THURSDAY, MARCH 31, 1887

A UNIVERSITY FOR LONDON

WE have from time to time informed our readers of the progress made in the attempt to organise the capacities for teaching and learning in London into a more complete and more efficient shape. The movement is most natural and admirable. What we have desired is to warn those interested in it not to lose sight of the full result obtainable while busied in their attempts to remove a particular grievance or further a particular interest. Each constituent of the future University—the Colleges and professional schools, the teachers and the students, the medical corporations, and the Senate and Convocation of the existing University of London—each is indispensable. Any one of these can block the way for the rest. Together they make up amply sufficient elements for the foundation desired, and this foundation would not be strengthened, but weakened, by attempts (which can never be realised) to bring in such heterogeneous elements as the British Museum or the Royal Society, the Government technical schools or the Corporation of the City and its Companies.

The present state of affairs is, we believe, pretty much as follows. The Convocation of the present University, in which the first efforts towards its reform began some six or seven years ago, rejected a scheme presented to it by a Committee of forty of its most distinguished members, of which Lord Justice Fry was the chairman. Among them were the present Home Secretary, the President of the Royal College of Surgeons, Mr. Justice Wills, Sir Joseph Lister, Dr. Wilks, Prof. Michael Foster, Dr. Bristowe, Mr. Power, Mr. Howse, Dr. Ord, Prof. Unwin, Mr. Thiselton Dyer, Mr. Anstie, Prof. Carey Foster, the Rev. Dr. Dale, and Mr. Cozens-Hardy. A second and much smaller Committee was then constructed by Mr. (now Sir Philip) Magnus, who had taken the lead in opposing some of the provisions of the previous scheme, and this Committee brought up, on report, a second and modified plan of reform, which passed Convocation last May, not without opposition, but by substantial majorities and with only minor alterations. This second Committee laid the amended scheme before the Senate and remain in charge of it. Meantime the Senate had appointed a Committee of its own members, who have for several months been elaborating a scheme of their own, who have already conferred both with the Committee of Convocation and with one appointed by the Teaching University Association, and who have now presented their Report to the Senate. Some opportune vacancies, which occurred in the latter body during the last two or three years, have led to the presence of Lord Justice Fry himself, and of Dr. Wilks, Dr. Pye Smith, and Prof. Carey Foster. It seems probable that a scheme of reform will be accepted both by Senate and Convocation, which will go as far as most who are sanguine could expect, and farther than most who are timid will approve. The Convocation of graduates will gain more direct representation, and the teachers of the Colleges which send up men for the University degrees will probably be also directly represented on the Senate. But a more important improvement, one that would be useful even if the Senate were to remain exactly as it is, will almost certainly be the institution of Boards of Studies, which will represent the teachers and probably the examiners in each Faculty, much like the standing Committees which sit under the same name at Oxford. The general body of teachers which would elect these Boards would include provincial as well as London Professors, and would more or less correspond to the Congregation of Oxford, but it would probably seldom meet, except for the purpose of election of the representative Boards of Studies.

The Association for Promoting a Teaching University held a general meeting several weeks ago, and admirable speeches were made, especially those of Mr. Marshall and Mr. Bryce, but it lacked the enthusiasm given by numbers. After communicating with the principal London Colleges and Medical Schools, the Council of the Association propose to apply either to the Crown or to Parliament, probably with the object of securing a Royal Commission on the whole question.

University College, after coquetting with the Victoria University (which has apparently not welcomed with great warmth the proposal of accepting so large and distant a Society as its daughter), is now engaged in direct negotiations with King's College, with a view to agreement upon a common plan of action. This is a prudent course, for if the reform of the University of London should prove unattainable or inadequate, the two chief Colleges, by acting together, would be far more likely to obtain the privileges which they then would rightly seek.

Meantime the great medical corporations have become tired of waiting. They represent the most urgent grievance, and are fully justified in pressing for its redress. They appear likely to ask for power to grant degrees to their own licentiates, though under what authority and on what terms, either of examination or of residence, they have not yet determined. They have the advantage of practically undivided counsels, of knowing what they want, and of having an indisputable cause of complaint. They are naturally supported by the whole influence of the medical schools of London, and it adds not a little to the complexity of the situation that those connected with University and King's Colleges prefer to throw in their lot with the other professional schools rather than to hold aloof and unite with the other Faculties of their own Colleges.

Of the several bodies concerned, it is possible that the Senate, or at least the Convocation, of the existing University may fear that the just value of its degrees, attained by fifty years' efforts, will be compromised by allowing teachers to have a voice upon the Senate. But they must see that if the University is forsaken by its two most important London Colleges after the secession of its only important provincial one (Owens College), and if the medical schools of London, which have supplied nine-tenths of its graduates in that Faculty, also forsake it, its position will be untenable. Even if it were suffered to exist as a degree-conferring machine for unattached and imperfectly-taught students all over the kingdom, it would become what its worst enemies have called it, a mere Government Board, and could scarcely keep the title of a University, still less of the University of London, when it had been stripped (or rather had stripped itself) of both characters. Moreover, Convocation would lose all importance, and could not possibly retain the only powers it at present possesses, of nominating certain members of the Senate and accepting new charters. The Senate would do its sole work, of choosing examiners and revising their lists, as a small body of salaried Government officials (probably in South Kensington), and no claim would remain for the unconnected waifs and strays who passed the examinations to take any part in the matter. No charters would be requisite, nor any apparatus of library or Senate House, laboratory or lectures. In fact all the efforts of the past twenty years would be thrown away.

Nevertheless, if the two original Colleges of the University secede, they will find the name, the prescription and the influence of the Senate too strong for them to wrest its powers from the present holders.

The medical corporations have far more influence and far stronger grounds; for the three or four strongest of them are organised as complete Colleges in their own Faculty, and give a more academic training to their students in medicine than either University or King's College does to students in arts, science, or laws. They might, perhaps, succeed in gaining power to grant degrees where the others failed, but this could only be by showing that no reasonable concessions were made to their just demands by the existing University.

Hence it will be seen that the present University of London, its two original Colleges, and the principal medical schools, have each of them the power of checking, if not of checkmating, each other's plans. Even if they agreed to urge their several objects without opposition to each other, the result would be three Universities existing together in London. One would have become a mere examining Government Board; another would consist of two ill-endowed and ill-consorted Colleges, without residence, with slender endowments, and compelled to extend their proper functions by attempting the instruction of partial students; the third would be a combination of two large professional corporations with Colleges in one faculty only, two or three well equipped, several very poorly furnished, and all of necessity rivals, scattered over the country, none of them endowed, and only able by the terms of their existence to give a second-rate degree.

What hope would there be of any one of these three so-called Universities even approximating to what a University of London should be? Each would be strong enough to prevent the others succeeding; none would be strong enough to absorb its rivals. Meanwhile the higher education would deteriorate rather than improve, endowments would be indefinitely postponed, and the prospects of the University laboratories, museums, and libraries of London sending out worthy contributions to the progress of human knowledge would become poor indeed.

When the several separate movements now in progress are checked by the necessity of obtaining the sanction if not the support of Government, we may hope that broader views will be taken of what is best for the community, and more sober views of what is practically attainable. Believing in the public spirit and the good sense of our countrymen, we have little fear but that, with patience and mutual concessions, a combined result will be obtained which will benefit all the parties to the new confederation, and promote the only interests with which this journal is concerned—the national interests of learning and of science.

A JUNIOR COURSE OF PRACTICAL ZOOLOGY

A Junior Course of Practical Zoology. By A. Milnes Marshall, M.D., D.Sc., M.A., F.R.S., Professor in the Victoria University, assisted by C. Herbert Hurst. (London: Smith, Elder, and Co., 1887.)

NOTICE will be found in the columns of this journal (vol. xxxiii. p. 242) of the second edition of a small laboratory hand-book by the senior author of the above-named work, entitled "The Frog; an Introduction to Anatomy and Histology." In the preface to that we read: "The second instalment of the work, containing directions for the examination and dissection of a number of animals chosen as types of the principal zoological groups, is in active preparation, and will be published shortly." The author further acknowledges "valuable help from Mr. C. H. Hurst, Assistant Lecturer in Zoology in the College." Mr. Hurst now appears as junior author, and, although the work here under review differs in some important respects from its predecessor above referred to, we presume that it is the promised "second instalment."

The volume opens with an introduction, confined to the consideration of practical hints as to methods of working and manipulation; then follow fifteen chapters, each devoted to some one type of organisation, and the whole closes with an appendix, dealing with the uses and methods of preparation of reagents. We have, in all, a most successful and important book of 421 pages.

The work is largely akin, in its more salient features, to many of its predecessors; but it stands alone in respect of certain methods of treatment, to which we shall refer duly. Thick type has been employed throughout for the various headings, and the authors adopt the plan, introduced in the aforenamed smaller work, of printing the directions for dissection in italics. In dealing with the complications of the vertebrate skeleton, they have availed themselves of the printer's art, by way of restricting descriptions of homologous sets of elements to corresponding and distinct types.

The introduction is a model of perspicuity, and so well set as to render it impossible for the veriest tyro to obtain anything but full benefit therefrom. The advice given is sound in the extreme, and such as could only have embodied the results of a long and well-tried experience. The directions for injecting blood-vessels are, perhaps, a little too elaborate, being worthy of the *préparateur's* art, rather than of the ordinary beginner; this, however, is a small defect on the right side. We note that under the section on microscopical examination all reference to the micrometer has been omitted. Directions for measuring objects under observation should certainly be added to the next edition.

The several chapters into which the book is subdivided differ most conspicuously from those of certain earlier works in the fact that the more general statements made are diffused throughout the whole, except so far as they serve to define an animal under consideration, or to set forth the predominant characters of a given system of parts. The chapters on Protozoa and the Leech may be consulted as fair examples. In the latter, advantage is taken of this method to force upon the student, somewhat prematurely, the fact that (p. 36) "the segmental arrangement affects in a marked manner the nervous, excretory, and reproductive systems, and, to a less degree, the circulatory and digestive organs," and the deduction that "it appears to result from a definite arrangement of parts which, in the ancestors of the leeches, were scattered irregularly through the body, much as in *Fasciola*" (dealt with in the previous chapter).

By way of contrast with its predecessor on the Frog, this volume is shorn of much that is histological. In the earlier work a special feature was made of this branch, but here it by no means receives that amount of attention which its importance demands. A start in this direction might well be made with the lung-structure of the bird and mammal, especially in view of the statement made (p. 389) concerning the mechanism of respiration in the former.

The detailed descriptions of the various animals chosen are, for the most part, exceedingly well rendered. A slight ambiguity has crept in in one or two places, and the descriptions of the vascular systems of the mussel and snail might well be amplified.

No portions of the descriptive text stand more in need of revision than those relating to the digestive glands. These are, in Anodon, Helix, Astacus, and Amphioxus, designated under the old term "liver." A certain amount of justification is forthcoming in the last-named case, in view of its blood-supply; but in the three first-named the striking results of recent research, which call for no comment here, ought at least to be suggested in the term "digestive gland" or "hepato-pancreas." While we would see, thus, the substitution of a modern term for one well-nigh obsolete, we would desire the withdrawal of the terms "kidney" and "ureter" as applied to the excretory organs of the Invertebrata. In the case of the mussel, in which a portion of that which our authors term "ureter," is glandular and secretory, the terminology as restricted by them becomes misleading.

Conspicuous among the novelties offered us are certain words new to students' books. The volume is fully up to date, and its authors are to be congratulated on having produced the first book for students in the language, which describes the receptaculum ovorum of the worm. As regards pure nomenclature, it is worthy of note that they have embodied, in describing the pterylosis of the bird's wing (p. 386), that introduced by Prof. Flower so recently as February 1886, in a lecture delivered at the Royal Institution; and necessitated by the splendid work in which he is being assisted by Mr. R. S. Wray. (The description of the barbules on the same page is in error.)

In dealing with the appendages of the insect, the nomenclature customarily applied to the crustacean limb is utilised. To this extension we heartily assent. On turning to the crustacean itself, we meet with an innovation far less deserving of support. Our authors, faithful to precedent, reduce the body of the decapod crustacean to twenty segments; but in so doing they discard the ophthalmic somite of their seniors, and press the telson into the service. This introduces a serious difficulty when the nervous system is taken into consideration, and a still more formidable one as concerns the homology of the eye-stalk. That is passed over in comparative silence, and, although we are not told so in as many words, it is clear that they regard it as in no way serially homologous with the appendages. The condition of the visual organ in the lower Crustacea and other arthropods, taken in conjunction with the facts adduced by Brandt and others in the morphology of the insect's eye, render it probable that the above view may turn out to be correct. Nor must it be forgotten that Boas has challenged (*Morpholog. Jahrbuch*, vol. viii.) the accepted interpretations of the antennule. There are, however, two sides to this question, and it is important to observe that M. Alphonse Milne-Edwards has recently described a decapod (*Palinurus penicillatus*, *Comptes rendus*, vol. lix., 1864), in which one ophthalmite was for the most part multiarticulate and antenniform. This remarkable fact is the more striking in view of the reversion to the antenniform type of certain post-oral appendages, seen in *Mastigopus* and *Apseudes* among the Crustacea, and so well known in the scorpion-spiders; whatever may be its precise significance, it is clear that the question of general homology of the eye-stalk, with which we are here especially concerned, is far from settled. The introduction of so sweeping a change into a book for juniors without due comment is, under these circumstances, a false step, especially when it is considered that the precise converse is stated in all other books current.

Equally unjustifiable, in that it affects another debatable question, is the statement (p. 379) that the bird's pre-pubic process corresponds to the pubis of mammals. Clear proof of this is not forthcoming. The student's hand-book is not the place for such dogmatisms: if asserted, they should be well qualified, and put as alternatives.

The retention of the old nomenclature for the bird's air-sacs, with its atrocious "*thoracic*" element, is disappointing; the substitution (p. 220) of "pericardio-*cœlomic*" for the well-tried pericardio-peritoneal canal of the fish is as misleading as it is misjudged; while that of "*connective*" for the time-honoured commissure is, on the whole, inadvisable. We live in a word-mongering age. New terms which do not mark a turning-point in advance, or at least the era of a new discovery, are stumbling-blocks, unless introduced by way of replacing irrelevant or absolutely fantastic precursors. Such is not the case with those here under consideration. Our position is somewhat that of the port-bound crew, in dread of being stranded on their own beef-bones.

Attention has been already directed to the diffusion of the more general matter throughout the text. This has been effected very successfully, and in well-chosen language deserving of the greatest praise; but we dissent from the method adopted. It will be generally admitted that Huxley and Martin's "Elementary Biology" dissipated for students of the subject, once and for ever, the subtle "cram"; and subsequent writers working along similar lines have, as was to be expected, attempted to improve upon the plan therein created, each after his own lights. Messrs. Marshall and Hurst have aimed at producing a work which they hope "may meet the wants of those who desire to obtain a practical acquaintance with the elements of animal morphology, and who find the existing manuals insufficient for their purpose." It is to be assumed that they have been especially mindful of the needs of their own College, but the work also covers most of the requirements for the elementary examinations of other schools, and we presume the authors would wish it a general circulation among pure devotees. This said, we proceed to inquire into the method of treatment, and find with much regret that, at the outset, such deductions as are incorporated in the text almost invariably precede the description of those facts upon which they are based. For example: on p. 141, the alimentary canal of the crayfish—itself complicated—is ushered in with the words that it is "a tube running in a nearly straight line from mouth to anus. Of this tube, the middle portion, or mesenteron, which is very short, is alone formed from the primitive alimentary tract of the embryo, and the 'liver' is an outgrowth of it. The stomatodæum, or anterior portion of the canal and the proctodæum, or hind portion, which together form almost the whole length of the canal, are both formed by invagination of the external surface of the body; and both have a chitinous lining which is continuous, at the mouth and anus respectively, with the chitinous external covering of the body." Then follows the detailed description. Again, the podical plates of the insect are twice mentioned before the student is told how to find them. The tympano-Eustachian passage of the bird is (p. 414) similarly treated; and here the generalisation given should, if introduced at all, have been rather inserted when dealing with the mammal, on the supposition that, as can hardly be doubted, the authors would have the student work over the animals in the order of presentation. In such cases as the dogfish skeleton (p. 198), the limbs of the mammal and bird (pp. 287 and 376), and the enumeration of the differences between Amphioxus and the higher Vertebrata (p. 168), the system is tolerable, by way of clearing the ground and exciting interest. When, however, as in the first-cited instance, the crowning triumph of the student's labour is thus anticipated and his reward forestalled, deduction on reflection upon his work falls flat, and one of the chief aims of the whole system is lost. This, to our thinking, constitutes the gravest defect in this valuable work.

In describing the rabbit's liver (pp. 306–7), the lobes are rightly enumerated, but the student is not informed upon what grounds the customary nomenclature is adopted. In this, and one or two other instances, explanatory clauses are needed, but not given.

The illustrations are excellent, reflecting the greatest credit upon all concerned, and artistic merit such as that of Fig. 28 cannot fail to strike the reader. Fig. 27 is unnecessarily complicated, too much having been attempted. The beautiful new figures of Amphioxus are especially deserving of praise; but more of them are wanted, in order to do justice to the excellent description which they illustrate. Comparison of this chapter with that on the liver-fluke calls for this increase in number, in view of the relative chances of the student's procuring specimens.

Being mindful of the difficulties of preservation of Amphioxus, it is to be regretted that, while full directions are given for cutting sections, those for preservation, which have led up to the splendid results incorporated in this work, should have been omitted. This, the more so, as the animal is to be obtained in the Channel Islands, and is therefore within reach of the native student (a fact which should be mentioned in the text).

In dealing with the higher vertebrates, the authors follow one of their predecessors in first describing the skeleton. We doubt the advantages of this system, especially as in this work we have an "almost entire omission" of the muscular system, held to be "of subordinate educational value." The book, taken as a whole, is highly welcome and most admirable. It is provided with an exceedingly good index, and presented in a form demanding our sincere thanks alike to authors, printers, and publishers. Taking it, in conjunction with its predecessors, into account, we have to congratulate the student of zoology upon his accessions. This volume yields ample return for the immense labour which its authors have bestowed upon it; it is well worthy of the school which they represent, and of its prototype above named.

It is significant that the only typographical errors which we have detected should be the occasional absence of **i** and **r**. This fact might repay a careful research at the hands of the printer.

The authors state in their preface that "corrections or suggestions from those who use the book will be very gratefully received." Having dealt above with the more important matters which occur to us, we append comments on some of the more obvious among those of wholly minor importance, noted in perusing the volume.

Before proceeding to do this, we wish to call attention to two matters of exceptional note: the first, the respiratory folds of the lining membrane of the fish's mouth; the second, the attachment of the styloid element of the rabbit's hyoid-arch to the paramastoid process. It is indeed remarkable, seeing that these structures are of such common occurrence, and that they have been presented to every native student of recent years, that there is not yet a text-book in the language, or out of it for the matter of that, in which they are described. This is the more surprising in the case of the respiratory folds, in consideration of their general development among the gnathostomatous fishes.

The Hydra. We cannot accept the description of the supporting lamella as the "mesoderm"; it is misleading if not erroneous.

The Leech. There is no mention of the intermediary nerve.

The Earthworm. The description of the histology of the nervous system needs amplification, especially as concerns the distribution of the nerve-cells, by way of bringing out the nature of comparison with the other types. The account given of the blood-vessels is incomplete; the sub-intestinal trunk (described by Horst, *Niederland. Tidschr.* vol. xxxvii., and others) is not mentioned, that term being applied, in error, to the supra-neural vessel.

We strongly dissent from the description given of the œsophageal glands. Further investigation is necessary before we can accept their subdivision into the two categories here proposed. By our contemporaries, as by ourselves, much variation has been observed in their number and relationships, and we have seen examples in which all contained calciferous concretions and opened into the gut.

The Edible Snail. In describing the liver, the terms left and right have been transposed. Mention should be made of the salient features, in structure and distribution, of the teeth of the radula.

The Lancelet. To the description of the supposed excretory canals of Lankester (p. 178) there should be added that of the much more likely one of Hatschek (*Zool. Anzeiger*, vol. vii.). We accept the senior author's views on oviposition, but Quatrefages' observation should have been mentioned unless finally disproved.

The Dogfish. The remarks on ossification (p. 194) are erroneous. The statement (p. 211) that the labial cartilages probably "belong to the same category as the extra-branchials" is unfortunate, in view of Dohrn's discovery that the latter are displaced rays of the gill-septum.

In describing the relative positions of the roots of the spinal nerves (p. 252) the terms dorsal and ventral have been transposed. The description is irreconcilable with Fig. 36.

The Rabbit. The description of the shoulder-girdle needs revision, with respect to the coracoid element and the relations of the clavicle. The statements concerning the morphological value of the pisiform would be better free of bias, in view of the tendency of current research. In describing the pelvic girdle, mention of the cotyloid bone has been omitted, and consequently we find the statement that the pubis forms a portion of the acetabulum (cf. Parker, P.Z.S., 1882; also Leche and Krause, *Internat. Journ. of Anat. and Hist.*, vols. i. and ii.). The Eustachian cartilage is deserving of note.

The structural differentiation of the lining membrane of the stomach and base of the rectum need description. The duct of the infra-orbital gland is insufficiently noted; the description of the cæcum needs revision. It is interesting to find that the authors have not discovered the ducts of the rectal glands.

The statement explanatory of the uterus masculinus must be withdrawn or considerably modified, in face of Kolliker's belief that it is a derivative of the Wolffian ducts ("Entwickelungsgesch.," 2nd edition, p. 981). Its structural features and relationships are much more intelligible on this view.

The description of the fifth ventricle needs modification, and that of the spiral valve of the portal vein might well be inserted (Hyrtl, *Sitzb. Akad. Wien.*, 1879).

The Fowl and Pigeon. Note of the more important muscles of the syrinx, as also of the larynx of the mammal, might advantageously be added.

The ventricle of the olfactory lobe is not mentioned, either in the bird or rabbit.

In conclusion, we would wish to draw attention to the satisfactory manner in which the authors have apportioned the several chapters of this successful volume in accordance with their respective value—no light task of its kind. The thoroughness of the book is one of its most striking features.

G. B. H.

EMBRYOGENY OF THE ANTHROPOID APES

Recherches Anatomiques et Embryologiques sur les Singes Anthropoides. By J. Deniker. (Paris, 1886.)

THIS work was presented to the Faculty of Science of Paris as a thesis for the degree of Doctor of Natural Science, and was approved of by it as sufficiently meritorious to warrant the bestowal of that degree on the author. It consists essentially of a comparison of the fœtus of the gorilla and of the gibbon with that of man, and also with young and adult anthropoids.

The embryogeny of the anthropoid apes, notwithstanding the great interest which it presents, is unfortunately little known, probably owing to the difficulties of obtaining embryo specimens. The author has therefore done well to utilise the opportunity which presented itself to further our knowledge of the subject, by publishing the descriptive anatomy of the fœtus of the gorilla and the gibbon which he has had the opportunity of studying. His account of the anatomy of these specimens is rendered more valuable by the comparison he has made between them and the human embryo, and between them and the adult animals of their respective species.

The work begins by a careful description of the external characters of the embryo gorilla and gibbon: the attitude, external form, coloration, and integumentary characters are respectively detailed with much care. The placenta and fœtal membranes were fortunately preserved with the fœtus of the gibbon, and their characters are described and figured, but unfortunately these parts were not obtained with the young gorilla, and so could not be described. A *résumé* is given of the observations of Owen, Huxley, Turner, and others on the placentation of apes and monkeys. The next section contains an account of the weight and dimensions of the various parts of the body of the respective fœtûs. Of the former little can be said on specimens preserved in alcohol, but the dimensions of the entire body, the head, trunk, and extremities, are carefully detailed in a tabular form, with the corresponding measurements in the human fœtus at the fourth and fifth month, and of the adolescent gorilla. A second table shows the relations which the dimensions of the several parts bear to the length of the body, and a third table those between the trunk and the extremities, and between the different segments of the latter. These tables show several interesting points in regard to the proportions which the various parts of the body bear to one another in the course of development. During the second half of intra-uterine life the upper extremity in the anthropoids is much shorter in relation to the length of the trunk than in the adult, and the same relation holds good with respect to the length of the fore-arm as compared with that of the upper arm. In the human fœtus of the same age, on the other hand, the upper extremity presents almost the same proportions that it does in the adult. The relative length of the superior extremity as compared with that of the inferior changes likewise considerably in the course of development. Thus in man during the earlier stages of embryonic life the lengths of both extremities are almost equal, but in the anthropoid apes, at an early period even, the length of the superior limb exceeds that of the inferior.

The skeleton of the fœtus is next compared with that of the adult anthropoids. In treating this part of the body the author naturally devotes considerable attention to the various parts of the skull, and has drawn up several valuable tables of its measurements in the fœtus and adult. The second chapter on the skeleton is devoted to a description of the vertebral column, and the limb bones; while the third treats of the dimensions of the individual bones. The points of ossification of the skull are found to be the same in man and the anthropoid monkeys, but the rate of their development in the monkeys in many important respects differs from what obtains in man. In general it may be stated that the frontal region ossifies more rapidly, whereas the occipital and petro-mastoid regions ossify more slowly than in man. The cranial sections unite probably in the same order as in man, but generally at an earlier age, nevertheless there are certain exceptions to this which are pointed out. The brachycephaly of the skull of young anthropoids diminishes as age advances. Elongation of the facial part of the skull occurs much more rapidly than that of the antero-posterior diameter of the cranial part, until the eruption of the teeth. Passing on to the osteological characters of the rest of the skeleton, we find that the points of ossification of the borders of the vertebræ in the fœtus of the anthropoids do not appear in the same order as in man, as they seem to form simultaneously in all the regions of the vertebral column. The points of ossification of the pleurapophyses of the cervical and sacral vertebræ appear later than in man. This is especially the case in the sacral region of the gibbon. The spinous processes of the cervical vertebræ are shorter in the fœtus and young gorilla than in the adult. In the former the sacrum is broader, the coccyx longer, and the sternum larger, than in the latter. The different segments of the upper and lower limbs, except the carpus, ossify more rapidly in the anthropoid monkeys than in man; the lower limb ossifies, however, more slowly than the upper.

The muscular anatomy of the young and adult anthropoids is fully described and compared, and presents many points of considerable interest. Contrary to the opinion of Bischoff, the muscles of the face are found by the author to be very distinct, not only in the adult but even in the fœtal state. The arrangement of the muscles of the neck, fore-arm, leg, hand, and foot are particularly noteworthy, especially when compared with those in man.

The encephalon of the fœtal gorilla was found to weigh 28 grammes, and equalled a sixteenth part of the entire weight of the body. In the fœtus of both the gorilla and the gibbon the cerebellum is very small, and is completely covered by the cerebrum. The relative and absolute dimensions of the brain of the fœtal gorilla correspond to those of the human fœtus at the fifth month, but in its convolutions it was equivalent to those of the human fœtus at the sixth month, while the frontal lobe corresponds to that of a seven-months child.

The heart of the fœtal gorilla, though absolutely smaller than that of the human, is much greater in proportion to the size of the animal; it is also more voluminous than that of the adult of the same species.

The form of the hyoid bone of the anthropoid apes resembles that of man more nearly in the fœtus than in the adult. Its ossification takes place earlier than in man. The ventricles of the larynx of the fœtal gorilla resemble those of man, and are not continued into the laryngeal sacs.

The development of the dentary follicles of the gorilla and gibbon takes place earlier than in man. The eruption of the milk-teeth occurs in the same order as in man, except that in the gorilla the teeth of the upper jaw appear before those of the lower, that is to say, the reverse of what generally obtains in man. The cæcal appendages increase relatively to age in the gorilla, while in man the contrary appears to be the rule. The spleen of the fœtal gorilla differs in form from that of other anthropoids and from that of man, and resembles more nearly the spleen of a carnivore. The liver of the gorilla has the four-lobed type-form common to the majority of mammals, and in this respect differs from that of man and the other anthropoids.

The work concludes with a chapter on the general result of the author's observations, in which he confirms the statement made several years ago by Huxley that the structural differences between man and the Primates which approach nearest to him are not greater than those which exist between the latter and the other members of the order of the Primates.

OUR BOOK SHELF

The Geographical and Geological Distribution of Animals. By Angelo Heilprin, Professor of Invertebrate Palæontology at, and Curator-in-charge of, the Academy of Natural Science of Philadelphia. (London: Kegan Paul, Trench, & Co., 1887.)

THE author of this book tells us that, while anxious to present to the student a work of general reference, wherein the more salient features of the geography and geology of animal forms could be sought after and readily found, he also wished to call attention to the more significant facts connected with the past and present distribution of animal life, so as to lead to a correct conception of the relations of existing faunas. The need of such a work will be generally acknowledged, and, without doubt, this little volume of some 400 pages does to a great extent supply the need; but it may be that the time has not quite arrived for the appearance of a perfectly satisfactory work on the subject. Though the record of both geographical and geological distribution is a vast one, still there is a vast deal more of the record yet to come, and the very pages of Prof. Heilprin's work show what immense additions to the facts and the deductions drawn from these are based on the as yet incomplete publication of the results of the *Challenger* Expedition. When the author has these results to rely on, we find a certainty of fact and a sureness of deduction which give confidence to a general reader or to a student.

The volume consists of three parts. In the first part the distribution of animals throughout space is treated of; in the second the succession of life, the faunas of the different geological periods, and the appearance and disappearance of species are dealt with; in the third the present and past distribution of individual animal groups is considered. On the many still debatable points the author is always judicious, giving when necessary the opinions both for and against; nor, as far as we have been able to judge, does he fail to call attention to difficulties that surround many of the problems he has to refer to. In reference to the subject of the appearance of species, we observe that he regards the once burning question of the animal nature of Eozoon as settled "through the negative researches of King, Rowney, Julien, and Möbius, the elaborate memoir of the last-named being conclusive."

For the class of readers for whom this work is meant, a glossary of the technical terms employed would have been very useful. Most of them can be learned on reference to original sources, but it would have been convenient to have them within the same cover.

Life-Histories of Plants. By Prof. McAlpine. (London: Swan, Sonnenschein, Lowrey, & Co., 1887.)

THIS book may be dealt with in a very few words. It professes to give the essential features in the life-histories of a considerable number of types. The descriptions are extremely scanty, but in spite of this, room has been found for many very doubtful statements. Thus we have Dodel-Port's speculations as to the fertilisation of red seaweeds by the agency of small animals quoted as if they were well-established facts (p. 184). Chara is spoken of as "a sort of transition stage" between the red and brown seaweeds (p. 199). We fail to find any grounds for this extraordinary statement. We are informed that in Selaginella "the rain or dew will settle in the hollow of the leaf, and help to float the zoosperms; but in Pinus their dry and motionless representatives are more exposed to the wind on the outer surface of the leaf" (p. 279). It would be difficult to frame a sentence more hopelessly inaccurate than this.

The following passage from the introductory chapter is worth quoting: "Morphology by itself is thus seen to be a matter of mechanism, revealing nothing higher than a combination of mechanical movements, harmonious in action and beautiful in execution; but physiology, dependent on structure for the interpretation of the phenomena of life and the causes thereof, seeks to reveal the inner life as well as the outward expression of it" (p. 10). It will probably be new to most of us to learn that morphology reveals movements at all, mechanical or otherwise.

At p. 179 "apogamy" and "self-fertilisation" are used as equivalent terms; at p. 138 Spirogyra is said to produce gonidia, and at p. 25 reproduction in Selaginella is said to take place by means of a true seed.

We have only cited a few examples of positive errors, but throughout the book the terminology is strange and confusing, even where not absolutely incorrect.

The book is presumably intended for students "cramming" for examinations, but even for this purpose we fear that it will prove worse than useless. D. H. S.

LETTERS TO THE EDITOR

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

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

Vitality, and its Definition

It is perhaps desirable that I should offer a few words of explanation, by way of reply to several of your correspondents, who have commented upon certain statements in my recent address to the Geological Society.

In the first place, I think that any candid reader of that address will acquit me of being guilty of such presumption as to make a statement, on my own authority, concerning the vitality of seeds. My object was to contrast the greater stability of mineral structures with the lesser stability of animal and vegetable structures. Consequently I selected what I thought would be regarded as the *extreme* examples of prolonged vitality in the animal and vegetable worlds respectively. It was quite sufficient for my purpose that competent botanists have cited the case of the germination of seeds taken from ancient Egyptian tombs as authentic, and that a botanist of such eminence as A. de Candolle should assure us that it is "not impossible." As a matter of fact, I have been informed, however, by a reliable authority that experiments on the germination of seeds taken from mummies have very recently been conducted to a successful issue.

With respect to Mr. Herbert Spencer's definition of life, my object was not to find fault with it but to show that the differences between "organic" and "inorganic" matter are of so shadowy a kind as to defy definition. Even straining the meaning of the word "correspondence" so as to give it the force implied in the passage cited from the "Principles of Biology" by your correspondent Mr. Collins, I maintain that in those changes undergone by minerals to which I apply the term "physiological" there is a complete "correspondence with external sequences." When the temperature of a crystal is altered through a certain range, expansion and contraction take place unequally in accordance with the molecular structure of the mass. In consequence of this unequal expansion and contraction, stresses are produced and the crystal undergoes an internal molecular rearrangement, which is determined by a latent "organisation," though it can only be detected, perhaps, by its action on the light-waves. But now let another set of forces come into play, namely, the chemical action of liquids containing gases in solution, and immediately the effects of the former change are seen in the manner in which the crystal yields to the new forces operating upon it. This *secondary* change is in fact only rendered possible by the primary one having taken place. But the changes produced by solvent action in turn weaken the stability of the whole mass, permitting other chemical affinities to assert themselves, in consequence of which the crystal enters upon a long series of metamorphoses which terminate in the complete "dissolution" of the ties that held together its molecules; it thus becomes a pseudomorph, a sort of mineral corpse, with the external form of the original crystal only, but without any of that capacity for undergoing a wonderful cycle of changes which was its original endowment. After this the materials of the "dead" crystal may be used up to form the substance of new ones.

It is scarcely necessary to add that I had no serious intention of asserting that minerals do actually live, in the sense in which "living" is popularly understood. All I care to insist upon is that minerals, like animals and plants, go through definite cycles of change, dependent on their environment, and that the distinction between "organic" or "living" matter and "inorganic" or "lifeless" matter is therefore not a fundamental one. Surely no better proof of this can be adduced than the fact that the more exact we try to make our definitions of the terms "life" and "organisation," the more shadowy and intangible become the distinctions upon which we are driven to depend. I am perfectly satisfied with Mr. Herbert Spencer's admission of "insensible modifications and gradual transitions which render definition impossible." But if this be the case, it is surely not wise to maintain that the science of "non-living" beings must differ totally in its aims and its methods from that of "living" beings. To bring out into clear relief the analogies between the science dealing with the mineral kingdom and those concerned with the animal and vegetable kingdoms was the main object of my address. JOHN W. JUDD

March 28

"The *Gecko* moves its Upper Jaw"

THUS by the substitution of one reptile for another—of the gecko for the crocodile—the well-remembered zoological statement in Arnold's Greek prose is at length put upon a satisfactory foundation. In the spring of 1886, I captured a small gecko (*Tarantola mauritanica*) at Rome, and I have hitherto succeeded in keeping it alive and in health. One of the first things I noticed about it was the extraordinary vigour with which so small an animal would bite one's finger. And the effect produced was certainly rather due to the lizard's expression of intense ferocity during the process than to the pinch which it was able to give. The expression chiefly depends upon two things—the fact that the anterior part of the head may be bent downwards, and that the eyes are retracted into the head. Examining the former movement more carefully, it was seen that in opening the mouth the upper jaw is distinctly although slightly raised above the normal, so that the profile of the upper surface of the head becomes almost straight (compare Figs. 1 and 2). In biting fiercely it is common for the upper jaw to be depressed below the normal, as is plainly seen in a profile view (compare Fig. 3), although in other positions the curvature of the head is

FIG. 1.—The Tarantola in the normal position of rest.

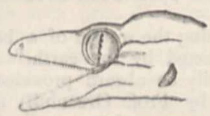


FIG. 2.—The Tarantola prepared to bite, with the upper jaw raised.

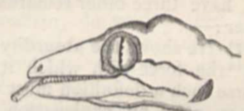


FIG. 3.—The Tarantola biting,—a common position, in which the upper jaw is depressed below the normal.

normal, and again in others the profile may remain straight in biting (as in Fig. 2). As far as I could observe in Tarantola, the upper jaw was always raised in opening the mouth, and the profile of the head straightened from its normal curve when at rest, but on closing the mouth in biting the movement of the upper jaw depended upon the relative position of the animal to the object which it was biting. This depression of the upper jaw may be also often witnessed when the mouth is closed, and it may be produced by applying slight pressure to the head. The animal seems to make the most of its powers of expression, for on provocation it opens its relatively huge mouth with the greatest readiness, and will keep it open for a considerable time, during which its appearance is sufficiently awe-inspiring. The fact that the anterior part of the skull is not co-ossified with the posterior part is well known. Thus in Huxley's "Anatomy of Vertebrata" (1871, p. 225) the following statement is made concerning the geckos: "Neither the upper nor the lower temporal arcades are ossified, the post-frontal being connected with the squamosal and the maxilla with the quadrate by ligament;" and Mr. Boulenger informs me that had he been asked whether the upper jaw of such lizards is moved in biting, he would have been inclined to answer in the affirmative, reasoning from the well-known condition of the skull. But I believe it has not been hitherto actually observed that such movable articulations possess a functional value in the living animal, and that the geckos must be added to the well-known instance of the parrots as Vertebrata which move the upper jaw in biting. It is extremely probable that the same observations will be found to hold for other families of lizards. EDWARD B. POULTON

Wykeham House, Oxford, March 1

Weight and Mass

TILL some quite new facts are discovered, such as shall force us to reconsider our convictions (which have not been lightly formed), I do not think it profitable to accept a quasi-metaphysical challenge from my friend Prof. Greenhill. He has at heart, as strongly as I have, the cause of *definiteness* and *accuracy*:—and if he, as is natural for one in his position, feels inclined to sympathise with the "vernacular" of Engineers rather than object to it as I do, there is nothing for it but to agree to differ. My remarks on this aspect of the subject were of the most cursory and general character; and I went so far as to say that, as the book in question was written by a practical man for practical men, "perhaps we ought not to complain."

I cannot, however, go *so much further* as to allow, with Prof. Greenhill, that it is "perfectly correct" to use the words pound or ton "side by side in two senses." As regards this practice I, in turn, must quote from an unpublished letter of Clerk-Maxwell's. [The passage purports to be part of a (reported) speech by a well-known Evolutionist.]

"He regretted that so many . . . . were in the habit of employing the word in a sense *too definite and limited* to be of any use in a complete theory. . . . . He had himself always been careful to preserve that largeness of meaning which was too often lost sight of in elementary works. This was best done *by using the word sometimes in one sense and sometimes in another*; and in this way he trusted he had made the word occupy a sufficiently large field of thought."

I have three other remarks to make upon Prof. Greenhill's letter:—

(1) He shows the absurdity of defining the weight of a body as "the force with which it is attracted by the earth." Of course such a definition must necessarily be absurd provided it comes *after* an explanation (given by Prof. Greenhill) that "weight" is to be understood in the sense of "mass." But from this explanation itself it would unfortunately follow that *a body has weight even when it is no longer heavy*; as, for instance, when it is in a (supposed) cavity at the centre of the earth! Prof. Greenhill says that "weight" is "used in ordinary language in most cases" in the same sense as "mass." Surely the great majority of men regard weight from the point of view of the sublime Porthos:—

"Ma vaisselle d'argent . . . . qui doit peser de mille à douze cents livres, CAR je pouvais à grande peine soulever le coffre qui la renferme, et ne faisais que six fois le tour de ma chambre en le portant."

(2) He also speaks of certain difficulties imposed by the "rules of language." I do not ascribe to them so lofty an origin. They are the offspring of the dogmatic ignorance which has peopled the realms of science with Centrifugal Force and its fellow monsters.

(3) He has commented solely on a passing remark in my article, and says nothing as to its main purpose. I hope, however, that he will eschew "statical" measures of force, and give his hearty aid as well as his good wishes in the war of extermination which must perpetually be waged against the too luxuriant undergrowth of the scientific garden:—the circle-squarers, the perpetual-motionists, and (in the case before us) *the measurers of potential energy in terms of horse-power*.

P. G. T.

An Error in Maxwell's "Electricity and Magnetism"

IT may be allowed to me to remark that the error mentioned on pp. 172 and 223 of NATURE has its origin really in Helmholtz's renowned paper ("Ueber die Erhaltung der Kraft," 1847, p. 67), and that it thence found its way into most of the text-books on electricity. It has sometimes been detected and hinted at; for the first time, I believe, in C. Neumann's paper published in the *Ber. d. k. sächs. Ges. d. Wiss*, at Leipzig (1871), "Elektrodynamische Untersuchungen mit besonderer Rücksicht auf das Princip der Energie." There we find (p. 436) the formula—

$$T\nabla + T_1\nabla_1 = T^2w + T_1{}^2w_1 - TT_1\frac{dV_{01}}{dt} + \frac{dF}{dt},$$

which is identical with the equation of energy given in NATURE, p. 223, if we put—

$$\nabla_1 = A_1,\ w_1 = R_1,\ -TT_1V_{01} = T_m,\ F = T_e,\ \&c.$$

The formula is followed by the remark that it agrees entirely with the formula given by Helmholtz, the only difference being the last term $\frac{dF}{dt}$, which in the latter is wanting; thus we may say that by Helmholtz the potential energy of the system invariably is expressed by zero.

Being formerly unaware of Neumann's researches, I, by another way, came to the same results, see the paper "Das Princip der Energie in seiner Anwendung auf die ponderomotorischen und elektromotorischen Wirkungen des elektrischen Stromes," published in the *Sitzber. d. k. böhm. Ges. d. Wiss*, (*vide* NATURE, vol. xxxii. p. 308). In this paper I have hinted at *one* probable cause of this and similar mistakes and their relatively difficult discovery, of which the repetition of the error in the *best text-books* is a decisive proof. This cause I believe to be the trivial circumstance that there is no consistent and generally accepted notation of the different forms of potential and energy. This renders the comparison of different writings on this subject sometimes quite perplexing. When, for example, two authors denote the *same thing*, the one by V, the other by $-V$, and when the first writes the expression $d(T_1T_2V)$ in the form—

$$T_1T_2dV + T_2VdT_1 + T_1VdT_2,$$

the other the *identical* expression $-d(T_1T_2V)$ in the form—

$$T_1T_2dV - T_2d(T_1V) - T_1d(T_2V),$$

it may happen that they themselves and also other readers overlook the difference of sign, and that they continue to reason as *if their* V *were identical*. Such mistakes occur oftener than is supposed. See the interesting note at the end of Sir William Thomson's paper on "Capillary Attraction," NATURE, vol. xxxiv. p. 369.

Could there not be found a means of avoiding the inconveniences caused by such mistakes and the loss of labour spent in detecting them? I dare not hint at the possibility of an international system of notations of the most important physical quantities; thoroughly consistent, and recommended by the highest scientific authorities; for the realisation of such a system would probably meet difficulties quite insurmountable.

Prague University, March 12 A. SEYDLER

Tabasheer

MR. DYER in his article on "Tabasheer" in NATURE of February 24 (p. 396), throws out the suggestion that the silica deposited in the joints of bamboo may have undergone a process of dialysis. It may be of some interest to him, and to your readers generally, to learn that plates of transparent compact silica, SiO_2, may be formed by dialysing the basic soda silicate. Four or five years ago I discovered this, and succeeded in producing plates a quarter of an inch in thickness and four inches in diameter, by placing the basic silicate of soda within a dialyser, which was floated on dilute sulphuric acid, 1 part to 20. The plate of silica was formed in the floated vessel. A similar result may be obtained by placing in a wide test-tube a portion of basic silicate. Taking care that the upper portion of the tube is quite free from adhering silicate, the dilute acid should be poured on to the surface of the silicate without disturbing it. After a few hours the silica is eliminated in a crystalloid form.

Possibly the first process may help us to understand how tabasheer may have been deposited, while the second may throw some light on the formation of raphides, carbonic or some other acid being the active agent.

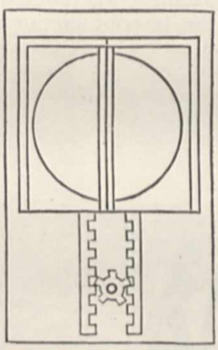
16 Savile Street, Hull, March 15 THOMAS ROWNEY

A Method of Illustrating Combinations of Colours

IN NATURE, vol. iv. p. 346, there is a description by Mr. Allen, of Sheffield, of some methods of showing the combination of various colours on a screen. He used a biunial or "dissolving view" apparatus to produce overlapping disks of colours, and also three lenses mounted close together in place of the ordinary single lantern objective, and giving images of three apertures in a lantern slide, close to which were placed cells of coloured liquids.

His experiments suggested to me the following method, which I have used for some years past, and for which only the ordinary single optical lantern is required.

A lens 10 cm. in diameter and 15 cm. focus is cut in half, and the two halves are mounted in frames so as to be capable of sliding past each other precisely in the same way as the divided object-glass of a heliometer. The motion is given by a pinion acting on racks in the same way as in the ordinary double-barrelled air-pump.



In the frames which carry the semi-lenses are cut grooves in which slips of coloured glass, or gelatine, or cells of coloured liquids may be placed; and the whole is fitted on the nose of the lantern in place of the usual objective, a diaphragm with round aperture about 3 cm. in diameter being put into the slide-holder.

Thus, when the two semi-lenses are so placed as to have their principal axes coincident, they act as a single lens and form one image of the aperture on the screen: but when they are moved past each other by turning the pinion, two disks of light are shown which can be separated entirely or made to overlap to any required extent. If, then, glasses or liquids of any given colours are placed in front of the semi-lenses, the compound colour produced by their union can be easily shown, either simultaneously with the component tints, or alone by accurately superposing the disks, thus avoiding any disturbing effect of the intrusion of other colours upon the eye.

It is in this way easy to show, taking four prominent colours, blue, green, yellow, and red, that blue + yellow = white; blue + red = purple; green + red = yellow, &c.

In place of coloured liquids, which are "messy" and liable to change, I almost always use coloured glasses, either singly or superposed (cobalt-blue, for instance, cemented to "signal-green" glass gives a good pure blue). Such glasses can by patient and careful selection be obtained of almost any required tint and intensity. H. G. MADAN

Eton College, March 26

Ice-Period on the Altai Range

IT is generally assumed that in the Altai Range there are no traces of so-called ice-ages. Hitherto, however, only ridges on the borders of the Altai Mountains have been examined. The geological phenomena of the mid-Altaic regions are still almost quite unknown. In the course of last summer it happened to me to visit some parts of the south Altaic regions—the Narim Range in the vicinity of Altaiskaia, Stornitza, or Koton Karagay, the neighbourhood of the Cossack settlement Oorool, then the so-called Katoon's Pales with their snowy giant Belooha. Subsequently I travelled in the valleys of the Belaia and Chernaia Berels, and visited the valley of the Arassan lakes and some other places. Everywhere I was struck by many and various traces and remnants of a large icy cover, which has left either strong glacier deposits, or abundant remains of moraines, or pieces of granite covered with lines. The valleys, too, bear on them the indubitable signs of glacial origin. In a word, there can be no doubt as to the existence of a large ancient icy cover here. Were these glaciers contemporaneous with the ice-age of Europe and North America, or do they present themselves as a quite independent system? My own observations convince me of their independence. The Altaic ice-period had, I think, its own causes. The Altaic system of mountains is of great antiquity; and its ridges were probably much higher at one time than they are now. Perhaps the whole system rose far above the line of eternal snow, although at present this line is reached only by some of the highest summits. It is probable, too, that in those very remote times the meteorological conditions of the country were far harsher than at present, because glaciers were more numerous and descended lower, digging the V-shaped valleys of the Katoon River, of the White and Black Berels Rivers, of Chindagatooy, &c.

The question of the periodicity of glacier-ages has again been raised lately, and perhaps it is from the Altai and from the Blue Alps that we may obtain the solid data for the complete solution of this very important question. A. BIALOVESKI

Oostkamenogorsk, November 1, 1886

A Claim of Priority

J'AI eu récemment l'occasion de lire dans le *Philosophical Magazine* (Août 1886) la description très-intéressante d'un "intégrateur sphérique," combiné par Mr. Frederick John Smith, et qui semble être une modification de celui du Prof. Hele-Shaw. Mais l'idée première de ces appareils, et c'est sur quoi je dois appeler votre attention, m'appartient sans doute, car dans le No. 630 du journal anglais NATURE (Novembre 24, 1881) j'ai donné la description d'un "Anémomètre Intégrateur," fondé sur le même principe, et qui a été plus tard cité dans le *Quarterly Journal of the Royal Meteorological Society* (No. 43, 1882), par Mr. Laughton ("Historical Sketch of Anemometry and Anemometers").

La modification imaginée par Mr. F. J. Smith, tendant à supprimer ou à amoindrir, autant que possible, le moment d'inertie de la sphère, me parait excellente, surtout s'il fallait transmettre des vitesses quelque peu considérables. Mais quand il s'agit simplement d'enrégistrer celle du vent sur une échelle modérée, je crois que la forme primitive suffit, et, d'après plusieurs essais que j'ai faits, une bille d'ivoire roulant sur des cylindres de bronze c'est ce qui donne les meilleurs résultats.

Je vous prie, Monsieur le Directeur, de vouloir bien faire constater dans votre estimable journal cette réclamation de priorité, ainsi que d'agréer mes plus sincères remercîments et l'assurance de ma considération très-distinguée.

Observatoire de Madrid, le 12 Mars V. VENTOSA

Oktibehite or Awaruite?

IN the notice of the proceedings of the Geological Society of London (NATURE, December 23, 1886, p. 190) the discovery in New Zealand of a nickel alloy allied to *oktibehite* appears to be claimed by Prof. Ulrich, of Dunedin. This requires explanation, as the mineral was first determined, and named *awaruite*, after the locality, by Mr. W. Skey, Analyst to the N.Z. Geological Survey Department on September 28, 1885, and described by him in a paper read on October 25, 1885, and published in the local papers at the time, as well as afterwards in the Transactions of the N.Z. Institute, vol. xviii., issued May 1886. A notice of it is also given in my twenty-first annual Museum and Laboratory Report, June 1886, of which I inclose a marked copy. It will be observed that while Ulrich accepts the identity of the New Zealand alloy with *oktibehite*, Skey's analysis shows that its formula is $2Ni + Fe$, while that of the latter mineral is $Ni + Fe$.

JAMES HECTOR

N.Z. Geological Survey Office, Wellington, N.Z., February 9

AËRIAL VORTICES AND REVOLVING SPHERES

A STRIKING series of experiments on aërial vortices and revolving spheres has lately been made by M. Ch. Weyher, one of the directors of the important establishment for mechanical constructions at Pantin. An account of these experiments, with illustrations, appeared in a recent number of *La Nature* (February 26). As the results obtained by M. Weyher are very interesting, we reproduce the more important figures, and translate the descriptions given by our French contemporary.

Fig. 1.—*Aërial Vortices.*—A glass cylinder of about 0·40m. in diameter by 0·70m. in height, has an upper cover, pierced by a hole through which passes the shaft of the drum, the latter being formed of one or two paddles of cardboard put cross-wise upon the vertical shaft.

The cylinder contains some sawdust, or, better still, some oatmeal. If the oatmeal is put at first so as to form

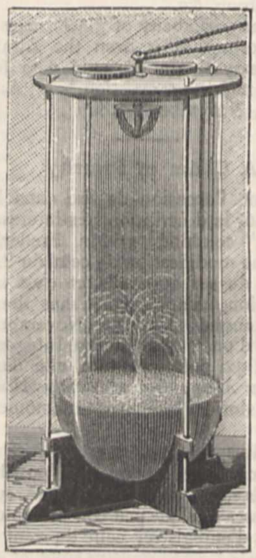


FIG. 1.

a cone or mound, and if the drum is turned round, a little waterspout can be seen forming at the top of the mound. Gradually the mass of oatmeal sinks into a hemisphere.

The matter runs without ceasing into spirals from the circumference to the centre; there it forms at first the lower cone, and then the upper reversed cone, in which the particles of oatmeal describe spirals, going from the centre to the circumference.

The whole system describes a primary general sphere, more or less distorted, the centre of which (where the two cones meet) is more or less deranged by the earth's gravity. If this is looked at from above, a hollow funnel is seen upon the axis: it is there that the air is most rarefied by rotation, and it is there that the finest particles come.

Substituting for oatmeal in the apparatus small light balloons inflated with air, the general movement can be followed. When the balloons are on the exterior circumferences, they fall in slow spirals; when they reach the circumferences nearer the axis of rotation, they rise rapidly upon a helix at a much more extended pace. In short, the experiment shows that, given a mass of air, if a

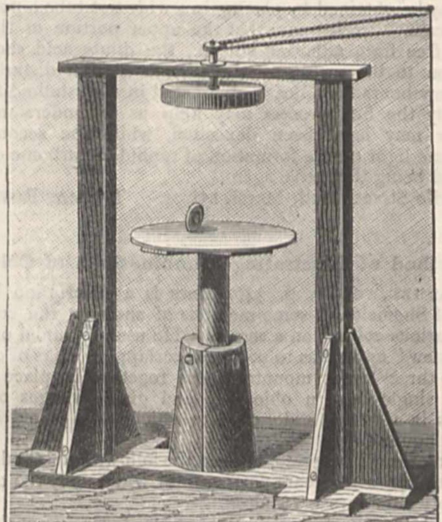


FIG. 2.

movement of rotation round a vertical axis is imparted to it this air falls constantly by the exterior circumferences, and rises by the interior circumferences, and the *whole* volume passes unceasingly through the centre of

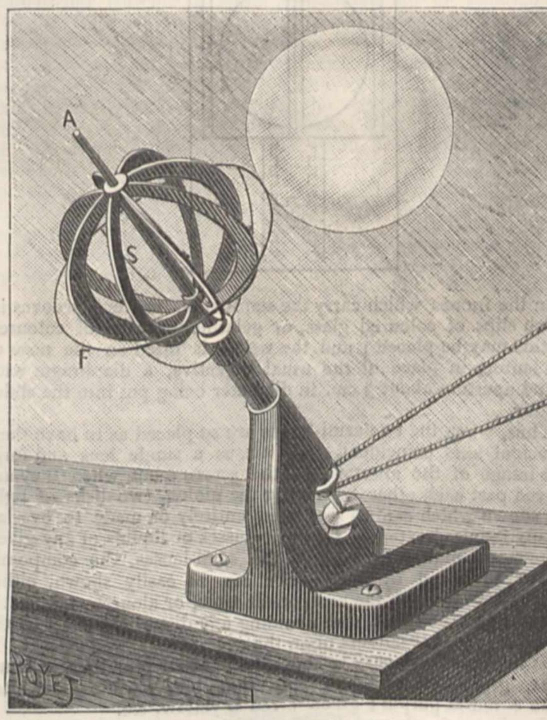


FIG. 3.

the vortex, drawing into its movement the substances or particles therein immersed.

Fig. 2.—A plate of glass or any other material is placed below a drum with paddles; when this drum is put in

motion, we immediately place upon the plate a disk or a coin, to which the fingers give a first movement of rotation round one of its diameters.

The hand being quickly drawn back, the aërial vortex continues to make the coin turn round like a top, and absolutely keeps it captive in its radius of action. The coin, while turning upon one of its diameters, makes a sphere, and a later experiment will show that a revolving sphere constitutes a centre of attraction.

Fig. 3.—*Equilibrium of Revolving Spheres.*—A free sphere keeps itself in equilibrium, and turns round another sphere, to which a rapid movement of rotation is imparted.

The apparatus consists of a pin, A, which is able to turn in a support, and has a pulley, made to receive a transmitted movement. Upon the pin A is placed a sphere, S, composed of from eight to ten flat circular pieces (these may be either flat disks, or disks cut into a crescent shape; it does not matter which). The pin may be at any angle whatever to the horizon; in this experiment it is inclined at 45°, but it may be horizontal

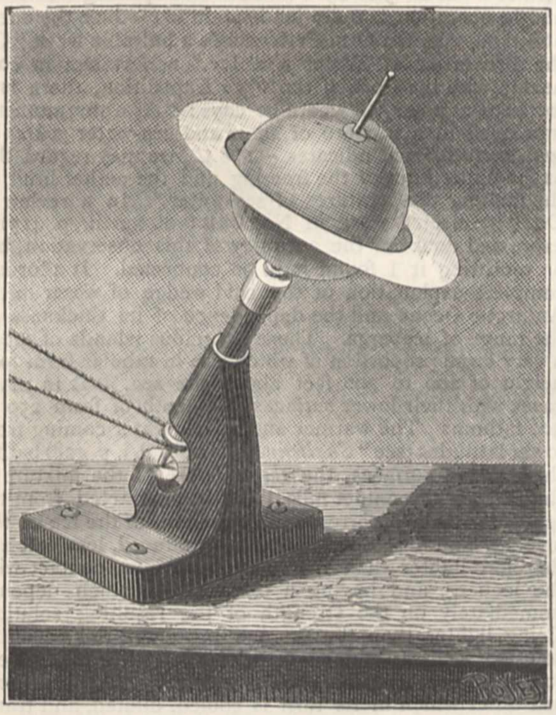


Fig. 4.

or vertical. The angle of 45° was chosen because it seemed to be most difficult for the experiment, which would therefore be the more conclusive. When the sphere S is turned round rapidly, you feel on the hand a strong blast which escapes all around from its equator. Bits of paper which are placed near it are thrown far away. Nevertheless, if a balloon is put near this blast, it is quickly attracted towards the revolving sphere, and describes orbits round it in the plane of the equator. As the experiment took place in a room, where there were obstacles producing eddies, and as also gravity has too much effect by reason of the proximity of the ground, it is very difficult to obtain a regular movement. The balloon comes easily in contact with the revolving sphere, and is then driven away by the collision too far to be caught again. A very simple contrivance consists in placing round the sphere S a wire guard or circle of iron, F, 1 millimetre in diameter, attached to the support by three similar wires.

The balloon will then keep on turning round the motive sphere, even ceasing to touch the guard in the lower part under the action of gravity. The experiment can be made in different ways, and the guard may even be suppressed, but these variations teach us nothing new.

In studying the vortex movements which the sphere imparts in the medium in which it is plunged, we easily calculate the ratio of the attraction which it exercises on the balloon.

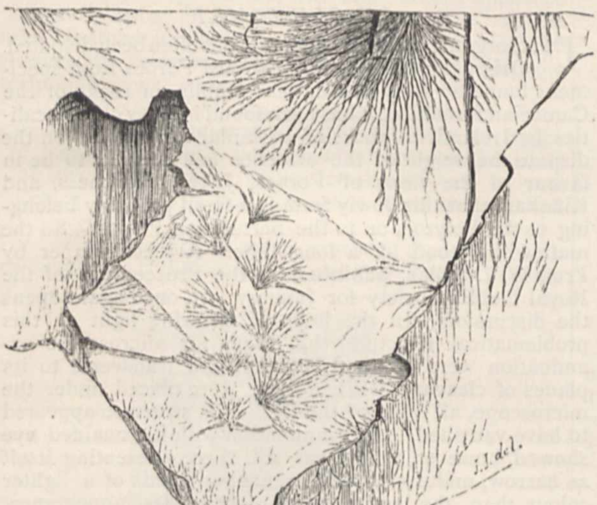
Fig. 4.—The guard of the revolving sphere is taken away, and we place parallel to its equator a circle of paper with an interior diameter greater than the exterior diameter of the sphere; the circle is caught into the movement of rotation, and maintains itself strongly in the plane of the equator.

ON OLDHAMIA

THE organic origin of Oldhamia has often been disputed. Originally described by Edward Forbes from specimens found at Bray Head, near Dublin, in rocks of the Cambrian formation, it has been found in a few other localities in Ireland, in rocks of a similar formation. In the dispute the weight of the evidence has seemed to be in favour of the views of Forbes, Jukes, Harkness, and Kinahan, that this lowly form is a fossil probably belonging to the Polyzoa, or to the Sertularian Polyps. So the matter has stood for a long time. A recent paper by Prof. W. J. Sollas, published in the Proceedings of the Royal Dublin Society for January last, once again opens the discussion. In the hope of throwing light on this problematical structure, thin slices for microscopic examination were cut, both parallel and transverse to its planes of cleavage. When these were placed under the microscope, all trace of the Oldhamia structure appeared to have vanished. An examination with the unaided eye showed, however, that it was still there, presenting itself as narrow, undulating, and branching bands of a lighter colour than the surrounding matrix. Its appearance, moreover, varied in an extraordinary manner according to the direction in which it was viewed. Looked at obliquely in a strong light, the thread-like bands are brilliantly illuminated, and appear faintly coloured with spectral tints; looked at directly, the bands become fainter, and are less clearly distinguishable from the matrix. In certain positions the slice taken at right angles to the bedding has an appearance somewhat suggestive of shot-silk, and, from the planes of cleavage, markings which remotely resemble in form the dendritic markings of Sutton stones extend into the surrounding matrix.

These appearances suggest the presence of some mineral possessing high reflection or refraction arranged in more or less parallel planes. Mr. Teall, in the same paper, gives full details of the mineral characters of the rock. Aided by these, Dr. Sollas finds that the lighter-coloured bands, which correspond to the Oldhamia markings, owe their distinction from the surrounding matrix to the presence of an excess of sericite scales; and that the curious shot-silk appearances are produced by the local deflections of these scales from parallelism with the cleavage planes into directions tangential to curves, which are probably transverse sections of those long ridges which, when seen on the exposed surface of a cleavage plane, are recognised as the usual form of Oldhamia. It would appear possible that these ridges are wrinklings of the cleavage planes produced during the shearing which led to their formation. These observations were made on the form known as *O. radiata*, and in some supplementary remarks Dr. Sollas adds that when Oldhamia is present it shows itself on the surface of the laminæ as rounded discontinuous ridges, which are without definite boundaries, and have the appearance of fine wrinkles. When the phyllode is fractured obliquely to the cleavage laminæ, the Oldhamia markings are found to extend through the rock as fine ridges or wrinkles which mark the surface of oblique fracture in a similar manner to those of the cleavage face. In fact, the appearances are remarkably similar to those of *ausweichungs-clivage*, described by Heim in his "Gibergsbildung"; but the observations throw no light on the remarkable radiate form sometimes assumed by the structure. In a paper in the same journal Mr. Joly mentions that, in examining specimens of *O. antiqua* and *O. radiata*, he detected the following peculiarity: a sunken or depressed delineation of one form accompanied a raised or relieved delineation of the other form. Thus, if on any specimen *O. antiqua* appeared as a depression, on that same surface the *O. radiata* appeared in relief.

From this observation it appeared probable, if any meaning was to be attached to the relation, that a further



relation would be found to obtain between the mode of delineation and the position in the rock. This, a further examination revealed; in this order: on the upper surface, or what was most probably the surface of deposition (the cleavage of the Cambrian slate of Bray Head coincides generally with the plan of bedding), the *O. radiata* appeared invariably as a depression, the *O. antiqua* in relief.

When fragments were peeled off the slate, the marks were found to be transmitted, or extending to the layers beneath, so that lines on the upper are seen as continued on the adjacent lower layer, this, too, for thicknesses exceeding a millimetre. The accompanying woodcut recalls the appearance of a surface of rock in which this is fairly well shown.

ON THE DISTRIBUTION OF TEMPERATURE IN THE ANTARCTIC OCEAN[1]

IN the regions of the Antarctic Ocean where icebergs are numerous, and where in winter the sea-water freezes, the distribution of temperature in the deeper layers of water is peculiar. The facts are detailed in the "*Challenger* Narrative" (vol. i.). The general result of her observations went to show that, from the most southerly station, a wedge of cold water stretches northwards for more than 12° of latitude, underlying and overlying strata at a higher temperature than itself (p. 418).

Although the conditions and facts likely to throw light upon the cause of the existence of this cold intermediate or superficial stratum overlying water which at any rate in its upper layers has a temperature higher than that of freezing distilled water are discussed, no satisfactory explanation of the phenomenon is given. One important fact is noticed at page 421. "The fact that the cold wedge above referred to extended north just as far as the icebergs did in March 1874 points to there being some connexion between the temperature and the presence of melting icebergs." It is well known that icebergs consist of land-ice, which is as nearly as possible pure frozen water, and melts in the air at 32° F. It was thought that the effect of immmersion of such a substance in a medium having a temperature 3° F. lower than its melting-point would be to indefinitely preserve it, that in fact only the lower surfaces of the icebergs large enough to reach to a depth of 300 fathoms would suffer any melting at all. The existence of the cold stratum was ascribed wholly to the cold brine, separated from the ice on the freezing of the sea-water, sinking downwards with an initial temperature of from 28°·5 to 29° F. This cause, though existing and in operation, is quite inadequate to produce the effect observed. In Dr. Otto Pettersson's admirable work "On the Properties of Water and Ice," undertaken in connexion with the work of the *Vega* Expedition, there is a footnote at page 318 where he says: "As a thermometer immersed in a mixture of snow and sea-water *which is constantly stirred* indicates − 1°·8 C., we may regard this as the upper limit of the freezing and the nether limit of the melting temperatures of sea-water." In a review of Dr. Pettersson's work in NATURE (vol. xxviii. p. 417) I expressed doubt of the accuracy of this observation, but on repeating it I found it to be confirmed. It affords a complete explanation of the cold wedge of water in the Antarctic Ocean and the dependence of its thickness on the range of icebergs. These enormous islands of ice, a very large proportion of which rise in tabular form to a height of 200 to 300 feet above the sea, float in many cases with their lower surfaces at a depth of from 250 to 300 fathoms. The warmer and denser water coming from lower latitudes (see "*Challenger* Narr." vol. i. p. 428) bathes these lower surfaces, the temperature of the mixture at the surface of contact falls, the heat abstracted from the sea-water melts a corresponding amount of the ice of the iceberg, and a saline solution is produced, less salt and therefore lighter than the water away from contact with the iceberg, and having a temperature which depends immediately on the strength of the resulting solution. Being lighter than the surrounding water, this resulting solution necessarily flows up along the sides of the berg to the surface, and its place is taken by fresh undiluted sea-water which in its turn is cooled, diluted, and transferred to the surface. The result is the production of a most energetic engine of circulation and means of cooling and equalising the temperature of the water within the reach of icebergs. As there is continual renewal of the ocean water brought into contact with the ice, and as its composition is constant, the temperature produced is practically constant, namely 28°·8 to 29°·0 F., or − 1°·7 to − 1°·8 C. The layer of lighter water from 50 to 80 fathoms thick at the surface is due principally to this melting of land-ice, though it is also due in very small proportion to the melting of sea-ice.

Table giving the temperature at which ice melts in sea-water containing different percentages of chlorine

Temp. C.	1°·0	1°·1	1°·2	1°·3	1°·4
Per cent. Cl... ...	1·040	1·131	1·222	1·313	1·404
Temp. C.	1°·5	1°·6	1°·7	1°·8	1°·9
Per cent. Cl... ...	1·495	1·586	1·678	1·769	1·880

This table is taken from a paper on ice and brines, communicated to the Royal Society of Edinburgh on March 21, 1887.

[1] Abstract of a paper read by Mr. J. Y. Buchanan before the Royal Society of Edinburgh, March 21, 1887.

The density (at 15°·56 C.) of the sea-water which comes in contact with the lower surfaces of the icebergs is 1·0255, which represents a chlorine percentage of 1·90. Ice actually *melting* in this water would produce a temperature of – 1°·92 C. When ice is *immersed* in this water it lowers its temperature, and a portion of the ice is melted, producing dilution. The concentration, therefore, or chlorine percentage, which will determine the melting temperature of the ice, will be a little lower than that of the original sea-water. From the *Challenger* observations we see that, on the confines of the pack-ice the cold stratum of water has a uniform temperature of 29° F. (– 1°·67 C.). Ice melts at this temperature in sea-water containing 1·65 per cent. of chlorine. In this process ice is melted, so that 100 grammes pure warm sea-water become 119 grammes of diluted cold sea-water. It will be observed that the ice which has been formed in the atmosphere at a temperature of 32° F. comes in this way to be melted at a temperature of 29° F.; and the pressure exerted by the 300 fathoms of sea-water, though it may assist in the lowering of the melting temperature, is insufficient to account for the amount.

TO FIND THE DAY OF THE WEEK FOR ANY GIVEN DATE

HAVING hit upon the following method of mentally computing the day of the week for any given date, I send it you in the hope that it may interest some of your readers. I am not a rapid computer myself, and as I find my average time for doing any such question is about 20 seconds, I have little doubt that a rapid computer would not need 15.

Take the given date in 4 portions, viz. the number of centuries, the number of years over, the month, the day of the month.

Compute the following 4 items, adding each, when found, to the total of the previous items. When an item or total exceeds 7, divide by 7, and keep the remainder only.

The Century-Item.—For Old Style (which ended September 2, 1752) subtract from 18. For New Style (which began September 14) divide by 4, take overplus from 3, multiply remainder by 2.

The Year-Item.—Add together the number of dozens, the overplus, and the number of 4's in the overplus.

The Month-Item.—If it begins or ends with a vowel, subtract the number, denoting its place in the year, from 10. This, plus its number of days, gives the item for the following month. The item for January is "0"; for February or March (the 3rd month), "3"; for December (the 12th month), "12."

The Day-Item is the day of the month.

The total, thus reached, must be corrected, by deducting "1" (first adding 7, if the total be "0"), if the date be January or February in a Leap Year: remembering that every year, divisible by 4, is a Leap Year, excepting only the century-years, in New Style, when the number of centuries is *not* so divisible (*e.g.* 1800).

The final result gives the day of the week, "0" meaning Sunday, "1" Monday, and so on.

EXAMPLES

1783, *September* 18

17, divided by 4, leaves "1" over; 1 from 3 gives "2"; twice 2 is "4."

83 is 6 dozen and 11, giving 17; plus 2 gives 19, *i.e.* (dividing by 7) "5." Total 9, *i.e.* "2."

The item for August is "8 from 10," *i.e.* "2"; so, for September, it is "2 plus 3," *i.e.* "5." Total 7, *i.e.* "0," which goes out.

18 gives "4." Answer, "*Thursday.*"

1676, *February* 23

16 from 18 gives "2."

76 is 6 dozen and 4, giving 10; plus 1 gives 11, *i.e.* "4." Total "6."

The item for February is "3." Total 9, *i.e.* "2."

23 gives "2." Total "4."

Correction for Leap Year gives "3." Answer, "*Wednesday.*"

LEWIS CARROLL

NOTES

IN the Report submitted yesterday at Edinburgh to the half-yearly general meeting of the Scottish Meteorological Society, the Council state that the work at the Ben Nevis Observatory continues to be carried on by Mr. Omond and the assistants in the same highly satisfactory manner as has been recorded in previous Reports. In addition to the laborious work of observing at all hours of the day and night, of reducing the observations, and forwarding copies for the Society and the Meteorological Council, the staff of the Observatory has given very effective assistance in the preparation of the tables of the meteorology of Ben Nevis now in the press. Several interesting researches are being conducted at the Observatory, the results of which will be communicated to a future meeting. The Directors took steps last autumn to raise subscriptions to clear off the debt on the institution, and to establish a low-level station at Fort William, at which hourly observations may be made for comparison with those at the Observatory. It is only by two sets of observations at the top and bottom of the mountain that the Ben Nevis Observatory can be utilised, with the desired success, in the furtherance of meteorological science, but particularly in that branch of it which concerns the improvement of the system of forecasting the weather of the British Islands.

ON Tuesday evening last the Lord Advocate stated in the House of Commons that the Scottish Universities Bill would shortly be introduced.

THE Paris Medical Faculty has decided to alter considerably the mode of competition for its Fellowships. The general object of the changes is to secure more original workers. The thesis (which has usually been the work, not of the candidate himself, but of his friends) is to be suppressed. Each candidate will henceforth have to deliver a lecture on his own scientific researches.

THE French Chamber of Deputies has decided that the buildings of the College of France shall be considerably enlarged. Fifty years ago, when this institution had only seventeen professors, its present buildings were sufficient; but now, when it has forty-one professors, they are very inadequate. It is to have four new lecture-rooms, a geological gallery, a set of rooms for other collections, a library, a meeting-room for professors, and eight laboratories. These additions will cost over 9,000,000 francs.

THE Anatomical Society, founded last September at Berlin, will hold its first general meeting at Leipzig on April 14. The Society has now over 170 members in England, Germany, Austria, Hungary, Switzerland, Holland, Belgium, Scandinavia, France, Russia, Italy, and North America.

DR. HANS REUCH, who has lately devoted much time to the study of earthquakes in Norway, has issued a tabulated circular, which has been reproduced in the entire Norwegian Press, requesting that reports of any phenomena observed in connexion with earthquakes may be sent to him. By Government permission all such reports may be transmitted through the post free of charge. Dr. Reuch asks especially for information on the following points: exact time of occurrence of the earthquake; the time compared with that of the nearest railway or telegraph station; locality of occurrence, and whether felt indoors or in the open; nature of soil; what the observer was occupied with; how many shocks were felt; nature of motion, undulating or oscillating; from what direction the shock came; whither it went; how long the motion lasted; what were its effects; did the shock resemble others experienced by the observer; was there any sound; was the sound heard before or after the earthquake; what was the interval between the shocks; were phenomena of restlessness in animals, or peculiarities of the weather, observed; if near sea or lake, were there any strange motions in the same; the names of any other persons who are known to have noticed the earthquake. Earthquake phenomena having been more than usually frequent in Norway during the past year, it is believed that Dr. Reuch's circular may be of considerable service to science.

AT a meeting of the Japanese members of the Seismological Society of Japan held at the Imperial University on January 20 (according to a report in the *Japan Weekly Mail*) two papers were read in Japanese. The first was by Mr. Kikuchi, on the geology of Corea. In it the writer described the geological map made by Prof. Gottsche, who visited that country after leaving Japan. The paper also gave a description of the geological formations and the minerals found in the different provinces of Corea, and showed that Corea differs from Japan in the fact that these formations in the former country are much older, and on that account more stable, than those in the latter. This, Mr. Kikuchi thought, might account for the comparative absence of seismological phenomena in Corea. The second paper, by Mr. S. Sekiya, was on recent destructive earthquakes. The writer described in succession the causes and effects of the earthquake which occurred in Japan on February 22, 1880; the earthquake at Ischia in 1883; the shock of October 15, 1884, in Japan; the earthquakes in Spain in 1884; those of the United States of last year; and the shock of January 15 in Japan. It was pointed out that the three earthquakes mentioned as occurring in Japan were very similar in their intensity, and that they extended over nearly the same area; but, with regard to their place of origin, the writer said the first two shocks originated in Tokio Bay, or in the ocean beyond the peninsula, while that of the present year originated in a spot to the south-west of the two previously mentioned. A third paper on the meteorology of Tokio was postponed. It appears from this and other reports which we have published from time to time that the Japanese Section of the Seismological Society, where the papers are read in the Japanese language, is, like the parent Society, in a very flourishing condition. It evidently supplies a demand for this department of science amongst Japanese who know no language well except their own.

AT the first meeting of the London Commission for the Melbourne Centennial International Exhibition, held on Thursday, the 24th inst., the chairman, Sir Graham Berry, said that the proposed buildings of the Exhibition would cover an area of more than 1,000,000 feet. It was decided that a deputation should ask Sir Henry Holland to take steps for the appointment, in connexion with the Exhibition, of a Royal Commission for the United Kingdom, and that the Foreign Office should be requested to communicate on the subject of the Exhibition with foreign Powers, India, and colonies other than Australasia.

ON Saturday evening last, a lecture on "The Habits of Ants" was delivered by Sir John Lubbock in the theatre of the Working Men's College, Great Ormond Street. The lecturer gave an interesting account of some of the results of his own observations, and brought forward much evidence to prove that ants possess "something more than mere instinct."

BY an Order in Council, dated March 7, Her Majesty has declared that the following antiquities shall be protected by the Ancient Monuments Act: (1) Little Kit's Coty House, or the countless stones of Tottington, at Aylesford, in Kent; (2) the chambered tumulus at Buckholt, in Gloucestershire; (3) the Druid's circle and tumulus on Eyam-moor, in Derbyshire; (4) the Pictish tower of Carloway, in Ross-shire; (5) the Ruthwell Runic cross in Dumfriesshire; and (6) St. Ninian's Cave, at Glasserton, in Wigtownshire. The Order will not come into force until it has lain for forty days before both Houses of Parliament.

IN the so-called Seelberg, where in 1816 the mammoth group which is the chief ornament of the Stuttgart Museum was found, further excavations are being made under the direction of Dr. Fraas. Many skeletons, weapons, and implements have been discovered, and Dr. Fraas is of opinion that the mammoth group found seventy years ago was artificially put together by prehistoric artists.

IN the *American Naturalist* there is an article by Mr. John Murdoch on what he calls "some popular errors in regard to the Eskimos." One of these "popular errors" is the notion that the Eskimos pass the winter "in a sort of hibernation, in underground dens, living in enforced idleness and supporting life by stores of meat laid up in less inclement seasons." Mr. Murdoch, who spent two winters at Point Barrow, says this is a wholly mistaken impression. In spite of the extreme inclemency of the climate, the winter, he asserts, is passed by the Eskimos "in one continued round of activity," and he gives a very interesting description of the manner in which they occupy themselves. Another "popular error" on this subject is the idea that the Eskimos always eat their food raw, and devour enormous quantities of blubber. At Point Barrow, Mr. Murdoch found that food was habitually cooked, although certain articles, like the "black skin" of the whale, were usually eaten raw. Taking into account the fact that the Eskimos have no butter, cream, fat, bacon, olive-oil, or lard, he doubts whether much more fat is consumed by them than by civilised peoples. At Point Barrow the fat of birds and the reindeer was freely partaken of, but comparatively little actual blubber either of the seal or whale was eaten. "Seal or whale blubber was too valuable,—for burning in the lamps, oiling leather, and many other purposes, especially for trade."

A BOOK on "Sensation and Movement," by M. Ch. Féré, of Paris, has just been published. The author tries to show how different sorts of sensations react upon the vasomotor and motor phenomena, as indicated by pletysphygmograph and dynamometer.

IN a work on "The Nationalities of Bohemia," lately published, Dr. L. Schlesinger shows that 37·11 per cent. of the population of that country are Germans, and 62·83 are Czechs The limits within which the languages of the two races are spoken are generally very sharply drawn. There are 13,184 inhabited places in Bohemia, and in 4304 of them German alone is spoken, in 8473 the Czech language alone. In only 407 places are both languages used.

THE death is announced of Prof. Simon Spitzer, Professor of Analytical Mechanics at the Technical High School of Vienna, the author of various well-known mathematical works. He died on March 16 at the age of sixty-one.

THE new University building at Upsala is approaching completion. It has been in course of erection since 1879, and will be one of the finest University buildings in Europe. It will be opened with great ceremony on May 18 next by the King of Sweden, in presence of delegates from the principal foreign Universities.

LAST week the American Government forwarded another consignment of whitefish ova to the National Fish-Culture Association. These have been taken from late spawners, and appear more healthy than the batch sent in January. The ova are well "eyed," and in some cases are on the point of incubation. A consignment of the Californian trout ova, viz. the Rainbow (*S. irideus*), has likewise been received by the Association from the American Government. This variety is likely to become highly popular in England on account of its unique colour and form and its capacity of gaining flesh rapidly.

WHEN the South Kensington Aquarium was closed, the sea-trout which had been maintained there were transferred to ponds in the Delaford Park Fishery; and in February last many ova were taken from them and crossed with the *S. fario*, as in previous years. There are now a large number of hybridised examples of *S. trutta* in the ponds produced from ova shed in the South Kensington Aquarium and crossed in a similar manner. The two-year-old specimens are now about 7 inches long, their size being much smaller than that of other trout of the same age. None of the fish have spawned.

THE meaning of the word "scientist" seems to be rather vague in the country in which it originated. In his annual address as President of the Philosophical Society of Washington, lately published, Mr. John S. Billings says the word was a coinage of the newspaper reporter, and, "as ordinarily used, is very comprehensive." Webster defines a scientist as "one learned in science, a *savant*." Mr. Billings, however, thinks that the suggestion conveyed by the word "is rather that of one whom the public suppose to be a wise man, whether he is so or not; of one who claims to be scientific." In his address, the subject of which is "Scientific Men and their Duties," he himself uses the term "in the broadest sense, as including scientific men, whether they claim to be such or not, and those who claim to be scientific men, whether they are so or not."

PROF. SARGENT, Director of the Arnold Arboretum of Harvard College, estimates that five foreign trees are planted in New England to one native. Yet, of all foreign trees introduced into America, the willow alone, he thinks, has qualities not possessed in a greater degree by some native. The European oak is perhaps the most unsatisfactory deciduous tree that has been experimented upon: it grows rapidly when young, but fails, when about twenty years old, from the cracking of the main stem, and then, after dragging out a wretched existence a few years longer, it miserably perishes. The Scotch pine dies long before reaching maturity, and the Austrian and the Corsican pine seem to be no better. The Norway spruce, which has been for many years the most widely cultivated foreign tree in Massachusetts, becomes decrepit and unsightly just at that period of life when trees should become really handsome in full development.

THE Sonnblick Observatory, in the province of Salzburg, Austria, is the highest in Europe, being 10,177 feet above the level of the sea. It was established chiefly through the exertions of M. Rojacher, proprietor of the mines in that district, in conjunction with the German and Austrian Alpine Club, and the Austrian Meteorological Society. Telephonic communication was established with Rauris, a distance of 15½ miles, and observations were commenced in September 1886. Observations at such elevated stations offer much that is of interest to science generally, and more especially as regards those problems of meteorology which relate to the variations of pressure, temperature, and humidity in the upper regions of the atmosphere. In the *Meteorologische Zeitschrift* for February last, Dr. Hann gives an interesting account of the first three months' observations. The mean temperature in October was 25°·9 F.; in November 15°·3, and in December 8°·1. In October, the decrease of temperature with height during the barometrical minima was, generally, rapid. But during the barometrical maxima it was very slow in the lower strata, up to about 5900 feet; then an increase of temperature with height frequently occurred. The periods of high pressure were generally warm intervals on the Sonnblick, and the periods of low pressure were cold intervals. It is noteworthy, however, that the change of temperature with height, in the strata between about 5900 feet and the summit, was almost independent of the conditions of weather, being nearly constant during the whole month, and amounting to about 1°·3 F. per 328 feet (100 metres); while in the lower regions, from about 1300 feet to 5900 feet, it varied between 0° and 1°·1. And, generally speaking, the same rates of decrease of temperature obtained in November and December. During the period of high pressure, on October 1 to 5, which was the warmest part of the month, the march of relative humidity showed a great contrast at the high stations and at the valley stations, humidity being greatest at noon at the high stations, and lowest in the valleys. As regards wind, it may be remarked that early in November the anemometer became a shapeless mass of hoar frost. It remains to be shown what use can be made of the observations on such elevated stations for the practical work of weather-forecasting. The observers of the Pic du Midi claim to have foretold, from the conditions at that Observatory, the disastrous floods that occurred in the South of France at the end of June 1875, and thereby to have rendered important services by their timely warning.

THE Norwegian Government has taken another step towards discovering the origin and nature of the terrible disease leprosy, which is so common on the west coast of Norway, by despatching Dr. G. A. Hansen, Director of the Leprosy Hospital at Bergen, to North America, for the purpose of inquiring into the heredity of the disease among Scandinavian emigrants to the United States.

SOME interesting statistics concerning the libraries of the United States have been printed in America from advance sheets of the forthcoming Report of the Bureau of Education. There are in the United States 5338 libraries, each with 300 volumes or over. Of these, 2981 have each 1000 volumes or over. Forty-seven have each over 50,000 volumes; and among the forty-seven are the public libraries of Boston, Chicago, and Cincinnati, and the libraries of Harvard, Columbia, Yale, Cornell, and Brown Universities. These forty-seven libraries aggregate 5,026,472 volumes; and the whole list of 5338 libraries aggregates 20,622,076 volumes, or one volume to every three persons in the country. In round numbers the United States has one library to every 10,000 of population, though in many States the proportion is far greater. New Hampshire, for example, has a library to every 2700 persons. Massachusetts and Connecticut furnish a library to every 3134 and 3479 persons respectively. California, Colorado, Wyoming, and Michigan, are well up on the list. Arkansas, which stands lowest, has one library to every 50,158 of population.

SOME time ago we reviewed a little book entitled "A Year with the Birds," by an Oxford Tutor. A second edition has now been issued. The author has added a chapter on the Alpine birds, and has also made a considerable number of additions and corrections in the original chapters.

THE annual general meeting of the Linnean Society of New South Wales took place on January 26. The usual address was delivered by the President, Prof. W. J. Stephens, who presented a general summary of all the scientific work included in the year's Transactions. He also drew attention to the labours of other scientific Societies of Australasia during the preceding year, and concluded with some observations on scientific teaching in general schools.

THE additions to the Zoological Society's Gardens during the past week include a Malayan Bear (*Ursus malayanus*) from Malacca, presented by Mrs. Bingham; a Common Squirrel (*Sciurus vulgaris*), British, presented by Mr. H. B. Meadows; two Tree Pipits (*Anthus arboreus*), British, presented by Mr. W. B. Tegetmeier; two Dwarf Chameleons (*Chamæleon pumilus*), two Robben Island Snakes (*Coronella phocarum*), a —— Toad (*Bufo augusticeps*) from South Africa, presented by the Rev. G. H. R. Fisk; two Pondicherry Vultures (*Vultur calvus*) from India, two Ocellated Sand Skinks (*Seps ocellatus*), South European, purchased; two Black Lemurs (*Lemur macao*), a White-fronted Lemur (*Lemur albifrons*), born in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 APRIL 3-9

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on April 3

Sun rises, 5h. 33m.; souths, 12h. 3m. 22·6s.; sets, 18h. 34m.; decl. on meridian, 5° 18′ N.: Sidereal Time at Sunset, 7h. 21m.

Moon (Full on April 8) rises, 12h. 29m.; souths, 20h. 12m.; sets, 3h. 44m.*; decl. on meridian, 15° 47′ N.

Planet	Rises	Souths	Sets	Decl. on meridian
	h. m.	h. m.	h. m.	° ′
Mercury	4 57	10 50	16 43	2 13 S.
Venus	6 26	13 53	21 20	15 46 N.
Mars	5 44	12 22	19 0	6 44 N.
Jupiter	20 16*	1 22	6 28	11 12 S.
Saturn	10 13	18 22	2 31*	22 29 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich)

April	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
7	46 Virginis	6	21 23	22 6	351 275
7	48 Virginis	6	22 59	0 2†	28 271
8	B.A.C. 4647	6	19 57	near approach	302 —
9	94 Virginis	6	1 12	2 22	59 273

† Occurs on the following morning.

April	h.	
3	13	Mercury stationary.
9	3	Jupiter in conjunction with and 3° 20′ south of the Moon.

Saturn, April 3.—Outer major axis of outer ring = 41″·9; outer minor axis of outer ring = 17″·5; southern surface visible.

Variable Stars

Star	R.A.	Decl.			
	h. m.	° ′		h. m.	
S Persei	2 14·8	58 4 N.	Apr. 9,		*M*
ζ Geminorum	6 57·4	20 44 N.	„ 4,	22 0	*M*
S Cancri	8 37·5	19 26 N.	„ 9,	21 57	*m*
V Boötis	14 25·2	39 23 N.	„ 9,		*m*
δ Libræ	14 54·9	8 4 S.	„ 6,	21 55	*m*
U Coronæ	15 13·6	32 4 N.	„ 6,	20 26	*m*
S Coronæ	15 16·8	31 47 N.	„ 6,		*M*
S Scorpii	16 10·9	22 37 S.	„ 4,		*M*
R Ursæ Minoris	16 31·5	72 30 N.	„ 5,		*M*
U Ophiuchi	17 10·8	1 20 N.	„ 3,	1 52	*m*
			and at intervals of	20 8	
U Sagittarii	18 25·2	19 12 S.	Apr. 5,	3 0	*m*
			„ 8,	2 0	*M*
R Scuti	18 41·5	5 50 S.	„ 8,		*m*
β Lyræ	18 45·9	33 14 N.	„ 3,	21 0	*m*
			„ 7,	2 0	*M*
η Aquilæ	19 46·7	0 43 N.	„ 6,	22 0	*m*
R Sagittæ	20 8·9	16 23 N.	„ 8,		*M*
δ Cephei	22 25·0	57 50 N.	„ 4,	2 0	*m*
			„ 7,	20 0	*M*

M signifies maximum; *m* minimum.

GEOGRAPHICAL NOTES

THE new number of the *Mittheilungen* of the Vienna Geographical Society contains several letters written by Dr. O. Lenz during his journey from Kasonge, on the Upper Congo, and the Shiré River, to the south of Lake Nyassa (June to December 1886). These letters are, to a large extent, occupied with details of the troubles which Dr. Lenz had with his men. Kasonge is a most unhealthy town. Bohndorf, Lenz's companion, was struck down with fever, and had to be carried most of the way, while small-pox broke out among his men, seriously hampering the proper work of the Expedition. Lenz left Kasonge on June 30, and reached the Island of Kavala, off the west shore of Lake Tanganyika, the head-quarters of Capt. Hore, on August 7. On the route he passed many villages recently built by Zanzibaris, the native population having retired into the forests and mountains. The region is mainly an open table-land, sometimes of a beautiful park-like aspect, and with the river-valleys thickly wooded. As Tanganyika was approached, the plateau rose to a height of 3000 to 4000 feet, with mountains rising from its surface to an equal height. The chief rock was granite, with crystalline slates, and wooded spurs. After staying a few days with Mr. Hore, Dr. Lenz crossed to Ujiji, which he reached on August 15. Here he found himself compelled to give up his proposed journey to Emin Pasha, and in a large boat he and his men sailed down the lake to the south shore, which he reached on September 27. Mr. Hore informed him that the Lukuga River now flows with a strong current out of Lake Tanganyika to the Lualaba. Mr. Hore, who has known the lake for ten years, assured Dr. Lenz that during that time its level has fallen 15 feet, and as the latter sailed down the lake he saw clearly enough the marks of the old shore-lines. With difficulty Dr. Lenz obtained assistance on the inhospitable south shore to continue his journey onwards to Lake Nyassa. This route has been traversed several times, and Dr. Lenz does not in these letters add much to our knowledge. It is a plateau with mountains rising from it to a considerable height, and to the south-west of Lake Tanganyika he came upon the sources of the Chambeze, which, flowing into Lake Bangweolo, may be said to form the remotest sources of the Congo. On October 17 he reached Nkonde, on Lake Nyassa, a station of the African Lakes Company, and thence made his way down the lake and on to the River Shiré, whence his last letter is dated, in December 1886.

IN the same number will be found the conclusion of Herr Glaser's paper on his journeys in South Arabia, in which he gives some important information on the various classes of the population. He speaks in the worst possible terms of the climate of the region: highland and lowland are equally bad, and deadly for Europeans.

THE leading paper in the last number of the *Verhandlungen* of the Berlin Geographical Society is Dr. Wolf's account of his important exploring work on the Sankuru, the great southern tributary of the Congo. This he navigated upwards from the Kasai, exploring its three great sources, the Lomomi, the Lussambo, and the Lubi. It is on the whole a magnificent water-way, its banks in many parts thickly wooded and densely populated. He gives much information concerning the two leading peoples here, the Bakutu and the Baluba, both of them evidently intruders on the Batua, the pygmy people referred to in our last number, the former coming from the north-west and the latter from the south-east. Herr Städinger adds considerably to our knowledge of the Niger region in his narrative of his journey from Loko, on the Binué, to the kingdoms of Saria, Kano, Sanfarra, Sokoto, and Gando.

HERR FERDINAND SEELAND contributed to a recent meeting of the Austro-German Alpine Club some useful data on the rate of movement of the Pasterz Glacier. On October 3 last he found the glacier entirely free from snow, and he was lucky enough to find six pegs which he inserted in 1882 near the Hofmann Hut straight across the glacier to the base of the Glockner, and also two stones which he laid down in 1884. In the four years 1882–86 the first peg had moved downwards 121·5 m. (*i.e.* at the rate of 3·5 mm. per hour), the second 162 m. (4·6 mm.), the third 175·5 m. (5 mm.), the fourth 192·3 m. (5·5 mm.), the fifth 201·5 m. (5·8 mm.), and the sixth 198·6 m. (5·7 mm.). Of the stones, in the two years one had moved 104·2 m. (5·9 mm.), the other 100·7 m. (5·8 mm.). According to these results (in the direction from the north edge of the glacier towards the centre), the mean rate of movement on a slope of 4 to 5 degrees is 5·23 mm. per hour, or 125·1 mm. per day. Herr Seeland left the pegs and stones where they were, and laid down other marks for future measurements.

LIEUT. WISSMANN, who has already done so much good exploring work in the Congo region, started in November last on a fresh expedition, from Luluaburg, the station on the River Lulua, an affluent of the Kasai. Wissmann goes first to the junction of the Lubi with the Sankuru, the great southern tributary of the Congo. Thence he will endeavour to push northwards and explore the unknown country in which the Lulongo, the Chuapa, and the Lomami take their sources. He will then seek to reach Nyangwé, when he will make up his mind either to proceed northwards to the Muta Nzigé, or south to explore the Lanji, the Lukuga, and the Upper Lualaba.

THE paper at Monday's meeting of the Royal Geographical Society was by Mr. J. T. Wills, on the region between the Nile and the Congo. It was a summary of all that we know of the region, and places us in a position to appreciate the value of any exploring work which may be done by Mr. Stanley. It deals succinctly with all recent explorations of the Upper Nile region, and with the intervening country between that and the Middle Congo. The valuable work of Dr. Junker, as well as that of Emin Pasha, receives special prominence. Mr. Wills rightly dismisses the Shari hypothesis in connexion with the Wellé-Makua, and insists on the identity of the Makua and Mobangi. The Mobangi is known to be a waterway not inferior to the main Congo for practical purposes; deep, never less than 600 yards wide, even in February, when the Kuta Makua certainly (and it too apparently) is at its lowest level; and navigable at all times from Stanley Pool 650 miles thence straight north-north-east to lat. 4° 20′ N. beyond the limit which the Congo State, by private treaty with Germany, has placed to its future "sphere of operations," and beyond the limits which the French will probably occupy if they win in their dispute with the Congo State as to which of the two shall not operate in the Mobangi basin. It is then found to turn sharply to the east, flowing from the east through a gap it has cut in a line of quartz and red clay hills 1000 feet high, hills which may be continuation of the hilly watershed between the Makua at Ali Kobo and the sources of the Ngala. One would expects rapids at such a place, but there is only a good current and some awkward rocks; after reconnoitering in a boat, Mr. Grenfell got the *Peace* through easily, in February. Where we know the Kuta Makua next, they are placid and colossal; the Shinko at Marra is still 90 yards wide, 20 to 35 feet deep in October, and only 1980 feet above the sea. The average fall thence to Stanley Pool (1070 feet above the sea) is by this only some 9 inches to the mile, and the main Congo appears to nearly maintain this slope up to Bangala, beyond the Mobangi mouth.

BIOLOGICAL NOTES

INJURIOUS FUNGI IN CALIFORNIA.—The following facts recorded by Prof. W. G. Farlow are not without interest in Europe: *Nicotiana glauca*, abundant in Mexico, attracts attention by its pleasing foliage and graceful habit; it is a native of Buenos Ayres, but is acclimatised in Mexico. Within the last few years it has escaped from cultivation in California, and is now a common weed by the roadsides. At San Diego Prof. Farlow noticed that the leaves were badly attacked by a fungus which formed large, grayish-black spots on both sides of the leaves. Examination proved it to be *Peronospora hyoscyami*, De Bary, which was first found on *Hyoscyamus niger*, L., in Europe, where it does not appear to be at all common. Since it is well known that the species of Peronospora attack different species of flowering plants which belong to the same natural order, it is much to be feared that the disease which now attacks *N. glauca* may sooner or later extend to the cultivated tobacco, which belongs to the same genus. If this were to happen, the injury to the tobacco would be very great, since, by causing large spots on the leaves to rot, they would become worthless for manufacturing purposes. The question of the possible spread of the disease is one of importance, for it would be a very serious thing if it were to reach the great tobacco-growing regions of States like Virginia.

FERTILISATION OF CASSIA MARILANDICA.—The relation of insects to flowers continues to be a question of profound interest, but Mr. Meehan thinks that the dependence of a plant on insect aid is rather an indication that, instead of any material aid to its race being gained, its race is nearly run; he thinks that the opposite assumption has been an injury to the study of the main questions on fertilisation, and that the statements of Darwin and Asa Gray do not warrant the generalisations that have been drawn from them. In *C. marilandica* the phenomena attending pollen-formation are curious and apparently little known. The stamens are arranged in different sets. There are three beneath the pistil—the two lateral ones are very strong and equal the pistil in length, the central one immediately beneath the pistil is as long as those on each side, but more slender. Immediately above the pistil are four stamens, with short stout filaments, the anthers being perfectly formed and nearly as long as in the lower set. Above are three petaloid stamens. All the stamens have long black anthers, full of pollen, but which seems never to burst the anther cases. The only opening is at the apex, and this opening is covered by a membrane—never opening except by insect agency. As soon as the flower expands it is freely visited by humble-bees, and, as their loaded thighs evidence, for the pollen. To collect this they alight on the anthers of the long and lower stamens, as on a platform, make an opening in the apex of each of the four shorter ones, and then rifle them of their contents. A mass of plants containing eighty-eight flower-stems was watched on July 30, and the same lot for an hour on August 6, but no attempt was seen to be made by the bees to get the pollen from the longer anthers, or to use them in any way but as a platform. It would be very difficult for the bees to stand anywhere so as to have power to pierce the apical membranes of the longer stamens. When the flowers matured, and the anthers were ready to fall, they were examined, the four short ones were empty sacs, the three lower ones were full of pollen. These latter served no visible object to the flower or its insect visitors. While, however, no pollen could be detected on the stigmatic surfaces, still three out of every twelve flowers yielded a pod, and panicles of flowers covered so as to prevent egress of insects, neither produced fruit nor did a single anther open at its apex. In this case it would appear as if the fertilisation depended on the accident of the extracted pollen escaping from the insect to the stigma, and yet to an ordinary observer this plant would seem one specially arranged for cross-fertilisation. (Proc. Acad. Nat. Sci. Phil. 1886, p. 314.)

VARIATIONS IN THE NERVE-SUPPLY OF THE LUMBRICALES MUSCLES IN THE HAND AND FOOT, WITH SOME OBSERVATIONS ON THE PERFORATING FLEXORS.—Dr. H. St. John Brooks has lately investigated the subject of the varieties in the nerve-supply of the lumbricales. He finds—(1) Discrepancies in the statements of English and Continental anatomists. All these writers appear to be in error about the normal or commonest arrangement of the nerves to these muscles in the foot, and they appear never to have noticed a *double* supply to the third lumbrical in the hand. (2) Varieties of innervation that the author has observed in man, with an account of the nerve-supply in the orang, gibbon, and macaque monkey. He has discovered nerves entering the deep surface of the second (or indicial) lumbrical muscle in both hand and foot; these nerves, he believes, have never before been described: the latter, however, has been seen by Prof. D. J. Cunningham in the foot of a negro, and is recorded by him in his notes (as yet unpublished) of the anatomy of the negro foot. The following statistical table is compiled from the author's notes:—

Table of Variations in the Innervation of Lumbrical Muscles

	Cases
HAND	
First and second by median; third and fourth by deep ulnar	9
Third by median and deep ulnar (others as before) ...	6
Second and third by deep ulnar	1
First, second, and third by median (deep dissection not carried out)	2
Total	18
FOOT	
First by internal plantar; second, third, and fourth by deep external plantar	8

In the orang, gibbon, and macaque, the second lumbrical of the foot was supplied as in the above table. (3) Prof. Cunningham (*Challenger* Reports, vol. xvi.) has shown that, in Thylacinus and Cuscus, the lumbricals of the manus are all supplied on their superficial surface; a similar arrangement is found in the pes of the fox-bat; here, however, the deep external plantar also furnishes twigs to the two outer lumbricales. (4) It appears probable from these facts that the lumbricals were all originally supplied on their superficial surface: the deep nerve (ulnar in hand, external plantar in foot) is, on this hypothesis, gradually displacing the superficial (median; internal plantar). This invasion of the deep nerve has advanced further (in the case of the lumbricals) in the human foot than in the hand. The reverse is the case with the innervation of the short muscles of the pollex and hallux. (5) There is a general correspondence between the innervation of a particular lumbrical muscle and that belly of the long perforating flexor of which it is a part; this fact is best made out in the case of the first or indicial lumbrical of the hand and the indicial belly of the flexor perforans, which are both supplied by the median; it is also seen in the fourth lumbrical and the belly of the long flexor ending in the tendon to the little finger (both by ulnar); also in the third lumbrical and annular belly (both of which have typically a double nerve-supply). In the foot and leg this part of the investigation presents special difficulties, which have, however, in a measure been overcome by minute dissections of the posterior tibial nerve and its branches, conducted under water. (*Dublin University Reports.*)

ON CERTAIN MODERN DEVELOPMENTS OF GRAHAM'S IDEAS CONCERNING THE CONSTITUTION OF MATTER[1]

I.

THERE is a certain fitness in our selecting this place to do honour to-night to the memory of Thomas Graham. For was in the chemical laboratory of this Institution that Graham carried out, upwards of half a century ago, the experimental investigations which culminated in his memorable discovery of the law connecting the rate of movement of a gas with its density. This law, combined with that of Boyle, which connects the volume of a gas with its pressure, and with the law of Charles, which expresses the relations of the volumes of gases to heat, has done more to give precision to our knowledge of the constitution of matter than all the speculations of twenty centuries of schoolmen.

Graham was made Professor of Chemistry in the Andersonian Institution in 1830, and it was from here that he gave to the world his classical paper "On the Law of the Diffusion of Gases," read before the Royal Society of Edinburgh, December 19, 1831. I am fully conscious that my only claim to be regarded as worthy to pronounce this eulogium of Graham arises from the circumstance that I also have had the good fortune to hold the Lectureship of Chemistry in this place; and with forerunners like Birkbeck, Gregory, and Graham, I may well be proud of an honourable and distinguished ancestry. This association with the Andersonian Institution naturally quickened my interest in Graham and his works, and my frequent opportunities of conversation with the late Dr. James Young, of Kelly, who for so many years was its President, and who was, as we all know, also one of Graham's discoveries, and for a long time, both here and in London, one of his most trusted assistants, enabled me to learn much of Graham's personal character and mode of work. On the occasion of the gift of Brodie's fine statue of Graham to the city by Dr. Young it fell to my lot to prepare the short biographical notice of my distinguished predecessor, which, with other papers relating to the matter, is, I understand, deposited in the archives of your Corporation. And I may be pardoned, perhaps, for recalling with what mingled feelings of pride and trepidation I set myself to the execution of that task.

In the preface to the admirable reprint of Graham's papers which we also owe to the filial piety of Dr. Young, the late Dr. Angus Smith has indicated in precise and even luminous language Graham's position in that chain of thinkers which includes Leucippus, Lucretius, Newton, and Dalton. Indeed, of all Angus Smith's papers with which I am acquainted there is none, to my thinking, more charming than this little introductory essay of a dozen octavo pages, in which, with unwonted perspicacity, he has defined Graham's place in the history of speculative philosophy. Angus Smith has here crystallised out, as it were, the thoughts of a life-time of literary research and meditation. Probably, no man—certainly no contemporary of Graham's—was better fitted by knowledge and by sympathy to form a sound critical estimate of such a position than the biographer of John Dalton. Angus Smith's mind was simply steeped in the old Hellenic philosophy. To him even Kapila was more than a name, and the atomic systems of India matters of more than conjecture or of passing interest. There was much in Smith's intellectual nature to make such inquiries congenial to him. With all his leaning towards objective science he had a Highlander's love of the mystical and a Lowlander's passion for metaphysics. And yet nothing is more admirable than the manner in which, in this essay, these qualities and this wealth of learning are subordinated and held in check, and nothing more striking than the way in which, in a few graphic strokes, done with a master hand, lightly yet firmly, with a consciousness of power and a sense of restraint, Graham's place in the evolution of the atomic philosophy is set forth.

It is here claimed for Graham that he was a true descendant of the early Greeks, and that to him belonged as of right the mantle of Leucippus. Atoms and eternal motion were as much fixed articles of his creed as they were of that of Heraclitus. But with no one of the older Greeks was Graham's thought more in harmony than with that of Leucippus. He, with his wider knowledge of the so-called "elemental" forms of matter, and of the persistency with which the specific properties which we associate with our "elements" are retained, could yet share with the old Greek his conceptions of the essential oneness of matter. It was with Graham, as Smith says of Leucippus, that "the action of the atom as one substance taking various forms by combinations unlimited, was enough to account for all the phenomena of the world. By separation and union, with constant motion, all things could be done."

In one respect Graham's position as an atomist is unique: no man before him had dedicated his life to the study of atoms and atomic motion. These fundamental ideas are intertwined to make up, so to say, the silver thread which runs through the work of forty years. They were the dominant conceptions of his life. Even in his earliest paper, published when he was just twenty-one, in which he treats of the absorption of gases by liquids, we are able to detect in the phraseology employed that his mind had been already permeated by the notion of atomic movement. That he should be familiar, even at this time, with the conception of atoms in the Daltonian sense is hardly surprising when we remember that he had already come under the influence of Thomas Thomson, whose place in the history of science is probably that of the first great exponent of Dalton's theory of chemical combination. But the idea of motion was never with Dalton an integral part of his theory, nor, in so far as it was necessary as serving to explain the phenomena of chemical union, was it held by Thomson. And this is the more remarkable when we remember that Dalton had discovered for himself the fact of the molecular mobility of a gas, and that his first glimpses of the truth of his great law were obtained by the study of chemical combination among gases. Graham was doubtless cognisant, in a general way, of the speculations of the early Greeks, but there is no evidence in any of his writings, nor has anything been preserved in the reminiscences of his friends and contemporaries, to indicate that he was knowingly influenced by them.

This continuity of idea is indeed the most striking characteristic of Graham's labours; all his work seemed to centralise round this fundamental conception of atomic motion. "In all his work," says Smith, "we find him steadily thinking on the ultimate composition of bodies; he searches after it in following the molecules of gases when diffusing; these he watches as they flow into a vacuum or into other gases, and observes carefully as they pass through tubes, noting the effect of weight and of composition upon them in transpiration. He follows them as they enter into liquids and pass out, and as they are absorbed or dissolved by colloid bodies, such as caoutchouc: he attentively inquires if they are absorbed by metals in a similar manner, and finds the remotest analogies, which, by their boldness, compel one to stop reading and to think if they be really possible. He follows gases at last into metallic combination, and the lightest of them all he makes into a compound with one of the heavier metals, chasing it finally through various lurking-places until he brings it into an alloy and the form of a medal, and puts upon it the stamp of the Mint. Indeed he is scarcely satisfied even with this, and he finds in bodies from stellar places—in meteoric iron—this same metallic hydrogenium which he draws out from its long prison in the form of a gas. . . If we examine his work on Salts and on Solutions we have a similar train of thought. One

[1] The Triennial "Graham Lecture," given in the Hall of the Andersonian Institution, Glasgow, on March 16, by Prof. T. E. Thorpe, F.R.S.

might have slighted the importance which he attached to the water of salts and the temperature at which it was reduced, but in his hands it was a revelation of some of the most mysterious internal phenomena of these bodies.

"A chemist must take great pleasure in following Graham when he seeks the laws of the diffusion of liquids and traces their connections, especially when they lead to such results as he expressed by dialysis, a process founded on a new classification of substances, and promising still the most valuable truths. We see in the inquiry how Graham thought on the internal constitution of bodies, by examining the motion of the parts, and from the most unpromising and hopeless masses under the chemist's hands—amorphous precipitates of alumina or of albumen—brought out analogies which connected them with the most interesting phenomena of organic life. Never has a less brilliant looking series of experiments been made by a chemist, whilst few have been so brilliant in their results or promise more to the inquirer who follows into the wide region opened."

In a short paper entitled "Speculative Ideas respecting the Constitution of Matter," originally published in the Proceedings of the Royal Society for 1863, Graham has left us his Confession of Faith upon the subjects to which he had devoted the whole of a thoughtful life. He conceives that the various kinds of matter now recognised as different elementary substances may possess one and the same ultimate or atomic molecule existing in different conditions of movement. Graham traces the harmony of this hypothesis of the essential unity of matter with the equal action of gravity upon all bodies. He recognises that the numerous and varying properties of the solid and liquid, no less than the few grand and simple features of the gas, may all be dependent upon atomic and molecular mobility. Let us imagine, he says, one kind of substance only to exist—ponderable matter; and further that matter is divisible into ultimate atoms, uniform in size and weight: we shall have one substance and a common atom. With the atom at rest the uniformity of matter would be perfect. But the atom possesses always more or less motion, due, it must be assumed, to a primordial impulse. This motion gives rise to volume. The more rapid the movement the greater the space occupied by the atom, somewhat as the orbit of a planet widens with the degree of projectile velocity. Matter is thus made to differ only in being lighter or denser matter. The specific motion of an atom being inalienable, light matter is no longer convertible into heavy matter. In short, matter of different density forms different substances—different inconvertible elements as they have been considered.

It should be said that Graham uses the terms "atom" and "molecule" in a wider sense than that which the limitations of modern chemistry have imposed upon them, and that he is referring to a lower order of molecules or atoms than those which more immediately relate to gaseous volume. The combining atoms of which he conceives the existence are not the molecules of which the movement is sensibly affected by heat with gaseous expansion as the result. According to Graham, the gaseous molecule must itself be viewed as composed of a group or system of the inferior atoms, following as a unit laws similar to those which regulate its constituent atoms. He is in fact applying to the lower order of atoms ideas suggested by the gaseous molecule, just as views derived from the solar system are extended to the subordinate system of a planet and its satellites.

We cannot as yet fix any limit to this process of molecular division. To Graham the gaseous molecule is a reproduction of the inferior atom on a higher scale. The diffusive molecules, the molecules or systems which are affected by heat, are to be supposed uniform in weight but to vary in velocity of movement in correspondence with their constituent atoms. Hence the molecular volumes of different elementary substances have the same relation to each other as the subordinate atomic volumes of the same substances.

On this basis Graham builds up a conception of chemical combination. He points out, in the first place, that these more and less mobile or light and heavy forms of matter have a singular relation connected with equality of volume. Equal volumes of two of them can coalesce together, unite their movement and form a new atomic group, retaining the whole, the half, or some simple proportion of the original movement and consequent volume.

Chemical combination thus becomes directly an affair of volume and is only indirectly connected with weight. Combining weights are different because the densities, atomic and molecular, are different. The volume of combination is uniform, but the fluids measured vary in density. This fixed combining measure—Graham's *metron* of simple substances—weighs 1 for hydrogen, 16 for oxygen, and so on with the other "elements."

Graham, however, points out that the hypothesis admits of another expression. Just as in the theory of light we have had the alternative hypotheses of emission and undulation, so in molecular mobility the motion may be assumed to reside either in separate atoms and molecules, or in a fluid medium caused to undulate. A special rate of vibration or pulsation originally imparted to a portion of the fluid medium enlivens that portion of matter with an individual existence, and constitutes it a distinct element or substance.

The idea of the essential unity of matter finds its analogy, to Graham's thinking, in the continuity of the so-called physical states of matter. He clearly perceived that there is no real incompatibility in the different states of gas, liquid, and solid. These physical conditions are, indeed, often found together in the same substance. The liquid and the solid conditions supervene, as Graham puts it, upon the gaseous condition rather than supersede it. They do not appear as the extinction or suppression of the gaseous condition, but as something superadded to that condition. Graham conceives that the three conditions (or constitutions) probably always co-exist in every liquid or solid substance, but one predominates over the others, just as the colloidal condition or constitution which intervenes between the liquid and crystalline states extends into both, and probably affects all kinds of solid and liquid matter in a greater or less degree. Hence, to Graham's thinking, the predominance of a certain physical state in a substance appears to be a distinction analogous to those distinctions in natural history which are produced by unequal development. Liquefaction or solidification does not involve the suppression of the atomic or molecular movement but only the restriction of its range.

Such then are Graham's ideas, formulated in 1863, respecting the probable constitution of matter. I have purposely stated them in great detail, and for the most part in Graham's own words. The paper is very short, but it has evidently been put together with great care. It is impossible not to be struck with the evidence it affords of Graham's insight, his grasp of principles and power of co-ordination. Consider, for example, what he says respecting the continuity of the so-called physical states of matter, and bear in mind upon what an extremely small experimental basis it rested at that time. The observations of Caignard Latour were almost forgotten, or at all events their significance was not understood. The classical work of Andrews was not yet published. And yet this work and that of a dozen experimentalists in France, Russia, and Germany, has only served to confirm and expand Graham's fundamental conception. The whole paper shows Graham in a very different light from that in which the student of to-day might be apt to regard him. The greater number of his memoirs are mainly the records of measurements, but Graham was not a great measurer in the sense in which we apply that term to such men as Regnault, Magnus, or Bunsen. Very little of his work was done by his own hands, and it must be confessed that the earlier experimental portion was occasionally intrusted to apparently inexperienced assistants. Graham had, however, the *forscherblick* which characterises the true investigator, and he possessed a really marvellous faculty of sifting out the small grain of fact which often lay hidden beneath a mass of imperfect observation. And yet he was in no hurry to theorise. He patiently added fact to fact, repeating and verifying his observations long after he had got an inkling of the truth towards which they were tending. He laboured like Faraday, *ohne Hast*, *ohne Rast*, and his work is a monument of patient, concentrated thought, and of a singleness of purpose which never swerved.

"Experimentarian philosophers" of Graham's type (to use a phrase which Hobbes of Malmesbury once flung at the progenitors of the Royal Society) have very similar intellectual tendencies. One is insensibly led to compare Graham with the greatest of our English atomists—John Dalton. If you will turn to Dr. Henry's "Life of Dalton," and read the charming analysis of Dalton's mental characteristics, made by one who knew him well and who had studied him carefully, you will find that practically all that is there stated is equally applicable to Graham. Both men were pre-eminently endowed with the faculty of contemplating abstract relations of space and number, and each began his researches with the expectation that all empirical phenomena were to be brought under the control of mathematical laws. Thus Dalton strove to prove that the changes produced in the gaseous and liquid states of matter vary as the square, cube, or some other simple function of the temperature; Graham, in like manner, sought to show that the movement of his diffusive molecules, whether in liquids or in gases, was related to some equally simple function of their mass. Henry says of Dalton that "his inmost mental nature, and all its outward manifestations were in the language of the German metaphysicians, emphatically subjective. Thus in special or objective chemistry he has left absolutely no sign of his presence; no great monograph on an individual body and its compounds; no memorable analysis of a substance deemed simple into yet simpler elements; no new element—no Neptune—added to the domain of chemistry." Every word of these sentences could be applied with equal truth to Graham. The tendencies of both men were essentially introspective. Each was capable of the most patient concentrated thought and of steady prolonged attention, wholly abstracted from external objects and events. I have heard the late Dr. Young narrate the most extraordinary instances of Graham's power of mental abstraction. Dalton said of himself that, "If I have succeeded better than many who surround me, it has been chiefly, nay, I may say, almost solely, from unwearied assiduity. It is not so much from any superior genius that one man possesses over another, but more from attention to study and perseverance in the objects before them, that some men rise to greater eminence than others."

It seems like a contradiction in terms when we reflect for a moment upon the characteristic features and tendency of his work, to say that Graham, like Dalton, was utterly devoid of the quality we call imagination. Henry says of Dalton that imagination had absolutely no part in his discoveries; except, perhaps, as enabling him to gaze, in mental vision, upon the ultimate atoms of matter, and as shaping forth those pictorial representations of unseen things by which his earliest as well as his latest philosophical speculations were illustrated. Graham would not allow his fancy even that amount of play. Even in the speculative essay from which I have quoted so largely, it seems as if every word had been weighed and every sentence put together with slow laborious thought. This passionless aspect of his work seems to have greatly impressed Angus Smith, himself a man of lively sympathy and of quick susceptibility. "His works," says Smith, "are full of care, but not of joy."

(*To be continued.*)

SCIENTIFIC SERIALS

American Journal of Science, March.—On the absolute wave-length of light, by Louis Bell. The experiments here described were undertaken with a view to check the results obtained by C. S. Pierce for Prof. Rowland's great map of the solar spectrum, and to furnish a value of the absolute wave-length as nearly as possible commensurate in accuracy with the micrometrical observations. For the wave-length of D, at 20° C. and 720 mm. pressure, Mr. Bell obtains 5896·08, or *in vacuo* 5897·71, as compared with 5896·22, Rowland's micrometer measure from Pierce's preliminary result, and 5895·89, Thalèn's correction of Ångström, both in air at ordinary temperature and 760 mm. pressure. But neither of these was corrected for errors in the gratings; hence, obviously, the cause of the discrepancy.—On the relative wave-length of the lines of the solar spectrum, by Prof. Henry A. Rowland. This measurement of the relative wave-lengths of the spectrum and its reduction to absolute wave-lengths by some modern determination has been undertaken in connexion with the photographic map of the solar spectrum on which the author has been engaged for several years, and which is now finished from the extreme ultra-violet wave-length 3200 down to wave-length 5790. Appended are tables of coincidences and of wave-lengths of standard lines.—The norites of the "Cortlandt series" on the Hudson River, near Peakskill, New York (continued), by G. H. Williams. Here are studied the mica norites, the augite norite (hyperite), pyroxenite, and the iron ore and emery in the Cortlandt norite. Owing to incipient alteration, easily visible under the microscope, the West-Chester County emery appears to be of less commercial value than that of Asia Minor.—Natural solutions of cinnabar, gold, and associated sulphides, by George F. Becker. In the course of investigations on the geology of the quicksilver deposits of the Pacific slope, the author has made some studies, here detailed, on the question of the state of combination in which quicksilver is dissolved in natural waters. The solubility of zincblende, pyrite (marcasite), copper sulphides, gold, and other associates of cinnabar, is incidentally examined, the quantitative analysis involved in the process being made by Dr. W. H. Melville.—Fluviatile swamps of New England, by N. S. Shaler. In examining the fresh-water swamps of this region, the author has carefully studied the geographical distribution of those formed along the banks of rivers. Although the inquiry is mainly limited to the post-glacial changes in the valleys trending northwards, much light is incidentally thrown on the pre-glacial altitude of the continent. It is made evident that these valleys could not have been excavated by streams of their present slope; hence the inference that the descent of the northward flowing rivers must have been more rapid in pre-glacial times than at present; in other words, this part of the continent was at that time relatively less elevated in its northern parts than it is at present.—On the Mazapil meteoric-iron which fell on November 27, 1885, by William Earl Hidden.—On observations of the eclipse of August 18, 1887, in connexion with the electric telegraph, by Prof. David P. Todd. Referring to his remarks in the Proceedings of the American Academy of Arts and Sciences for 1881, p. 359, the author points out how the proposed method of telegraphic transmission of important observations might be adopted during the eclipse of August 18 next.—On two new meteorites from Carroll County, Kentucky, and Catorze, Mexico, by George F. Kunz. The Kentucky iron has some ethnological interest in connexion with the ornaments of meteoric iron occurring in the mounds of the Little Miami Valley, Ohio, all apparently belonging to one and the same meteoric fall. The Catorze mass, weighing 92 pounds, was found near Catorze, San Luis, Potosi, in 1885. It is one of the caillite group of Stanislas Meunier, and shows the Widmanstätten lines very finely. Analysis: Fe 90·09; Ni and Co 9·07; P 0·24; with specific gravity 7·509.

Rivista Scientifico-Industriale, February.—On the cause of the electric discharge accompanying thunderstorms, by Prof. G. Guglielmo. The views of Ermann and Peltier are here subjected to close scrutiny, and shown to be inadequate to account for these electric phenomena.—On the variations in the electric resistance of antimony and cobalt in the magnetic field, by Dr. G. Faé. The author's researches show that, apart from the intensity of the observed effects, antimony behaves in the way determined by Righi for bismuth, and cobalt in the way determined by Thomson for iron and nickel.

Rendiconti del Reale Istituto Lombardo, February.—Summary of the meteorological observations recorded in the Brera Observatory, Milan, during the year 1886, by E. Pini. The daily, monthly, and annual means are tabulated for the atmospheric pressure, temperature, rainfall, velocity, and direction of the winds throughout the year.—Meteorological observations for the month of January, 1887, at the same Observatory.

SOCIETIES AND ACADEMIES

London

Royal Society, March 10.—"Note on Induction Coils or 'Transformers.'" By John Hopkinson, M.A., D.Sc., F.R.S.

"Note on the Theory of the Alternate Current Dynamo." By John Hopkinson, M.A., D.Sc., F.R.S.

March 17. — "The Embryology of Monotremata and Marsupialia." Part I. By W. H. Caldwell, M.A., Fellow of Gonville and Caius College, Cambridge. Communicated by Prof. M. Foster, Sec. R.S. (Abstract.[1])

(1) *The Egg-membranes.*—In Monotremata, in very young ova, a fine membrane exists between the single row of follicular cells and the substance of the ovum. This membrane, which I will call *the vitelline membrane*, at first increases in thickness with the growth of the ovum, and through it pass numerous fine protoplasmic processes connecting the protoplasm of the follicular cells with that of the ovum, and serving to conduct food granules, which, appearing in the neighbourhood of the nuclei of the cells, travel thence to the ovum; food granules also appear in the neighbourhood of the germinal vesicle, and travel away from it: hence the horseshoe-shape of the yolk-mass as seen in section.

[1] The author being at the present time in Australia and so unable to correct the proof of this abstract, I have undertaken this duty. In doing so I have ventured, for the sake of what appeared to be increased clearness, to introduce into § 1 some modifications of the author's manuscript, being guided therein by the author's more detailed account given in the fuller paper.—M. Foster, Sec. R.S.

The time during which food granules are thus passing from the follicular cells to the ovum may be called "the yolk forming period."

It is succeeded by a period during which the vitelline membrane again becomes thin, the follicular cells are reduced to a single layer, and the cells are very thin and flat. This period may be called the "absorption of fluid period," since during it the ovum absorbs large quantities of fluid through the thin vitelline membrane and single layer of thin follicular cells, and thereby increases largely in size.

This is in turn succeeded by a third period, during which the follicular cells again become active, multiply, increase greatly in size, and give rise between themselves and the vitelline membrane to a deeply standing homogeneous layer, which I will call *the chorion*. This period may hence be called "the chorion forming period." All these three periods are gone through while the ovum is still in the follicle.

Upon the bursting of the follicle and the reception of the ovum in the Fallopian tube, a few of the follicular cells remain attached to the chorion; the majority are left behind within the burst follicle.

During the passage along the Fallopian tube, the vitelline membrane again increases in thickness, and the chorion, also increasing in thickness, absorbs fluid and becomes *the albumen layer*. Outside this now appears a new structure, *the shell* or shell-membrane, of tough parchment-like consistency,[1] not staining with reagents. I have not yet traced the deposition of the shell to the activity of any special glands; but I can say that the shell-membrane does not increase at the expense of the chorion or albumen layer.

After reaching the uterus both vitelline membrane and shell-membrane increase in thickness, but the albumen layer diminishes and disappears, serving apparently for the nutrition of the ovum. Immediately beneath the vitelline membrane a new layer is now seen in hardened preparations; but it may be shown that this layer is really fluid, yielding a coagulum which stains deeply with reagents, the fluid being apparently derived, through the membranes, from the uterine glands.

In Marsupialia the history of the vitelline membrane, save that "the yolk forming period" is not marked off from the "absorption of fluid" period, is similar to that in Monotremata. I have not been able to trace the beginning of the "chorion" while the ovum is still in the ovary, in Marsupialia; but in an ovum of Phascolarctos from the uterus, I found a chorion like that of Monotremata, and surrounded moreover by a thin transparent membrane—a *shell-membrane*. Within the uterus the chorion, increasing in thickness, becomes transformed into an albumen layer, and is eventually absorbed, passing through the vitelline membrane to nourish the ovum, so that eventually the vitelline membrane comes to be close to the shell.

As in Monotremata, a coagulable, and, when coagulated, deeply staining fluid makes its appearance between the vitelline membrane and ovum (blastoderm).

The shell-membrane persists until the developing ovum becomes fixed to the walls of the uterus, after which it disappears.

The paper then compares the egg-membranes just described with those of Placentalia, and those of Vertebrata generally.

(2) *Segmentation.*—The telolecithal ova of Monotremata and Marsupialia go through a partial segmentation. The ova of Placentalia segment completely, but the resulting blastodermic vesicle is identical with that produced by partial segmentation in Monotremata and Marsupialia.

In Monotremata there is a posterior lip to the blastopore similar to that of Elasmobranchii. The epiblast grows in so rapidly from the sides, that a primitive streak region is formed in front of the posterior lip long before the epiblast has inclosed the yolk. This uninclosed area in front of the primitive streak probably includes a region where the hypoblast (yolk) has secondarily broken through the epiblast. The existence of such a region would hide the position of the anterior lip of the blastopore. The circumference of the circle made up by the larger arc of the edge of the blastoderm on the yolk, and the smaller arc of the posterior lip of the blastopore, is a measure of the quantity of yolk in a meroblastic ovum.

In Marsupialia the epiblastic growth incloses the hypoblast at a very early age, except over a narrow slit in front of the posterior lip of the blastopore. This slit corresponds to the area inclosed by the circle described above in a meroblastic egg. The primitive streak is not conspicuous at an early age because of the large size of the cells. No hypoblast projects through the epiblast in front of the primitive streak region. I would explain the segmentation and the gastrula of Placentalia in the same way. Balfour's objection ("Comp. Embryol." vol. ii. p. 187) to Van Beneden's original comparison of the blastopore of the rabbit with that of a frog, is explained away by the presence of a posterior lip to the blastopore in Marsupialia. My explanation postulates the existence of a similar structure in the rabbit. The blastopore of the rabbit corresponds therefore to the whole area marked out by the growing epiblast and the posterior lip of the blastopore, before the closing of the primitive streak region, or to this area minus the secondary extension, caused by the projecting yolk, in Monotremata.

[1] In the laid egg of Echidna I have not detected calcic salts, but that of Ornithorhynchus gives rise to gas when treated with dilute acid.

Linnean Society, March 17.—Mr. W. Carruthers, F.R.S., President, in the chair.—A recommendation of the Council to present to the British Museum, Kew, and the Oxford Botanical Gardens, the Society's carpological collection was submitted to the Fellows, but not approved by them.—Mr. C. B. Clarke, F.R.S., was elected into the Council in the place of Dr. H. Trimen, who resigned.—Mr. A. O. Walker read a paper on the Crustacea of Singapore. These were collected by Surg.-Major Archer during 1879–83. The species were chiefly dredged in 15–20 fathoms, or got on shallow banks. A full list is given of all the forms identified, and several new species are described. Among these are: *Doclea tetraptera*, *Xanthe scaberrimus*, *Maii miersii*, and *Caphyra archeri*.—A paper was read by Dr. Geo. King, on the genus *Ficus*, with special reference to the Indo-Chinese species. The genus *Ficus* was founded by Linnæus, and included seven species ("Species Plantarum," 1st ed.) Later editions contained 118 species. Blume described 93 Malayan figs, and Roxburgh 55 Indian species. In the "Hortus Cliffortianus" Linnæus clearly comprehended the difference of the sexes, *i.e.*, Caprifig = male, the so-called Fig = female, and *Erinosyce* = hermaphrodite. Vahl seems to have misunderstood the arrangement of the sexes, and Blume apparently followed him. Roxburgh is the first writer who examined minutely the florets of nearly the whole of the species, finding two androgynous and the majority monandrous. Later on Gasparini and Miquel each made a careful study of the flowers of the genus, and separately gave different classifications of the group. Miquel subsequently altered his arrangement, making divisions into six sub-genera, while enumerating 405 Old World, 128 American, and twenty-two species of doubtful nativity. In the "Genera Plantarum" of Bentham and Hooker four of Miquel's sub-genera are admitted, a fifth considered doubtful, and a sixth rejected. These authors regarded Miquel's divisions as too loosely defined, and recommended a re-working of the group. Dr. King goes into a lengthened description of the structural peculiarities of the flowers of the genus *Ficus*. He specifies (1) male, (2) pseudo-hermaphrodite, (3) neuter, and (4) female fertile flowers. Besides these, he states that there occurs in all the species of *Ficus* a set of flowers originally named by himself "*insect-attacked-females*," but for which he has adopted Count Solms-Laubach's term "*gall-flowers*" (*Bot. Zeit.* 1885); the latter botanist having anticipated him in publication, though King's researches had been commenced earlier. King enters into the question of these gall-flowers, stating that, in the majority, the pupa of an insect is present, and this pupa can usually be seen through the coats of the ovary. The pupa when perfected escapes into the cavity of the receptacle by cutting its way through or by bursting these coats; and fully-developed winged insects are often to be found in considerable numbers in the cavity of the fig. The opening through which each insect has escaped from the ovary in which it has been developed is afterwards clearly visible. The pupa of the insect must become encysted in the ovary of the gall-flower at a very early period, for about the time at which the imago is escaping from the ovary the pollen of the anthers of the male flower is only beginning to shed. Now, there is nothing in itself remarkable in the mere occurrence in the genus of numerous flowers having the general form of females, which yet by reason of certain peculiarities in their structure are incapable of fertilisation by pollen practically barren; while at the same time their structural defects fit them for becoming the nidus for the larvæ of special insects. But, when the manner in which these malformed female flowers are disposed in the receptacle is inquired into, it becomes clear that through the interposition of insects these malformed female flowers may play a most important part in the life-history of many species of the genus *Ficus*. Thus from the peculiarities in the structure and arrangement of the flowers, Dr. King is of opinion that the evolutionary history of the genus *Ficus* may be traced. On data derived therefrom he arranges the Indo-Malayan species into two great groups, the second of these being again divided into three subsidiary sub-groups as follows :—

Ficus, Linn.	Group I. Pseudo-hermaphrodite.			Palæomorphe
	Group II. Unisexual	Sect. 1		Urostigma
		Sect. 2		Synœcia
		Sect. 3	A	Sycidium
				Covellia
			B	Eusyce
				Neomorphe

Physical Society, March 12.—Prof. G. Carey Foster, Vice-President, in the chair.—Mr. Shelford Bidwell described some experiments which seem to show that the electrical resistance of suspended copper and iron wires, alters with the direction of the testing current. The apparatus used consisted of a metre bridge with coils of 100 ohms in the gaps adjoining the standard wire, the other two arms being two suspended wires united at the top, to which point one terminal of the galvanometer was joined. A commutator placed in the battery circuit served to reverse the testing current. When a wire is suspended vertically the stress increases from below upwards, and the author believes the observed effects to be due to the absorption of heat by the current as it passes from a stretched towards an unstretched part of a copper wire, and the evolution of heat when it passes from an unstretched towards a stretched part. As the apparatus was arranged the current passed up one side and down the other, heating the one and cooling the other, thus disturbing the position of balance. If iron wires were used the heating and cooling effects were reversed. Prof. S. P. Thompson suggested loading the wires at different points in order to vary the stress without using such long wires, and Mr. C. V. Boys thought still shorter wires could be used by joining the ends to a revolving spindle and stretching them by centrifugal force.—On a lecture experiment in self-induction, by Mr. Shelford Bidwell. A telephone is placed in series with the secondary coil of an induction coil and another coil whose self-induction can be raised by inserting a core of iron wires, or another coil, or both. The effect of introducing the iron core is very marked, reducing the sound enormously. If a coil of wire containing an iron core be inserted, the effect of short-circuiting the coil is to increase the sound in the telephone. The same author also described and showed an experiment due to Dr. Fleming, in which a disk of copper inclined at an angle of 45° to the axis of a coil of wire and suspended bifilarly, is deflected by passing an undulatory current round the coil. In explanation of the former experiment, Dr. Fleming wrote down the formulæ for the effective resistance and self-induction of a circuit near another closed circuit, which show that the former is greater and the latter less for undulatory than for steady currents. He had not arrived at any satisfactory explanation of the deflection of the copper disk. Prof. Ayrton exhibited a tuning-fork worked electrically, in which the pitch could be varied by altering the self-induction of the circuit, or by varying the position of the make-and-break screw. Mr. C. V. Boys referred to his experiments, published in 1884, on the impulse given to metal disks suspended in a magnetic field whose strength is suddenly changed, as being of a similar character to that described by Mr. Bidwell, and suggested the use of aluminium instead of copper in future experiments, owing to its conductivity for the same weight being greater. Prof. Thompson said he had recently used a similar apparatus to that described by Mr. Bidwell as an illustration of the effect of self-induction, and pointed out the uses of self- and mutual-induction in multiplex telegraphy and telephony. As an explanation of the deflection of the copper disk by alternating currents, Prof. Foster thought it possibly due to its initial position being that of maximum sensibility, and therefore each impulse had less effect than the preceding one. Mr. W. M. Mordey mentioned a simple arrangement for varying self-induction used by Mr. Ferranti to control the power of incandescent lamps worked by alternating currents, and Prof. Ayrton described a closed magnetic circuit of great self-induction, used to protect voltmeters on the telpher line at Glynde from disastrous inductive effects produced by breaking the locomotive circuit. Referring to tuning-forks, Mr. Bosanquet thought some self-induction was necessary in order that the current should act to the best advantage in attracting the prongs at the proper instant. Further remarks were made by Mr. Boys and Prof. Perry.—On a lecture experiment to show that capacity varies inversely as the thickness of the dielectric, by Profs. W. E. Ayrton and John Perry. The authors consider it easy for students to see that, other things remaining constant, capacity is proportional to area. Taking this as proved, a condenser is arranged such that the area A of the insulated inner coating varies as the thickness t of the dielectric, and the potential difference between the coatings is found by experiment to be constant. Then since capacity $= \frac{\text{quantity}}{\text{potential}}$, and both the latter being constant, therefore the capacity of the condenser is constant. But by the construction of the apparatus $\frac{A}{t}$ is constant, and it is assumed that capacity varies as A, therefore capacity must vary inversely as t. —Note on magnetic resistance, by the same authors. Two iron rings about 6 inches diameter, made from the same bar of best Swedish iron about half an inch in diameter, were wound with insulated wire in two halves, so that a current could be sent round either or both halves, and the resulting induction measured by the throw of a ballistic galvanometer placed in series with a few convolutions of wire wound round the outside of the main winding. One of the rings was continuous, and the other had a small air space of about 0·8 mm. in a plane perpendicular to that of the ring and passing through its axis, as if the ring had been cut by a saw. The primary object of the experiments, which were made by Messrs. Aldworth, Dykes, Lamb, Robertson, and Zingler, of the Central Institution, was to determine whether there was any appreciable "surface magnetic resistance." The results do not show any such resistance, and the relative resistance of air and iron as calculated from the unsaturated parts are about as 1200 to 1, a number agreeing fairly well with those obtained by other experimenters. From this the authors conclude that for small distances magnetic resistance of air is proportional to length. When the magnetising current was passed round the one half of the divided ring on which the test coil was wound, a greater induction could be obtained than by any other way of magnetising, and this the authors do not attempt to explain. Mr. Bosanquet said he had always found greater inductions obtainable in the middle of bar electro-magnets or open magnetic circuits, than could be produced in closed magnetic circuits, and thought the above observations confirmed his own results. A discussion followed in which Mr. C. V. Boys, Mr. W. M. Mordey, Mr. Bosanquet, and Prof. Perry took part.—On account of the late hour the reading of a note on dynamo machines and motors, by Profs. Ayrton and Perry, was postponed till the next meeting.

Zoological Society, March 15.—Dr. St. George Mivart, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during the month of February 1887.—Mr. Howard Saunders exhibited a young male Harlequin Duck (*Cosmonetta histrionica*), shot off the coast of Northumberland on December 2 last, and remarked that it was the second authentic British-killed specimen in existence.—Mr. Oldfield Thomas read a paper on the Bats collected by Mr. C. M. Woodford in the Solomon Islands.—A communication was read from Mr. W. R. Ogilvie Grant, containing an account of the birds collected by Mr. C. M. Woodford at Fauro and Shortland Islands, in the Solomon Archipelago, and in other localities of the group.—A communication was read from Mr. G. A. Boulenger, containing a second contribution to the herpetology of the Solomon Islands.—Mr. Oldfield Thomas read a paper describing the milk-dentition of the Koala (*Phascolarctos cinereus*), which was shown to be in the same state of reduction as had been described by Prof. Flower in the case of the Thylacine.—A second communication from Mr. Boulenger contained a description of a new Gecko of the genus *Chondrodactylus* from the Kalahari Desert, South Africa, based on a specimen which had been presented to the Natural History Museum by Mr. J. Jenner Weir. The author proposed to call it *C. weiri*.

Geological Society, March 9.—Prof. J. W. Judd, F.R.S. President, in the chair.—The following communications were read :—On *Chondrosteus acipenseroides*, Ag., by Mr. James W. Davis.—On *Aristosuchus pusillus*, Ow., being further notes on the fossils described by Sir R. Owen as *Poikilopleuron pusillus*, Ow. ; on *Patricosaurus merocratus*, Seeley, a lizard from the Cambridge Greensand, preserved in the Woodwardian Museum of the University of Cambridge ; on *Heterosuchus valdensis*, Seeley, a procœlian crocodile from the Hastings Sands of

Hastings; on a sacrum, apparently indicating a new type of bird (*Ornithodesmus cluniculus*, Seeley), from the Wealden of Brook, by Prof. H. G. Seeley, F.R.S. In the last paper, after some remarks on the characters of the sacrum in birds, Ornithosauria, and Dinosauria, the author proceeded to describe a sacrum composed of six vertebræ in the Fox Collection, now at the British Museum, and then to compare the fossil with the corresponding bones of the three groups named. The resemblance to the Dinosaurian and Ornithosaurian sacral vertebræ was less than those which connected the fossil with birds. From the latter it was distinguished by the smaller number of vertebræ in the sacrum, the absence of sacral recesses for the lobes of the kidneys, and the form of the articular face of the first sacral vertebra. But the small number of sacral vertebræ in *Archæopteryx*, the want of renal recesses in *Ichthyornis*, and the characters of the articulation in the Solan goose showed that these differences were not essential; and the author concluded that the fossil belonged to a true bird, but that it formed a link with lower forms, and approximated more to Dinosaurs than did any other Avian type hitherto described.

Chemical Society, March 17.—Dr. Hugo Müller, F.R.S., President, in the chair.—The following papers were read:—The action of heat on nitrogen peroxide, by Dr. A. Richardson.—Supersaturation of salt solutions, by Dr. W. W. J. Nicol. This paper contains an account of experiments on the physical constants of supersaturated and dilute salt solutions. The solutions were examined in two ways: (1) concentration constant and temperature varying; (2) temperature constant and concentration varying; in this way it was possible to pass from dilute to supersaturated solutions, and to examine the change in the various physical constants. The electric conductivity, specific viscosity and rate of expansion were examined by the first method. The specific viscosity and density by the second. In every case it was found that the curve corresponding to the non-saturated solutions was perfectly continuous with that for the supersaturated solutions. From this the author concludes that the constitution of dilute, saturated, and supersaturated solutions is the same. Supersaturation is explained by the hypothesis that the substance in solution is not the same as that which crystallises out. A supersaturated solution of sodium thiosulphate deposited crystals of the composition $Na_2S_2O_3,H_2O$ when evaporated *in vacuo*, showing that the solution does not contain the pentahydrate. The author believes that the salt in solution is combined with the whole of the water, an opinion based on his experiments on vapour-pressures and molecular volumes. Colour changes in solution are not, he believes, due to hydration, but to rearrangements of the salt molecule similar to that which occurs in the case of chromium sulphate. Dr. Nicol's views were criticised by Mr. Pickering and Dr. Armstrong.—The formation of γ-naphthalenesulphonic acid by means of sulphuric anhydride and on γ-dihydroxynaphthalene, by Dr. Henry E. Armstrong and Mr. W. P. Wynne.—α-Cyanonapthalenesulphonic acid, by Dr. Henry E. Armstrong and Mr. S. Williamson.—Addendum to paper entitled an explanation of the laws which govern substitution in the case of benzenoid compounds, by Dr. Henry E. Armstrong.—The transformation of citric acid into pyridine-derivatives, and on the constitution of pyridine, by Dr. S. Ruhemann.—Silver containing bismuth, by Mr. William Gowland.

Royal Meteorological Society, March 16.—Mr. W. Ellis, President, in the chair.—The following papers were read:—Notes on taking meteorological observations on board ship, by Capt. D. W. Barker. The author makes various suggestions as to the placing of meteorological instruments on board ship with the view of securing uniformity.—Marine temperature observations, by Dr. H. R. Mill. After briefly sketching the principal historical methods of observing temperature beneath the surface of the water, Dr. Mill discussed in some detail the relative merits and defects of the two instruments now in common use for this purpose. The self-registering maximum and minimum thermometer on Six's principle, even with the addition of an outer bulb to protect it from pressure, has certain inherent defects. It merely shows the highest and lowest temperatures passed through, the indices are liable to be shaken from their proper position, and it requires long immersion in order to attain the temperature of its surroundings. Mr. J. Y. Buchanan has shown how, by the use of mercury and water piezometers, the actual temperature at a given point may be obtained, no matter how the temperature between that point and the surface may vary. Such instruments have not been much used, and now a modification of the mercurial outflow thermometer, patented by Messrs. Negretti and Zambra as the "standard deep-sea thermometer," is largely used. When fitted in a frame which admits of the thermometer registering at a precisely known depth, admirable results are obtained by it. The manner of using these thermometers in the Scottish frame and of conducting temperature trips in comparatively shallow water was described; and the best ways of recording the observations and elaborating the results were alluded to; the work of the Scottish Marine Station on the Clyde sea area being taken as an illustration. The importance of marine temperature observations as bearing on submarine geography, on navigation, on the distribution of animal life, and consequently on fisheries, was alluded to. The paper was illustrated by diagrams, and by the exhibition of the apparatus which was described.—After the reading of these papers the meeting was adjourned in order to afford the Fellows an opportunity of inspecting the Exhibition of Marine Meteorological Instruments and Apparatus which has been organised under the auspices of the Society.

Victoria Institute, March 7.—The Rev. Dr. Walker read a paper on insect life in the East, in which he gave a full report of his entomological researches in Egypt and the East, and drew special attention to the very great number of British varieties that he had captured in various parts of the world. During the discussion, Dr. Sydney Klein remarked on the value to science of Dr. Walker's labours, and, in regard to insect life in the East at night, said that when passing a night among the ruins of Ephesus he found its superabundance manifested by the actual roar of chirps, scrapings, rattles, hummings, and cries from the country round, quite equalling his experience in the woods of Central America. Mr. Hastings C. Dent gave an account of his observations in South America and elsewhere.

MANCHESTER

Literary and Philosophical Society, January 17.—Prof. W. C. Williamson, F.R.S., in the chair.—Mr. Henry Hyde exhibited a leaf of *Bryophyllum calycinum*, with young plants growing out of the margin.—Dr. Alex. Hodgkinson read a paper on cavities in minerals containing fluid, with vacuoles in motion, and other inclosures.—Prof. W. C. Williamson, F.R.S., gave a practical demonstration by means of sections, shown by the oxy-hydrogen camera, of the structure and development of young roots. Beginning with those of the maize as they appear within the seed, Prof. Williamson exhibited and explained those of the vine, of the bean, of the crown imperial, and of the several species of cycads, illustrating the changes which roots undergo between the uniform structure seen near the root or tip, to their more advanced condition, as seen first in the roots of endogenous plants, and afterwards in the more complicated ones of exogens.

PARIS

Academy of Sciences, March 21.—M. Janssen, President, in the chair.—On the movement of a solid in a liquid, by M. Halphen. A theoretical demonstration is given of the general proposition that this movement consists of (1) a uniform helicoidal motion round a fixed axis in space; (2) a uniform rotation round a fixed axis in the solid; (3) a periodical movement.—On the great atmospheric movements in connexion with MM. Schwedoff, Colladon, and Lasne's cyclonic theories, by M. Faye. The paper is devoted to a refutation of these various theories, which are stated to be mainly due to the confusion caused by failing to distinguish between movements produced artificially in the air or water by a simple rotatory action, and the natural cyclones, tornadoes, waterspouts, &c.; the two orders of phenomena having only an apparent relation to each other.—Some observations and reflections on the earthquake of February 23 at Antibes, by M. Ch. Naudin. At this point of the coast the sea suddenly retired about 3 feet, soon returning with considerable velocity to its normal level. This and the associated phenomena are attributed, not to any volcanic action or to the gases confined in vast subterranean cavities, but to the resistance offered by certain parts of the terrestrial crust to the electricity generated in the globe itself. It is pointed out that these disturbances occur always in districts destitute of forest growths which might serve to discharge the atmospheric electricity, and on this is founded a fresh argument for replanting lands that have become disafforested.—On the red fluorescence of alumina, by M. Lecoq de Boisbaudran. Some experiments are described leading to the inference that this fluorescence is due to the presence of traces of chromium in ordinary alumina, and cannot be produced by the pure earth itself.—Earthquakes in connexion with fire-damp, by

M. F. A. Forel. It is suggested that the series of slight vibrations almost invariably following the first great shocks may tend to cause the escape of fire-damp in mines, and that the precautions against this danger should consequently be redoubled in mining districts within the range of the general disturbance.—On a possible cause of the earthquakes of 1755, 1884, and 1887, by M. A. Blavier. An attempt is made to associate these occurrences with an abnormal accumulation of ice in the Polar waters, causing a deflection of the Rennel branch of the Gulf Stream, attended by great climatic changes and a slight disturbance of equilibrium in the submarine bed, followed by a possible local fracture along the line of least resistance. The in-rush of cold oceanic waters would appear to be indicated by the disappearance of the sardines from the West Coast of Europe in the years in question.—On the employment of gas as a constant source in experiments on radiation, by M. Edouard Branly. In this communication a comparative study is made of the moderator lamp and gas jet, as two sources of mean temperature in these experiments.—On the tartrate of antimony, by M. Guntz. A process is described for preparing in the pure state the acid tartrate of antimony, which Peligot obtains by alcoholic precipitation of a concentrated solution of the oxide of antimony in tartaric acid.—On the presence and quantitative analysis of alumina in wine and the grape, by M. L. L'Hote. The results are given of experiments made to determine the presence in appreciable quantities of antimony in Burgundy, Roussillon, and some other red wines.—Note on some new syntheses in the fatty series by means of the chloride of aluminium, by M. Alphonse Combes.—On the microbe of yellow fever and its attenuation, second note, by MM. Domingos Freire, Paul Gibier, and C. Rebourgeon. In continuation of their studies on this microbe, discovered by them in 1884, the authors describe a process by means of which the virus may be attenuated and converted into a prophylactic vaccine.—Calorimetric studies on sick children, by M. P. Langlois. The experiments here described show that in chronic disorders with hypothermy there is a diminution of caloric, which increases in maladies with hyperthermy.—On certain characteristics of the pulse in morphiomaniacs, by Messrs. B. Ball and O. Jennings. The observations here illustrated by sygmographic tracings serve both to detect the practice in patients secretly addicted to the taking of morphia and to remove the craving for intermittent doses.—Mineralogical study of the Fort Duncan meteoric iron recently presented to the Paris Natural History Museum, by M. Stanislas Meunier. The analysis of this specimen, found in 1882 near Fort Duncan, Maverick County, Texas, shows a remarkable resemblance to the mass which fell at Braunau, Bohemia, on July 14, 1847. It yielded: iron, 92·02; nickel, with traces of cobalt, 6·10; residuum, 1·80; density 7·699.

STOCKHOLM

Royal Academy of Sciences, February 9.—The following papers were accepted for insertion in the Proceedings of the Academy:—On the so-called anomalous dispersion, by the late Colonel C. E. af Klercker. On benzol and toluol monosulcombinations, by Dr. Mats Weibull.—The Lettersted Prize for 1887 for the best original scientific work was awarded to Prof. F. A. Smitt for his "Critical Index of the *Salmonidæ* in the National Museum," whilst the amount of the same legacy for special scientific work was awarded to Prof. A. G. Nathorst for his researches on the Tertiary flora of Japan.—The Secretary announced that the Proceedings of the Academy for 1886 were completed, and that the first part ("Aurores boréales") of Series II. of the work "Observations faites au Cap Thordsen, Spitzberg, par l'Expédition Suédoise," published at the expense of the Academy, was issued.—The following two papers were also presented by Prof. Berlin:—On six isomeric acids of toluol disulphone, by Dr. P. Klason. On the substitution of the amido group in aromatic combinations for hydrothion as well as oxysulphuryl by means of diazo combinations, by the same.—Prof. Edlund advanced a strictly mathematical demonstration showing the correctness of his theory regarding unipolar induction.—Prof. Gyldén presented the following papers:—Untersuchungen über einen speciellen Fall des Problems der drei Körper, founded on studies at the Stockholm Observatory, by Dr. P. Harzer, of St. Petersburg. On the absolute correctness of terms of expression employed by Prof. Gyldén in order to solve the problems of three bodies, by himself, which paper will shortly appear in the *Acta Mathematica*.—Prof. Smitt announced the appearance of a new edition of the illustrated work "Skandinaviens Fiskar" ("The Fishes of Scandinavia"), in which are a number of original drawings by Herr W. von Wright, belonging to the Academy, which have never been published before. He also presented the first report of the Ornithological Committee appointed by the Academy.—Prof. Mittag-Leffler presented the following papers:—On convergents to definite integrals, by Herr C. B. S. Cavallin. On a treatise by Ascoli relating to the integration of the differential equation $D^2u = 0$ for a given Riemann surface, by Dr. G. Eneström. Integration der differential Gleichung $D^2u = 0$ in einen beliebigen Riemannischen Fläche, by Prof. Giulio Ascoli, of Milan.—The Secretary presented the following papers for insertion in the Proceedings:—On the influence of chlorium on α-acetic naphthalid, by Prof. Cleve. On naphthalid acids, by Dr. A. G. Ekstrand. On α- and β-naphthamidoxim, by the same. On the resin acids in galipot, by Dr. A. Westerberg. On pteropods in the Zoological Museum of the Upsala University, collected by Capt. G. von Scheele, classified by Dr. H. Munthe. Notes on Permian fossils from Spitzbergen, by Prof B. Lundgren. Einfluss der Neutralsalze auf die Reactionsgeschwindikeit der Verseifung von Actylacetat, by Dr. S. Arrhenius.

BOOKS, PAMPHLETS, and SERIALS RECEIVED

Ligaments, their Nature and Morphology: J. B. Sutton (H. K. Lewis.)—School Hygiene: Dr. A. Newsholme (Sonnenschein).—Atlantic Weather Charts, part 1, from August 1 to November 7, 1882 (Stationery Office).—Electrical and Anatomical Demonstrations: Dr. H. Tibbits, (Churchill).—Memoirs of the Literature College, Imperial University of Japan, No. 1; The Language, Mythology, and Geological Nomenclature of Japan, viewed in the light of Aino Studies: B. H. Chamberlain and J. Batchelor (Tōkyō).—Verhandlungen des Naturhistorischen Vereines, Zweite Hälfte (Max Cohen, Bonn).—Colonial and Indian Exhibition; Reports on the Colonial Sections: Edited by H. T. Wood (Clowes).—Monthly Results of Observations made at the Stations of the Royal Meteorological Society for the Quarter ending September 30, 1886 (Stanford).—Instantaneous Photography for Amateurs (Seers, Bath).—General Guide to the British Museum, Natural History.—Quarterly Journal of the Royal Meteorological Society, January 1887 (Stanford).—Studies from the Biological Laboratory, Johns Hopkins University, vol. iii. No. 9.

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