rémuneration pécuniaire quelconque. C'est gratuitement et dans l'intérêt de la Science seulement qu'ils s'en occupent; par consequent les renseignements fournis à mon estimable ami M. Gray, par je ne sais qui, sont faux.

Recevez, Monsieur, l'assurance de ma consideration tres distingué.

MILNE-EDWARDS
Membre de l'Institut de France, et Associé Etranger de la Société Royale de Londres

Paris, ce 13 fevr.

Animal Locomotion

IT is not my intention to go through the detailed proofs of the different statements in my review of his work to which Dr. Pettigrew objects, and which his letter of last week in no way falsifies, nor to show how he has quite missed the point of an observation of mine which he condemns as "utter nonsense," but simply to answer the question with which he ends his remarks. At first sight it might seem that the active dilatation of the heart during diastole did depend on an inherent power in the muscular fibres of the ventricles to elongate, but the peculiarities of the coronary circulation are quite sufficient to explain the phenomenon without the introduction of so unnecessary a theory as that of Dr. Pettigrew. For in the heart when removed from the body, as in the living body during diastole, the injection of fluid into the coronary vessels causes the whole heart to open up from the congestion of the ventricular walls, and so produce the active dilatation which is well known to occur. This explanation was proposed by Brücke, and by myself some years later (Journal of Anat. and Phys.)

A. H. GARROD

WHILE admitting that Dr. Pettigrew appears to have made mistakes in his figures, and that he has not explained his views in the clearest manner, nevertheless it appears to me that, on the very important question of whether a bird's wing during onward flight moves downward and forward or downward and backward, he is right in asserting the former to be the fact.

The arguments of Mr. Garrod and Mr. Ward against this view seem to be founded on two assumptions—that the wing during its down-stroke is an inflexible plane, and that during its upward motion the quills open so perfectly that there is neither vertical nor horizontal resistance. But every feather of a wing is highly flexible towards its extremity, so that during the down-stroke the whole posterior margin of the wing must be curved up by the pressure of the air, thus forming a highly effective propelling surface owing to the rapid motion of this part of the wing. During the upward stroke the feathers open freely so as greatly to diminish, though not wholly to prevent, downward reaction; but the broad soft web of each quill will be bent down by the rapid escape of air between the quills, and this will necessarily give a forward motion, probably equal to that attained during the down-stroke, in which the small curved surface has a greater resistance and more rapid motion. If then the up- and the down-stroke both produce onward motion, the resultant of this motion will be in the direction of the mean position of the wings, which we may take to be about that of the body of the bird; but if the down-stroke were directed *backward* and the up-stroke *forward*, the resultant onward motion would be obliquely downward, and this downward angle of motion would tend to be so much increased by the continual gravitation of the body that the surplus vertical reaction of the down-stroke over the up-stroke would not be able to overcome it. A slight upward angle of the mean position of the wing-plane seems therefore to be essential to secure horizontal forward motion as a general resultant of the upward and downward action of the wings under the influence of gravitation; and to Dr. Pettigrew belongs the merit of showing that this is one of the most important characteristics of the flight of birds, and, probably in a still greater degree, of that of insects. A bird's wing is a highly complex apparatus, subject to a variety of flexures and motions in every feather; and it is only by a careful consideration of the action of the resisting medium on these variously curved elastic surfaces, both during the upward and downward motion of the wings, that we can arrive at any definite notion of their supporting and propelling effect. The experiments of Prof. Marey do not seem to contradict the theory of Dr. Pettigrew, as far as I can make out from an abstract of these given in the "Ibis" for 1870, p. 267; though, as his apparatus only gave the motion of the wing relatively to the body of the bird, they are not of very much value in determining the absolute angular position of the wings, which is what we want to arrive at. The highly-inclined position of a hovering bird is more to the point, as any less degree of inclination would lead to onward motion.

ALFRED R. WALLACE

On the Variability of the Node in Organ-pipes

THE variability of the node is an unrecognised phrase. Something similar in kind relating to the node will be remembered as having been mentioned by scientific writers in a cursory manner, then set aside as evidence of too doubtful interpretation to call for more extended comment.

From the time of Savart it has been known that the nodal division of the open organ-pipe does not take place at the exact half of the length, that the half nearest the embouchure is the shorter of these "unequal halves"—a contradictory term apologised for yet sanctioned, I believe, by the late Prof. Donkin.

The displacement of the node is perhaps the most significant fact that in the natural history of organ-pipes presents itself to the attention of the investigator, be he student or teacher. Why it should have been passed by as though its meaning were not worth wrestling for is incomprehensible. Since Savart wrote no light has been thrown on this singular phenomenon, for the explanation which has been afforded (presently to be quoted), cannot be called in any degree satisfactory. In the illustrations of nodal division given in various scientific works there is a puzzling contrariety hardly to be accounted for except on the supposition that our engravers are as niggardly conservative in design as the buried Egyptians, or that the engravings themselves are the cherished heirlooms of our publishers. In one work a representation of the manometrical nodal division after Kœnig will be given, but *carefully* corrected and revised by the aid of a pair of compasses; in another a beautifully accurate copy of the original, so lopped to suit the size of the page that much mental effort and distortion of reasoning are incumbent on the reader in vain attempts to bring the engraving into harmony with the accompanying text, young eyes are mystified, it needs cold "well-worn eyes" to appreciate these fine economics of the publishing art; in another the manometrical nodal positions will be properly defined and, by some negligent inconsistency, on an opposite page an organ-pipe be depicted, admirably exact to theoretical localisation, in direct contradiction of knowledge. Faults of this kind should not be allowed to pass, they weaken faith in the teacher and are harassing to the inquirer.

Kœnig in his own illustrations represents the displacement of the node as it is indicated under experiment, for this one condition of truth to nature had been too often before him in his manometric flames to allow of his disregarding its faithful portraiture. The difference he shows to exist as to position corresponds very closely with that we arrive at by other means, by calculation of scales and by the practical teachings of experimental study of the relations and arrangements of organ-pipes. Of the cause of the displacement Kœnig offers no elucidation.

The following explanation is quoted from Prof. Airy's treatise on "Sound and Atmospheric Vibrations." In the section on open organ-pipes he says:—

"It was found by Mr. Hopkins that the node next the open mouth of the pipe was somewhat less distant from it than that given by theory, or, which amounts to the same thing, that the place where the air has always the same density as the external air is not exactly at the pipe's mouth but somewhat exterior to it."

The extent of the disparity would be but very imperfectly comprehended under this vague delineation. Other authors have attempted explanation, in substance the same as the above, to account for the disparity; the summary of the whole is, that science brings forward no better plea than the surmise of a probable place, somewhat exterior to the mouth, which the air-wave of the *lower half* of the pipe has to attain before it can be properly said to be completed in length. Truly an illogical conclusion if this line of reasoning is carried out. In common fairness the *upper half* of the pipe may claim to be credited with a reasonable amount of wave-prolongation, seeing that at the higher orifice the internal column of air pulsates the atmosphere with far greater vigour than at the mouth, and consequently that for a similar attainment of density the due addition of wave-length would only serve to increase the disparity in relation to the *half below* the node.

A displacement of some sort thus receives acknowledgment although as yet the variability of the node is unsuspected.

The actual extent of the disparity between the "unequal halves" can be ascertained. It is subject to laws of relation of as definite a character as are found in other dynamical problems when the elements of calculation are delicately defined. An approximate estimate will be sufficient for the present purpose. For avoidance of the inconvenient "unequal halves" it will be permitted me to coin two simple terms as more distinctively representative, and to speak of them as super-nodal and sub-nodal.

If a standard open diapason pipe be made for some designed pitch, whatever that pitch may be, it may safely be predicted that the pipe will stand considerably short of the full theoretical length; æsthetically judged for musical quality, it ought to be about one-eighth less, a difference much affecting the veracity of scientific argument.

Doubtless it would be somewhat a novelty for a scientific lecturer to tell his audience that one-eighth of the whole wave-length was lost by conversion into organ-pipe vibrations, yet, unless he innocently accepts the ironical reply of Galileo on the pump question, that "perhaps Nature is indifferent to a few feet," he is strictly in this dilemma: if the pipe is a natural standard of wave-length, the velocity of sound in air computed on the basis of the pipe's length falls very far short indeed of the philosophical estimate, 1,125 feet per second; on this ruling the latter should be pronounced to be irreconcileably wrong, *or else* the frank admission made that there is no "necessity of relation" that the wave-length in an organ-pipe, giving a defined pitch, and the wave-length in the free air corresponding to that note should be identical.

Taking the several classes of pipes, from the Diapason to the Vox Angelica, ranging from the pipes of the most vigorous to those of the softest intonation, the amount of difference from full measure varies from one-eighth to one-twelfth *less* than that which theory demands. The loss is mainly due to the cause which enforces nodal displacement.

Our immediate inquiry is, what is the extent of displacement of the node, and what its variability? Divide the length of the already reduced pipe into seven equal parts, and the unequal halves will be in the ratio of 4 to 3. Four parts belonging to the super-nodal half, and three parts to the sub-nodal half, subject to a relative variability, according to the position of the pipe in the range of octaves, and subject to a fluctuating variability determined by force of wind, diameter of pipe, character of scale, relative size of mouth, mode of voicing, and other details, changing the proportion, perhaps, to 6 : 5, or even to 7 : 6. Whatever the extent of the variability, change in result rigidly follows change in details, with a calculable value. When, instead of the fundamental note, the pipe vibrates in harmonic nodal divisions, the lowest half-segment takes upon itself almost the whole difference, and not merely a proportional share in comparison with its segmental relation to the whole pipe. A remarkable fact, but one fully accounted for in that which I have termed the aëro-plastic reed theory (NATURE, vol. viii. p. 25) for it is easy to me visibly to demonstrate that the harmonic-independent and the harmonic-concomitant are originated in the pipe by totally different natural processes.

The nodal difference detected by Mr. W. Hopkins was much smaller in extent, but there is an important distinction not to be overlooked: his experiments (recorded in the Transactions of the Cambridge Philosophical Society, vol. 5) were not made with organ-pipes, but with glass tubes supported in position over a glass plate, the plate being set in vibration by friction. He expressly rejected organ-pipes by reason of their intractibility and of the difficulty of obtaining results from them of the nature desired.

In like manner we continually find experimentalists rejecting organ-pipes as insubordinate pupils; they prefer dumb pipes and the artificial speech by tuning-forks, and having obtained such negative evidence, make a clean transfer of their conclusions to all argumentative reasonings and expositions of the nature and functions of the original, living, speaking organ-pipes. The Hon. M. Strutt, in his paper on the Theory of Resonance, printed in Phil. Trans. Nov. 1870, says:—

"Independently of these difficulties, the theory of pipes or other resonators made to speak by a stream of air directed against a sharp edge is not sufficiently understood to make this method of investigation satisfactory. For this reason I have entirely abandoned this method of causing the resonators to speak in my experiments, and have relied on other indications to fix the pitch."

Prof. Airy is as evidently dissatisfied with the state of theory and experiment, using such phrases as these: "the matter, however, demands more complete explanation;" "that obscure subject, the production of musical vibrations in a pipe by a simple blast of air;" "possibly when the mathematical calculus is farther advanced, this may be shown," &c. Beyond the province of mathematical analysis his survey is keen, and with foresight of the results of possible experiments.

At the present date our best authorities are in effect repeating the assertion of Biot that "the particular properties of the vibrations of confined air in tubes are not yet sufficiently explained." The disturbing influence of some unknown agency may be discerned in Dulong's experiments of filling organ-pipes with various gases, and estimating the velocity of sound in these gases by the pitch produced. Similar experiments on this method are referred to by Herschel, and he, noticing how the results gave for hydrogen gas a velocity differing by one-fourth from that which theoretically had been calculated, could only account for it by supposing an impurity in the gas used for the experiments. There is little need to resort to the supposition of an impurity; it is quite sufficient to know that an agreement in length of organ-pipe and aërial wave-length was assumed which does not exist, and that, moreover, the mechanical nature of the organ-pipe, and its delicate apparatus so wonderfully balanced for the attainment of its ends, had escaped observation. The admirable method of experiment for ascertaining the velocity of sound in gases, devised by M. Kundt, by means of glass tubes and lycopodium seed, is free from the same source of error; and, as might be anticipated, comparison shows a marked difference in estimates. In respect of carbonic acid gas and hydrogen gas, for instance, Dulong differs from Kundt, his estimate in the one case being less by one-fifth of the whole, and the other more by one-fourth; the divergence interprets itself, indicating the relation of their densities to the compelling force, the unseen mechanical action at the mouth of the organ-pipe. This will be clear when the "air-moulded reed" is fully understood in its nature and functions. When the magnetism of the earth is perceived, the dip of the needle to the north or south of the equator in accord with its localisation is explained.

The confession of "obscurity" amounts to a concession that the old theory has been found wanting, that it is inadequate to deal with facts. Whether in dealing with the larger questions here brought into discussion, or with the simpler class, the mere modifications of structure, it is equally incapable. If, for instance, a stopped pipe is pierced through the stopper and a short open pipe inserted, say a third or fourth the diameter and a third or fourth the length, what will be the effect of this on the pitch? The old theory would reply, the added length would cause a flattening of pitch, and then will come a proviso for safety's sake, that if the change converted it into an open organ pipe then the pitch would be raised in accordance with the open length. We go to Nature for her say in the matter, and find that the pitch is raised not flattened, and that the extent is about a quarter of a tone, and that *further lengthening* of the smaller pipe takes back the pitch again just its quarter tone. If another stopped pipe is drilled at the back with a hole of a diameter a third or fourth of that of the pipe, but so that it shall be at a higher level than the lip or edge of the mouth, in effect shortening the air column by admission of external air at a higher point, what will be the result? On the old theory we should expect the pitch to be higher in consequence. Appealing to the ear we know that, on the contrary, it is flattened. These results cease to be anomalies when viewed under the new theory, and indeed they would be predicted with confidence as the necessary outcome of the conditions.

The proposition that in an organ-pipe there is no constant wave-length for an ascertained pitch, will no doubt be discountenanced as novel and revolutionary, but it is true and will have to be acknowledged. A further proposition that in an open organ-pipe there are three different velocities speeding at different rates, concurring in every vibration, and essential to the synchronic time of its note, has a still more aggressive aspect defiant of law. Not so. It is because law—"known law," does not cover the facts, is unstable in its applications, and is deficient in prevision, that there is room for new hypothesis which does not play fast and loose with nature; the utmost exactitude of length in an organ-pipe is as indispensable in this as in the older theory, but the relation is one of proportion to a system, and the least and every variation will make imperative suitable or corresponding modifications in other portions of the structure. Only a whistle, yet with more to marvel at for delicacy of organisation and beauty of adaptation "than is dreamt of in philosophy."

As regards "fixity of wave-length," that characteristic reappears in a new relation, and we shall find that, allowing for retardation by friction, the super-nodal half-wave of the pipe corresponds very closely with length in atmosphere. The cause of the displacement of the node is involved in the physical action taking place at the mouth of organ pipes, the consideration of which is reserved for a further communication.

HERMANN SMITH

Auroral Display

As a few remarks on the aurora of the 4th may be of interest to some of your meteorological readers I append the following notes:—

At 6.15 P.M. on Wednesday, the 4th inst., an aurora commenced in the northern part of the sky which gradually went down towards the south.

7.15.—Semicircle from W. to E., streamers shooting up from it.

7.25.—Light more diffused, a few streamers at N.W.

7.30.—A semicircle of diffused light from W.S.W. to E.

7.35.—Bright line of light from W.S.W. to E.; no streamers.

7.40.—A very faint irregular line of light from W.S.W. to E.

7.45.—Diffused light.

7.50.—Same as at 7.45.

7.55.—Streamers shooting down from zenith all round. Very fine.

8.—Bright at N.N.E. Streamers N. and N.N.E. A sharp S.E. breeze.

8.5.—Bright light at N.W. No streamers.

8.10.—Streamers at N.E.

8.15.—Streamers at S.S.E.

9.—No aurora perceptible.

From the above, we note one peculiarity, namely, that the aurora was chiefly in W. + E. or W.S.W. and S.S.E.

WILLIAM HY. WATSON

Braystones, near Whitehaven, Feb. 9

[We have received letters concerning this aurora from several other parts of the country.]

THE PHOTOGRAPHIC SOCIETY

ALTHOUGH we published last week a letter from Mr. Baden Pritchard, Hon. Sec. of the Photographic Society, impugning the justice or accuracy of our strictures on that Society, our esteemed correspondent has not caused us to change our opinion.

We have now before us the Journal of the Society for the past year (a summer vacation of three months excepted), and certainly it furnishes *primâ facie* evidence of the most apathetic and inefficient condition which is consistent with continuous existence. The numbers contain eight pages each, the page little more than half the size of that of NATURE, and in the whole year's proceedings there are twelve pages devoted to science, half of this being a lecture by Prof. Stokes; three or four papers of considerable value on technical points of photographic interest, and much which the charity of any semi-learned society would be largely strained in giving paper and ink to.

There is no mention of scientific or other committees, no provision for them in the laws, no reports of investigations made or to be made, no notice of scientific discovery abroad or recognition of discovery at home. Mr. Pritchard has no need to assure us that the body "does not profess to be a purely scientific one"—the scientific element in it, so far as its own record shows, is purely fortuitous.

But without demanding scientific labours from a body not "purely scientific," we do not even find evidence of common activity in the research of practical problems, and if any of its members are, as Mr. Pritchard suggests, engaged in researches on the process and nature of film best suited for transit of Venus observations, they have not had faith enough in the countenance of their Society to place their labours before it, or ask its assistance in performing them.

Since our article appeared, the revolution alluded to has taken place, and that part of the Society in favour of reform having a majority at the meeting appointed for the discussion of the question, have carried an amendment to the laws providing that henceforward the Society at large shall select its council, and that the majority of the actual council shall not have the power to select for retirement such members as it sees fit and to decide who shall replace them, as has actually been the case hitherto; it has also been decided that the presidency shall rotate. These measures were, as we learn from the photographic papers, strongly opposed by the council, and upon being carried by a majority of 30 to 23 (the council itself voting in the minority) the entire body resigned.

As the meeting at which this stroke of singular policy was made, was that for the election of the new members of council, these were enabled to assume the reins of government and prevent the, otherwise inevitable, total dissolution of the Society. And now that the reformers have its affairs in their own hands, it is to be hoped that it will begin a new life of efficiency, and, remembering that it owes the cause of its existence to the labours of scientific men, give its most efficient aid to those scientific researches in which it has become an important element of investigation, as well as to those of a more technical nature which have given photography so great a commercial and industrial value. And on the other hand we bespeak for it the aid and countenance of all scientific men whose researches are in any way dependent on photography, and give it, in its reformation, our best wishes for that complete success and efficiency which will make it as useful to Science as honourable to itself and its members.

NOTES FROM THE "CHALLENGER"

THE following contributions to the literature of the *Challenger* Expedition appear in the *Cape Monthly*. The first contribution consists of a few notes from Commander Maclear, written on the day of the *Challenger's* departure from Simon's Bay, and will give our readers an idea of the work still before the Expedition :—

On leaving Simon's Bay, if the weather permits, dredgings and temperature soundings will be taken on the Agulhas bank; then sail made for Marion Island. This and the Crozetts will be examined ; the last may be occupied by the French as an observing station for the Transit of Venus. Then for Kerguelen Island. It is not likely that the weather will allow a regular series of soundings to be taken as hitherto, but some doubtless will be taken on the passage.

Kerguelen's, or Island of Desolation, will be a fertile field of exploration in every department of science, and as it is to be one of the stations for watching the Transit of Venus, special information will be collected for the use of the astronomers who will go there towards the close of next [this] year. The longitude of the island will be determined by chronometrical measurement from the Cape, and again to Melbourne, and with the great number of chronometers (16) that the *Challenger* has on board, the longitude should be determined very accurately.

After leaving Kerguelen, Macdonald Island will be examined, and search made for a harbour there ; and then a stretch will be made to the Ice Barrier. The investigations in the neighbourhood of the ice are very important, but great care will have to be taken not to get entangled in the ice. With steam power, and the clear weather there is likely to be in February, little danger need be apprehended. If the season should be fine, some considerable time will be occupied in this region, but if not, after a short stay, sail will be made for Melbourne, which will probably be reached in the end of March. After a few days there, to obtain the rates of the chronometers, we go on to Sydney to refit and, if necessary, dock. This terminates the second stage of our voyage.

Leaving Sydney about the middle of May 1874, and carrying a line of soundings to New Zealand, we next examine the islands about the Coral Sea and Torres Straits in August 1874 : New Caledonia, New Guinea, Arofura Sea, Kaepang in Timor, Java Sea, Macassar, Celebes, and reach Manilla in November. We next look up the doubtful islands of the Western Pacific ; visit New Ireland, the Solomon Islands, and Pellew, and Japan will be reached in March 1875. From Japan we cross to Vancouver's, and then to Valparaiso, examining Eastern Island and Sulay group in our course. Leaving Valparaiso in the end of 1875, we go through the Straits of Magellan to Falkland Isles, Rio de Janeiro, Ascension, and England in the middle of 1876.

The other communication, of a different order, comes from a gallant Blue Jacket, who speaks for himself and the *Challengers* and their labours somewhat irreverently thus :—

FROM JACK SKYLIGHT TO HIS OLD SHIPMATE

A Letter without much Rhyme and with a little Reason

We've crossed the Line a many times in craft both great and small,
And of them 'ere fish that's thereabouts I've caught 'em nearly all.
It aint becos I wants to boast I says as "it is so,"
But 'cos I think that wot is wot I'm just the bloke to know.
I'll first acquaint you, topmate, with the nature of my dooty,
And show you what I've larned since last we met, my beauty.
I jined this craft last winter, got rated on her ledger
A swabber, jobber, scrubber, a sounder, and a druger.
I know, old ship, when this you see you'll say I'm flyin' hi,
But it's true as Polly-Arris is above us in the sky.
At sea we sounds—no matter, Bill, if every blessed thread
Aloft or low of canvas before the wind is spread,
In it comes ! And down there goes, I've really quite forgotten
How many fathoms (half-inch), Bill, until we touches bottom.
Sometimes the timmey-noggie that holds the weights don't G
And then a fog* arises as is horrible to see.
We flies in all directions, like cats on houses sportin',
The luff cries out, the donkey shies, and makes a dreadful snortin'—
It aint a regular ass, Bill, but one of them inventions
They puts aboard a man-of-war with various intentions,
To wit, it nicks the complement, and gives the honest Jacks
More time to study politics and read their Sunday tracks.
The donkey does the hauling in, which is no doubt a blessin',
For if it had to come by hand, oh ! lord, 'twould be distressin'.

We've a many curious ratins, a lot of long shore tallies
For scientifick genelmen, their servants, and their valleys.
Don't yer see these learned bosses have come to search the ocean,
But for what, old son, 'twixt you and I, I'm blow'd if I've a notion.
I've 'eard 'em talk of Artic drift and walleys under water,
And specs next week to find they've nab'd old Davy and his darter.
Of course you know they've got to find the link atween the species,
Some say as there's a coon aboard as liks it all to pieces ;
I cannot tell, for well you know it aint the likes o' me
That's got a chance like swells abaft the curus sight to see.
The scientifick swells, old chap, are mad on mud, and great
On getting things like what we used in Chiney for our bait.
You know them squids and stuff we tried for catching them there conger ?
Well, it's the same ; but then the name is many a fathom longer.
They seems to me to make a deal and show a great surprise
At things we've seen, Bill, many times, when first they meet their eyes.
Perhaps its 'cos the thing's alive their fancies somewhat tickle,
They only having seen them home screwed up in brine or pickle.

I've told yer how we sounded, now I'll tell yer how we druge,
And if my life's a angel's I'll leave yer for to judge.
We hangs the drege at the yard-arm to a sort o' kind of buffer—
At explernation, Bill, yer no I always was a duffer—
It aint a bad doge neither ; for when its pulled it streches
And gives a kind of surge when the dredge at summat ketches ;
It's like a koncertina, Bill, but where the wind is squoze,
From end to end a set of stays like Inde rubber goes :
A block is tacked at bottom and through it runs the line—
Which is the werry bane of life to this old pal of thine ;
I've burnt my hands, I've spiled my close, I torn my underneath,
I bark'd my shins and nik'd my back, and loosened all my teeth—
All through that blessed line, Bill, which, trifling as it seems,
Is wuss nor all the nightmares that ever hunts in dreams.
The care that is required for to keep that line from breakin'
If your stationed near the donkey is a awful undertakin' ;
The thing flies thro' your fingers, and if stationed near the drum,
Its safe to nab you somehow by a finger or a thumb ;
Then there's the pipe and others, Bill, that raise a shout, and call

* Row.

Till you'd almost think they'd been and caught the devil in the trawl;
The trawl's for fancy drugin' and the work's about the same,
The only diff'rance I can see is that wot's in the name.

A scientifick genelman, our Genius on the cruise,
Explained to us the hanimals, their habits, and their use;
I don't tumble to it much; but, Bill, he spun a yarn
About the objeck of the cruise which I was glad to larn.
He said 'twas for the good of man to raise him summat higher,
Since it was proved by some one that a monkey was his sire;
I don't see how it follers—but he sed from wat he found
There was fields of blazing sea weed below upon the ground;
And every little blessed thing we druge out of the sea
Was for the good of all mankind, including u and me.
He likewise said, and bid us all partikilarly remark,
That at the bottom also 'twas most exceedin' dark,
Cause from twenty million fathoms once we got a curus prize
(He didn't want 'em in the dark) a fish with many eyes.
He told us that we'd all be dooks when this 'ere cruise is done;
I think he was mistaken, or he meant he would be one.

Thare goes the pipe, my hearty; so I'll no more at present write
But ax you to believe yours most faithful

JACK SKYLIGHT

THE COMMON FROG*

X.

The Nervous System of the Frog.

THE nervous system consists of the brain, spinal marrow, and nerves.

The whole consists of a soft, white substance, ultimately composed of minute threads, termed *nerve-fibres*, and minute round bodies called "ganglionic corpuscles."

The brain is contained in the cavity of the skull, and consists of a rounded mass made up of corpuscles and fibres, and itself contains a cavity which is a remnant of the original canal formed by the upgrowth and overclosure of the walls of the primitive groove of the embryo.

The spinal marrow (as has been said earlier), traverses the canal formed by the successive neural arches of the vertebræ being directly continuous with the brain which it, as it were, continues on down the back. Like the brain, it is largely composed of corpuscles, as well as fibres, and itself contains a longitudinal cavity (continuous with that in the brain), which is also the ultimate condition of the canal formed from the primitive embryonic groove.

The nerves generally (which are made up of fibres) proceed forth from the brain and spinal marrow, which therefore are called the *central*, or (from their position along the dorsal axis of the body), the *axial* portion of the nervous system.

All the nerves which so proceed together constitute what is called the *peripheral*, or (because going to the limbs which are appendages of the trunk), the *appendicular* portion of the nervous system.

From the brain proceed the nerves of special sense: a pair, one on each side, going to the nostrils (1, the *olfactory nerves*), another pair going to the eyes (2, the *optic nerves*), and a third pair going to the ears within the skull (3, the *auditory nerves*). Other nerves go to the tongue and palate, ministering to taste, and again others to the little muscles (orbital muscles), which move the eyeball in various directions, and to different parts of the face.

The nerves which come forth from the spinal marrow are called spinal nerves. They proceed out in pairs (one on each side), and are distributed to the limbs and trunk.

Each nerve consists of fibres, of the sorts proceeding respectively from the ventral (in man anterior), and the dorsal (in man posterior) aspects of the spinal marrow. But these two kinds of fibres are distributed side by side in the ramifications and distributions of each nerve.

* Continued from p. 266.

The fibres which come ultimately from the dorsal aspect of the spinal marrow are those which carry inwards the effect of a stimulus applied towards their ultimate termination, and are therefore called *afferent*, or *sensory*.

The fibres which come ultimately from the ventral aspect of the spinal marrow, are those which carry an influence outwards, and produce a contraction in the muscles, and are therefore called *efferent* or *motor*.

It is the nervous system of the Frog, rather than any other set of its organs, which has especially excited interest and attention. It is especially to the relations *inter se*, of the parts of this system that inquiry has been directed. The relations, that is, of its central or axial portion (the brain and spinal column) to its peripheral or appendicular portion (the nerves of the body and limbs).

In the ever memorable year 1789, Galvani accidentally discovered in the separated legs of certain Frogs, prepared for broth, those motions produced by irritation of the exposed great nerve of the thigh, now so familiar to most. This action was long called galvanism, after this observer, not, however, that he was absolutely the first to notice a fact of which he was but a re-discoverer—Swammerdam as long ago as 1658 having observed such motions.

They are generally considered as demonstrating the purely "reflex action" of the nervous system—the responsive action, that is, upon muscles, of nervous centres acted on by external stimuli without the intervention of sensation.

It is affirmed that not only will a decapitated frog endeavour to remove an irritating instrument by means of its hind legs and feet; but that if a caustic fluid be applied to a spot easily reached by one foot, the decapitated frog will apply that foot to the spot. More than this, if that foot be cut off it will move the stump as before, seeking to reach the spot, and failing so to do, will then apply the other foot to the irritated locality.

These, and such experiments, are of course conclusive, if the common assumption be conceded that the brain is the indispensable nervous instrument of sensation.

It may be, however, that the faculty of sensation may be subserved by the spinal cord without the brain, and if so, all these much vaunted experiments are valueless as regards the proof of pure reflex action, not but that they are of extreme interest, as showing what may be done in lower animals without the intervention of any brain action whatever.

Mr. G. H. Lewes has long contended against the attribution of sensation to the brain exclusively, and Dr. Bastian has recently supported and enforced similar views.

The latter remarks in his "Beginnings of Life,"—"instead of accepting the popular view, that the brain is the organ of mind, I believe it would be nearer the truth to look upon the whole nervous system as the organ of mind."

Dr. Bastian here uses the word "mind," not as denoting a rational intellect but as a generic term equivalent to psychical activity.

It may be remarked in passing that these views of Messrs. Lewes and Bastian closely approximate, as far as they go, to that most rational belief that the soul of every creature is whole and entire in every atom of its bodily structure so long as the latter preserves its integrity and vital activity.

The brain of the frog consists of the same essential parts as does the brain of all the vertebrate animals, including man. In the form and in the proportions of those parts, however, it differs extremely from the higher animals (and above all from man) and resembles the lower forms—the brain of the frog (and of Batrachians generally) offering a much closer resemblance to that of a lizard than to that of a mammal.

The brain of man consists of the following fundamental parts:

1. A pair (one on each side) of small rounded bodies, each connected, by a long stalk, with the mass of the brain,

and each shaped somewhat like a life preserver. These are the "*olfactory* lobes," and from the swollen head of each proceed the delicate nerves of smell.

2. An enormous pair of folded masses which form the great bulk of the human brain and are called the *cerebral lobes* or hemispheres. These are so large and preponderant in man, as to hide every other part of the human brain when that organ is viewed from above.

3. A relatively very small portion, but one easily recog-

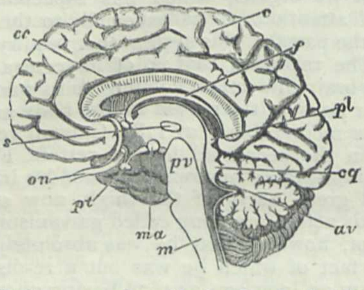


FIG. 69.—The Brain as seen when a Vertical Longitudinal Section has been made through its middle. *Av*, arbor vitæ of the cerebellum; *c*, cerebrum; *cc*, corpus callosum; *cq*, corpora quadrigemina; *f*, fornix (between the fornix and the corpus callosum is the septum lucidum); *m*, medulla oblongata; *ma*, corpus mammillare; *on*, optic nerve; *pl*, pineal gland; *pt*, pituitary body; *pv*, pons Varolii; *s*, soft, or middle commissure.

nised since it supports two conspicuous little bodies. One of these (Figs. 69, 70, 71, *pl*) is called the *pineal gland*, and projects more or less upwards; the other (Figs. 69, 70, 71, *pt*) projects downwards and is called the *pituitary body*.

4. An also very small portion relatively, is distinguished by bearing certain small prominences (Fig. 69, *cq*, and Fig. 70, *na* and *te*) placed behind the pineal gland, and called *corpora quadrigemina*.

5. A rounded mass of finely folded brain-substance, placed at the lower part of the back of the head beneath the hinder portion of the cerebral hemispheres. This is

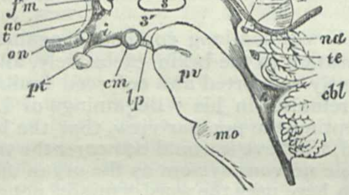


FIG. 70.—Enlarged and Diagrammatic View of a Vertical Section carried through the Corpus Callosum and the parts below. *ac*, anterior commissure; *cc*, corpus callosum; *cbl*, cerebellum; *cm*, corpus mammillare; *f*, fornix; *fm*, foramen of Monro; *i*, infundibulum; *lp*, locus; perforatus medius; *mo*, medulla oblongata; *na*, nates; *on*, optic nerve; *pc*, posterior commissure; *pv*, pons Varolii; *pl*, pineal gland; *pt*, pituitary body; *s*, soft, or middle commissure; *sl*, septum lucidum; *t*, lamina terminalis; *te*, testes; *v*, velum interpositum (between it and the fornix is a space enclosed by the folding over of the cerebrum upon the roof of the third ventricle); 3, upper, and 3', lower part of third ventricle; 4, fourth ventricle—between them is the *iter a tertio ad quartum ventriculum*.

called the *cerebellum*, and when cut through exhibits singular, radiating, tree-like markings, due to the infoldings of the surface of the organ, and called the *arbor vitæ* (Fig. 70, *av*).

6. That part which directly continues the brain into the spinal marrow (Fig. 71, *m*). It is overlapped by the cerebellum, and contains that portion of the remnant of the primitive nervous canal, which is named the *fourth ventricle*. This sixth fundamental part of man's brain is called the *medulla oblongata*.

On turning to the brain of the frog from that of man it is at first sight difficult to find out the resemblances, and to determine which portions of the one answer to definite regions of the other.

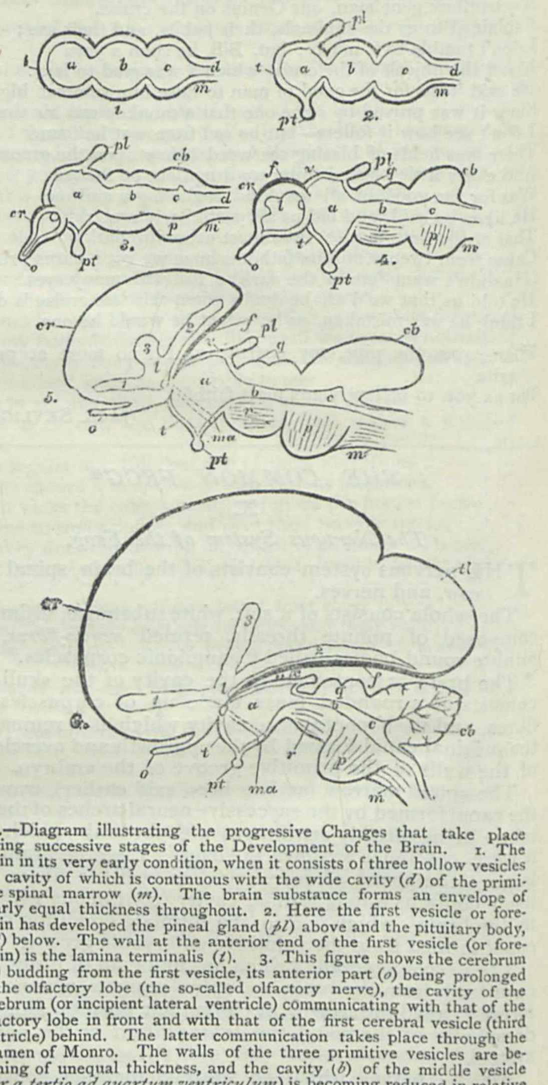


FIG. 71.—Diagram illustrating the progressive Changes that take place during successive stages of the Development of the Brain. 1. The brain in its very early condition, when it consists of three hollow vesicles the cavity of which is continuous with the wide cavity (*d*) of the primitive spinal marrow (*m*). The brain substance forms an envelope of nearly equal thickness throughout. 2. Here the first vesicle or fore-brain has developed the pineal gland (*pl*) above and the pituitary body, (*pt*) below. The wall at the anterior end of the first vesicle (or fore-brain) is the lamina terminalis (*t*). 3. This figure shows the cerebrum (*cr*) budding from the first vesicle, its anterior part (*o*) being prolonged as the olfactory lobe (the so-called olfactory nerve), the cavity of the cerebrum (or incipient lateral ventricle) communicating with that of the olfactory lobe in front and with that of the first cerebral vesicle (third ventricle) behind. The latter communication takes place through the foramen of Monro. The walls of the three primitive vesicles are becoming of unequal thickness, and the cavity (*b*) of the middle vesicle (*iter a tertio ad quartum ventriculum*) is becoming reduced in relative size. 4. The cerebrum is here enlarged, and the inequality in thickness of the wall of the primitive vesicle is increased. The thickened upper part of the wall of the cerebrum is the fornix (*f*). 5. This figure shows the cerebrum still more enlarged, and with a triradiate cavity (*l*, 1, 2, 3). The fornix has now come to look slightly downwards; dotted lines indicate the downward extension of its anterior part, into the corpora mammillaria. 6. Here the cerebrum is still more enlarged and backwardly extended. The fornix is shown bordering the descending cornu and extending into the temporal lobe (*tl*) of the cerebrum, which lobe is destined to descend (when the brain is fully developed) so much more that it comes to advance forwards. The fornix borders the margin of the very thin outer wall of the descending cornu, which when torn forms the fissure of Bichat. The bending back of the cerebrum has now almost enclosed (between the fornix and the velum) the space (*x*) which in Fig. 4 is widely open, making what is morphologically called the outside of the brain come practically to be in its very centre. *a*, fore-brain; *b*, mid-brain; *c*, hind-brain; *cb*, cerebellum; *cr*, cerebrum; *d*, cavity of the medulla; *f*, fornix; *l*, lateral ventricle; *m*, medulla oblongata; *ma*, corpora mammillaria; *o*, olfactory lobe; *p*, pons Varolii; *pl*, pineal gland; *pt*, pituitary body; *q*, corpora quadrigemina; *r*, crura cerebri; *t*, lamina terminalis; *tl*, temporal lobe of the cerebrum; *x*, space, enclosed by the extension backwards of the cerebrum; 1, anterior cornu of lateral ventricle; 2, its middle or descending cornu; 3, its posterior cornu.

In the earliest conditions of the human brain the resemblance is much more marked and obvious; it is later that the correspondence between the brain of the frog and that of man becomes so disguised through the unequal growth of different portions of the organ in the human brain as it advances in its growth and development. The same six successive portions, however, exist in each.

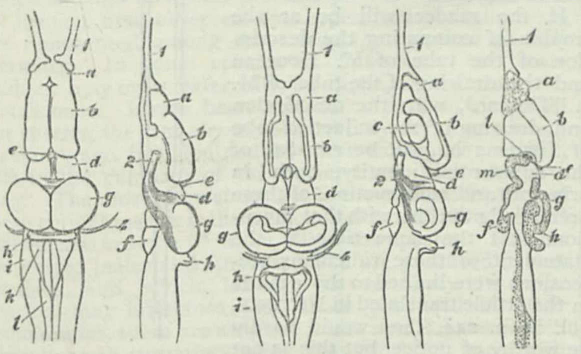
1. In the frog the olfactory lobes acquire a much larger relative size, and they retain permanently an internal cavity which exists only transitorily in man.

2. The cerebral lobes (or hemispheres) exceed those just noticed but are insignificant indeed, when compared with the corresponding human structures. They may, however, be more insignificant than in the frog, as, for example, in the lamprey, where they are actually smaller than the olfactory lobes. In that the cerebral lobes of the frog each contain a cavity (the lateral ventricles) they have a character which is constant in all animals above fishes; they open by a common aperture (foramen of Monro) into the cavity of the next brain segment behind.

3. This third segment retains a great relative magnitude compared with that of man.

4. The fourth segment, however, consisting of the optic lobes, attains a still further relative development, though consisting only of two bodies instead of four, but these contain a cavity not found in the corpora quadrigemina of the human brain.

5. The fifth segment, the cerebellum, is very small, and



1 2 3 4 5

FIG. 72.—Brain of Bull Frog in various views. 1, Dorsal view. 2, Lateral view; 3, Transverse horizontal section showing the cavities of the olfactory cerebral and optic lobes. 4, Longitudinal section a little to the left of the median line. 5, Longitudinal section in median line. The corpus striatum, *c*, is here exposed to view and also a body, *g*, within the optic lobes. 5, Longitudinal section in median line. In all five figures:—1, Olfactory nerve; 2, optic nerve; 4, auditory nerve; *a*, olfactory lobe; *b*, cerebral lobe; *c*, corpus striatum; *d*, optic thalamus; *e*, pineal gland; *f*, pituitary body; *g*, optic lobes; *h*, cerebellum.

smaller than the same part in animals both higher and lower in the scale; indeed, in the frog class, this organ may be said to be at its minimum. When cut it exhibits no trace of an *arbor vitæ*.

This fact has a special interest as bearing on alleged functions of this portion of the brain.

It has been asserted by some that the cerebellum ministers to the sexual functions, by others that this part coordinates and directs locomotive movements, and, quite lately, that it is related to movements of the eyes.

The first two of these hypotheses seem to be completely overthrown by our frog. In the first matter there is anything but a deficiency of energy and activity, and as to the second, many reptiles are less active and continuous than the frog in their locomotive efforts. As to the third hypothesis, it should be remembered that the eyes of the Frog are large and very moveable, as also that they require a power of ready adjustment to enable the animal to secure its insect prey.

6. The sixth and last segment of the brain, the medulla oblongata, is also relatively large, and is exposed to view through the rudimentary development of the cerebellum which, as has been said, overlaps it in man.]

It has been already said, that in man and the higher animals there are nerves supplying the orbital muscles and different parts of the face.

The eyeball in man is moved by six little muscles, four straight, (the *recti*) and two *oblique*, one being the upper, the other lower, oblique.

Now a nerve called the *third*, because it follows the first two (olfactory and optic) goes from the brain to all the orbital muscles except the upper oblique and the outer rectus.

Another nerve, the *fourth*, proceeds to the upper oblique muscle only.

The *fifth nerve* is a very large one, and supplies the nose, tear-gland, eyelids, upper and lower jaws, tongue and teeth.

The *sixth nerve* is a very small one indeed, being exclusively applied to the outer rectus muscle of the orbit.

The *seventh nerve* is, in part, the auditory nerve in part it sends fibres to the face.

The *eighth nerve* is a very complex structure, and consists of, at least, three nerves united together, all arising from the medulla oblongata. It sends branches to the parts about the throat, as well as to the organ of voice, to the lungs, the stomach and the heart.

The nerves of the frog exhibit certain intermediate conditions like those we have seen to exist in various other parts of its anatomy.

In the higher vertebrate animals, as in Man, the

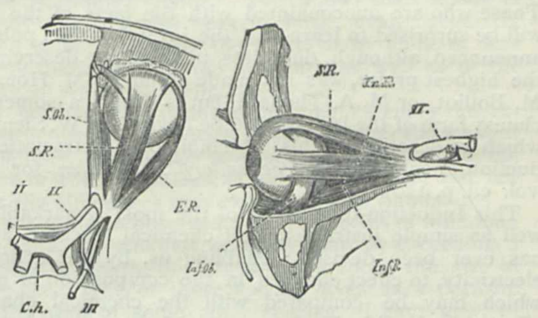


FIG. 73.—The Muscles of the Eyeballs, viewed from above and from the outer side. *R.S.*, the superior rectus; *Inf.R.*, the inferior rectus; *E.R.*, the external rectus; *In.R.*, the internal rectus; *S.Ob.*, the superior oblique; *Inf.Ob.*, the inferior oblique; *Ch*, the chiasma of the optic nerves (*II.*); *III.*, the third nerve, which supplies all the muscles except the superior oblique and the external rectus.

muscles which move the eye-ball are supplied by three distinct nerves termed respectively the 3rd, 4th, and 6th. The 5th nerve being a very large and complex one, sending branches to various parts of the head and its organs.

Now in the frog there is no distinct 6th nerve, it being replaced by an extra branch of the 5th nerve. This modification, however, is but one step towards a condition which obtains in the Mud-fish (*Lepidosiren*), when all these three nerves are quite blended with one division (the Ophthalmic) of the fifth nerve.

Again in the higher Vertebrates, as in Man, the 8th nerve is a very large and complex one, and distributed as in him. It is also so distributed in the adult frog.

In the tadpole, however, this nerve shows a very different arrangement. After issuing from the skull this nerve sends a branch down the outer side of each branchial arch and then gives off a very long one, which extends laterally, *i.e.* along the side of the body and tail.

Nothing like this exists in any Beast, Bird or Reptile, but when we come to the class of Fishes we encounter a precisely similar state of things. Here we find the eighth nerve sending a branch to each branchial arch, and giving off a great nerve proceeding along the side of the body and tail, and on that account named the *nervus lateralis*.

ST. GEORGE MIVART

(*To be continued.*)

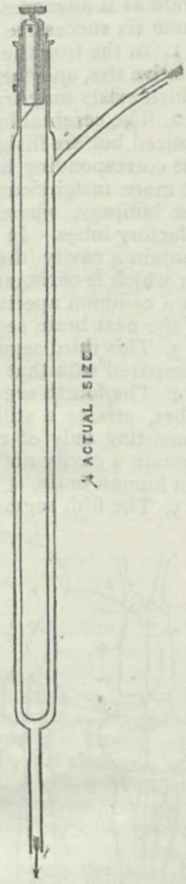
THE INDUCTION TUBE OF W. SIEMENS

A TRANSLATION from a French periodical, *La Nature*, of an article on "Tubes for silent electrical discharges," appears in NATURE of Jan. 29 (vol. ix. p. 244). After referring to the action of the electric spark upon oxygen gas, the author of the article continues: "For the purpose of more easily obtaining ozone, M. Houzeau has recently constructed an apparatus worked by a Ruhmkorff coil, in which there are no longer sparks, but only dark discharges—*effluvia*—far more efficacious in the production of modified oxygen." Again, it is said, that M. Houzeau "has recently devised an apparatus for the preparation of ozone, which is spreading rapidly among the laboratories, and which has already yielded very remarkable results." A description of the apparatus is then given; further on, it is said, that "M. Houzeau is not the only one who has made use of the tubes whose structure he has made known, but that M. Boillot, a writer, it appears," well known to the readers of the *Moniteur*, "has made some further propositions about them; and lastly, that M. A. Thénard" (whose investigations constitute the main subject of the article) "has brought to bear on the construction of the tubes a further modification which makes them still more efficacious." A description and drawing of the apparatus of M. A. Thénard is given. Those who are unacquainted with the facts of the case will be surprised to learn that the invention thus publicly announced, although, doubtless, in principle deserving of the highest praise, was not made either by M. Houzeau, M. Boillot, or M. A. Thénard, but is simply a somewhat clumsy form of the Induction-tube devised by W. Siemens, which is described in his "Memoir on Electrostatic Induction," contained in *Poggendorff's Annalen*, for 1857 (vol. cii. p. 120).

This Induction-tube is one of the most remarkable, as well as simple instruments, of chemical research which has ever been devised; enabling us, by the action of electricity, to effect changes in the composition of gases which may be compared with the chemical changes effected in liquids by the agency of the voltaic battery. A few words in explanation of the instrument may interest the readers of NATURE.

The simplest form of induction-apparatus consists in two thin glass plates, of which one side is coated with tin-foil, and which are so arranged that the uncovered surfaces are parallel to one another, and separated by a uniform, narrow interval of about one or two millimetres filled, say, with air. If this apparatus be charged with electricity by a sufficiently charged Leyden jar, at the moment of the charge the air between the plates becomes luminous, and the same appearance is presented when the apparatus is discharged. To produce this effect, however, the apparatus must be charged beyond a certain limit, determined, in each case, by the special arrangement of the apparatus and the materials employed in its construction. Now, if the two plates of tin-foil be respectively connected with the terminals of a powerful Ruhmkorff's coil, the apparatus is successively charged with electricity and discharged; these operations being alternately repeated in such rapid succession that the air, in the interval between the plates, appears permanently luminous. We have, moreover, evidence of the occurrence in this interval of chemical changes determined by the electric action, in the odour and characteristic properties of ozone which may be recognised in a current of air or oxygen compelled to pass between the plates. The conclusion drawn by Siemens from this experiment is, that the electric polarisation of the particles of a dielectric cannot be carried beyond a certain point; and that if it be attempted to accumulate electricity in the apparatus beyond this point, the excess of this tension or polarisation appears in the form of the dynamical phenomena occurring between the plates, namely, light, heat, and chemical change. (*Poggendorff's Annalen, loc. cit.*, p. 119).

6.a



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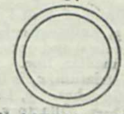
6b



⅓ ACTUAL SIZE

Now it is evident that in this arrangement the two sheets of glass may be replaced by two concentric cylinders of glass, the interior of the inner cylinder and the exterior of the outer cylinder being coated with tin-foil, as in the case of the plates. It is precisely this change which is effected in the induction-tube of Siemens, but with the additional advantage that in the induction-tube a regular flow of the gas to be operated upon may be maintained, that the experiment may be made at any required temperature, and the gaseous products of the experiment collected for examination. The construction of this induction-tube will be readily understood from the annexed drawing (taken from *Pogg. Ann.* loc. cit.), where the ring shows the horizontal section of the tube.

If the reader will be at the trouble of comparing the description of the tube of M. Houzeau and the drawing of the tube of M. A. Thénard, with the description and drawing of the induction-tube of Siemens he will be satisfied of the substantial identity, both in principle and construction, of these pretended novelties with that invention. At the same time if the statement of these ridiculous pretensions were limited to those made in the article translated in NATURE, vol. ix. p. 244, they would hardly be worthy of notice, but this is not quite the case. The induction-tube of Siemens under the title of "the tube of M. Houzeau," is being rapidly acclimatised as a French discovery. In the article on ozone contained in a recent number of the "Dictionnaire de Chimie," which bears evidence of being the work of a highly competent writer, where we might expect to find a comprehensive treatment of the subject, a similar lapse occurs. We have there, too, a drawing of the tube of M. Houzeau, which is described as "a happy modification of the tube of M. Babo," but not a word is said about Siemens, the inventor of the tube, whose name is simply dropped. Other similar instances might be brought forward which have afforded an opportunity of rectifying these mistakes, but of which no advantage has been taken. I have therefore ventured to make these remarks, not only I may say in the interest of justice, but also, having myself made many experiments with the induction-tube of Siemens, I have learned, perhaps, more than others to appreciate its value and feel myself under a special debt of gratitude to the inventor.

B. C. BRODIE

RECENT RESEARCHES ON TERMITES AND HONEY-BEES

THE accompanying letter, just received from Fritz Müller, in Southern Brazil, is so interesting that it appears to me well worth publishing in NATURE. His discovery of the two sexually mature forms of Termites, and of their habits, is now published in Germany; nevertheless few Englishmen will have as yet seen the account.

In the German paper he justly compares, as far as function is concerned, the winged males and females of the one form, and the wingless males and females of the second form, with those plants which produce flowers of two forms, serving different ends, of which so excellent an account has lately appeared in NATURE by his brother, Hermann Müller.

The facts, also, given by Fritz Müller with respect to the stingless bees of Brazil will surprise and interest entomologists. CHARLES DARWIN

Feb. 11

"For some years I have been engaged in studying the natural history of our Termites, of which I have had more than a dozen living species at my disposition. The several species differ much more in their habits and in their anatomy than is generally assumed. In most species there are two sets of neuters, viz., labourers and soldiers; but in some species (*Calotermes* Hg.) the labourers, and in others (*Anoplotermes* F. M.) the soldiers, are wanting. With respect to these neuters I have come to the same conclusion as that arrived at by Mr. Bates, viz. that, differently from what we see in social Hymenoptera, they are not modified imagos (sterile females), but modified larvæ, which undergo no further metamorphosis. This accounts for the fact first observed by Lespès, that both the sexes are represented among the sterile (or so-called neuter) Termites. In some species of *Calotermes* the male soldiers may even externally be distinguished from the female ones. I have been able to confirm, in almost all our species, the fact already observed by Mr. Smeathman a century ago, but doubted by most subsequent writers, that in the company of the queen there lives always a king. The most interesting fact in the natural history of these curious insects is the existence of two forms of sexual individuals, in some (if not in all) of the species. Besides the winged males and females, which are produced in vast numbers, and which, leaving the termitary in large swarms, may intercross with those produced in other communities, there are wingless males and females, which never leave the termitary where they are born, and which replace the winged males or females, whenever a community does not find in due time a true king or queen. Once I found a king (of a species of *Eutermes*) living in company with as many as thirty-one such complemental females, as they may be called, instead of with a single legitimate queen. Termites would, no doubt, save an extraordinary amount of labour if, instead of raising annually myriads of winged males and females, almost all of which (helpless creatures as they are) perish in the time of swarming without being able to find a new home, they raised solely a few wingless males and females, which, free from danger, might remain in their native termitary; and he who does not admit the paramount importance of intercrossing, must of course wonder why this latter manner of reproduction (by wingless individuals) has not long since taken the place through natural selection of the production of winged males and females. But the wingless individuals would of course have to pair always with their near relatives, whilst by the swarming of the winged Termites a chance is given to them for the intercrossing of individuals not nearly related. I sent to Germany, about a year ago, a paper on this subject, but do not know whether it has yet been published.

"From Termites I have lately turned my attention to a still more interesting group of social insects, viz., our stingless honey-bees (Melipona and Trigona). Though a high authority in this matter, Mr. Frederick Smith, has lately affirmed, that "we have now acquired almost a complete history of their economy," I still believe, that almost all remains to be done in this respect. I think that even their affinities are not yet well established, and that they are by no means intermediate between hive- and humble-bees, nor so nearly allied to them, as is now generally admitted. Wasps and hive-bees have no doubt independently acquired their social habits, as well as the habit of constructing combs of hexagonal cells, and so, I think, has Melipona. The genera Apis and Melipona may even have separated from a common progenitor, before wax was used in the construction of the cells; for in hive-bees, as is well known, wax is secreted on the ventral side: in Melipona on the contrary, as I have seen, on the dorsal side of the abdomen; now it is not probable, that the secretion of wax, when once established, should have migrated from the ventral to the dorsal side, or *vice versâ*.

"The queen of the hive-bee fixes her eggs on the bottom of the empty cells; the larvæ are fed by the labourers at first with semi-digested food, and afterwards with a mixture of pollen and honey, and only when the larvæ are full grown, the cells are closed. The Meliponæ and Trigonæ, on the contrary, fill the cells with semi-digested food before the eggs are laid, and they shut the cells immediately after the queen has dropped an egg on the food. With hive-bees the royal cells, in which the future queens have to be raised, differ in their direction from the other cells; this is not the case with Melipona and Trigona, where all the cells are vertical, with their orifices turned upward, forming horizontal (or rarely spirally ascending) combs. You know that honey is stored by our stingless bees in large, oval, irregularly clustered cells; and thus there are many more or less important differences in the structure, as well as in the economy, of Apis and Melipona.

"My brother, who is now examining carefully the external structure of our species, is surprised at the amount of variability, which the several species show in the structure of their hind legs, of their wings, &c., and not less are the differences they exhibit in their habits.

"I have hitherto observed here 14 species of Melipona and Trigona, the smallest of them scarcely exceeding 2 millimetres in length, the largest being about the size of the hive-bee. One of these species lives as a parasite within the nests of some other species. I have now, in my garden, hives of 4 of our species, in which I have observed the construction of the combs, the laying of the eggs, &c., and I hope I shall soon be able to obtain hives of some more species. Some of our species are so elegant and beautiful and so extremely interesting, that they would be a most precious acquisition for zoological gardens or large hot-houses; nor do I think that it would be very difficult to bring them to Europe and there to preserve them in a living state.

"If it be of some interest to you I shall be glad to give you from time to time an account of what I may observe in my Melipona apiary.

"Believe me, dear Sir, &c.,

"FRITZ MÜLLER"

MARS*

IN the previous article were mentioned some of Professor Kaiser's conclusions. We are induced to add a few further remarks, from their general applicability. The delineation of the heavenly bodies, he says, is always a very difficult task, especially when, as in the case of Mars, we have to deal with features more or less indistinct, delicately and gradually shaded. With the most powerful telescopes the disc is but small; and on it we find a mass of ill-defined and frequently very feeble spots, which require close attention for their disentanglement, and it is hard to obtain a clear conviction as to the outlines and shadings that have to be drawn. The difficulty is much increased by the inces-

* Continued from p. 289.

sant undulations of the air; and in the seldom-recurring moments of stillness so much under good circumstances is visible, that even the best artist cannot draw it all in half an hour, a period during which usually there are but a very few tranquil glimpses, and after which the planet will have materially changed its aspect from rotation. Even were it easier to distinguish what is actually visible, it requires great practice to represent it faithfully; and whoever has had personal experience of the difficulties of such designs will have but a limited confidence in the various portraits or the supposed changes that they represent. As a further illustration of these difficulties he refers to the representations of the Orion nebula by Rosse, Lassell, Secchi, and Liapounov (he could have added Herschel II.); or the portraits given by Bond, and others, of Donati's Comet. He might have cited, had he known of it, Prof. Young's remark as to the solar corona (where, however, these difficulties are heightened by the excitement of the moment), that "the drawings made by persons standing side by side differ to an extent that is sometimes really ludicrous, and has induced more than one astronomer who had not himself seen an eclipse, but judged only from the written accounts and sketches, to declare his belief that this whole outer corona is a mere subjective phenomenon."

The justice of Kaiser's remarks will readily make itself felt, but they do not exhaust the subject; something may perhaps be added as to the "personal equation" of vision. Independently of mechanical defects in the eye, there are inaccuracies of perception; and even if the rays have kept an uninterrupted and undeviating course to the retina, they do not always produce corresponding impressions on the mind. Whatever may be the cause, we frequently meet with defects in the sense of form, or proportion, or inclination, or even the presence of features which are not the immediate objects of attention. Comparisons of size are often very erroneous; craftsmen well know the meaning of "a true eye;" and the expression "I did not see it," is constantly employed with reference to a thousand objects whose representation on the retina is all the while unquestionable. It is in these respects that celestial photography is invaluable as recording everything and putting everything in its proper place; but photography, as Kaiser observes, is inapplicable to the light of Mars. Another point, too, might have admitted of notice. Although we may certainly, with him, be baffled in reconciling Rosse and Lassell, we may bear in mind, as regards the comparison of larger and smaller instruments, Dawes's important remark to the effect that a certain relative proportion of light and power may be essential to the visibility of some classes of difficult objects.

Without subscribing implicitly to the whole of Kaiser's views, some of which admit of doubt—as, for instance, when we contrast his assertion that the spots are never sharply defined, with the clearness and keenness of outline occasionally recorded by Lockyer and others—we may well admit their general accuracy. But we find it more difficult to accompany him in his inferences as to the planet's physical constitution.

The earth-light upon the moon having been found by Schröter more conspicuous when it proceeded from the hemisphere of our globe containing the largest amount of land, Kaiser implies that it has hence been inferred that (as it is difficult for us not to imagine other planets constituted like our own), the brighter and darker portions of Mars are equivalent to land and water. Whether such an opinion may have been arrived at in this circuitous way or not, it seems highly probable without any reference to lunar appearances. The eminently absorptive power of water is well known; even a thickness of seven feet will, it is said, diminish the incident light by one-half; and below 700 feet it is quenched in unbroken darkness; and the quantity of diffused light reflected from its surface would be inconsiderable, while the solar image at the distance of the Earth would be too minute, in all probability, to be visible. This reasoning would seem fairly to hold its ground against that of the Leiden astronomer, who does not believe that seas so looked upon would show such innumerable gradations in tone, or be so invariably ill-defined at their edges, while the same telescope gives perfect sharpness to the polar snows. He goes in fact so far as to say that if we may form any conclusion from their aspect, it is, that they cannot resemble seas such as our own. But as to distinctness of boundary, his experience is not accordant with that of other excellent observers, especially Lockyer, who remarks that "the effect of a cloudless and perfectly pure sky both here and on Mars appears to be, that the dark portions of the planet become darkest and most distinctly visible; the coast-lines (if I may so call them) being at such times so hard and sharp that (as has been mentioned by Mr. Lassell) it is quite impossible to represent the outlines faithfully." A more natural inference, it seems to the writer, would be that these fluid masses contain large areas of very slight depth, that the edges are in many places very shelving, and that possibly they may be the more transparent from the absence of salt. Other astronomers, Kaiser tells us, but without mentioning their names, have reversed the idea, and thought the bright parts to be seas, but they do not thus escape his objections on the score of definition, nor account for the dusky tracts which some of the great bright expanses contain. He has perhaps got hold of a more substantial difficulty in the aspect of the north polar region, where the white spot is often encompassed by a widely-extended dark zone with many gradations of tint. The width of this belt, very great when foreshortening is taken into account, is no doubt variable: Beer and Mädler ascribed it to the non-reflective power of the damp surface bared by the rapidly melting snow. On the whole, when Kaiser considers that nothing is established with certainty but the existence of an atmosphere and the connection of the polar spots with the seasons, we hesitate to follow him; and we should prefer the conclusion of Phillips, adopted by Lockyer, that "over a permanent basis of bright and dusky tracts, a variable envelope gathers and fluctuates, partially modifying the aspect of the fundamental features, and even in some degree disguising them under new lights and shades, which present no constancy, a thin vaporous atmosphere probably resting on a surface of land, snow, and water." A more protracted course of observation may possibly modify in some way this result, but so far as past investigations extend, we may say that nothing has been detected inconsistent with it. Could we be actually transported to that far distant surface, we should probably find much to astonish us that we cannot so much as conjecture here; it was a sound remark of Schröter's that unity in variety is the universal character of creation; and the spectroscope of Huggins has already in this instance confirmed it by the detection of absorption-lines the cause of which is utterly unknown. Our future inquiries should be conducted in that impartial spirit which is equally ready to admit the indications of discrepancy and of resemblance, and which is more anxious to ascertain facts than to seek their premature elucidation. We have as yet read but a part of the inscription on that golden shield: some of it has probably been deciphered correctly; how much of the remainder may give way we know not; but the whole, it will never be given to us to understand.

The extensive researches in which Dr. Terby of Louvain has for some time been engaged, and in which he has shown unwearied diligence and perseverance, if embodied, as we trust they will be, in one comprehensive result, will give material assistance in disentangling and concentrating our present scattered and discordant materials, and we may look forward with hope to the very promising opposition of 1877; when, if the seasons on both planets are as favourable as their mutual proximity, we may reasonably expect some advance to be in store for us. The great object will naturally be the identification of the dark spots, as well as a more careful delineation of their boundaries: attention will doubtless be paid towards obtaining a definitive value for the rotation; but in this direction progress is not very material, as we have already a sufficient approximation. Those who would see an extraordinary instance of the most painstaking and protracted efforts to get rid of a trifling uncertainty may apply themselves to the 23 pages of Kaiser, in which all kinds of varied combinations are tried to reconcile some conflicting decimals of a second, for to these the question is reduced at last. Cassini, as far back as 1666, had fixed the rotation at 24h. 40m. with surprising correctness for his day. Herschel I. brought it to 24h. 39m. 21·67s. but, as Beer and Mädler perceived, the omission of one rotation, and of the effects of phasis and aberration, vitiated the result. They in turn gave 24h. 37m. 23·7s. Kaiser, from many elaborate comparisons, deduced a mean of 22·62s., but Proctor having found a value of 22·735s. the former, who thought the English astronomer's coincidences illusory, went into the whole subject afresh with marvellous minuteness, and got out a final mean of 22·531s., discovering by the way some unexpected inaccuracies, convincing himself that the correctness of the best drawings has been greatly over-rated, and finally, in much mortified perplexity, leaving it to every one to choose his own combination. No computation, he says, can make us sure to the hundredth of a second; and unless observations become very much more precise, it will be several centuries before such a result will be obtained: how much the wiser mankind would be for it, is another question, which we need not discuss here. But there is, perhaps, no great difficulty in divining the cause of the Professor's troubles. Epochs of rotation could only be safely taken from drawings made with that special object, and few such probably exist; the designer usually either contenting himself with a general likeness, or being occupied about details, the study of which would of itself render him less attentive to mere position. In future, these objects might be better separated; and while the artist busies himself with the *minutiæ* of the picture, the rotation-seeker should employ himself exclusively in estimating the co-ordinates of some conspicuous points—a process which admits of a mean taken between many proportional valuations.

Several other desirable matters of inquiry will readily offer themselves. Measures of ellipticity have as yet yielded only contradictory results. The inclination of the axis, last deduced by Oudemans in 1852, may be susceptible of correction; and the excentric position of one or both of the snow-spots, and the unsymmetrical position of the isothermal poles, would be matters of interesting investigation. The amount of the latter deviation, first measured by the elder Herschel, has been given so very differently by different observers, even at the same opposition, that it evidently is open to fresh determination. The well-known colours will of course catch the eye; and attention may be paid to the question whether the green, or as others think blue, tint of the dark parts (which Kaiser saw as grey only) is really, as Herschel II. implies, the mere result of contrast. The effect may be possibly thus heightened; but no one who saw one of the great seas as the writer did with a 9in. silvered speculum on April 4, 1871, could doubt the independent existence of a beautiful clear blue-grey tint, the more certain as a shading on another part of the disc was of a brownish hue: nor does it seem to have been noticed that no effect of contrast has been traced in the polar snows. The luminous and occasionally coloured patches and segments on the limb should receive attention, and the position of "Dawes' ice-island" be scrutinised; such a brilliant speck I witnessed at the above epoch, but I believe in another situation. Black points should be looked for, as such have been detected by Mitchell and Dawes; and it should be noted at the time of any conspicuous feebleness of the markings, whether the sharpness of the limb indicates the cause to be further distant than our own atmosphere: and in general the "daily—nay, hourly—changes in the detail and in the tones of the different parts of the planet, both light and dark," described by Lockyer, should be carefully watched and recorded;

"In tenui labor;"

nevertheless, none of these little matters will be considered insignificant by those who love to behold in such things the footsteps of Creative and Upholding Power.

T. W. WEBB

NOTES

WE have received some interesting notes of the work done by the eminent Russian explorer, Dr. von Miclucho-Maclay, which we hope to publish next week. Contrary to the advice of everyone, this intrepid traveller and true devotee of Science is determined upon again visiting the east coast of Papua. When his researches here are complete he intends to visit some of the islands of Polynesia and certain parts of the coast of Australia. This, he calculates, will take up five or six years. The Governor of the Dutch East Indies, like a true man of Science, had given Dr. Maclay, for the last six months, roomy and comfortable quarters in his palace at Buitonrovg. It would be well if all in high position would imitate this kind of "patronage."

THE Meteorological Committee of the Board of Trade have resolved to commence the issue of lithographed copies of the twenty-four hourly tabulated readings, taken at their seven observatories, for every element which is observed continuously, commencing with January 1, 1874. The sheets will be issued quarterly, and the issue will be a limited one. The subscription for a copy is 1*l.* per annum, to cover a portion of the expense of production. The sheets will not be distributed with the publications of the office.

M. L. QUETELET, the founder and director of the Brussels Observatory, died in Brussels on Monday night, aged 77. He leaves a son, M. Ernest Quételet, who inherits the scientific enthusiasm of his father.

THE letter which has been received from Consul Prideaux, and the extract from Cameron's letter published in the *Academy*, adds but little to the details we gave some time ago concerning Livingstone's reported death. Lake Bemba is identified by Consul Prideaux as Lake Bangweolo, and a letter from the Arab Governor of Unyanyembe fixes the spot where the great traveller died at Lobisa. A letter to Dr. Petermann from the German African traveller and Austrian Consul at Zanzibar, Mr. Richard Brenner, merely repeats the statements already known. Dr. Kirk, under date Feb. 12, writes to the *Academy* as follows:—"This morning I have heard indirectly from Zanzibar, and find people there who could judge, still question the truth of the story ot Livingstone's death. Like us, they see nothing but native report to base it on." Let us hope that this is the real state of the case. As Zanzibar and Ujiji are at present at peace it is expected that there will be no difficulty in getting the Doctor's valuable journals. It is gratifying to see from Mr. Markham's letter in yesterday's *Times* that through Sir Samuel Baker's determined energy, the route to Zanzibar has been virtually opened up from the north.

THE letter above referred to from Consul Brenner, states that a German botanist, M. Hildebrand, has been preparing, for a year past, to undertake a journey into the interior of the Galla country and Somali Land.

A SHORT course of Lectures on the Growth of Physical Science during the last twenty-five years, is to be given at the request of a number of gentlemen in Edinburgh, in St. George's Hall, by Prof. Tait, of the University of Edinburgh. The first lecture is to be given to-day.

AT the Annual General Meeting of the Glasgow Geological Society, on Thursday last, Sir William Thomson gave an address on "The Influence of Geological Changes on the Earth's Rotation." We hope to be able, very soon to give an abstract of this address.

THE *Times* announces that the following arrangements have been made in consequence of Mr. Henry Cole's retirement last year from the post of Secretary of the Science and Art Department and Director of the South Kensington Museum:—Sir Francis Sandford, Secretary of the Education Department, will also be Secretary of the Science and Art Department; Major Donnelly, R.E., Official Inspector for Science, will be Director of Schools of Science and Art and affiliated institutions; Mr. Norman MacLeod will remain Assistant Secretary of the Science and Art Department; and Mr. Philip Cunliffe Owen, Assistant Director of the South Kensington Museum, will be the Director of that Museum.

PROF. HELMHOLTZ has communicated to the Academy of Sciences of Berlin a paper on "The Direction of Balloons," in which he enters into a number of elaborate calculations. In his calculations he directs attention only to the relation between the force and the weight, and supposes that the means at our disposal will enable us to construct the envelope of the balloon and its motive power. But, Prof. Helmholtz says, "it appears to me that here there exists a great difficulty in the way of execution, for the solid parts of the machine do not preserve the necessary solidity when they are much enlarged, although they continue to be geometrically similar; they then must be made thicker, and consequently heavier. To obtain the same effect with small motors at great speed, there is a loss of work. We can only work economically then with motors of large surface urged by a motion relatively slow. One of the great practical difficulties will then be to obtain the necessary dimensions without overloading the balloon."

PROF. H. A. NEWTON thus criticises the Report of the British Association Committee on Units in the March number of *Silliman's Journal*:—The *dyne* or unit of force which is proposed by the committee is to be a new unit of the same nature as a gram-weight, or the earth's attraction for a gram-mass, and having no commensurable ratio with it. Now our simplest and most useful ideas of force are derived at once from weight. It seems to us that, of necessity, this will always be the case. Probably the learned committee have no expectation that even among scientific men the new units will entirely replace what they call the vulgar ones. If, then, their recommendation is accepted, we shall create for certain departments of mechanical science new units of force and energy which are in no useful ratios to those used in other departments of science, and by people at large. Is there not some way of avoiding this great evil? Societies are formed and sustained whose main and most worthy object is to get rid of such confusions. We think the proposed units should be stoutly challenged to show a necessity for their being. We do need, it may be added, a new *name* for the earth's attraction upon a gram of matter at some fixed place. The words *gram*, *pound*, *ton*, &c., have had to do service in two different senses, that is, as mass, and as force. If any good word could come into use that shall express the earth's attractive force for a gram of matter at some place that may be agreed upon, it would meet a real want.

THE collection of Humming Birds of the late M. Jules Bourcier is to be sold by auction at Paris on March 2. M. Bourcier's collection of these birds was, a few years ago, the best and most complete in existence, embracing numerous types of the species described by the French naturalists, and specimens collected by himself during his residence in Ecuador as French Consul.

MR. A. S. NAPIER, of Owens College, Manchester, who has been elected to a Natural Science Scholarship at Exeter College, Oxford, received the first part of his science training at Rugby. Mr. W. E. Hoyle, of Owens College, has been elected to a Natural Science exhibition in the same College.

THE Japanese Government have, through their Legation in London, appointed Mr. R. Routledge, B. Sc., F.C.S., to the Professorship of Chemistry and Physics in the Imperial College at Yeddo. Mr. Routledge was formerly of the Owens College, Manchester, where he studied Chemistry under Dr. Roscoe, and afterwards took high honours at the University of London.

WE gladly call attention to the action taken by the British Association, "Boulder Committee," under its secretary, the Rev. H. W. Crosskey. A large printed form has been prepared, with a set of well-drawn up questions, and spaces for the answers of those who may be inclined to assist the Committee in their praiseworthy work. Copies of this form may be obtained by applying to Mr. Crosskey, 28, George Road, Birmingham.

A TELEGRAM from Cairo announces that Dr. Beke has succeeded in discovering the true Mount Sinai. It is said to be situated one day's journey west of Akaba, is called by the Arabs the Mountain of Light, and is 5,000 ft. high. On the summit were some sacrificial remains of animals.

MISS FRANCES STRICKLAND, of Appleby-court, Tewkesbury, has offered to found at the University of Cambridge a curatorship of the Ornithological collection formerly belonging to her brother, Mr. H. F. Strickland, F.R.S., and presented to the University in 1867 by his widow. Miss Strickland proposes to endow the office with a permanent stipend of 150*l*. per annum. The principal conditions attached to the gift are that the curator be appointed by the foundress during her lifetime, and afterwards by Mrs. Catherine Strickland, and, on the decease of these two ladies, by the superintendent of the University Museums of Zoology and Comparative Anatomy, but in each case with the consent of the Vice-Chancellor. That the curator is to be subject to the authority of the superintendent of the museums, and that his first duty be the proper custody and efficient preservation of the Strickland collection, making an accurate catalogue of it, so that the collection be of the greatest service to Science. He would be required to reside in the University; and in case of the abolition of the office of superintendent of the museums the curator shall be appointed and removed by the Professor of Zoology and Comparative Anatomy with the consent of the Vice-Chancellor. The Council of the Senate recommend the acceptance of Miss Strickland's liberal offer.

ON this day week there passed from among us a countryman whose power has been but too little appreciated, and far too little recompensed by ourselves or other European nations. Sir Francis Pettit Smith was, to all intents and purposes, the discoverer of the screw-propeller, a method of progression as practically advantageous as it is theoretically perfect; nevertheless, the benefits which he has derived from his indebted countrymen are but a paltry annuity and an equally insignificant decoration. Considering the little encouragement given by our Government for first-class work, it is really a matter of surprise that any should be produced at all.

AT the meeting of the Academy of Sciences at Paris, on Feb. 9, the candidates to be recommended to the Minister of Public Instruction for the chair of Comparative Embryogenesis at the College of France, were balloted for. The names of MM. Gerbe, Balbiani, and Dareste, were presented to the meeting, and the result of the voting was to select the two former gentlemen as the Academy's nominees for the post.

CAPTAIN S. P. OLIVER writes us concerning a meteor-cloud which he observed at Buncrana, Co. Donegal, on Feb. 5, at about 9.10 P.M. local time. He saw what he at first thought to be a comet's tail, viz. a broad band of silvery white and luminous cloud extending in an arc from S.E. by E. to N.W. by W., as near as he could judge, from horizon to horizon, but tapering towards the extremities. The apex of this arc, which was some four or five degrees in width, was as nearly as possible on the meridian at about 80° elevation from the horizon. The band passed within three or four degrees above the upper stars of Orion. Through this luminous cloud the stars shone brightly. The edges appeared well-marked, and there was no appearance of that serpentine track into which meteor-clouds frequently dissolve. Several "shooting-stars" were visible the same evening. One especially he noticed which seemed to come from a radiant point at the S.E. extremity of the above-named cloud.

MESSRS. SMITH, ELDER, and Co. have a new edition of Mr. Charles Darwin's work on the "Structure and Distribution of Coral Reefs" in preparation.

MICHELET, the celebrated historian, who died within the last few days at Cannes, aged 76 years, has written a few sensational books on natural history. "L'Oiseau" and "L'Insecte," had an immense circulation, although their real scientific value was very small.

M. REINWOLD, one of the largest Parisian scientific publishers, is just publishing a translation of Haeckel's "History of Creation." It is prefaced by M. Charles Martin, one of the most celebrated correspondent members of the French Institute. Consequently Darwinism is not to be considered as having been extinguished in France by the last rejection of Darwin by the Academy. Neither will the success of Haeckel's great work be paralysed by the cry of *no more Germanism* raised in certain quarters.

CAPT. MOUCHEZ, who has been appointed the chief astronomer for St. Paul's station on the Venus Transit Expedition, is publishing, at the expense of the French Admiralty, a map of the Algerian coast on the scale of $\frac{1}{120000}$. The survey was executed on a new plan and only lasted 18 months. Although Algeria extends about 750 miles east-west, M. Mouchez has determined all his stations by a series of triangulations executed on shore, independently of the situation of his boats or ships.

FOR some years past much interest has been excited in the United States in reference to the erection of a large telescope, and possibly a complete astronomical observatory on the high portion of the Rocky Mountains. As preliminary to this, a number of careful examinations have been made of the optical qualities of the atmosphere in various portions of the Western country. Of these special interest attaches to the expedition of Professor Davidson of the Coast Survey, whose report to the California Academy of Sciences, states that the meteorological tables kept at Summit Station, on the Sierra Nevada, 7,042 feet above the sea, during the year ending November 1867, show that out of 358 days and nights only eighty-eight were cloudy, nearly all of these occurring in the winter months, during which the snowfall was about forty-five feet, the winter not being unusually mild. The summer weather is very pleasant, the nights cool, and the atmosphere wonderfully clear. The mountain flanks are covered with verdure during the summer, and there is freedom from great clouds of dust. Prof. Davidson says that, owing to the steadiness of the atmosphere, observations at this elevated point would in one or two nights be of greater value than the results of six months' observations at lower stations. Higher and perhaps more desirable positions exist in the immediate neighbourhood of Summit Station; and the interest excited by Prof. Davidson's report probably has, to a considerable extent, influenced the determination announced in a recent letter of Mr. J. Lick, the well-known millionaire of San Francisco. This gentleman has indicated in a letter to the California Academy of Sciences, and again in a letter to Prof. Joseph Henry, his desire to establish an observatory in the best possible location, and provide it with the largest and finest astronomical instruments. He proposes to this end to set aside one million dollars as a permanent endowment fund. This is a monument and a renown which few are rich and wise enough to achieve for themselves, and it is greatly to be hoped that the founder of the Lick Observatory may live to enjoy the congratulations of his State and country.

PROF. JAMES ORTON, of Vassar College, N.Y., has just returned to the United States from South America, where he has been engaged in a second exploration of the Amazons. The general object of his recent travels in South America, was to supplement his expedition in 1867, when he crossed the continent from west to east, *viâ* Quito and the Nipo wilderness. His route in 1873 was up the Amazons from Para to Yurimaguas on the Hoallaga River; thence up to the Paravapura and its tributary, the Cachiyeen to Balsa Puerto; thence over the Icuto Vange on foot to Moyobamba; thence across and among the Andes to Chachapoyas and Cayamarca, crossing the Upper Mavañon, or Balsas, and striking the coast at Pacasmayo; thence to Lima and its immediate region; thence to Mollendo, Areguipa and Puno on the shore of the Lake Titicaca. He was the first traveller to pass from the Pacific to the Lake by the railway just finished by Mr. Meiggs. The prime object of his explorations was to study the physical geography, geology and topography of the Amazons. On these points he obtained a vast amount of new and reliable information. He found that the Upper Amazon (Marañora), has been grossly misrepresented in all the more recent maps of Peru. He made everywhere, but especially in Northern Peru, large collections in natural history, to throw light upon the distribution of animal life. Prof. Orton will condense the results of his expedition in a work on the Physical Geography, Natural History, and Commercial Resources of the Valley of the Amazons.

FRESH advices to January 11, received from the German exploring expedition in the Lybian Desert, under Gerhard Rohlfs, announce that the expedition had reached the important oasis of Dachel, containing 17,000 inhabitants. Valuable geographical discoveries had been made, and six maps of the country had been taken.

THE metrical system has just been adopted in Germany for the measurement of distances. The official papers have published the order with decrees that henceforth the kilometre shall replace the Prussian mile.

THE additions to the Zoological Society's Gardens during the past week include a pair of Coatis (*Nasua nasica*) from South America, presented by Mr. W. P. Chambers; an Egyptian Fox (*Canis niloticus*) from Port Said, presented by Mr. J. T. Keane; a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. R. Wilkinson; a Great Kangaroo (*Macropus giganteus*), born in the Gardens; five Branched Sea Horses (*Hippocampus ramulosus*) from the coast of France, purchased; a Capybara (*Hydrochœrus capybara*) from Rio Negro.

SCIENTIFIC SERIALS

In the *Journal of Botany* for January, there is no paper of special general interest, the illustration being that of a new British moss *Tortula inclinata*. Mr. J. G. Baker describes a number of new or little known capsular gamophyllous Liliaceæ; and Mr. F. E. Kitchener gives an "elementary proof of the rule for detecting spiral arrangement." The first article in the February No. is an illustration of how much yet remains to be done in completing the British flora, being a description with a plate of a British Dock, *Rumex maximus*, discovered by the Hon. J. L. Warren in the neighbourhood of Lewes, where it was recorded many years since, but not having been observed in the meantime, had been generally treated as an error. There is no other paper bearing specially on British Botany, but a very useful account of the Esparto-grass of commerce, by Mr. J. R. Jackson.

Astronomische Nachrichten, No. 1972. The elements of Henry's comet, 1873, by E. Weiss and Aug. Zielinsky, the following elements are given :—

	Weiss. Berlin Time.	Zielinsky. Paris Time.
T =	Oct. 1·80022	Oct. 1·765792
Π =	50° 18′ 18″·5	50° 18′ 42″·96
☊ =	176° 43′ 14″	176° 43′ 21″·88
i =	121° 28′ 58″·8	121° 27′ 48″·19
log. q =	9·585297	9·5866441

A list of fifteen new nebulæ is given, which M. Stephan observed at Marseilles.

Poggendorff's Annalen der Physik und Chemie, No. 10, 1873.—We may first notice, in this number, some observations relating to phenomena of light.—M. Behrens contributes a paper on the production of coloured light through elective reflection. The reflected and transmitted light of opal and other bodies was examined with a micro-spectroscope; and it is shown that certain substances may have colour without absorbing light, and that the two spectra (from reflection and transmission, respectively) are exactly complementary of each other. This, he says, occurs more frequently than one might suppose.—Dr. Nöggerrath draws attention to the production of light in grinding of hard stones, as witnessed in the agate-works at Oberstein and Idar. In the case of all hard stones (which the workmen press with their hands against large grindstones revolving thrice in a second), a strong red light appears between the object and the grindstone, with a red halo and emission of sparks. Transparent stones, however, are lit up throughout with a beautiful yellowish-red light, like that of glowing iron, so that it seems as if the workman must burn his hands (though the rise of temperature was not above 10° or 12° R.). The author invites research in this direction, for which the works named present good opportunity.—The concluding portion of M. von Bezold's paper on the law of colour mixture and the physiological primary colours, is given; the author is led to some valuable deductions which we cannot here stop to particularise.—M. Valerius, in a note on binocular, as compared with monocular, vision, comes to the conclusion that the proportion of brightness of an object, looked at successively with both eyes, and with one, is nearly independent of the absolute amount of illumination: and with ordinary candle or gas flame, does not exceed 1·15. He afterwards found that his left eye was less sensitive than the right; had he used the latter, the proportion in question would be somewhat less. The measurements were made with Foucault's photometer.—M. Kundt contributes a paper on the vibration of rectangular, and especially of square, *air plates*; meaning, by an air plate, a thin layer of air enclosed between two solid plane plates applied to each other (it may be either in communication with the external air, or closed all round). He makes the vibration-forms visible by means of cork powder; and the present communication chiefly shows that the vibration-numbers observed in the entirely-closed air plates agree with those deduced from theory, to less than 1 per cent.—Dr. Hübener gives an account of researches on transpiration of salt solutions through capillary tubes. The velocity of outflow is found to be inversely as the equivalent weights; which may be explained (the author thinks) by the fact, that in compounds with high equivalent weight the molecules are larger than in those with low. If, then, equal weights of two salts of different equivalent weight be dissolved in a liquid, there will be present in the solution of the heavier salt larger but fewer molecules than in the other solution. Hence, in the solution of the first salt, the molecular surface in contact with the solvent will be less than in the second liquid; and the internal friction will be less; thus (other conditions equal), there will be greater mobility.—A paper by Dr. Dibbits discusses, at some length, the dissociation of ammonium salts in aqueous solution; the results detailed being both qualitative and quantitative.—M. Rammelsberg communicates a second note on natural compounds of tantalum and niobium; and Dr. Bender describes an ingenious method of determining the time of vibration of a material pendulum. The remaining matter does not specially call for notice.

SOCIETIES AND ACADEMIES

Royal Society, Feb. 5.—"On the Anatomy and Habits of the genus *Phronima* (Lattr.)." By Dr. John Denis Macdonald, F.R.S., Staff Surgeon R.N., Assistant Professor of Naval Hygiene, Netley Medical School.

Of all groups of Crustacea the Amphipoda would appear to exhibit the widest range, in the modification of their parts or organs, without obliterating the delicate lines of natural affinity running through them as a whole. This is well exemplified in the interesting paper of Dr. R. Willemoes-Suhm, naturalist to the *Challenger* Exploring Expedition, "On a new Genus of Amphipod Crustaceans" founded by him, and named *Thaumops*. This genus, although exhibiting many characters in common with *Phronima*, presents some striking points of difference traceable in the external jaw-feet, caudal appendages, the position of the generative bone, and certain particulars in its external anatomy.

During the exploratory voyage of H.M.S. *Herald*, in the S.W. Pacific, numerous species which I have always been in the habit of referring to the genus *Phronima*, were taken in the towing-net; and I might remark that the assumed parasitic habit of these creatures was never, at least, a prominent fact to me, they were so often taken either perfectly free, or tenanting a nidamental case. Those who, like Dr. Suhm, are acquainted with deep-sea dredging, are usually cautious how they refer the doubtful products to their proper habitat; whether it be the bottom that has been reached, or some zone of the watery space above. Indeed it is quite possible for the narrow area of the tallow-arming of the deep-sea lead to include fortuitously, and carry down *Phronima* or any other little crustacean naturally living near the surface; and contact with the bottom would finally press it into the tallow, so as to mislead the observer as to its true habitat. Conversely, in bringing up the dredge from a given depth, it may finally carry with it any more superficial objects casually lying in the track which it takes.

The author then describes a species of *Phronima* captured in lat. 30° 16′ S., long. 176° 27′ W.

The evidence of Dr. Willemoes-Suhm supports my own experience that there is no metamorphosis in this group; and as it is very probable that the history of the development of *Thaumops* would resemble that of *Phronima*, the following observations may be of some importance, as carrying the process a little further than it has perhaps yet been traced by him :—

In lat. 21° 0′ S. and long. 17° 45′ W. off the island of Ono, Fiji group, apparently the same species of *Phronima* as that above referred to was taken in the towing-net, but with the addition of a numerous progeny of young in a large gelatinous but tough nidamental case. This interesting nest was shaped like a barrel, but with both ends open, and the external surface was somewhat tuberculated and uneven. The wall of the tube presented numerous round and puckered openings, observing no very definite arrangement, but through which entering currents were observed to pass. These openings in general pierced the tuberculations, though not invariably.

An external membrane, with an internal lining, was distinctly visible, both seeming to be continuous at the rims of the tube. The space between these layers was filled up with a pulpy substance, in which scattered nucleiform bodies were detected with a higher power of the microscope.

In a subsequent commission on the North-American and West-Indian Station in H.M.S. *Icarus*, I have frequently captured "*Phronima* in its bay," as my messmates would say. In order to bring the swimmerets into full play, the animal protrudes its body tail foremost from the case, only calling into use the fine tips of the third and fourth pairs of thoracic limbs to hold fast its charge. When it fully retires into the case, the claws of the two posterior pairs of legs are pressed backwards against the lining membrane, so as still more effectually to secure its hold on the approach of danger.

Royal Society, Feb. 12.—"Note on the Synthesis of Formic Aldehyde," by Sir B. C. Brodie, Bart., F.R.S.

In a former note I communicated to the society the result of an experiment in which a mixture of equal (or nearly equal) volumes of hydrogen and carbonic oxide had been submitted, in the induction-tube, to the electric action. My expectation in making the experiment had been that the synthesis of formic aldehyde would be thus effected according to the equation $CO + H_2 = COH_2$. The only permanent gas, however, other than the gases originally present in the induction-tube, which appeared in the result of the experiment was marsh-gas. When a mixture of hydrogen and carbonic acid gas were similarly operated upon, the same hydrocarbon, together with carbonic oxide, was formed. I have now, however, succeeded, by a modification in the conditions of the latter experiment, in attaining the object which I originally had in view. Evidence of this is afforded by the following analysis:—The gas analysed was the result of submitting to the electric action equal volumes of hydrogen and carbonic acid. After removal from the gas of carbonic acid and carbonic oxide, and also of a trace of oxygen, 191·2 volumes of gas remained, in which were found at the conclusion of the analysis 2·6 volumes of nitrogen. Deducting this amount of nitrogen, 188·6 volumes of gas remain, containing the residual hydrogen in the gas, together with any gases besides carbonic oxide formed in the experiment. This gas was analysed by the addition of oxygen and subsequent detonation by the electric spark, the absorption of the carbonic acid by potash, and the removal of the oxygen over by pyrogallate of potash. The results of the analysis entirely concur with the assumption that the 188·6 volumes of gas were constituted of hydrogen, marsh-gas, and formic aldehyde in the proportions given below.

Hydrogen	183·2
Marsh-gas	0·2
Formic aldehyde	5·2
	188·6

The composition of 100 volumes of the gas being,

Hydrogen	97·14
Marsh-gas	0·10
Formic aldehyde	2·76
	100·00

Another experiment was attended with similar results, only that the proportion of marsh-gas was somewhat greater.

The result of this experiment may be considered to be given in the equation $CO_2 + 2H_2 = COH_2 + H_2O$. I have reason to believe that formic aldehyde is also formed in the reaction of hydrogen and carbonic oxide; and that the marsh-gas found (in both experiments) results from the decomposition of this substance, possibly according to the equation $2COH_2 = CO_2 + CH_4$. I do not now dwell upon this subject, as it is my intention very speedily to lay before the Society, together with other matters, the details of the various experiments which I have made in reference to it.

Geological Society Feb. 4.—His Grace the Duke of Argyll, K.T., F.R.S., president, in the chair.—The following communications were read:—"The Physical History of the Valley of the Rhine," by Prof. A. C. Ramsay, LL.D., V.P.R.S., vice-president. The author first described the general physical characters of the valley of the Rhine, and discussed some of the hypotheses which have been put forward to explain them. His own opinion was that during portions of the Miocene epoch the drainage through the great valley between the Schwarzwald and the Vosges ran from the Devonian hills north of Mainz into the area now occupied by the Miocene rocks of Switzerland. Then after the physical disturbances which closed the Miocene epoch in these regions the direction of the drainage was reversed, so that after passing through the hill-country between the lake of Constance and Basel, the river flowed along an elevated plain formed of Miocene deposits, the remains of which still exist at the sides of the valley between Basel and Mainz. At the same time the Rhine flowed in a minor valley through the upland country formed of Devonian rocks, which now constitute the Taunus, the Hundsruck, and the highland lying towards Bonn, and by the ordinary erosive action of the great river the gorge was gradually formed and deepened to its present level. In proportion as the gorge deepened, the marly flat Miocene strata of the area between Mainz and Basel were also in great part worn away, leaving the existing plain, which presents a deceptive appearance of having once been occupied by a great lake.—"On the Correspondence between some Areas of Apparent Upheaval and the Thickening of Subjacent Beds," by W. Topley, Geological Survey of England. The author referred to many instances in which beds have unequal development, being much thicker in some places than in others; and the main object of his paper was to show that such thickening and thinning of beds has an important effect in producing the apparent dip of overlying beds. The thinning of any one bed may have an appreciable effect in producing or increasing its own apparent dip; but where a whole series of beds thin constantly in one direction, the amount of the dip of one of the higher beds, due to the *sum of the thinnings of the underlying beds*, is often very considerable. It is generally supposed that the dip of any bed is due to great movements of the earth's crust; from the facts mentioned the author argued that our inferences as to such movements will vary according to the beds which happen to be exposed at the surface. It is evident, from the faults intersecting strata, that upheavals and disturbances have taken place; but unless we assume every bed to have been deposited on a perfectly horizontal plane, we cannot infer the amount of such upheaval from the present position of the bed. In all cases we must take into account the actual or possible thinning of underlying beds. The beds which support geological basins frequently thin towards the centres of those basins, thus producing, wholly or in part, the basined form of the strata. It was, however, shown that the beds of the basins themselves frequently thicken towards the centre of the basins.

Anthropological Institute, Feb. 10.—Prof. Busk, F.R.S., president, in the chair.—The second part of the paper "Explorations amongst ancient Burial Grounds, chiefly on the sea-coast valleys of Peru," was read by the author, Mr. Consul Thomas J. Hutchinson. The paper treated of the burial grounds from Lima northwards, as did the former part of the paper on those from Arica to Lima. Mr. Hutchinson described a burial place with the Aymara name of Parárá on the Oroya railroad at a station called Chosica, and at an elevation of only 2,750 feet above the level of the sea, and so named from its grinding stones used for bruising corn, numbers of which lie amongst the cenotaphs. Those were said by Prof. Forbes to be used for cooking purposes, because the Aymaras are stated to have occupied a part of Peru of which the minimum elevation is 10,000 ft., and therefore where the boiling of water is a difficult matter to accomplish. The flattened and elongated skulls mentioned by Dr. Tschudi and Prof. Forbes were touched upon—an illustration of one of these from an elevation of 10,000 ft. above the sea being given. Mr. Hutchinson recommended a further and more extensive exploration of the mounds and Huacas in Peru to illustrate the rich treasures of archæology with which that country abounds.—A joint paper by Mr. Tyrwhitt Drake and Mr. A. W. Franks was read, on skulls and implements from Palestine.

Photographic Society, Feb. 10.—James Glaisher, F.R.S., president, in the chair.—A special general meeting was held to decide whether two new laws, previously proposed, should be adopted, or whether the Council's amendment to appoint a committee to revise the laws generally be accepted. The Council's amendment was lost. The anniversary meeting of the Society was held afterwards, when the balance-sheet, showing an improved financial position, and the report of the Council, were read and adopted. The President and Council, interpreting the rejection of their amendment as a vote of want of confidence, then tendered their resignations, which were accepted.

MANCHESTER

Literary and Philosophical Society, Jan. 19.—Microscopical and Natural History Section.—Mr. Joseph Baxendell, F.R.A.S, vice-president of the Section, in the chair.—Mr. Joseph Sidebotham, F.R.A.S., read a paper no "The similarity of certain Crystallised substances to Vegetable forms." The author called attention to the formation of verdegris on insect pins, in old Entomological collections. This substance makes its appearance where the pins pass through the thorax of the insects, and in length of time grows into a considerable mass of flocculent matter, of a brilliant green colour, and often breaks up the insects and also destroys the pins. It consists mainly of acetate or formiate of copper in combination with fatty or oily matter. On examination of various specimens under the microscope, they were found to present a great variety of forms, filamentous and ribbon-like structure, often resembling various fungi, in some cases so nearly, that it was difficult to believe that the fibres and fruit-like forms are not really organic bodies. The author expressed his opinion that these bodies were simply crystals, modified in their formation by the oil contained in the insects, with which the crystals are in some way combined. Some of the specimens exhibited were taken from insects collected twenty-five years ago.

LIVERPOOL

Geological Society, Feb. 12.—Mr. T. Mellard Reade, F.G.S. read a paper containing a series of novel investigations on the action of tides on the sea-bottom. Applying a formula used by civil engineers, the result of practical observation in tidal estuaries, to the observed currents at the surface at various points in the St. George's and English Channels, it was proved, by comparison with experiments instituted for ascertaining the moving powers of running water on materials of various specific gravity and bulk, that, conditions being otherwise favourable, tidal currents were capable of destructive erosive action on the sea-bottom. Mr. Reade then entered elaborately into the phenomena of the tides in the Irish Sea, in the English Channel, and surrounding seas, using Captain Beechey's admirable observations for this purpose. Mr. Reade infers from a consideration of a variety of circumstances that the materials of the Irish Sea bottom are principally composed of re-arranged glacial drift, either eroded off the bottom or off the coast by the sea itself, or poured into it by the many rivers in the north-west of England, south of Scotland, and west of Ireland, draining vast basins mostly covered by glacial clays and sands. These materials, notwithstanding the oscillatory character of the tidal streams, have in the main a slow, progressive motion down channel, and out as far into the Atlantic as the little Sole Banks. Clear cases of the erosive action of the water on the bottom were then given. It was shown that there are pits or gullies excavated in the bottom in both the English and Irish channels, and that these depressions have generally their major axes conformable in direction with the set of the stream tide; and that the contour lines of the bottom approximately follow the same direction. The most remarkable of these excavations is the North Channel Gulley, off the coast of Wigtonshire, twenty miles long, one mile wide, and from 400 ft. to 600 ft. deeper than the surrounding bottom, and which the strong tide existing there has either partially or wholly excavated, and now keeps open. In conclusion, Mr. Reade expressed his conviction that the diurnal and semi-diurnal movement of the tides, acting down to the profoundest depths of the ocean, accounts for the preponderance of life in it over that exhibited by the fauna of the Mediterranean.

EDINBURGH

Royal Society, Feb. 16.—Sir William Thomson, president, in the chair.—The president read obituary notices of deceased Fellows of the Society.—The following communications were read:—On the Kinetic Theory of the Dissipation of Energy, by Sir W. Thomson.—On the Electric Conductivity of Iron at a Low Red Heat, by Prof. Tait.—On the Stresses due to Compound Strains, by Prof. C. Niven, communicated by Prof. Tait.

GLASGOW

Geological Society, Jan. 15.—Mr. E. A. Wünsch, vice-president, in the chair.—Mr. R. L. Jack, of H.M. Geological Survey, read a paper on a Boulder-clay, with broken shells, in the lower valley of the River Endrick, near Lochlomond, and its relation to certain other glacial deposits in the same neighbourhood. The author stated that the elevation of Lochlomond above the sea is so trifling that there is no difficulty in classing it with the sea-lochs that indent the western Highlands. A depression of 20 feet, or the removal of the superficial deposits traversed by its short outlet, the Leven, on its way to the Clyde, would restore it to its former condition. He then called attention to a deposit which he had observed in the course of his work on the geological survey near the south-eastern angle of Lochlomond, and whose relation to the already-known members of the glacial series seemed to deserve particular attention. The deposit is a true typical till, in every respect similar to the old boulder-clay or till of the Lowlands of Scotland. In a matrix of stiff unstratified clay, brown in colour, like the subjacent Old Red sandstone rock, are scattered stones of various sizes, blunted, smoothed, and marked with striations in all directions, but most frequently in the direction of their longer axis. It presents, however, one remarkable peculiarity that distinguishes it from the common till—it contains worn and broken fragments of marine shells. Though he had not found any clear instance of an older deposit below this shelly till, he believed its place was above the old boulder-clay, and that it was also the product of land-ice. He believed the till to be the product of land-ice—the *moraine profonde* of a large glacier which filled up the lake, covered the islands, and climbed the rising ground between the Leven and the Endrick to the height of at least 320 feet. This glacier, in all probability, existed during the latter portion of the period which preceded the "great submergence" of the land.—Mr. John Young read a paper on the occurrence of a bed of highly indurated Sandstone, with water-worn quartzite pebbles, interstratified with the trap of the Campsie Hills. The bed is probably of lower carboniferous age, and indicates one of those periods of repose between the great outbursts of igneous rock matter of which the Campsie Fells are principally built up.

PARIS

Academy of Sciences, Feb. 9—M. Bertrand in the chair.—The following papers were read:—On *Balistique intérieure*, by General Morin. This was a paper on the various forces acting on a projectile whilst still in the bore of a gun.—On the devitrification of glass, by M. Eug. Peligot. The author decides that, contrary to the received opinion that this effect is due merely to a crystallisation of the glass, it is due to the formation of a definite silicate having a formula corresponding to that of a pyroxene.—On the action of water on lead, by M. Balard.—New clinical and experimental researches on the movements and repose of the heart, and on the mechanism of the passage of the blood through its cavities when in the normal state, by M. Bouillaud.—On the preservation of vines threatened by *Phylloxera*, by M. de la Vergne.—On the problem of three bodies, by M. E. Mathieu.—On the resistance of glass tubes to rupture, by M. L. Cailletet. The author finds that a tube stands pressure from the outside better than from the inside. The pressures, however, which a tube can stand from the inside are very great. One of 9 mm. internal diameter and 1 mm. thickness, containing 6·9 c.c., was submitted to an outside pressure of 460 atmospheres, without injury, and subsequently to an internal pressure of 104 atmospheres, when it burst.—On the use of a double refracting prism for determining the axes of ellipses, by M. Jaunetaz.—On some new bands produced in the absorption spectrum of chlorophyll by reagents containing sulphur, by M. J. Chautard.—On a new process for preserving wood, by M. Hatzfeld.—On the hardness and density of carbon obtained from pure sugar, by M. F. Monier.—On the flight of birds, by M. E. Bertin.—On an electric fire-alarm, by MM. A. Joly, and P. Barbier.—On the measurement of heat, by M. G. West.—On a case of monstrosity, &c., by M. Claudot.—Theorems concerning algebraic equations, by M. F. Lucas.—On the impossibility of certain double equations, by M. A. Genocchi.—On the conditions necessary for a conic with a curve of any order to have a contact of the fifth order, by M. Painvin.—On the chemical characteristics of the uredo of maize, &c., by M. Hartsen.—On the consecutive effects of the removal of the mammæ in certain animals, by M. de Sinéty.

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