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" *To the solid ground*
Of Nature trusts the mind which builds for aye."—Wordsworth

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Reviews and Our Bookshelf.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground
Of Nature trusts the mind which builds for aye.*"—WORDSWORTH.

THURSDAY, MARCH 4, 1909.

ASPECTS OF MODERN SCIENCE.

Science in Modern Life. By several authors. Edited by Prof. J. R. Ainsworth Davis. Vol. i. Pp. xvi + 188. Vol. ii. Pp. viii + 187. (London: Gresham Publishing Co., 1908.) Price, each volume, 6*s.* net.

IT is intended in this work, which will be completed in six super-royal octavo volumes, to survey the whole ground of science in its modern developments and aspects, and to present the results in language capable of being comprehended by lay readers. "Briefly," the prospectus states, "its aim is to give a connected account of present-day science, with special reference to its influence on modern life." A number of illustrations in the text, and many full-page plates—some in black-and-white, and others in colour—add to the interest and attractiveness of the work.

In the first volume, Mr. A. C. D. Crommelin deals with astronomy, and Mr. O. T. Jones with geology. In some respects the treatment of both subjects is reminiscent of text-book style. There can, indeed, be little difference between a good text-book and a work of this character: the fault of both, from the point of view of the average reader, is that of attempting too much. The student desires conciseness and comprehensiveness in his science manuals, but for the general reader these qualities should be subservient to that of lofty and stimulating thought. Unless this is borne in mind, a work upon any branch of science must become chiefly a catalogue of facts and theories no more interesting than a Hebrew genealogy.

The opening volume cannot claim a high place as an apostolic statement of the scientific spirit, or as a work distinguished by scope or style from a multitude of others. It is, however, an accurate and orderly record of the chief results of scientific inquiry in the domains of astronomy and geology; and as such it should achieve success. Mr. Crommelin devotes more attention to modern problems of astronomy than is usually the case, and has managed to compress a large amount of information in the seventy-one pages taken up by his section of the volume. Readers acquainted with the principles of physics will follow with interest the work described, but without this knowledge some parts will be unintelligible. For instance, about a dozen lines are devoted to the spectroscope and spectroheliograph; and it is obvious that unless the reader knows something more about these instruments, clear ideas as to the meaning of the results obtained by them can scarcely be anticipated. Mr. Jones begins with denudation and deposition, and passes to earth movements and igneous and metamorphic rocks, and cycle of denudation; he then indicates how the geographies of past ages can be reconstructed, and describes the changes and characteristics of the various periods. A good series of full-page maps, and a coloured geological map of the British Isles, are valuable aids to the study of the text.

The second volume contains the conclusion of Mr. Jones's treatment of geology, a contribution on chemistry by Mr. J. P. Millington, and one on physics is commenced by Mr. J. H. Shaxby. As Mr. Millington has essayed to present the most prominent points of organic, inorganic, and industrial chemistry in about 40,000 words, his task has been a difficult one, but his performance of it is very creditable. Whether the significance of some of the statements made—particularly in the treatment of organic chemistry—will be understood without a preliminary study of the subject must be left to individual experience to decide. The noteworthy characteristic of Mr. Shaxby's chapters on measurement, motion, properties of matter and heat, and, indeed, of the greater part of the work, is the attention given to modern research and thought.

In a work by several authors, equality of treatment and the ability to distinguish between the essential and unessential can rarely be secured from all contributors; and no greater success in this direction can reasonably be hoped for than that realised in the present volumes. At the same time, we may remark that the three sections so far completed differ from each other in scope and style; one suggests the text-book, another is too systematic to be of interest, and the third is difficult to follow in parts except by readers having some acquaintance with the subject. Probably the work will be best read and appreciated by readers who have already acquired a rudimentary knowledge of scientific principles and desire to know something of the problems and positions of branches of natural knowledge beyond the boundary of their own experience.

A sectional model of the frog, showing the external and internal parts of the animal, and its development from the fertilised egg to the stage in which the tail of the tadpole has nearly disappeared and the hind- and fore-legs are present, is presented with the second volume. The model should be of assistance in suggesting instructive observations to the student or teacher of natural history.

When the work is completed it will form a very useful compendium of pure and applied science, and should find a place on the shelves of many libraries. The editor is to be congratulated upon the plan, and the publishers upon the attractive form in which they have executed it.

THE EXPERIMENTAL METHOD IN ZOOLOGICAL RESEARCH.

Experimental Zoology. Part i., Embryogeny: an Account of the Laws governing the Development of the Animal Egg as ascertained through Experiment. By Dr. Hans Przibram. Pp. viii+124; 16 plates. (Cambridge: University Press, 1908.) Price 7*s*. 6*d*. net.

THE publication of a new work on experimental zoology is a sign of the times. Until comparatively lately the experimental method was not widely adopted in the pursuit of zoological inquiry. The morphologist, as a general rule, confined his attention to the form and structure of animals and the changes through which these pass in the progress of individual development, without regard to the different ways in which form and structure arise in embryogeny and the forces which control the modes of growth.

The founding of the *Archiv für Entwickelungsmechanik* was a new departure in serial zoological literature, and served to emphasise the growing importance of that branch of study which is called developmental mechanics, while the subsequent issue in America of a new journal, *The Journal of Experimental Zoology*, in which the range of subjects discussed is somewhat more extensive, was a further advance in the recognition of the experimental method as a means of zoological research. Still more recently Prof. T. H. Morgan has published a volume on "Experimental Zoology" in which he deals not only with problems of animal morphology, but with others which are in their essential nature physiological. But physiology, as ordinarily understood, still tends to signify human physiology, and the study of function in the lower forms of life, excepting in so far as it serves directly to elucidate the vital processes of the higher animals, and more particularly man, remains as yet a much neglected department of biology.

Experimental zoology may be held to comprise all those branches of zoological inquiry, whether morphological or physiological, which are conducted by observation combined with experiment. That the fundamental problems in biology cannot be solved without recourse to the experimental method is a generalisation which zoologists have been a little slow to accept, and the complete absence in this country (and, indeed, in nearly every country) of experiment stations where animals can be kept under constant observation in a natural and healthy environment is a circumstance which contrasts strangely with the comparative wealth of equipment in other branches of observational science. It is greatly to be hoped, therefore, that the appearance of such works as Dr. Hans Przibram's, which is to treat of all departments of experimental zoology, will be the means of compelling greater attention to the pressing needs of this branch of study.

We are told in the preface that the work is to be issued in five parts, each of which is to be complete in itself. The present volume deals with fertilisation and the first development of the individual organism without regard to its origin; the phenomena of regeneration are to be discussed in part ii.; variation and heredity in part iii.; the growth of the developed organism and the relation between the cell nucleus and the cytoplasm in part iv.; while the last volume is to be devoted to general physiological problems, including that of sex. The part now under notice is an English translation by Miss Hertha Sollas of a German edition published last year.

We are informed at the end of the preface that "the author has read the proofs [of the translation] and has made such additions as were necessary to bring it up to date." Nevertheless, we cannot refrain from remarking on the absence of any reference to several not unimportant papers that have appeared in recent years, and in our opinion the first chapter is calculated to convey a wrong impression of the present state of the fertilisation problem. Thus it is recorded that Winkler succeeded in fertilising sea-urchin ova with the extracted juice of spermatozoa, but there is no mention of the subsequent work of Gies (published so long ago as 1901), which showed that Winkler's results were due to osmotic influences, and not to the action of the sperm extract. Gies's interpretation has since been accepted by Loeb, while Pichou's results (published in 1905) were confirmatory of those of Gies. There is at present no experimental evidence that spermatozoa contain specific substances which, when extracted, are capable of fertilising ova. Again, in the italicised conclusion at the end of the first chapter we read that

> "the cause which determines the transition of the resting animal egg cell to a state of progressive development must be sought in an acceleration of the vital processes which, even in the resting egg, are always going on."

Loeb, however, has pointed out (1906) that if such a conclusion were correct, normal sea-urchin eggs should segment if kept for a sufficiently long period, and, further, that it ought to be possible to induce segmentation by heat, since heat is known to accelerate chemical reactions, but neither of these results could be obtained. Loeb has suggested, therefore, that the spermatozoon, in conjugating with the ovum, may very possibly remove from the latter a negative catalyser or condition, the presence of which in the ovum somehow inhibits the process of development. Strangely enough, the present work contains no account of Loeb's conclusions in regard to this matter.

Delage's recent paper (1907) is referred to in a couple of lines, but there is no mention of the fact that his latest method of artificially fertilising sea-urchins' eggs differs radically from those employed by Loeb, and consequently there is no reference to the very important conclusions which Delage deduces from his results. Moreover, we should have expected an allusion to the fact that the symmetry of the sea-urchins which Delage succeeded in rearing was hexameral instead of pentameral, an observation which seems to us to have an important bearing on recent Mendelian research and teaching. Furthermore, the statement on another page that Delage has described half the ordinary number of chromosomes for parthenogenetic echinoderms is misleading, since this author says distinctly that in such cases the normal number becomes restored by a process of "auto-regulation."

The account given of fertilisation is followed by interesting chapters on egg-structure, mitotic cell division, gastrulation, the mechanism of the development of differentiation, and the influence of external factors. We have no space left in which to criticise these. Although we have not refrained from pointing out certain shortcomings, this does not prevent us from congratulating both author and translator on the production of what is, on the whole, a very useful summary of embryogenetic research.

Francis H. A. Marshall.

MODERN PHARMACOGNOSY.

Handbuch der Pharmakognosie. By Prof. A. Tschirch. Parts ii. to viii. (Leipzig: Chr. Herm. Tauchnitz, 1908.) Price 2 marks per part.

THE general scheme of this important work on pharmacognosy having been described in a previous issue of Nature (vol. lxxviii., p. 629, October 22, 1908), the manner in which the scheme is being carried out may now be examined.

The bulk of the first four parts, in all about 116 pages, is devoted to "pharmacoergasy," that is, the cultivation, collection, and preparation of drugs. Numerous instances, perhaps not very systematically arranged, of the cultivation of drugs in remote ages are cited, and accounts are given of modern attempts to acclimatise important medicinal plants. The great problem of pharmacoergasy is, according to the author, the determination, not only of the conditions of growth simply, but also of those conditions that most conduce to the formation of valuable constituents, a problem which presents a boundless field for investigation. The irrationality of a number of the processes at present in use for drying drugs is indicated, and suggestions made for their improvement.

The times at which leaves and other organs should be collected are stated in general terms, but doubt may well be expressed whether these are not in several, perhaps many, instances incorrect; at least they have not been sufficiently substantiated either by chemical or biochemical assay. To allude to definite instances, it has recently been well established by the physiological experiments of Dixon supporting the assays of Fromme that the first year's leaves of the foxglove are practically of equal value with the second year's, although Prof. Tschirch would reject them as worthless. Chemical assay has also demonstrated the practical equality of the first and second year's henbane leaves, and probably also those of the annual plant were the leaves only of the latter collected and properly dried. Even the best period for the collection of aconite and belladonna cannot yet be regarded as firmly established. Schroff may well have been the first to indicate the time at which hemlock fruits should be gathered, but the admirable researches of Farr and Wright determined the point definitely by analysis.

In this section enzymes and their influence are considered, though perhaps more emphasis might be laid on their prejudicial action, and on the means now generally advocated and adopted for obviating it. A most comprehensive list of the plants cultivated in Europe and the United States is included in this part of the work, as well as a chapter on the collection of drugs, well illustrated by a number of photographs. The preparation of drugs is discussed at some length, and consists practically of well-known processes which are commonly given under each drug, but are here collected together.

Part iv. deals with "pharmacoemporia," or the commerce in drugs, a section of pharmacognosy which has until lately been only too much neglected, though of the greatest interest. Here the various routes that commerce between the East and the West has taken from ancient to modern times are briefly, though not too lucidly, traced and explained by three maps. Excellent accounts are given of the drug sales in London, Hamburg, and Amsterdam, those in London being accompanied by several illustrations identical with those first published in the *Pharmaceutical Journal* by Mr. Heap, an acknowledgment for which has doubtless escaped the author. Photographs of the most important harbours of the world illustrate this section of the work.

The commercial varieties of drugs and the packages in which they are exported form the chief subject of part v. In part vi. the advantages and disadvantages of the various pharmacognostical systems of classification that have from time to time been proposed are fully discussed, the author being in favour of one based upon the chemical relationships of the chief constituents, though he admits that such a system is at present impracticable, as the constitution of so few of the constituents is sufficiently well known. For all teachers of pharmacognosy the chapter on instruction in the science will probably possess the greatest interest; it certainly deserves to be most carefully studied, as it is replete with stimulating suggestions. Most welcome will also be the abundant literary references, constituting the first bibliography of pharmacognosy.

Pharmacozoology is very briefly dealt with, and stands in sharp contrast with the rest of the work. Considering the success that has attended the development in recent years of organotherapy, it is difficult to understand why such widely used parts of animals as the thyroid gland, suprarenal capsule, &c., and such products of animals as pepsin, pancreatin, wool fat, &c., have been excluded from the animal drugs enumerated by the author.

All the parts of the handbook that have appeared are most profusely illustrated, and Prof. Tschirch must be congratulated on the excellence of his work.

HENRY G. GREENISH.

SCIENCE IN THE TEXTILE INDUSTRIES.

The Structure of the Wool Fibre and its Relation to the Use of Wool for Technical Purposes. By Dr. F. H. Bowman. Pp. xx+475; with many coloured and other illustrations. (London: Macmillan and Co., Ltd., 1908.) Price 8s. 6d. net.

THIS is a companion volume to the one on "The Structure of the Cotton Fibre," which was reviewed in these columns in July, 1908, and is to be followed by a third volume dealing with the silk fibre. The subject-matter is treated in a very thorough manner, commencing with a description of the structure of the skin and the genesis of the hair or wool fibre which clearly indicates the mode of its subsequent development. The physical structure of the fibre determines its behaviour during the various mechanical processes of spinning and weaving; and this important point is well brought out in the valuable and interesting portion of the book devoted to it.

Thirty-two distinct varieties of sheep are described, of which four are inhabitants of Europe, fifteen of Asia, eleven of Africa, and two of America; but there appear to be at least thirty-one subvarieties of the common sheep (*Ovis aries*), some of which differ to a greater extent than certain sheep which are regarded as distinct varieties. It is considered probable that all varieties were originally derived from two—the long- and the short-tailed sheep—both of which in the wild state grow an outer covering of hair and a softer, finer inner covering of wool, the latter increasing and the former being gradually eliminated by domestication.

The domestic sheep was first produced in Asia, and spread thence to Europe with advancing civilisation, its introduction into Greece being probably enshrined in the legend of the golden fleece.

The scientific breeding of sheep was first systematically carried out in England, but is now practised in all the important sheep-rearing countries. In this connection it is interesting to note the effect of the frozen-meat trade on the production of wool. Before the introduction of cold-storage transit, the carcase of the sheep at the Antipodes was of much less value than it is to-day. Sheep farmers therefore confined their attention to breeding for wool, but now have to pay more regard to the production of good mutton, the fleece being relatively less important.

In dealing with the question of sheep-dips, which are necessary on account of the parasites which infect all animals with a hairy or woolly covering, the author very properly condemns all compositions containing tar, or lime and sulphur, and advocates arsenical dips. The important question of the preparation of wool for the market receives, as it deserves, full attention, and the recommendations of the Wool Trade Committee of the Bradford Chamber of Commerce are given in full. Briefly, the trouble is caused by the presence of vegetable matter in wool, which may arise from want of care in packing or lack of cleanliness in the shearing house. The importance of this matter arises from the fact that the vegetable matter may accompany wool fibre throughout the whole of the manufacturing operations, and, on account of its very differing dyeing properties, may greatly detract from the appearance of the finished material even when present in very small amount.

The investigation of the mechanical structure of the wool fibre is traced back by the author to 1664, in which year a Dr. Hook read a paper before the Royal Society on the structure of various hairs, but, of course, the power of his microscope was very limited. About 1690 Leeuwenhoek published several illustrations of the microscopical structure of wool, and in 1742 H. Baker also read a paper on the subject before the Royal Society; but a Mr. Youatt, in 1835, using a compound microscope with a magnification of 300 diameters, claimed to have been the first to discover the true nature of the surface of the wool fibre.

The author of the present volume was, however, the first to make a systematic and comparative study of the microscopic structure of wools of various origin and at various stages of growth, and his illustrations, which are reproduced in the book, have for many years been considered as standards, and have been reproduced in most text-books dealing with wool manufacture or dyeing.

The description of the chemical nature and properties of wool is not so exhaustive or quite as satisfactory as that portion of the book dealing with the mechanical structure, but the chapter on the strength and testing of worsted yarns is excellent, and emphasises the importance of spinners and manufacturers making full use of such scientific aids as are now available.

The chapter on the theory of dyeing and colour is the least satisfactory in the book, and the excellent coloured diagrams represent the only feature which warrants inclusion.

The book is one of considerable importance, and will doubtless take the position of a standard work in the libraries of all connected with the textile industries.

WALTER M. GARDNER.

TREATMENT AND DISPOSAL OF SEWAGE.

(1) *Principles of Sewage Treatment.* By Prof. Dunbar. Translated by Dr. H. T. Calvert. Pp. xxiii+271. (London: Charles Griffin and Co., Ltd.) Price 15*s.* net.

(2) *Sewer Construction.* By Prof. Henry N. Ogden. Pp. xii+335. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 12*s.* 6*d.* net.

(3) *Modern Methods of Sewage Disposal.* By W. H. Trentham and J. Saunders. (London: Sanitary Publishing Co., Ltd., 1909.) Pp. viii+60. Price 2*s.* 6*d.* net.

(1) THE development of the investigation into sewage purification has proceeded on different lines in England and Germany, owing largely to the fact that practical necessities have compelled English towns to attempt some measure of purification in the absence of complete scientific information, whereas it has been possible in Germany to devote, in the first place, more attention to the theoretical aspect of the problem.

The author of this book is one of the foremost among German investigators, and consequently it cannot fail to be received with interest by those engaged in the problem of sewage purification in England; it fills a place in the literature of the subject, the requirements of which no existing work completely satisfies.

Presumably the favourable situation of many Continental towns in regard to the discharge of sewage into rivers of relatively large volume is responsible for the fact that the theory of sedimentation and technique of screening has received more attention in Germany than in England, as in certain cases thorough screening or efficient sedimentation of the sewage is all the prevailing conditions require. Where further biological treatment is necessary, it is doubtful, however, whether any elaborate screening device can be considered economical.

On pp. 47 to 59 a series of interesting and ingenious methods for screening sewage is described, and, later, valuable experiments of several German investigators are quoted with regard to the effect of varying rates of flow on the deposition of the suspended solids.

The author's conclusions in regard to the design of sewage sedimentation tanks, viz. that shallow tanks of simple construction are, as a rule, preferable to tanks of great depth, will doubtless meet with general approval.

When dealing with septic tanks the author's conclusion is that preliminary anaërobic treatment, so far from being beneficial, is actually detrimental to subsequent filtration, and he supports this conclusion by the statement that organic matter can be nitrified without the preliminary production of ammonia.

In view of the fundamental importance of this latter point, and that the author's results are not in accordance with those of Adeney, Boulanger and Massol, and other workers, it is disappointing that particular experiments are not given or specific references quoted.

It may be here mentioned that the value of the extensive bibliography given at the commencement of the book is very considerably diminished by reason of the fact that no reference is made to the text of the book, and in the majority of the cases the subject-title is omitted; this is true for all references to the author's own publications.

The absorption theory of sewage purification, which is now generally accepted as affording the most rational explanation of one of the important phases in the biological purification of sewage, is very thoroughly dealt with on pp. 140 to 149, although the experiment given previously in regard to the time of passage of sewage through a filter cannot, on account of insufficient data, be considered conclusive. W. Clifford[1] has shown in a thorough manner that this question is dependent on the following factors:—(1) Rate of application of sewage; (2) depth of filter; and (3) interstitial water, which is determined by the size and character of filtering material. As an example of what may occur in a fine-grade filter he found, when liquid was applied at the rate of 200 gallons per sq. yard to a filter 3 feet deep, composed of clean clinker $\frac{1}{8}$ inch to $\frac{3}{8}$ inch size, the average time of percolation was rather more than three hours.

The chapter on contact beds is, in the opinion of the reviewer, one of the most valuable sections of the book, as it contains a series of interesting and complete experiments, the results of which help in the elucidation of the purification changes effected.

In view of the fact that the author appears to be in favour of complete aërobic treatment, it is somewhat surprising to find that Dibdin's slate filters are dismissed as irrational, although their object is to retain the suspended solids in such a manner that aërobic decomposition may be effective.

In general, the author favours the adoption of percolating filters, but in stating their disadvantages he omits the question of production of flies and increased fungoid growth, attendant on certain types of these filters. The use of a carefully graded layer of fine material on the surface of a filter, as a means of distribution, as recommended by the author, is supported by a considerable body of experience, both in this country and on the Continent.

Dr. Calvert is to be congratulated upon an admirable translation.

(2) A course of lectures given by the author in the College of Civil Engineering, Cornell University, forms the basis of this book, which is published as a continuation of a previous work of the author's on "Sewer Design."

Outstanding features of the book are the large number of well-produced diagrams and drawings, illustrative of a great variety of constructional work carried out in various towns in America, and the numerous references, which the engineering student will find very useful.

In view of the present tendency in America to use reinforced concrete for the construction of large sewers, the various examples of this class of work described in chapter vi. will be of interest to the English engineer.

1 Proc. Inst. C.E., vol. clxxii., part ii.

Although the book is written from the point of view of American practice, and consequently certain sections, such as the chapter on estimates and costs, will not be found so useful to English workers, the general information on constructional work, which is mainly descriptive, should be found helpful by students and those engaged in English practice.

(3) The authors have performed the unenviable task of condensing the whole problem of sewerage and sewage disposal within fifty-six small pages, in such a manner as to give the lay mind a good and, on the whole, fairly accurate elementary idea of the subject. It necessarily follows that the information afforded will not be found so useful to those actually engaged in sewage work.

In view of the adverse opinion expressed in Dunbar's "Principles of Sewage Treatment," it is interesting to note that the authors strongly advocate the preliminary treatment of sewage in aërobic slate filters.

EDWARD ARDERN.

OUR BOOK SHELF.

Explication mécanique des Propriétés de la Matière, Cohésion, Affinité, Gravitation, &c. By A. Despaux. Pp. 352. (Paris: Félix Alcan, 1908.) Price 6 francs.

THIS is an attempt to explain everything in terms of a mechanical hypothesis. The universality of application of his hypothesis is scarcely conveyed by the author in the title he has given to his book. Not only cohesion, affinity, gravitation, but also biological and psychological problems are brought within its range. What differences of opinion, therefore, may we not expect from those who read its pages! Such far-reaching generalisations must be backed up by exceptionally strong evidence before their acceptance can be reasonably entertained.

The author seems to anticipate that it will not be easy to secure adhesion to his views. He has little respect for what we may call the grand reserve of science. Official science, he says, is essentially conservative. When a discovery is made, it is said at first that it is not true; and then that it is not new. To some extent he is able to justify his belief in the "resistance" of science. Said Lavoisier, "I do not expect that my ideas will be adopted all at once." While he explained combustion by a simple combination, the partisans of phlogiston burned his effigy in Berlin. Avogadro received no attention from the French Academy, to which he presented his memoir, and it was only twenty years afterwards that he obtained recognition. Sadi Carnot's memoir remained unknown until, after twenty-four years, Lord Kelvin rescued it from oblivion.

Our author, therefore, does not expect impartiality from his contemporaries; it scarcely seems worth while to state our opinion upon his views. We will be content with indicating that he attempts to show that everything can be explained by supposing the molecule to consist of a sort of corkscrew which, spinning, sets up whirls and streams in the æther which he likens to those produced by a ventilating fan. If the molecule is "free," then by its own rotation it propels itself in space "like a fish in water or a bird in the air." It is then part of a gas. When it is part of a solid it is fixed in position, but by its rotation propels æther in front and sucks it in behind. This flow of æther through the molecule constitutes the electric charge; and so on; but for the remainder of this explanation of the universe we must refer the unbiassed reader to the volume itself.

Leçons de Physique générale. By J. Chappuis and A. Berget. Tome I. Second edition; completely revised. Pp. xii+669; illustrations. (Paris: Gauthier-Villars, 1907.) Price 10 francs.

IN a publishers' note it is claimed that the intention of this work is to fill up the gap between elementary treatises and those in which the exposition of physics is carried to its highest developments. With regard to any such works, of which numerous examples might be cited outside France, we may say there must necessarily be considerable resemblance one with another. It is in the higher developments that originality can come chiefly into evidence; so that it is not in any derogatory spirit that we assert that there is much in this book which can be obtained elsewhere, and which in such other places is as well presented as we find it here. But it would give quite an erroneous notion as to the contents of the volume if we were to be content with such an appraisement as this. For in many parts the treatment is so lucid, considering the difficulty of the matter, that we doubt whether it is possible to find a *better* book than this of the standard which it aims at attaining. It is specially rich in illustrations of classical apparatus employed in determinations for physical data.

The chapters dealing with thermodynamics are also exceedingly clear, and will be greatly appreciated by those who have mastered the mathematics necessary—which, it must be pointed out, is never very severe. The logic is beyond criticism, and the physical conceptions are accurate. We will only add that the present volume deals with measuring instruments, weight, elasticity, statics of liquids and gases, and heat. The second edition of the volume on electricity and magnetism has already appeared.

Biochemie. Ein Lehrbuch für Mediziner, Zoologen und Botaniker. By Dr. F. Röhmann. Pp. xvi+768. (Berlin: Julius Springer, 1908.) Price 20 marks.

PROF. RÖHMANN is a well-known physiological chemist, and has produced a work on that subject which will prove useful to teachers and students of that branch of science. The book is written from the standpoint of chemistry, and really is a text-book of organic chemistry which deals particularly with the substances found in animal and vegetable organisms. The biological and metabolic aspects of the subject are treated incidentally and, as a rule, with brevity. There is, for instance, no chapter that deals with the blood as a whole, but the pigment is dealt with in one place, the proteins in another, and so forth. The same is true for milk, urine, and the other secretions; there is no general survey of ferment action, of coagulation, of oxidation, and of other processes important from the point of view of the physiologist.

There are, however, many handbooks of biochemistry available to-day which deal adequately with its biological side. Prof. Röhmann's book is therefore useful as supplementary to these from the purely chemical side. To those engaged in research his book will be a great help; it contains a mine of bibliographical references, and chemical methods of analysis are described in detail. The pages bristle with chemical formulæ which make the book somewhat formidable to medical readers, to whom the book is partly addressed, and render it unsuitable for continuous reading except to those already well versed in organic chemistry. But to those who desire to find the latest authoritative information of a chemical kind it will prove an excellent work of reference.

W. D. H.

Geometry, Theoretical and Practical. Part iii. By W. P. Workman and A. G. Cracknell. Pp. ix+66. (London: W. B. Clive, 1908.) Price 1s. 6*d*.

THIS part of Messrs. Workman and Cracknell's textbook deals with the subject-matter of Euclid, book xi., on modern lines, and contains also an elementary account of the parallelepiped, sphere, and tetrahedron. The characteristics of previous parts are well maintained; the brevity of treatment and the conciseness of arrangement will appeal specially to examination candidates.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The γ Rays of Uranium.

OUR knowledge of the γ rays of uranium has until now been confined to their discovery by Rutherford (*Phys. Zeit.*, 1902, 517) and to the observations of Eve (*ibid.*, 1907, 185). The latter directed attention to their extraordinary feebleness and to their relatively low penetrating power. Eve found that uranium gives out only about one-tenth as much γ radiation as thorium when examined through 0·04 cm. lead, which is most remarkable, considering that it gives about six times more β radiation. Whereas the γ rays of thorium have the same value for the absorption coefficient as those of radium [$\lambda(\text{cm.})^{-1}$ = from 0·57 to 0·46 over a range of from 0·64 cm. to 3·0 cm. of lead], the uranium γ rays are far more easily absorbed. Eve gave the value 1·4 for λ for thicknesses of lead between 0·28 cm. and 0·92 cm. He stated that the radiation was homogeneous, that the absorption was exponential over this range, and that the rays were practically completely absorbed in 1 cm. of lead. He worked with uranyl nitrate.

Having at our disposal 50 kilograms of pure uranyl nitrate, provided by the generosity of a friend in connection with the work of one of us on the parent of radium (NATURE, January 28, 366), we have been able greatly to extend and in part to correct the work on the uranium γ rays. By a long sequence of chemical operations, known and new, but based largely on the magnificent chemical work of Sir William Crookes, who discovered the substance (Proc. Roy. Soc., 1900, lxvi., 409), we separated by far the greater part of the uranium X from the uranium, and obtained it, in the last separation, in the form of films weighing only a few milligrams. The operations absorb about twelve days. Uranium X contributes, as first shown by one of us (Trans. Chem. Soc., 1902, 860), none of the α rays, but all the β rays of the uranium, and, as is to be expected, and as the present work shows, the γ rays also. These have been found to decay at the same rate as the β radiation, namely, to one-half every twenty-two days. The initial β radiation of the bare preparation lit up an X-ray screen to about the same extent as 7 mg. of pure radium bromide contained in a sealed thin glass tube. The luminosity could be plainly seen in a fully lighted room when the screen was held in the shadow of the observer; but as Eve found, the γ radiation is extraordinarily feeble. It was accurately compared with that from a known quantity of pure radium bromide after passage through 2·5 cm. of lead by means of an electroscope. Under these conditions the uranium X was equivalent to 0·053 mg. of radium bromide. As shown later, it can be calculated that the lead screen cut down the γ rays of the uranium X to 20·6 per cent., and of the radium to 55 per cent., of their initial values. From these data, allowing for the decay during the processes of separation, it may be provisionally estimated that the radiation of the two elements, uranium and radium, is about as one to five hundred million when, as in the present case, absorption is eliminated and only the hard γ rays dealt with.

Before the activity of the preparation decayed too far we were able to determine accurately the absorption coefficient of the γ rays in fourteen substances. As Wigger found for the γ rays of radium (*Jahrb. Radioakt.*, 1905, 430), the absorption follows a strict exponential law after a certain initial thickness of substance has been penetrated, and the absorption coefficient is very nearly proportional to the density of the substance. Thus for lead between the thicknesses of 1 cm. and 5 cm.—and for all other substances over corresponding thicknesses—the absorption is within the very small limit of experimental error absolutely exponential. The value of the absorption coefficient, $\lambda(\text{cm.})^{-1}$, for lead is 0·62. In general, for all substances the value of λ/d, where d is the density, is about 0·055, as compared with 0·021 for the radium γ rays for thicknesses greater than 2·8 cm. of lead (Wigger). Thus the uranium γ rays are about two and a half times more strongly absorbed than those of radium.

The conditions of the experiment are of fundamental importance, as they affect very much the value obtained for the absorption coefficient. In our experiments the disposition was in the main similar to that of Wigger, in that the absorbing plates were clamped up tightly to form the base of the electroscope, and the preparation was placed in a definite position beneath. For insulators the upper surface was covered with a thin leaf of aluminium. Whenever practicable, the absorbing plates were all of the same material. Only for light substances, and for one experiment with mercury, was the base of the electroscope a plate of lead as in Wigger's experiments. Its thickness was 1·2 cm.

Our value for the absorption coefficient is entirely different from that given by Eve, and, indeed, it is a little doubtful what rays Eve observed. Over the range of thickness of lead he used, from 0·28 cm. to 0·92 cm., we find that the rays are not homogeneous, and the exponential law does not hold at all. There is present in relatively great intensity a *very* much less penetrating radiation, completely absorbed by 1 cm. of lead, with a value for λ from eight to ten times greater than for the penetrating type. The absorption and magnetic deviability of these rays are under examination. They would have been far less prominent relatively in Eve's measurements with uranyl nitrate than in ours with uranium X, owing to the strong absorption in the former case. It may be mentioned that the existence is to be anticipated of a very soft γ radiation corresponding to the extremely soft β radiation of uranium X (Schlundt and Moore, Levin, H. W. Schmidt). There appears to be no radiation corresponding with Eve's value of λ, but then his value for the γ rays of radium, 0·46, is about as different from Wigger's, 0·24, as his value for the uranium γ rays, 1·4, is from ours, 0·62.

The value found in our experiments for λ/d, 0·055, was actually obtained exactly for substances so different in density and nature as mercury, lead, aluminium, slate, and pine-wood, showing the remarkable range of the "density law" in this case. At the same time, we do not think it holds strictly, for brass (density 8·40) actually absorbed more than copper (8·80), and zinc (7·07) more than tin (7·25), in experiments which were strictly comparable and under good conditions. The actual experimental values of λ/d obtained varied within the extremes of 0·045 (one value for iron) and 0·068 (paraffin wax). Part of this variation, but not, we think, the whole, is doubtless due to experimental error. Although the exponential law holds, so far as we can see, quite strictly, the values obtained for λ appear to depend somewhat on the particular experiment in an as yet not completely explained way. We propose carrying out similar experiments with the γ rays of radium, in the hope of obtaining further light on the nature of the variation.

Beyond 5 cm. of lead, and corresponding thicknesses of other metals, λ appears to change and to become very much smaller, indicating the existence of a still more penetrating type of radiation than the γ, but our preparations are hardly sufficiently active to enable us to establish this beyond doubt. Here again the experiments we propose with the radium γ rays may throw more light on the matter.

Frederick Soddy.
Alexander S. Russell.

Physical Chemistry Laboratory, University of Glasgow, February 27.

The Radio-active Deposits from Actinium.

In Nature of February 25 there appeared a letter from Prof. McLennan containing the results of some experiments recently made by Mr. W. T. Kennedy on the behaviour of the active deposit from actinium emanation.

So far as may be judged from the details given of the observations, they substantially confirm the results obtained by the writer, which are to be found in the *Phil. Mag.*, May and June, 1908.

The suggestion that the differences in the quantity of active deposit observed on the positive and negative electrodes can be explained by the different rates of diffusion of the ions is an interesting one, but it seems likely that the determining factor is the frequency of collision between the active deposit particles and the gas molecules or ions with which they are mixed.

It is impossible to make a complete comparison between the experiments of Mr. Kennedy and myself until further data are available. S. Russ.

Physical Laboratories, Manchester University.

The Production of Prolonged Apnœa in Man.

Noticing the letter by Dr. H. M. Vernon in Nature of February 18 on "The Production of Prolonged Apnœa in Man" it recalled to my mind some observations on the same subject communicated to the *Philosophical Magazine* in 1833, vol. iii., p. 241, by Michael Faraday, and reprinted in his collected "Researches in Chemistry and Physics," pp. 358–62.

The effect of a bout of forced breathing in enabling a person greatly to prolong the time during which they can hold their breath was brought under the notice of Faraday by Sir Graves C. Haughton.

Faraday was ever one who put things to a practical use, and he gives directions as to the mode of proceeding when one had to enter a noxious atmosphere to rescue a person overcome by the fumes of a poisonous gas. He says:—"Avoid all unnecessary action; for activity exhausts the air in the lungs of its vital principle more quickly, and charges it with bad matter. Go collectedly, coolly, and quietly to the spot where help is required: do no more than is needful, leaving what can be done by those who are in a safe atmosphere (as the hauling up of a senseless body, for example) for them to do.

"Take the precautions usual in cases of danger in addition to the one now recommended [namely, by preparing the lungs by several deep breaths]. Thus, in a case of choke-damp, as in a brewer's vat, hold the head as high as may be; in a case of fire in a room, keep it as low down as possible."

He concludes his communication with a remark on the effect of increasing the pressure of the air breathed by giving the case in which Mr. Brunel, jun., descended in a diving-bell to a depth of 30 feet below the surface of the water, when it was found that both he and his companion could remain under water (by descending from the bell itself) for about twice as long as they could had the air they breathed only been under normal pressure. It would be interesting to know how long the breath could have been held in the above case had Mr. Brunel employed forced breathing, supplemented by three or four breaths of pure oxygen. If the relation of pressure and time during which the breath could be retained held good for the time of 8m. 13s. given by Mr. Vernon, this period should be increased to 16m. 26s. when air under two atmospheres (absolute) pressure was breathed, aided by about four breaths of oxygen. W. G. Royal-Dawson.

40 Creffield Road, Ealing, February 23.

A Winter Retreat.

Mr. George Gilbert, a market-gardener in Stonehaven, has shown me a curious phenomenon which I have not met with before, and which, I think, deserves to be recorded. About the beginning of November a number of children were playing at a tea-party, and they left among the herbaceous plants at the side of the walk an earthenware tea-pot, the dimensions of which were 4 inches by 3 inches. A few days ago the old tea-pot was discovered lying on its side and without a lid. In the interior, closely packed, were no fewer than thirty-seven of the common garden shelled-snail, and when ejected they were found to be all alive. They had spent the months in their winter retreat. Probably gardeners know that they can trap snails in some such way; at all events, one often finds snails in confined spaces and sheltered nooks. Still, the question arises, What led one mollusc to follow the others? Is it the sense of smell? What attracted no fewer than thirty-seven to this old tea-pot, probably a very snug and safe place? Still, there is a danger in being in a crowd. One can imagine how delighted a sea-gull would have been to have discovered this larder of fresh meat!

John G. McKendrick.

Priestley and Coulomb's Law.

In our text-books on electricity I do not remember to have seen Priestley's name associated with the proof of Coulomb's law as derived from the fact that no electrification can be obtained in the interior of a sphere charged with electricity.

In the article "Priestley" in the "Dictionary of National Biography" it is stated that Priestley anticipated Coulomb's law, and in looking into the matter I find foundation for the statement in the following paragraph from "The History and Present State of Electricity with Original Experiments," by Joseph Priestley, second edition, 1769, p. 711:—

"May we not infer from this experiment" (absence of electrification within an electrified cup) "that the attraction of electricity is subject to the same laws with that of gravitation and is therefore according to the squares of the distances; since it is easily demonstrated that were the earth in the form of a shell a body in the inside of it would not be attracted to one side of it more than another." C. J. Woodward.

Birmingham, February 26.

Barometric Oscillation.

In my remark referred to by Mr. Braak (February 18, p. 459) I merely meant the increase of temperature which inevitably occurs when a gas is compressed. The compression and warming are simultaneous; this is shown in the passage of a sound wave where the air is compressed and warmed, and expanded and cooled alternately many hundreds of times in a second. If a barometric change is followed by a change of temperature at some subsequent time the result must be due to other conditions than those to which I alluded. W. H. Dines.

Life and Letters of Prof. A. Newton, F.R.S.

I have been invited to write a life of the late Prof. Alfred Newton, F.R.S., of Magdalene College, Cambridge. If any of your readers who have letters or reminiscences or other interesting information about Prof. Newton will be kind enough to communicate with me, I shall be exceedingly grateful to them. I will, of course, undertake to return all letters, &c., to the senders.

A. F. R. Wollaston.

Savile Club, 107 Piccadilly, W., March 1.

THE ANTHROPOLOGY OF THE MURRAY ISLANDERS.[1]

NEVER, perhaps, has the anthropology of any people been studied so carefully and exhaustively as that of the islanders of the Torres Straits by the Cambridge Anthropological Expedition. Volumes have already been published on their physiology and psychology, on their linguistics, and on the sociology, magic, and religion of the western islanders. The present volume deals with the sociology, magic, and religion of the eastern islanders.

Under the somewhat vague term sociology are included chapters on folk-tales, birth and childhood customs, courtship and marriage, funeral ceremonies, trade, quarrels, and warfare, by Dr. Haddon; on genealogies, kinship, personal names, and social organisation, by Dr. Rivers; and on property and inheritance by Mr. Wilkin. The magic and religion are dealt with by Drs. Haddon and C. S. Myers.

The volume is full of the raw material from which a science of the psychological evolution of primitive societies may be built up, and is a model of careful and accurate methods of observation. In reading through the volume, however, one is impressed very much by the fact that the science of social psychology is still very much in its infancy. Is there anything, for example, in the race or in the environment which determines the peculiar character of these folk-tales? Dr. Haddon classifies them as nature myths, culture myths, religious myths, and tales about people. The difference in character between tales in different categories is not always obvious.

The studies in genealogies and kinship by Dr. Rivers approximate a little more closely to exact science. By painstaking inquiry the kinship of each individual in a fraternity is ascertained, and this forms the basis of valuable discoveries on regulation of marriage, taboo, &c. The Murray Islanders are exogamous, no marriages being permitted between contiguous villages. There appear to be certain definite functions attaching to kin; brothers or cousins preside at funerals, certain relatives can stop a fight, or take property without compensation.

The courtship and marriage customs are of considerable interest. The bride is stolen by the bridegroom from the house of the parents at night. "In the morning the parents would miss the girl and go in search of her. The *map le* then calmly informed them of what had happened, and the parents, calling on their friends to help, would rush off to the village of the abductor of their daughter brandishing their clubs and spears, and a fight would ensue, but very rarely was anyone injured. The lovers meantime remained in hiding pending the result of the fight." The parents are finally appeased by a payment made by the bridegroom and his friends. Polygamy is rare among the Murray Islanders, and polyandry is unknown.

The elaborate funeral ceremonies of the islanders are minutely described, and the authors remark that these ceremonies would occupy almost the whole time of the natives, if they were not dispensed with in the case of the very old and the young.

Law and government was formerly in the hands of the heads of a religious body known as the Malu fraternity, but has now been taken over by the Government of Queensland. The chief crime is wife beating. There appears to be a high standard of honesty in trade, as shown by the manner of purchasing a canoe, which is brought from a great distance and passes through the hands of a large number of intermediaries without any attempt to appropriate it or its price. A great deal of information is given about the native customs in trading which ought to be of considerable value to our traders.

FIG. 1.—A phase of the Ceremonial Dance of the Bomai-Malu *zogo le*. From vol. vi. of the Reports of the Cambridge Expedition to Torres Straits.

The chapters on magic and religion will be of great interest to the students of these subjects. The authors endeavour to distinguish between magic and religion by the criterion that magical objects produce the required result automatically, while religious actions depend for their efficacy upon an appeal to some extra human influence of a more or less personal nature. They have to confess, however, that in some

[1] Reports of the Cambridge Anthropological Expedition to Torres Straits. Vol. vi., Sociology, Magic and Religion of the Eastern Islanders. Pp. xx+316+30 plates. (Cambridge: University Press, 1908.) Price 21s. net.

ceremonies, such as the rain-making ceremony, the two are mixed up together.

Magical practices are in use among the natives to control the elements, to control vegetable life, to control animal life, and to control human beings. From this it may be inferred how important is the part that magic plays in the daily life of the native. To produce a good harvest, each plant or fruit has a special charm and ceremony. But magic may also be harmful, and is often used to injure an enemy or his property.

Religion, in the Murray Islands, appears to be chiefly represented by one important cult, known as the Bomai-Malu cult. A very strict secrecy is maintained about the ceremonies of this cult, but the

FIG. 2.—A phase of the Ceremonial Dance of the Bomai-Malu *zogo le*. From vol. vi. of the Reports of the Cambridge Expedition to Torres Straits.

authors appear to have succeeded in discovering everything of importance. The origin and nature of the ceremonies, their places and times, the participants, the ritual decoration, and ritual objects are all described at great length. The cult appears to have developed into a secret society or religious fraternity which has taken upon itself disciplinary functions. The cult includes initiation ceremonies for the young men, at which apparently some very good advice is given to the initiate.

There are a large number of valuable illustrations in the volume, including many figures in the text, and some thirty plates at the end. The work is produced in a manner which is highly creditable to the University Press.

THE CALIFORNIAN EARTHQUAKE OF 1906.[1]

WE owe so much to the activity of the institution founded at Washington by the generosity of Mr. Carnegie that it seems ungracious to find any fault, yet we must enter a plaint against the inconvenience of the form of publication which it has adopted. The instalment of the report on the California earthquake of April 18, 1906, now published, consists of two quarto volumes, of more than 450 pages in all, issued in paper covers, accompanied by an atlas which measures two feet in length and more than half a yard in breadth, a size which renders its accommodation in the libraries of most of those who will want to possess and use it a matter of great inconvenience, and necessitates its being stored and kept apart from the volumes which it accompanies. Yet this atlas might easily have been produced in a size that would match the text, for few of the twenty-five maps fill the whole of the sheets on which they are printed, and there are none which might not have been reduced in scale without any loss, and even in some cases with advantage; while those seismograms which could not be reproduced on a page of the same size as the text could have been folded, as is done by the Japanese Earthquake Investigation Committee, without any inconvenience.

Having given vent to this fault-finding we may turn to more congenial topics, and express our admiration of the thoroughness and completeness with which this important earthquake has been investigated and described. After a brief account of the geology of the region, we have a detailed account of that remarkable structural and topographical feature called the San Andreas Rift, which was closely associated with the earthquake. This rift follows a line of faulting, but appears to be the result of a different set of movements from those which produced the great up-and-down throw; for 600 miles, from Humboldt county, on the Pacific coast, to the Colorado Desert, it is marked by a narrow zone of depression, referable either directly to recent deformation of the ground or to erosion controlled by the lines along which this deformation has taken place. Though associated with faulting, often of great throw, as between opposite sides, the rift itself is a narrow strip containing a number of minor faults and fractures, running more or less in the same general direction, and dividing the ground into blocks of unequal size, which have sunk unequally between the margins of the rift. Throughout its length it is marked by steep scarps, generally of small height, ponds, and irregularities in the drainage lines which proclaim it as a region where earth-movement is recent or still in progress; and the greater earthquakes of the district are so commonly accompanied by movement along the rift that it has acquired the local name of "earthquake crack." In 1906 the movement was confined to about 190 miles at the northern end of the rift line, and, as revealed at the surface, appeared in different forms; at times there was but a single fissure, hardly discernible except by its effect in breaking and displacing roads and fences, at others there were several roughly parallel faults, and again, where the rock was covered by surface accumulations or alluvium, there was a series of fissures running obliquely, but arranged in

1 "The California Earthquake of April 18, 1906." Report of the State Earthquake Investigation Commission." By Andrew C. Lawson, Chairman, in collaboration with G. K. Gilbert, H. F. Reid, J. C. Branner, H. W. Fairbanks, H. O. Wood, J. F. Hayford, A. L. Baldwin, F. Omori, A. O. Leuschner, George Davidson, F. E. Matthes, R. Anderson, G. D. Louderback, R. S. Holway, A. S. Eakle, R. Crandall, G. F. Hoffman, G. A. Waring, E. Hughes, F. J. Rogers, A. Baird, and many others. 2 vols. Pp. xviii+451; 146 plates, 66 illustrations in text; atlas of 25 maps and 15 sheets of seismograms. (Washington: Carnegie Institution, 1908.)

echelon, so that the band of fissuring followed the general run of the movement in the underlying rock.

Following on the description of the surface movements along this rift, and the account of the retriangulation of the country on either side of it, is a detailed description of the distribution of the violence of shock, and discussion of the course of the isoseismals.

FIG. 1.—Characteristic Rift features south-east of Fort Ross. Fault-trace in foreground.

These have a peculiar distribution; the maximum violence was along a narrow band closely adjacent to the rift line, where surface displacements were greatest, but the progressive diminution of violence, as this line is left, is interrupted by a number of isolated areas of destructive violence. In discussing the explanation of these isolated centres of increased violence, the conclusion is reached that they are due to variations in the nature of the ground, and to be attributed to the well-known fact, illustrated by some interesting experiments contained in the report, that earthquakes are commonly more destructive on alluvium or made ground than on rock; but in attempting to ascribe all the irregularities in the course of the isoseismals to this cause, we cannot but feel that the committee, or, rather, its chairman, has given its support to an obsolescent theory. So many instances are now known of extended origins, and of earthquakes with more than one centre of maximum violence, that an attempt to refer an earthquake to a single centre of origin is no longer justifiable unless this hypothesis is easily reconcilable with observation. In this case it seems more reasonable to accept the isolated centres of destruction, or of increased violence, as independent centres of origin of the same great earthquake, not of separate local earthquakes, as suggested and controverted in the report.

The experiments, to which reference has been made, are of great interest, and throw light on some little understood earthquake phenomena. They were made with a shaking table, set in motion by a crank and connecting-rod, of the same type as that employed in the Japanese experiments on the overturn of columns; the table carried a box which was filled with sand or gravel, dry, or mixed with different proportions of water, and determinations were made of the amplitude and character of movement of the surface of the sand as compared with that of the table. With closely packed dry sand there was little difference, but with wet sand the amplitude was greater, and, what is more important, the reversal of motion much more abrupt, giving an acceleration which, in one experiment, was more than three times as great as that of the table. We have here a suggestion of the reason for this fact, which has often been observed, that the destructive effect of an earthquake is greater on alluvium near its junction with rock than on the rocks or further out on the alluvium, and it is to be hoped that this very interesting and suggestive line of experiment may be followed up more fully than was possible in time for the publication of the report.

Only a few of the more striking features of this report have been referred to; it would be impossible to deal in detail with the discussion on scales of intensity, the direction of vibratory movement, the effect of the shock on men and animals, and the many other matters described with a pro-

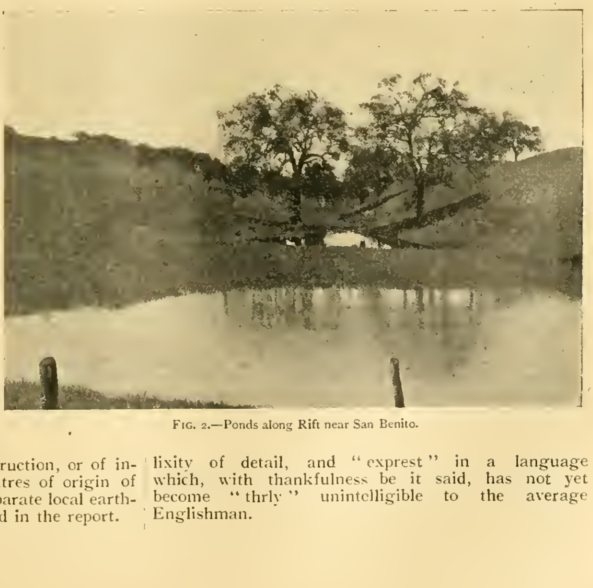

FIG. 2.—Ponds along Rift near San Benito.

lixity of detail, and "exprest" in a language which, with thankfulness be it said, has not yet become "thrly" unintelligible to the average Englishman.

RADIO-THORIUM.

DURING the past week accounts have appeared in the daily papers of a discovery emanating from America of "a new rival to radium" called radio-thor; and as in name and in the circumstance that the body is spoken of as a cheap substitute for radium the body bears obvious resemblance to radio-thorium, well known as one of the most interesting and promising members of the radio-active hierarchy at the present time, it may be of interest to compare the two bodies.

It is obvious that the resemblance begins and ends with the two points referred to. Radio-thor, we read, was discovered by Dr. Bailey, of Hahnemann Medical College, Chicago, in pitchblende from Colorado. It is stated in the recent report with which the public has been favoured, that the new body possesses all the curative properties of radium and none of its baneful after-effects, that the supply is apparently unlimited, and that it is within the reach of persons of moderate means. When placed in contact with the negative pole of a magnet it becomes luminous (!); it colours common glass like Bohemian glass; and is of immense value financially. Dr. Bailey, adds the account, claims to have discovered a positive remedy for locomotor ataxy, cancer, and other maladies that have long baffled the medical profession. The prolongation of life and the cure of all ills by its aid are also referred to airily by a colleague.

It is a relief to turn from this monotonously familiar exploitation of knowledge to the radio-thorium of science, the intensely radio-active product of thorium, giving α rays, first separated from the new Ceylon mineral thorianite, which consists mainly of thorium oxide, by Otto Hahn while working in Sir W. Ramsay's laboratory. Its period of half-change was determined to be two years by G. A. Blanc, who independently separated the substance from the sediments of the hot springs of Baden-Baden. The subsequent developments formed as fascinating a chapter of progress as any in radio-activity. The first product of thorium to be separated and recognised was the thorium X, of period four days, which Rutherford and Soddy found was left in solution when thorium is precipitated by ammonia. We know now it is the product of radio-thorium, which in this separation, as always, remains with the thorium. So closely allied are they in chemical nature that even to-day no process is known of separating them. Yet both thorium and radio-thorium are known alone because though the one is the product of the other, it is not the direct product.

There is an intermediate body, "meso-thorium," produced from thorium, and producing radio-thorium. Its period is not yet accurately known, but is estimated at seven years. It gives β rays only. Boltwood showed that in the ammonia separation referred to the meso-thorium goes with the thorium X, and leaves the radio-thorium with the thorium. In the course of a few years the radio-thorium all changes, leaving thorium alone, while the meso-thorium grows new radio-thorium, readily separable as before. In all probability all the radio-thorium yet prepared is not ready-made radio-thorium separated from thorium, as the investigators first thought, but re-formed radio-thorium produced during the separation from the easily separable meso-thorium.

As the result of these researches it was suggested by Rutherford that meso-thorium and its spontaneously appearing family of products—radio-thorium, thorium X, &c.—might serve as a cheap and effective substitute for radium for many purposes. In the Welsbach gas-mantle industry thorium salts are manufactured by the ton. The readily separable meso-thorium plays no part in the commercial application of thorium, and could be removed without injury to the product and with no appreciable waste of the substance during the manufacturing process. At first it would only give β rays, but in the course of a few years α radiation would make its appearance as radio-thorium and its products were formed. The substance would then comprise practically the whole of the radio-activity of as large amounts of thorium in as small amounts of matter as desired. For most purposes such a body would be as valuable as radium. The activity, it is true, would not be permanent, like radium essentially is, but it would last a good many years—long enough to be very useful—and its cheapness and the practically unlimited supply of it would compensate for this lack of permanence. It is to be hoped that the thorium manufacturers of Germany and America are following up this suggestion.

FREDERICK SODDY.

THE POOR LAW COMMISSION REPORT.

IT might be thought that this document would hardly furnish matter for consideration in a scientific journal, but those who have given the closest attention to subjects of poverty and public assistance are getting to be more and more convinced that it is to scientific study and the application of scientific principles, in other words, to the cultivation of a scientific spirit, that we have to look for the best remedies of the various evils of social life, and that it is by the want of that spirit that those evils have grown up.

The report in question will probably rank in future as an economic State paper of as great importance as that of 1832, upon which the reform of the Poor Law in 1834 was based. That report bore fruit for many years in a gradual reduction of the number of paupers and the volume of pauperism. Recently a reaction has taken place, and the number of paupers and the volume of pauperism have increased. The conclusion is irresistible that considerations other than scientific ones have been allowed to have undue weight.

The present report defines the principles upon which the poor law reform (incorrectly printed as "report" at pp. iv, 53, 80) of 1834 proceeded, as follows:—

(1) That relief should not be offered to able-bodied persons and their families otherwise than in a well-regulated workhouse.

(2) That the lot of the able-bodied should be made less eligible than that of the independent labourer outside.

With these principles there can be no quarrel, and to their having been carried into effect with more or less fidelity during the greater number of the years that followed must be attributed the decline in pauperism to which we have adverted. It is to the gradual weakening of these principles in later years that the reaction towards an increase in pauperism is due. The causes of this reaction and the remedy for it constitute the real problem which was submitted by the King in 1905 to the Commission which has just made its report after a patient investigation occupying more than three years.

One source of the failure of the present system has undoubtedly been the inefficiency of the local authorities charged with its administration. The boards of guardians are elected by popular vote, but that election attracts little popular interest. In London somewhat more than a quarter of the electorate trouble themselves to vote for a guardian, while nearly three times as many will vote for a member of Parliament. The result is that men are sometimes returned on those boards who are ignorant of the laws they are selected to administer, and who have other reasons for seeking election than their knowledge of or interest in the poor. Accordingly their administration is often faulty and ill-informed; and the Commissioners direct attention to many cases in which the allowances made by the guardians are helping to perpetuate social and moral conditions of the worst type. Even when the relief is given to the right people, it is too often inadequate in amount, and ill-adapted to the particular needs of the case.

The object of the Commissioners, therefore, is to ensure that henceforth the local public assistance authority shall be largely nominated from amongst men and women of experience, wisdom, and unselfish devotion to the public good, and shall be served by officers fully qualified by knowledge and by experience. For the higher offices it is suggested that there should be qualifying examinations, and highly trained officers will be required in what are now regarded as less important posts, *e.g.* that of labour master. For these purposes a graded public assistance service should be set up, which should include all officers concerned with the supervision, control, and disciplinary treatment of the poor, both male and female. In this service there should be more opportunity of promotion from the lower to the higher ranks, and no question of superannuation should hinder the transfer of efficient and promising officers from one local authority to another.

The recommendations of the Commissioners tend not merely to securing better qualified administrators, but also to the adoption of sound principles, which we may fairly define as scientific, in the distribution of public assistance. For example, the principle of classification is insisted upon, in institutions adapted to the various needs of the dependent poor, in lieu of the aggregation of all classes in the present workhouses. For those trespassers on public hospitality called "ins-and-outs" a system of detention should be adopted. Outdoor relief should be administered under those conditions of strict investigation and adaptation to the particular needs of the individual which are expressed in the term "case-work," and in such a manner as to strengthen the hands of sanitary authorities, and to elicit the support and cooperation of voluntary aid committees. The aged should be adequately relieved, and their comfort and happiness considered. Many recommendations are made as to the care, education, and medical supervision of children. The detention of feeble-minded, idle, and immoral paupers is recommended, and is a step which may help to the solution of a problem in eugenics.

Among the questions dealt with in this report for the determination of which the scientific spirit is essential, that of the relation of public assistance to voluntary aid—that is to say, of the relative functions of the community, of the charitable individual, and of the charitable foundation in the relief of distress—is one of the most important. Its consideration occupies eighty folio pages of the report, and we are glad to know that it has not been omitted from the programme of the British Science Guild, which has, at the suggestion of Sir William Bousfield, appointed a committee to work out this problem. The report will supply materials of great value to that committee. It bears testimony to the good results obtained by the labours of charity organisation societies in all parts of the country, which have long been imbued with that spirit; and it leads to nineteen specific recommendations, too minute to be referred to in detail, which justify the hope that that spirit will govern the administration of public aid and of charity in the future.

The report of the four members of the Commission who found themselves unable to sign that agreed to by their fourteen colleagues also confirms the views we have endeavoured to express. It declares the breaking up of the present unscientific category of the aged and infirm, and the substitution of a method of dealing separately with distinct classes according to the age and the mental and physical characteristics of the individuals concerned, to be a necessary preliminary of any effective reform.

Other problems which are discussed in these able documents require actuarial science for their solution, as, for example, the distress due to unemployment, invalidity assurance, old age pensions, friendly societies and trade unions, and the other provident institutions which have been so marvellously efficient as prophylactics against pauperism; but space will not allow of further discussion. Enough if we have shown the place of the scientific spirit in dealing with a great social and economic question.

THE METEORIC FIREBALL OF FEBRUARY 22 AND ITS STREAK.

ONE of the most notable meteors of recent years appeared on February 22 at 7.30 p.m., and was observed from the southern counties of England. It was a brilliant object, at first emitting an orange light, varying in intensity, then when about half its flight had been performed it suddenly blazed out with a steely-blue lustre and lit up the foggy atmosphere as though a huge rocket had exploded. It left a short, luminous streak where the chief outburst occurred, but this streak immediately intensified and soon extended along the whole path traversed by the meteor. Becoming bent and contorted, it assumed a variety of shapes and drifted to north-west under the action of upper wind currents. Diffusing itself into a broad, faint band of irregular form, it was ultimately lost amid the Milky Way about two hours after the time of its first projection. The long duration of the streak is almost without parallel in this country, though the Madrid meteorite of 1896 February 10 left a luminous band or cosmic cloud visible in the sky for $5\frac{1}{2}$ hours!

The meteor of February 22 was a Leonid, but the radiant is not quite accurately defined, as the flight of the object was very similar at most of the stations, for it slightly descended from Canis Minor to the southern region of Orion. But there is no doubt that the direction was from Leo, and the point of radiation seems well indicated at $175^\circ+16^\circ$ near β Leonis. Just possibly the radiant may have been at $155^\circ+12^\circ$, for I saw a fairly bright meteor on the same night passing slowly from $150^\circ+40^\circ$ to $148^\circ+49^\circ$, and directed from this centre 5° E. of Regulus. The height of the large meteor was from about sixty to twenty-six miles over the English Channel, about forty miles south of the coasts of Sussex, Hampshire, and Dorset. The luminous course was about 135 miles in length, and the velocity 20 miles per second. Several observations indicate a greater length of path and a lower elevation (22 miles) at the end, vertically over a point 50 miles S. of Plymouth. The best estimates for the duration of flight are 5–6 secs., 6–7 secs., and 8 secs. The fireball of 1898 February 20 had a radiant at $177^\circ+12^\circ$, and probably belonged to the same system.

As to the trail, at 8h. 12m. one trustworthy observer says the whole length of it was 100°; another gives 180°. Many excellent observations are to hand, and it may be possible to work out some interesting details concerning the velocity and direction of its drift. The great changes which affected it will, however, make this difficult. One bright bend in the luminous material moved to N.W. at a rate of eighty miles per hour, and appears to have retained approximately the same height of thirty-two miles while it travelled from over a point N. of Alderney Island to over Dartmoor. The streak of the fireball of 1894 August 26 moved to S.E. at a rate of 120 miles per hour, and was about fifty-one miles high. In fact, meteoric streaks from the swifter class of objects, such as Leonids, Perseids, and Orionids, are usually between fifty and sixty miles high. The streak or smouldering residue of the February 22 fireball was much lower than this, though the earlier portions of it exceeded fifty miles in height.

The burning or phosphorescence of the meteoric débris for so long a period after dispersion is remarkable. Moonlight could hardly have produced the effect, as our satellite was only $2\frac{1}{4}$ days old (setting at 8h. 19m.) and reflected little light. I have never observed meteor streaks to have a lengthened existence in the presence of the full moon, so that another cause inherent in the glowing material must be found for its extraordinary sustenance in the recent case. There must have been something special in its composition or in the condition of the air at the time.

I have received seventy-one observations of the meteor or of its trail, and other descriptions of very useful character ought to come from Havre, Cherbourg, and other places on the north coast of France and from the Channel Islands.

The phenomenon may be aptly described as *the* meteoric spectacle of a generation. As the nucleus sailed along its nearly horizontal course, its light was far from being even. It gave a series of outbursts, the brighter of which much exceeded the lustre of Venus. This comparison applies to a distance of 100 miles. The mate of a vessel in the Channel near Start Point says the light was astonishing, and broke out with startling vividness, so that anyone could have easily seen to read.

At the end of the meteor's flight it seemed to turn abruptly in its direction, and fragments or embers fell almost vertically earthwards about 3°. Then the trail bent to the east and extended rapidly in a horizontal path. The rate of this easterly drift, as seen at Dunstable, Farnham, and other places, was shown on drawings, and appears to have been more than 300 miles per hour, the visible length having increased about eighty miles between 7h. 30m. and 7h. 45m. Something more than mere wind currents would appear to have been instrumental in inducing this rapid translation. The easterly streak appears, in fact, to have occupied at 7.45 the place where the original train existed at 7.30, but which had risen about 20° a quarter of an hour later.

The nucleus of the meteor as it traversed its course threw off a train of fiery sparks, such as is often seen, but these quickly died away. Then slowly the durable streak or trail came out, intensifying rapidly and stretching across the sky like a silver ribbon very irregularly arranged. By one observer in the Channel it was watched for three hours, until it became faintly blended with the Milky Way in Cepheus and Cygnus.

The bend in the path of the fireball at the limits of its westerly flight and the remarkable streak which quickly formed far to the east are curious. It has been suggested that there may have been a second meteor responsible for the lower streak stretching to the eastward. But as hundreds of persons were watching the sky, it would have been and reported had it been visible. At the termination of the meteor's career it evidently suffered disruption by two violent explosions, the places of which were definitely marked by brilliant condensations at the angles of the bent streak. Is it possible that on the bursting and disintegration of the mass one large fragment was hurled in a direction nearly opposite to that of the original course? The resistance of the air at the comparatively low altitude of the meteor must have been considerable in checking its velocity, but some more potent influence must have suddenly stayed the westerly rush of the object, diverted it or its material earthwards, and then, as abruptly, dispersed it far and rapidly eastwards.

W. F. DENNING.

NOTES.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Mr. E. C. C. Baly, Sir Thomas Barlow, Bart., Rev. E. W. Barnes, Dr. F. A. Bather, Sir Robert A. Hadfield, Mr. A. D. Hall, Dr. A. Harden, Mr. A. J. Jukes-Browne, Prof. J. G. Kerr, Prof. W. J. Lewis, Prof. J. A. McClelland, Prof. W. McFadden Orr, Dr. A. B. Rendle, Prof. J. Lorrain Smith, and Prof. J. T. Wilson.

THE *Times* announces that a well-equipped aërodynamic laboratory is about to be established by the Aéro Club de France with the assistance of the State. It is computed that more than 5000*l.* will be required to start this project, the utility of which is unquestioned. Practical tests in planes, propellers, engines, &c., will be carried out at this laboratory.

THE seventh annual session of the South African Association for the Advancement of Science will be held at Bloemfontein during the week ending October 2, under the presidency of Sir Hamilton J. Goold-Adams, K.C.M.G. The assistant general secretary is Mr. E. Hope Jones, P.O. Box 1497, Cape Town.

THE sixth International Psychological Conference will be held at Geneva from August 3 to 8 next. An exhibition is being arranged, and a special section is to be devoted to animal psychology. M. E. Claparède, 11 avenue de Champel, Geneva, is the general secretary, and M. Cellerier, Montchoisy, Geneva, is the treasurer.

THE Paris correspondent of the *Daily Chronicle* states that the wireless telegraph station on the Eiffel Tower has been receiving messages from the station at Glace Bay, Canada, a distance of 3250 miles. A new installation is being fitted at the Eiffel Tower, by means of which it is hoped to establish wireless telegraphic communication with Saïgon (Cochin China), a distance of 6800 miles.

ON Thursday next, March 11, Mr. A. D. Hall will begin a course of two lectures at the Royal Institution on "Recent Advances in Agricultural Science." The Friday evening discourse on March 12 will be delivered by Mr. S. G. Brown on "Modern Submarine Telegraphy," and on March 19 by Mr. R. Threlfall, F.R.S., on "Experiments at High Temperatures and Pressures."

THE Berlin correspondent of the *Times* announces the death of Prof. H. Ebbinghaus, professor of philosophy at the University of Halle, at fifty-nine years of age. Prof. Ebbinghaus contributed extensively to the *Zeitschrift für Psychologie*, of which he was the founder, while of his several books the best known are his work "On the Memory" (1885), and the first volume, which appeared three years ago, of the unfinished "Principles of Psychology."

AN exhibition of optical and ophthalmological appliances will be held in the rooms of the Medical Society of London on March 12 and 13, from noon to 10 p.m. each day.

MUCH interest is being taken in the International Aëronautical Exhibition which will be opened at Frankfurt a. M. in the beginning of July next. Four sheds will be reserved for airships, which will make ascents, with passengers, from the exhibition grounds. Frequent ascents will also be made by ordinary balloons, and various aëronautical societies have been invited to take part in them. Flights with aëroplanes, in which some of the best-known aviators will compete, promise to be of special interest. Industries connected with aëronautics will be represented, and one section will be devoted to inventions and apparatus of the past. Wireless telegraphy and carrier pigeons will be employed for communications to and from the exhibition, and some prizes of considerable value will be awarded.

TELEGRAPHIC messages from Havana through Reuter's Agency announced that on February 27, beginning at 11.21 a.m., the seismograph there was disturbed intermittently for forty minutes. The earth waves moved from east-north-east to west-south-west. A message from Palmi, Calabria, on the same date states that a violent earthquake shock was felt there at 1.50 a.m., and that two other shocks followed later. From the same source it is reported that a slight shock was felt at Reggio di Calabria at 6.45 p.m. Reuter further reports that soundings taken in the Straits of Messina and in the ports of Messina and Reggio di Calabria show that no alteration in the ocean floor in those parts or in the coast-line was caused by the recent earthquakes. Prof. Milne recorded at Shide, Isle of Wight, on February 27, at 4.58 p.m., an earthquake of great intensity, which was at its maximum at 5.36 p.m. The origin of this disturbance was about 5000 miles distant.

THE thirty-first annual general meeting of the Institute of Chemistry was held on Monday, March 1, Prof. Percy F. Frankland, F.R.S., the retiring president, in the chair. In his presidential address, Prof. Frankland emphasised the fact that whilst the well-being of the community is greatly promoted by the services of competent chemists, the mischief which can be wrought by the ill-trained and incompetent is incalculable. It is one of the chief duties of the institute to maintain a high level of training for professional chemists by demanding of candidates for its membership evidence of thorough training, and by requiring them to pass searching examinations. Particular attention has been given lately to the educational side of the institute's activity. Referring to research, Prof. Frankland reminded the fellows that the results of research are not necessarily recorded in the Transactions or Proceedings of a scientific society or journal. There is a vast amount of research involving originality and attainments of the highest order which from its very nature cannot be published at all. Many chemists whose names are not associated with academic researches are nevertheless fully equipped and highly original investigators. There is much training in originality of thought and experimental procedure which is not called research, and much of what is called research involves no originality in the thought or deed. After congratulating the institute on the choice of Dr. George T. Beilby, F.R.S., as the new president, Prof. Frankland thanked the fellows and associates for their kindness and consideration during his term of office. On behalf of the fellows and associates the president then presented an illuminated address to Mr. David Howard, in recognition of his services to the institute in various capacities, as member of council, honorary treasurer (eighteen years), president, vice-president, and censor, extending altogether more than thirty years, at the same time congratulating him on the approach of his seventieth birthday, while yet retaining remarkably his health and vigour.

THE Elizabeth Thompson Science Fund, to which reference has been made in previous years in these columns, established "for the advancement and prosecution of scientific research in its broadest sense," now amounts to 5200*l*. As accumulated income will be available next month, the trustees of the fund desire to receive applications for grants in aid of scientific work. This endowment is not for the benefit of any one department of science nor for men of science of any particular nationality, but it is the intention of the trustees to give preference to investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from the fund must be accompanied by full information as to the precise amount required, the exact nature of the investigation proposed, the conditions under which the research is to be prosecuted, and the manner in which the grant asked for is to be expended. All applications must reach, before March 15, the secretary, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A. Decided preference will be given to applications for small amounts, and grants exceeding 60*l*. will be made only in very exceptional circumstances. Prior to 1898, eighty-one grants were made, and of these seven only have yielded no published result. Since 1898 sixty-five further grants have been made, and the work aided by some of them is still unfinished.

THE weather report for the week ending last Saturday, February 27, shows that the temperature over England was considerably below the average, especially in the south, the deficiency in the south-east of England amounting to 5°.4. In the south-west and south-east of England the shade temperature fell below 15°. At Greenwich the thermometer in the sun's rays registered 97° on February 22, whilst during the preceding and following nights the exposed thermometer on the grass registered 11°. The lowest shade temperature for February was 19°, on the morning of February 23. The mean temperature at Greenwich for February was 37°, which is about 2°.5 below the average of the previous sixty years. Frost occurred in the open each night with the exception of February 4 and 5. The rainfall was less than one-half of the normal, whilst the sun was shining ninety-one hours, which is thirty-four hours more than usual. The summary given by the Meteorological Office for the thirteen weeks which constitute the winter, ending February, shows that the mean temperature was generally below the normal, the extreme readings ranging from 59° in the south of Ireland, and 58° in the east of Scotland and the east of England, to 3° in the Midland counties and the south-east of England. The rainfall was deficient over the entire kingdom, the deficiency ranging from 4·21 inches in the south-west of England to 0·24 inch in the north of Ireland. The duration of bright sunshine was generally in excess of the average, especially over the southern portion of England. At the close of February and on the opening days of March a touch of real winter was experienced over the entire area of the British Islands, as well as generally over western Europe; sharp frosts occurred in all parts, with heavy snow.

THE Bill "to promote the earlier use of daylight in certain months yearly"—formerly known shortly as the Daylight Saving Bill—is down for the second reading in the House of Commons to-morrow (Friday). The Bill represents the shape of the resurrection of a measure which passed its second reading in the House a year ago, and was referred to a select committee. The unscientific character of the proposal and the confusion which would follow should the measure ever find a place in the Statute-book were stated clearly in NATURE of July 9, 1908. To the views expressed in that article most competent authorities will subscribe. For the sake of history, we give the substance of the measure, but it is difficult to believe that the House of Commons will consent to the system of self-deception which is advocated by the promoters of the Bill, with complete disregard of the consequences. The operative clauses of the Bill are as follows:—(1) From two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in April* in each year until two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in September* in each year the local time shall be in the case of Great Britain one hour in advance of Greenwich mean time and in the case of Ireland one hour in advance of Dublin mean time, and from two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in September* in each year until two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in April* in each year the local time shall be in the case of Great Britain the same as Greenwich mean time and in the case of Ireland the same as Dublin mean time. (2) The time hereby established shall be known as summer season time in Great Britain and Ireland, and whenever any expression of time occurs in any Act of Parliament, deed, or other legal instrument, the time mentioned or referred to shall, unless it is otherwise specifically stated, be held in the case of Great Britain and Ireland to be summer season time as prescribed by this Act. (3) Greenwich mean time as used for the purposes of astronomy and navigation shall not be affected by this Act. (4) This Act shall apply to the United Kingdom of Great Britain and Ireland, and may be cited as the Summer Season Time (Great Britain and Ireland) Act, 1909.

IN the course of a paper published in vol. iv., Nos. 1 and 2, of the *Bio-chemical Journal* on the relations of certain marine organisms to light, Prof. B. Moore directs particular attention to the periodicity of their phosphorescence. That light from without influences this phenomenon is demonstrated by the fact that the periods of activity and rest in regard to phosphorescence follow, respectively, the hours of daylight and darkness. How deep-seated is this periodicity has been demonstrated by experiments on copepods, in which it persisted for no less than twelve days in the absence of the accustomed recurring stimulus of nocturnal darkness and diurnal light. It is added that the phosphorescence of these copepods in captivity is spontaneous, and although increased by mechanical stimulation, goes on vigorously even when the organisms are at rest and undisturbed.

THE February number of the *Zoologist* contains a remarkably interesting account, by Mr. H. W. Bell-Marley, of hunting the hump-backed whale in Natal waters. For some years it has been observed that between May and August large numbers of hump-backs pass between Natal and the Delagoa Bay coast, and in May, 1908, some enterprising Norwegians obtained permission to set up a whaling-station on the Bluff side of the channel. Their success may be judged from the fact that between July and the early part of September no fewer than one hundred and two hump-backs and two rorquals were taken. The supply is, however, not exhausted, as the writer describes steaming into the midst of a school of about a score of these monsters, the movements and gambols of which afforded a most wonderful and thrilling spectacle. Nevertheless, such vigorous fishing cannot long be carried on without seriously diminishing the numbers of the whales, and Mr. Bell-Marley is of opinion that, if their extermination is to be prevented, action ought forthwith to be taken by the Colonial Government.

AN interesting pamphlet, written by Mr. H. A. Ballou, has just been issued by the Imperial Department of Agriculture for the West Indies on "millions" and mosquitoes. Millions are small fishes, the full-grown female measuring about $1\frac{1}{2}$ inches in length, while the male is much smaller; they belong to the species Girardinus, the particular variety dealt with in the pamphlet being *G. poeciloides*, De Filippi. They live in shallow water, and are such voracious feeders on the eggs, larvæ, and pupæ of mosquitoes that these insects are unable to breed in streams and ponds stocked with them. They commonly occur in Barbadoes, and in consequence the Anopheles mosquito, which disseminates malaria and breeds only in shallow streams, pools, or marshes, has never been able to spread, and Barbadoes is free from malaria. The Imperial Department has since 1905 made shipments of these fishes to several West India islands, and from all sources favourable reports have been received. At Antigua the Board of Health has undertaken the work of stocking all the ponds and streams, and the mosquito nuisance has abated in consequence. It is pointed out, however, that certain varieties of mosquitoes, *e.g. Culex fatigans* and *Stegomyia fasciata*, breed in small temporary collections of water, such as those found on house-tops, in rain-water tanks, bottles, the concavities of leaves, &c., and will therefore escape destruction by the "millions."

DARWIN and the mutation theory form the theme of the opening article, by Mr. C. F. Cox, in the February number of the *American Naturalist*. After mentioning that the great evolutionist would not have accepted, at least in its entirety, the mutation theory of de Vries, the author states that "he was compelled to concede that what we now call mutation had occasionally taken place and become the starting point of new races, but he was none the less unshaken in the conviction that this process was exceptional and extraordinary, and that, as a rule, a new species originated by the gradual building up of minute and even insignificant deviations from the average characters of an old species. . . . For the doctrine of 'insensible gradations,' which touched mainly a minor premise in his general argument for evolution, Mr. Darwin was almost willing to relinquish the essence of the whole matter, which was his claim to the discovery of a *vera causa* in the evolutionary process. . . . The establishment of the theory of natural selection was Mr. Darwin's greatest and most original achievement. Time has proved that he could have afforded to stand upon the general validity of this theory, though everything in his argument in its favour had needed review and modification. . . . Properly regarded, the mutation theory does not antagonise or weaken the doctrine of natural selection—on the contrary, it merely offers itself as a helpful substitute for, or adjunct to, one of Darwin's subordinate steps in the approach to a consistent philosophy of the origin of species, leaving the great cause of evolution as efficient as ever. It is, therefore, one of the tragedies of science that in this matter Darwin should have been ready to surrender his main position rather than to receive and to join forces with those who were coming to his aid."

IN the number of *Man* for February Mrs. M. E. Cunnington describes the result of the excavation of a late Celtic rubbish-heap near Oare, in Wiltshire. From the number of potsherds unearthed it was supposed by some authorities that the mound represents the accumulated débris of a pottery; but there are no signs of distortion during baking in any of the fragments, and the number of animal bones points to the existence of a considerable settlement. The pottery falls into two classes, that of native manufacture and that imported. Most of the examples of the former type are not inelegantly shaped bowls with a contracted mouth and bead rim. These are of purely British manufacture, and are characteristic of the late Celtic period, like the examples from Weymouth in the British Museum and those of the same period at Colchester. The foreign ware is of various types—Belgic of the first century A.D., green-glazed Roman ware from Gaul, and several pieces of very thin white and cream-coloured pottery, which probably came from Rheims about the same time. More remarkable are examples of the rare Arretine ware, while the absence of the later Gaulish red Samian corroborates the date of this accumulation, which seems to have been made just before the Roman occupation of that part of the island. If the date of the neighbouring Martinsell Camp could be established, it is possible that its garrison may have had some connection with the inmates of this settlement.

THE *National Geographic Magazine* for January continues its campaign against the destruction of the State forests of America by lessons drawn from two countries of the old continent. Mr. E. L. Harris, in his notes on the buried cities of Asia Minor, shows that in the neighbourhood of Pergamus the ruin has been so widespread that it is doubtful if any rational system of forestry can now restore the trees which once covered the higher grounds and permitted a flourishing agriculture in that region. Mr. F. N. Meyer points out that in a large part of northern China, which in the time of Marco Polo was the seat of extensive silk culture, the mulberry trees have disappeared, the rivers once used for carriage of goods have shrunk in volume, and the deserted wells bear witness to the shameful destruction of the forests. The denudation of the hill-sides is said to have diminished the rainfall, the soil on the slopes has disappeared, and disastrous floods result from the rapid dissipation of the water in the rainy season. Here, too, the mischief seems to be almost past remedy, and unless the Chinese Government takes immediate and active measures the eastern extension of the Mongolian desert is inevitable.

THERE is certainly room for a popular, well-illustrated periodical dealing with the lighter side of geographical work, and this want seems likely to be supplied by the new magazine *Travel and Exploration*. The March number contains articles by competent writers describing expeditions in many parts of the world. The best of these is that by Lord Hindlip on a hunting trip in the Nahlin or Cassiar mountains, near the famous Dawson Trail leading to Klondike, in which he was successful in obtaining fine specimens of the wild sheep. Miss E. C. Sykes is also a little off familiar ground in her account of a ride along the little-known route in northern Persia from Meshed to the railway line which runs between Merv, Askabad, and Krasnovodsk. The scheme of this new periodical includes reviews of current geographical literature, which, it may be hoped, will soon develop into an adequate bibliography.

A SUMMARY and bibliography of literature dealing with Russian botany, that was published in 1906, has been issued as a supplement to the *Bulletin du Jardin impérial botanique*, St. Petersburg. The contents are, it may be mentioned, practically inaccessible except to Russian scholars.

SIR JOSEPH HOOKER has made a further contribution to the classification of the genus Impatiens in the first number of the *Kew Bulletin* for the current year, where he furnishes a description of species from Indo-China and the Malayan Peninsula. The comparison of selected characters leads to the conclusion that the species from these regions are closely allied, and show some affinity with Burmese species, but differ greatly from the Chinese. Four of the specimens are made the types of new species. Another systematic article is provided by Mr. T. A. Sprague, being a revision of the section Omphacarpus of the genus Grewia.

DR. M. SAMEC communicates to the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften* (vol. cxvii., part v.), Vienna, a note on the variation in the intensity of light at different altitudes. During a balloon journey he took a series of readings for comparison with measurements made by Prof. Wiesner in the course of his investigations regarding the amount and nature of the light falling upon plants. Readings were taken of the intensity of sun-light and of diffused light. The figures are somewhat irregular, but the intensity of sun-light increased with ascent, and more rapidly than the intensity of the diffused light. The measurements of light reflected from below showed a series of maxima corresponding with the passage of the balloon over water.

AN account of the constructive work for restraining the flow of torrents and of the *reboisement* of mountain slopes near Interlaken contributed by Mr. C. E. C. Fischer to the *Indian Forester* (January) should indicate to the authorities in India the value attached to such precautions in Switzerland, and may possibly help towards the establishment of a similar policy. Although avalanches and storms are important factors in denudation, the prime agent is the browsing goat. The chief features in construction are the retaining walls built at intervals across the valley, the channels for leading off the streams, and wattle fences for checking the downward flow. Grass is planted between the fences, and prepares the ground for early settlers such as *Sedum annuum* and Adenostyles; later on, Parnassia, orchids, aconites, and other plants appear on the scene, and in two or three years alders or pines may be planted.

WE have received a discussion of the winds at Rome by Dr. I. Massarini, deduced from anemograph records for 1876–1905, and reprinted from the Annals of the Italian Meteorological Office, vol. xxvii., part i. The author has dealt with the subject in great detail, and has calculated, *inter alia*, the frequency of wind direction under sixteen points and their velocity with respect to the hours of the day, as well as for months, years, and for periods of ten and thirty years; also the velocity for the same periods, irrespective of direction, and has exhibited the results in fifty-four tables and nine plates. We can only note here the following general remarks:—(1) Direction. The most frequent winds are (in order of their frequency) N.N.E., N., and S.; the least frequent is the E. wind. (2) Velocity. The strongest winds are S.S.E., S., S.S.W., and N.N.E.

(the last two having equal values). The weakest wind is from N.W. During three years, 1873–5, a Robinson anemometer was in operation; the author has supplemented his valuable work by a separate discussion of these data.

The Memoirs of the Indian Meteorological Department, vol. xx., part v., contain a laborious and valuable analysis, by Mr. R. L. Jones, of the records of the anemograph (Meteorological Office pattern) at the Madras Observatory for eleven years, 1865–75. The tables give (1) the mean hourly movement of air, irrespective of direction, for each hour of the mean day of each month and for the year, and the constants of the periodical formulæ; (2) mean hourly southerly and westerly components, and the constants of the periodical formulæ, with computed values in each case. The chief features of the mean monthly air movement (irrespective of direction) are (*a*) a nearly uniform increase during the hot-weather period; (*b*) a more or less uniform decrease approximately during the south-west monsoon period; (*c*) a nearly uniform increase during the transition period; (*d*) a nearly uniform decrease approximately during the cold-weather period. The curves showing the daily variations exhibit a general resemblance to the daily variations in air temperature. The resultant air movement deduced from the southerly and westerly components is (1) between north and east during the transition and cold-weather periods; (2) between east and south during the hot-weather period; and (3) between south and west during the south-west monsoon period.

Some of the troubles which have to be faced by engineers in Egypt are described by Mr. J. B. Van Brussel in an article on mechanical irrigation plants in the *Engineering Magazine* for February. Part of the Nile irrigation station at Wadi Kôm-Ombo consists of a steel canal 5200 feet in length and nearly semicircular in section, 20 feet diameter, and about 12 feet deep. The canal is used for conveying water from the service reservoir and distributing it to earth canals, or culverts, and is made up of seventeen sections, each about 310 feet long and constructed of riveted steel plates 6 millimetres thick. The sections are connected by expansion joints, and have a fall of level of 1 centimetre per 310 feet. Great difficulty was experienced in preserving the level while building, owing to the action of the wind passing through spaces where the dry foundation sand had been removed for riveting, thus causing the sand to drift and the wood cradles to sink. Often a whole section would sink several inches in a night. During the construction difficulty was also experienced due to unequal expansion. According to the side of the canal on which the sun was shining more strongly, the end of a section would move out of the centre line to one side or the other to the extent of as much as 4 inches. This movement stopped when the earth was banked up round the steel structural work, and the water began to flow through the canal.

The January number of *Ion* contains a translation of the second memoir of the radium commission of the Academy of Sciences of Vienna. It deals with the evolution of heat by radium, and for it Drs. E. von Schweidler and V. F. Hess are responsible. Experimenting with more than a gram of radium-barium chloride enclosed in a glass tube a millimetre thick, surrounded by a copper vessel 5 millimetres thick, they have found that the heat generated by 1 gram of pure radium in these circumstances is 118 gram-degrees per hour. *Ion*, by a curious misprint, omits to give its readers this number.

An examination of the whole of the material at present available on the variation of the refractive indices of mixtures of liquids with their composition has led Dr. V. F. Hess, of the University of Vienna, to formulate, in a paper which appears in the July, 1908, number of the *Sitzungsberichte* of the Academy of Vienna, a simple law for the refraction constant of a mixture. If the excess of the observed density of a mixture over that calculated from the densities of the constituents be divided by the observed density, and if the corresponding quotient for the refraction constants be found, Dr. Hess shows that if it is assumed that the two quotients for each mixture are proportional to each other, the calculated values of the refraction constants may, by a proper choice of the factor of proportion, be made to agree very closely with observation. The factor differs in value for each pair of liquids, changes a little with change of temperature, but is practically the same for all rays of the spectrum. Any one of the three refraction constants at present in use may be used in the calculations.

The moving-coil galvanometer is now used so extensively on account of its insensibility to outside magnetic disturbances that Dr. M. Reinganum's article in the *Physikalische Zeitschrift* for February 1, describing two methods of making the instrument suitable for measuring smaller currents than it has been capable of measuring previously, will be welcomed by many of our readers. In the first method about 6 centimetres of soft iron wire, 0·33 millimetre diameter, is attached to the top of the coil outside the strongest part of the magnetic field, and at right angles to the lines of the field. In the second method a similar piece of magnetised steel wire is attached to the coil parallel to the field, but with its poles reversed. In each case the sensitiveness of the instrument is greatly increased, and in one case described by the author, with the steel wire, it was raised to ten times its original value without the deflections ceasing to be proportional to the current passing through the coil.

In Reprint No. 101 from the Bulletin of the Bureau of Standards, v., 2 (Washington: Government Printing Office, 1908), Mr. Louis Cohen discusses the influence of terminal apparatus on telephonic transmission. It is pointed out that when a telephonic wave reaches the receiving instrument part of it is reflected, and that the proportion of the reflected and absorbed waves is a function of the frequency. Thus every harmonic will be affected differently, and a certain amount of distortion will be produced. The subject is eminently suited for the methods of mathematical analysis which the author applies. The outcome of the discussion is that in short-distance transmission the introduction of a condenser into the circuit will improve the transmission. This is the conclusion derived from an application to a cable 30 km. long. For long-distance transmission, taking as an example a length of 300 km., the author finds that the condenser has little effect.

Messrs. Macmillan and Co., Ltd., have published the "Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College for the years 1899–1908." The papers have been edited by Messrs. E. J. Brooksmith and R. M. Milne, who have also provided answers. The price of the volume is 6*s*.

Messrs. Crosby Lockwood and Son have just published the second edition of Dr. J. Erskine-Murray's "Handbook of Wireless Telegraphy." The original work was reviewed in Nature of October 3, 1907 (vol. lxxvi., p. 563). About fifty pages of new matter have been added, and the whole text has been revised in the light of present knowledge of the subject.

MESSRS. H. W. COX AND CO. have issued a new catalogue of electromedical apparatus, which contains, in addition to the descriptions of the apparatus, short sketches of the theories of their action, and instructions how best to set them up. It should prove of exceptional value to medical practitioners who have not had the advantage of a practical training in the manipulation of physical apparatus.

WE have received from Washington a copy of the report of the Librarian of Congress and of the report of the superintendent of the library buildings and grounds for the fiscal year ending June 30, 1908. Like all American reports, it is of a detailed and exhaustive character, and provides information as to accessions, expenditure, new arrangements, and other matters of particular importance to librarians. It is of interest to note that, in addition to the Library of Congress, with its million and a half books—to say nothing of manuscripts, prints, maps, and charts—there are above a score of libraries maintained by the Federal Government at Washington. Among these may be mentioned those of the Department of Agriculture with 60,000 volumes, the Bureau of Education with 82,000, the Geological Survey with 80,000, the Patent Office with 80,500, and the National Museum with 20,000. Some of the special collections, like that of the U.S. Geological Survey, are unique in character, so it is easy to see that the American student is very fortunate in his facilities for reference to standard authorities and original sources.

OUR ASTRONOMICAL COLUMN.

THE SPECTRA OF VARIOUS NEBULÆ. The spectra of several nebulæ, as photographed at Heidelberg with the Waltz reflector, are briefly described by Prof. Wolf in No. 4305 of the *Astronomische Nachrichten* (p. 151, February 16).

Prof. Wolf states that the planetary nebula N.G.C. 6210 = B.D. + 24°.3048 is so bright that he is able to photograph the ten lines of its spectrum with only a brief exposure. These include six of the chief lines, at $\lambda\lambda$ 501 (i.), 434 (iii.), 410 (iv.), 397 (v.), 387 (vi.), and 373 (vii.), lines at $\lambda\lambda$ 412, 447, and 496, and $H\beta$; the second nebula line, at λ 469, is not recorded, and $H\gamma$ is clearly double.

The Ring nebula in Lyra shows the seven chief lines, $H\beta$, and the line at λ 496, but no spectrum of the central star is registered. Exposures without the spectrograph give an image of the ring in twenty seconds, but give no trace of the star, thus showing that the latter is less active, photometrically, than the ring itself. Using Wratten and Wainwright's "panchromatic" plates, Prof. Wolf also got the C line of hydrogen registered, and found it to be as bright as the other hydrogen lines. By using an open slit, annular images showing the monochromatic forms and sizes of the nebula were obtained; the ring at λ 469 was found to be the smallest, whilst that at λ 373 is the largest.

Long exposures on the cluster of nebulæ near the galactic pole (12h. 53m., +28°.6) showed continuous spectra with maxima, but the condensations are too weak to measure. The spectrum of N.G.C. 6960, HV 15 Cygni, is purely gaseous, the brightest line being that at λ 373, followed by λ 434 ($H\gamma$), and traces of other lines. N.G.C. 6992, HV 14 Cygni, shows the same spectrum with the addition of $H\beta$. The Milky Way nebula, N.G.C. 2023, again shows the lines at $\lambda\lambda$ 373, 434, and 486, but the line λ 373 is abnormally bright, and there is a suspicion of an additional line at about λ 345.

THE PROPOSED PROGRAMME OF WORK FOR THE REYNOLDS REFLECTOR AT HELWAN, EGYPT.—From a note in No. 27, vol. ii., of the *Cairo Scientific Journal* (p. 417, December, 1908), we learn that the Reynolds reflector at the Helwan Observatory is to be used, primarily, for the photography of nebulæ lying between the equator and 40° south declination.

Mr. Knox Shaw shows that the instrument, owing to its comparatively short focal length, is unfitted for work on the sun and moon, whilst the absence of a large finder renders the photography of faint satellites impracticable; the ratio of the focal length to the aperture (30 inches) is only 4.5.

In the proposed zone there are between two and three thousand known nebulæ, of which the great majority have as yet only been observed visually, and, according to Keeler's estimate of their distribution, there should, in such a zone, be some 40,000; it therefore appears that the Reynolds reflector is provided with a very useful programme for a lengthy period.

OBSERVATIONS OF COMET TEMPEL₃-SWIFT.—In No. 4306 of the *Astronomische Nachrichten* (p. 159, February 18) Prof. Barnard records his observations of the periodic comet, Tempel$_3$-Swift (1908*d*), during its recent reappearance. Observations were made on four days in December, 1908, and the comet was found to be a small faint body of less than the sixteenth magnitude.

A new double star and two new nebulæ were discovered during the observation of the comet, and Prof. Barnard found that the star B.D. + 43°.53 is one of the finest crimson stars in the heavens; on December 20, 1908, he recorded it as an exquisite object as seen in the 40-inch refractor.

THE LEVELS OF SUN-SPOTS.—From Mr. Dodwell, of the Observatory, Adelaide, we have received a stereogram which confirms Dr. Krebs's observation of the different levels of sun-spots, referred to in this column for August 27, 1908 (No. 2026, vol. lxxviii., p. 402).

The two photographs from which the stereogram was prepared were taken by Mr. A. W. Dobbie, of Adelaide, during the solar eclipse of 1905, and the two groups of spots then visible on the solar disc distinctly appear to be at different levels. Mr. Dobbie used an 18-inch Newtonian reflector of 13 feet focal length, made by himself, and stopped down to an aperture of 4.5 inches. The exposures given were of about 1/1000th of a second duration, and the interval between the two was about 2½ hours.

A NEW "CAVE-NEBULA" IN CEPHEUS.—On a plate taken by him with the Bruce telescope at Heidelberg, on October 21, 1908, Dr. Kopff discovered an interesting nebula in the constellation Cepheus.

Later photographs taken by Prof. Wolf, with the Waltz reflector, show this object to be a good example of the singular phenomenon of cave-formation amongst Milky Way stars. The star B.D. + 69°.1231 is involved in the nebula, which is situated at the southern extremity of a long, starless space covered with intricate patches of nebulous matter and dark areas, and traversed by a bridge of stars, from east to west, at about 22h. 10m., +70° 0'. The position (1855.0) of the B.D. star is α = 22h. 10m. 1s., δ = +69° 31'.7.

A reproduction of the region showing this interesting object accompanies Prof. Wolf's paper describing it in No. 2, vol. lxix., of the Monthly Notices (R.A.S.).

THE RECENT MAGNITUDE OF NOVA PERSEI.—In No. 4303 of the *Astronomische Nachrichten* Prof. Nijland publishes the results of a series of magnitude observations of Nova Persei (No. 2) made at the Utrecht Observatory between July, 1904, and April, 1908. The apparent variations, if real, are unimportant and irregular, the four yearly values being 10.63, 10.53, 10.58, and 10.59, mean 10.58; on Father Hagen's scale this magnitude lies half-way between his stars 42 and 49.

DOUBLE-STAR MEASURES.—Nos. 4301 and 4302 of the *Astronomische Nachrichten* are devoted, to the extent of eighteen three-column pages, to the results of recent micrometer measures of double stars, made by Prof. Burnham with the 40-inch refractor of the Yerkes Observatory. The measures form part of the observer's general programme of observing neglected doubles, to investigate proper motions, and to provide material which may in future have special value in any discussion of the pairs given in the general catalogue.

A series of notes, dealing respectively with the individual systems, is also given, and will undoubtedly prove useful in any subsequent discussions.

SCIENTIFIC RESEARCH AND THE CARNEGIE TRUST.

THE seventh annual report, that for the year 1907–8, of the executive committee to the trustees of the Carnegie Trust for the Universities of Scotland, was submitted at a meeting held in London on February 24. The report contains a review of the activities of the trust during the seven years of its existence. In the first place, the committee directs special attention to the scheme of endowment of post-graduate study and research, which completed its first lustrum on September 30, 1908. The committee submitted the results of the scheme over the five years to independent authorities for examination and report. For this purpose the services were obtained, in the physical and chemical sciences, of Dr. J. J. Dobbie, director of the Royal Scottish Museum, and formerly professor of chemistry in the University College of North Wales; in the biological and medical sciences, of Dr. J. Ritchie, superintendent of the Royal College of Physicians' Laboratory, and formerly professor of pathology in the University of Oxford; and in the historical, economic, and linguistic sciences, of Prof. P. Hume Brown, Historiographer-Royal for Scotland.

The assistance offered by the scheme was of three kinds—scholarships, fellowships, and grants—in order, so far as possible, to reach all classes of workers. Selection was made, not by competitive examination, but for fellowships on the merits of original work already published, and for scholarships on the evidence of experts regarding the applicant's special fitness for the work proposed. No fixed number of foundations, nor even a definite total sum, was assigned to any one year. The aim of the scheme was, within the limits of the trust deed, to discover and supply the demand for assistance in higher study and research throughout Scotland. The actual expenditure upon the scheme for the first quinquennial period was 27,755*l*.

Two points in connection with the reports of the experts referred to above are mentioned. The first is that the reports must be taken as representing only part of the output of the universities of Scotland in higher study and research; for in many departments, and not merely in those outside the scope of the trust, much independent work of the kind is being done. The second is that in providing the scheme with so many able workers, as well as in affording laboratory accommodation and supervision, the universities deserve much of the credit due to its success.

In summarising the grants to universities and extramural colleges, the report states that, of the total grants during the past six years, amounting to 246,374*l*., 23,000*l*. has been allocated to libraries, 131,644*l*. to buildings and permanent equipment, and 91,730*l*. to teaching. In this allocation the committee was guided by the special needs of each institution as set forth by its governing body. It is gratifying to find, in the statements received from the universities and other institutions regarding their claims under the second quinquennial distribution, their general recognition of the great benefits that have accrued.

The second quinquennial scheme of distribution, besides making contributions of 65,250*l*. to buildings and permanent equipment and 20,500*l*. to libraries, will at the close of the period of five years have increased the resources of teaching in the four university centres by permanent endowments amounting to 87,500*l*., and have afforded during the five years an annual income of about 4150*l*. to meet ordinary expenditure.

During the period of seven academic years in which the scheme of payment of class fees has been in operation, the individual students whose fees have been paid by the trust number 8263, and the fees paid reach the total of 298,687*l*. Fifty-five beneficiaries under the scheme have made voluntary repayment of fees paid on their behalf, amounting in all to 881*l*.

With regard to school education of applicants, the committee has been able since the year 1907–8 to demand of all applicants a standard equivalent to that of the universities arts and science preliminary examination, or of the leaving certificate of the Scotch Education Department.

The expenditure for 1907–8 upon the research scheme and upon the laboratory was respectively 6340*l*. and 2185*l*., towards the latter of which the Colleges of Physicians and of Surgeons have together contributed 950*l*. Under the head of grants to university centres a sum of 73,998*l*. 5*s*. 9*d*. was available for distribution during 1907–8. The statistics of the payment of class fees for the academic year 1907–8 give the total number of beneficiaries as 3269, the total amount of fees paid as 43,256*l*., and the average amount in fees paid per beneficiary as 13*l*. 4*s*. 8*d*., an increase as compared with the preceding academic year of 107, 2154*l*., 16*s*., and 4*s*. 8*d*. respectively.

In his report on the scheme of endowment of post-graduate study and research, Dr. J. J. Dobbie, dealing with the physical and chemical sciences, remarks that a careful examination of the papers relating to the work of the Carnegie fellows, scholars, and grantees in the mathematical and experimental sciences has confirmed and strengthened the conclusions expressed in the report of January 19, 1905, as to the satisfactory working of the scheme for the encouragement of post-graduate study and research. The high standard set in the appointment of the first fellows and scholars has been well maintained in subsequent appointments. With few exceptions, the beneficiaries have fully justified their selection by the trustees. They have carried out successfully a large amount of research work. During the past five years thirty-seven individuals have been appointed to fellowships or scholarships, and twenty-five, not including fellows, have received grants. The detailed numbers, excluding grantees, are:—mathematics, 2; physics, 8; engineering, 4; chemistry, 23. It is a noteworthy circumstance that the fellows and scholars in chemistry outnumber the total of all the other branches of the mathematical and physical sciences. This may, perhaps, be accounted for to some extent, but not altogether, by the fact that the comparatively fresh field of physical chemistry offers certain attractions to students who formerly would have devoted themselves to purely physical research. Some students are thus classed with the chemists, who might with equal reason be reckoned amongst the physicists.

The fellows and scholars have contributed together one hundred and seventeen, and the grantees twenty-two, papers to the scientific journals. The papers in every case embody the results of original investigations conducted by their authors, and in the aggregate contain a very large number of new observations, some of which have proved of real value in furthering the development of the branch of science to which they relate. Nearly all the papers of the beneficiaries have been published in the journals of one or other of the great societies. It is well known that since the inauguration of the trustees' scheme the output of experimental work by the Scottish universities has greatly increased. In chemistry alone, in the course of the last two years, the number of papers dated from the laboratories of the Scottish universities which have been published in the Journal of the Chemical Society is twice as great as the number appearing in the two years immediately preceding that in which the scheme came into operation; and a still more important result is to be found in the opportunity which the scheme has afforded for co-operation within our laboratories. Although Scotland has in the past produced many eminent investigators, they have, with a few notable exceptions, been solitary workers. It is only within the last few years that "schools" of research, such as have long been the strength of the scientific departments of the German universities, have come into existence there, and the encouragement which the Carnegie scheme has given to this movement is not the least of its claims upon the gratitude of the scientific world.

Dr. James Ritchie, in reporting on the biological and medical sciences, states that during the period under review eighteen fellows have been at work. Of the total number, ten had previous to election to fellowships been beneficiaries of the trust, either as scholars or grantees. The distribution of the fellowships as regards the different branches of science were as follows:—agriculture, two; zoology, two (including one in protozoology); anatomy, three (including one in embryology and one in anthropology); physiology, six (including one in experimental psychology); pathology, five (including one in neurology). Of those appointed to scholarships, numbering in all forty-nine, eight have been promoted to fellowships. Of the others, eight resigned before the beginning of the academic year, and nine during the academic year in question. The departments of science in which the scholars proposed to work, or in which they have worked, are as follows, the numbers indicating the applicants in each branch:—geology, one; palæontology, one; botany, seven; agriculture, five; zoology, five; anatomy, two; embryology, two; physiology, three; pharmacology, two; pathology, eleven; surgery, two. The distribution of ninety-one grantees, according to their subjects, was as follows:—meteorology, one; geology, six; palæontology, two; botany, three; agriculture, four; zoology, ten; anatomy, seven; embryology, four; anthropology, one; physiology, sixteen; pharmacology, four; pathology, twenty-eight; therapeutics, five. The grantees fall into three groups:—(a) cases where grants have been made to persons holding responsible positions as heads of scientific departments or to assistants in such departments; (b) cases where grants have been made to persons in other positions, and who are engaged in research work in leisure time; (c) cases where grants have been made to young workers often in lieu of scholarships for which they have applied.

In concluding his report, Dr. Ritchie remarks that it is not difficult, in reading between the lines of the papers relating to the beneficiaries, to see that in very many cases the work which has been done would never have been undertaken unless the assistance of the trust had been given, and that in no corresponding period in the history of the universities of Scotland has so much research work of such uniformly high character been successfully carried on.

As regards historical, economic, and linguistic subjects, Dr. Hume Brown reports that, out of eighteen scholars and fellows, there are only four who have failed in greater or lesser degree to fulfil the conditions of the trust. What is noteworthy is that the work done has been original work, which really advances the various subjects undertaken by the beneficiaries. There appear to be three chief causes of the few failures that have occurred. Some candidates were recommended on the strength of their record of study in the universities, but it may happen that students who have distinguished themselves under the pressure of competition may show a lack of concentration when that pressure is removed. Such cases will occur, and can hardly be prevented. Another cause of failure is that the scholar had no clear conception of the work he undertook, with the result that time and labour were lost before he found his way to the essentials of his subject. The majority of the applicants for scholarships have had little or no previous experience in research, and it is important that they should be carefully supervised. The beneficiaries who have received grants are seventeen in all, of whom only one or two have proved more or less unsatisfactory.

At the annual meeting of the trustees on February 24 Lord Elgin moved the adoption of the report, Mr. Balfour seconded, and the motion was adopted unanimously.

In the course of his remarks, Mr. Balfour said:—This is a special occasion in the history of the trust. It is the first time that anything in the nature of a complete survey of the work that has been done under certain sections of the trust has been possible to us. It is the first time that the public can be really put in possession of information which will enable them to judge of the value of the great benefaction which the founder established for his countrymen and for the world. There is one department of the trust of which, since I am not a member of the executive, I may speak with a freedom of praise which would be quite impossible were any of the credit or any of the responsibility due to me. I refer to that portion of the work with which this great report is chiefly occupied—the portion of the work which consists in encouraging original research.

It is evident that this great object is partially ministered to by that portion of our endowment which is given to equipping libraries, laboratories, and providing our universities with all the modern appliances which seem ever more costly as the progress of science advances, and without which it is quite impossible for a modern university to do its proper work. But it is not on that portion of our labours on which I should like, specially at the moment, to congratulate Mr. Andrew Carnegie and the executive. It is rather upon the portion of the work which deals with the encouragement of those competent to carry on original work—an encouragement over and above that of merely supplying universities with the necessary equipment of books and apparatus. It is obvious that the task of selecting people who can do this work is very difficult and very delicate. It is surrounded with puzzling questions of administration, but the way it has been solved by the executive committee of the universities concerned, and the success which has attended their efforts, raises even the highest hopes of even the most optimistic and hopeful in connection with the movement. There is no greater waste in the world, and no more serious waste in the world, than waste of brains and intellect, of originality, and of scientific imagination, which may be used to further the knowledge of mankind of the history of the world, if men who are capable of carrying on investigations of this sort are given the opportunity of doing so. Competitive examinations are literally no test whatever of ability for original research. What is wanted is something much higher, much rarer, than the mere capacity for absorbing knowledge, and reproducing it rapidly when the time for examination comes round. What is required is some spark of that divine genius which shows itself in many ways, but which is, after all, a great element to which we must look for the progress of our race and the improvement of our civilisation.

What is it we want to do? We want to catch the man immediately after he has gone through his academic course, before he has become absorbed in professional life. At the moment when ideas spring most easily to the mind, when originality comes most naturally to the happily endowed individual, we want to catch him and turn him on to some inquiry which he is fully qualified to pursue with success. It is not an easy task to catch the man, and the number of men worth catching is not very large. The report speaks of a certain number of failures; there are not many among those who have been selected. It is amazing that the number is not much larger. No intuition will ever enable us to discover whether the man has anything beyond the ambition to do good work in original research. We have only to look at the reports of the experts who have dealt with the papers to consider the growth in the number of original papers accepted by scientific magazines which have issued from Scotland to see how much has been done to further this great cause of original research. We may divide the persons who are competent to carry on original research roughly into two classes, those who have the gift and ambition, but not one of those rare and overmastering ambitions which forces a man into this particular career for all his life. We have to catch them before they get absorbed in the necessary occupations of life and extract from them all we can in the way of invention and originality. Then there is a rare and higher class, those who seem born for research, to whom the penetration into the secrets of nature or into the secrets of history is an absorbing and overmastering passion, from which they will not be diverted or arrested except by absolute overmastering necessity of earning their daily bread and supporting themselves and their families. To these men it is all important, not for the sake of the men, but for the sake of the community, that they should have a chance of devoting their talents—rare talents—to that great work for which God undoubtedly intended them.

Work of the kind being done will never be able to be estimated by tables of statistics or measurement of output, but, in spite of that, will count, and count largely, among the affairs to which we shall owe the progress of knowledge, of invention, and of civilisation. Mr. Carnegie has, by this endowment of research, done a work which not only adds lustre to the history of his native country, but also has no provincial or national aspect about it, and will add to that stock of knowledge and invention which, when once made, is the common heritage of civilised mankind. In so doing Mr. Carnegie deserves not merely the thanks of those to whom he has entrusted the administration of his magnificent benefaction, but the thanks of the whole civilised world.

THE FUNCTIONS OF TECHNICAL COLLEGES.[1]

IN glancing over the early history of mechanics' institutes in this country, it is not at all clear that their founders believed that the maintenance of the position of Britain as an industrial nation was likely to depend in any direct way on the more scientific education of the working classes. The industrial position of the nation was still unchallenged, British labour was still as efficient as that of any other country, the organisers of industry were second to none in shrewdness and enterprise, and the rising suns of America and Germany were still below the industrial horizon. While the exact date at which these orbs arose may be uncertain, there can be no doubt that early in the last quarter of the nineteenth century they were already well above the horizon, and were beginning to cast sharp shadows across the industrial fields of Great Britain. Long before these signs had become obvious to the commercial and industrial classes, a number of far-seeing men, some of them industrial leaders, but the majority men of science or education, had raised the cry of more extended and popular education in science. Thanks to their advocacy this policy of reform began to make itself felt, and before the final decades of the century were spent the modern technical education movement was well under way.

Even if I were sufficiently informed to sketch for you the history of this movement, it would be superfluous for me to do so, as you are already familiar with the various stages in its development. My purpose in recalling the past was rather to help me to present to you the situation to-day, as it appears to me, not as a professed educationist, but as one who has for more than a generation been closely associated with industry and with the application of scientific methods to its development. I am fully conscious that my own views on the subject of technical education are still in process of crystallisation, and I cannot do more than ask you to accept me among your number as a student who desires to cooperate with you in advancing the great cause you have at heart.

These yearly gatherings may be regarded as halting places on our journey, from which we may look backwards over the various routes along which we have been travelling, and forwards into the country which still stretches ahead. The particular route on which it has been my lot to travel has not been wanting in variety and interest for the traveller, but as I have not yet reached the age at which my personal reminiscences could have any claim on your indulgent attention, I only refer to the journey in these general terms, and mainly because it has been made over one of the less frequented routes. As some of the hilly parts of the route happened by good fortune to be traversed in stimulating company and under favourable conditions of the atmosphere, the views which were then absorbed have left many vivid impressions, some of which have no doubt influenced me in my choice of a subject on which to address you.

It appears to me that the time has arrived when we may profitably review the position of the technical institutions in their more direct relations to the industries of the country. If we are possessed by the belief that the industrial future of the nation must largely depend on the spread of education in science and in the application of its laws to the affairs of daily life, then we cannot escape from the conclusion that it is our particular duty to see to it that we are taking a leading part in this vitally important work. This is the task which has been laid upon us by our founders and supporters, public and private. It is also the task to which we have committed ourselves from the moment when we began to enrol students in our classes. These students have come to us in the belief that we in our superior wisdom can guide and train them for the more assured places in the world of industry, so that our obligations to them also compel us to associate ourselves more and more closely with the industrial interests. It is hardly possible to over-estimate the importance of the task we have undertaken, and the more we appreciate its magnitude the more likely shall we be to cultivate only the broadest and most fully informed views of the lines on which we may hope to discharge it worthily.

While we must realise that this is essentially the task which is now laid upon the technical institutions, and that it devolves upon these bodies to take the lead in stating the problems which are involved and in working towards their solution, we none the less gratefully recognise the pioneer work of the universities in the same fields. It behoves us, therefore, to walk hand in hand with those universities which have established within their own boundaries faculties of applied science, and to avail ourselves of their experience, not only in this special department, but also in other fields of professional training. For the universities, however, this problem is only one among the many with which they are called upon to deal, while for the technical institutions it is the central problem. The very singleness of our aim, therefore, ought to give a force and concentration to our efforts which should go far to ensure success of a kind which has never before been attained.

The training of men for the practice of the learned professions has always been largely in the hands of the universities, and one of the principles which has been evolved in the organisation of this training is of the deepest interest for us, as it has an important bearing on the work we are called upon to perform. This principle is that the final judgment as to the courses of study and preparation should rest mainly with practising members of the professions. I think I am right in saying that in the faculties of law, of medicine, and of theology, this has been recognised, and that throughout their courses of study and preparation the students are brought into contact with practising members of the profession for which they are qualifying. They have thus the opportunity of realising the practical bearing of their intellectual studies on the work of their profession, and the intellectual atmosphere around them is that peculiar to their profession. One result of this is that when the graduates in these faculties leave the university they already possess the instincts of their profession, and are proud to be classed among its members. They may be, and probably are, very inexperienced members, but the fact remains that they have been professionally trained. This means that the knowledge they have acquired has already been to some extent correlated to the work which they are expected to perform. They have been trained to state the practical problems of their profession in a scientific way, and to look for their solution through the methods of accurate and intelligent observation and reasoning.

This principle is equally recognised outside the universities in the training required for the newer professions. The professional bodies which regulate the admission to their membership of civil engineers, architects, accountants, and analytical chemists, all require that the education of the candidates shall be of a definitely professional character, and it is always supervised by practising members of the particular profession.

If the training in our institutions is to be modelled on the lines of the best professional standards, we shall have to secure the active cooperation of representative men from those industries for which we propose to train our students. With the help of these representatives we must organise courses of instruction, practical as well as theoretical. We must give to the practical side the same kind of reality as is found in the clinical teaching of medical students, and it must be made compulsory for all who desire to obtain the full diploma of the college. It ought, therefore, to be supervised by a joint committee of the board of studies and the representatives of the industries. If the colleges, with the cooperation of industrial representatives who are themselves employers, can in this way organise and supervise the practical side of their training, the education of the engineer, the electrician, and the chemist will be rendered homogeneous from beginning to end, and the diploma will then be as definite a guarantee of complete professional training as the medical degree now is. In both cases the experience which only results from practice has still to be won, but the professional training will enable its possessor to begin to make his experience through his own practice.

[1] Address delivered at the annual meeting of the Association of Technical Institutions on February 5 by Dr. George T. Beilby, F.R.S., president of the association.

You will perhaps say that this is a counsel of perfection. Well, even if it be so, I think it is worth while occasionally to indulge in such counsels. I will therefore ask you to follow me rather more closely into the question. Let us first consider what is the present position as regards the training of the class of students whom we are supposed to understand best, the engineers. In this matter our colleges have been satisfied to follow on the lines laid down by those universities which confer a degree in engineering science. This degree, like the diploma of our colleges, is granted without any reference to office or workshop training. Under the "Sandwich system" time is given for the students who choose to do so to obtain a certain amount of experience in outside offices or workshops during the intervals between the university terms, but there is no direct supervision of this work, it is not even compulsory, and any student with the necessary intellectual capacity can take his degree quite as well without as with it. Though the universities and colleges take no official cognisance of the fact, yet the students are given to understand that if they desire to qualify themselves for responsible posts in the engineering world they must serve either a full or a modified term of apprenticeship in some recognised office or workshop before, during, or after their college course. They must be prepared, therefore, to devote from six to eight years to obtaining the full training required for their profession. Even the longer of these periods is not too long, but we must admit that it is a fairly large slice out of the life of a man, so that it behoves us to make sure that it is used to the best advantage. If we analyse the total period of eight years, or ninety-six months, we shall find that from twenty to thirty months are spent in close study and examination work, eight to ten months in holidays, fifty-six to sixty-eight months in the workshop or office. I find it difficult to believe that this is an ideal distribution of the time; at any rate, it appears to me that we ought to be able to put ourselves into a position from which we may be free to discuss it in its various aspects *and to modify it in an authoritative way if it seems right that we should do so.* Under present conditions these young men come to us and in effect say, "We want your degree or diploma, but as we shall also have to spend a number of years as apprentices we cannot afford to give you more than three years, therefore be good enough to do the best you can for us in that time," and we certainly try to do our best in the circumstances; but the circumstances are rather unfortunate, for do we not too often find ourselves helpless to contend against the "examination bogey" which obtrudes itself at every turn? So much book and lecture work has to be overtaken in three short years that if we attempt to develop the intelligence of the students in any directions which do not lie directly in the line of the degree, they are at once unsympathetic or even obstructive. The students cannot afford to give themselves any time to develop their own thinking and reasoning powers, and yet the time spent at college or university ought to be the great intellectual opportunity of their lives. Not once, but many times, have I been shocked by the absolutely unintellectual outlook of the bright and apparently capable young men who pass through our colleges. Now it appears to me that if these young men could come to us and say, "We know that we must give seven or eight years to preparing for our life's work, will you undertake to organise and supervise our training, practical as well as theoretical, for the whole period, and will you then give us a degree or diploma which will be a real mark of our professional training and fitness?" we could accept the larger responsibility with lighter hearts and with a hopefulness which we have no right to feel under present conditions.

Our larger institutions are in a unique position to deal with this matter in a courageous manner, for they hold a mandate directly from the people who are most deeply concerned in it. To put it at once on its broadest ground, the nation has a right to expect this from us. Some of the universities have given us a noble lead in our earlier development, but I am bold enough to think that we have outgrown that lead, and the sooner we recognise that fact the better it will be for those who are depending on us. Not only is public opinion on our side, but industrial opinion is being rapidly permeated with more advanced views on the mutual relations of science and industry. The most practical result for us is that industrial leaders and manufacturers are beginning to give us their active sympathy and cooperation. This appears to me to be the real key to the situation.

Speaking for the college with which I am associated, I can say that this cooperation is an accomplished fact. It is now some years since the governors instituted a regular system of committees of management for the different departments of work. These committees are empowered to deal, not only with the purely business matters which arise in their departments, but also with questions of educational policy, and they act as the intermediaries between the board of studies and the governors. The board of governors itself is fairly representative of the leading industries of the district, but the departmental committees are made more directly representative by coopting as members the heads of the leading manufacturing firms and professional men of acknowledged standing and reputation. The industrial leaders are now within the inner circle in the management, and can not only assure themselves as to the nature and quality of the educational work which is being done, but are able to exert a real influence upon it. For the students of the college the cooperation of the industrial leaders has a double advantage, for not only have they the assurance that their education is being conducted on lines approved by practical men, but they know also that these men are the representatives of the class which holds the key to the principal openings for their future employment.

By securing the cooperation of the industrial leaders we have taken an important step towards securing for our students the full professional training which seems to me so desirable. We have also made a beginning in developing an atmosphere of practicality in the college; but all the advantages of this union are not on the side of the college. Speaking as myself an industrial man, I can say that we also stand in much need of the kind of education which our close association with this work is admirably adapted to give us. Many of us have still no clearly defined ideas as to the way in which more scientific methods and more highly trained experts can be of advantage to our particular industries. Many who have the will to avail themselves of these helps are at a loss to understand in what way the new wine of modern technological training can be introduced into the old bottles of industrial tradition without disastrous consequences for both. If it is frankly admitted that both sides in the combination have much to learn, first from each other and later from their joint experiences, I am exceedingly hopeful that the way will be opened up for a very real advance in the scientific organisation of industry. As regards our trade classes, this principle of cooperation had to be admitted very early in the day. It was obvious that apprentices and learners could only be trained in craftsmanship by teachers who were themselves craftsmen. For the management of these departments committees have been formed which consist mainly of master craftsmen and employers. The trade employers have responded to our call, for they have found in these trade classes the modern substitute for, or supplement to, the old system of apprenticeship. We have in this instance an almost ideal fusion of the practical and theoretical sides of the training. The student passes so freely from workshop to college and from college to workshop that there need be no sharp line of demarcation between the two methods of obtaining knowledge. The soundness and practicality of his training in handicraft is assured, while on this foundation of craftsmanship we can build an equally secure superstructure of intellectual training suited to his needs. We can teach him to lay off his work with scientific method, and with a sound knowledge of the properties of the materials, and to conduct the various operations with a knowledge of the natural laws on which these operations depend.

The consideration of the system in force in the trade classes brings out more forcibly the weakness on the practical side of the training of engineers and chemists. The atmosphere of practicality which is so essential a feature in the one case is conspicuously wanting in the other; but this consideration may well encourage us to hope that the combined system which works so admirably in the trade classes may lend itself in a modified form to the solution of the more complex problem of the practical training of the engineer and chemist.

The problem is certainly more complex, but from the industrial point of view it is really not more serious than that which has already been faced by the handicraft trades. If the manufacturers and industrial leaders can be brought to realise, as the master craftsmen have done, that it is our central purpose to educate our students of all classes in the best possible way for their future work in industry, then I feel assured that we shall gradually secure more and more of their active help and cooperation. Without this help it would obviously be impossible for us to organise the workshop or other practical training of our students, but with it the difficulties may easily be surmounted.

If we are to undertake the organisation of the practical part of the training of our students, the cooperation of the employers will be necessary (1) to keep us supplied with a sufficient number of posts for temporary apprentices or learners in their works, and (2) to enable us to keep some kind of supervision over the students during their training. Probably a visiting inspector would be required, whose duty it would be to keep in touch with the managers of the works in which the apprentices are placed. This officer would be invaluable in making all detailed arrangements between the managers and the college, and in arranging for the distribution and re-distribution of apprentices among the various works.

It is well to remember that in seeking for opportunities for practical training we are not necessarily restricted to engineering works. In connection with the various municipal enterprises, electric lighting and power works, gas, water, and sewage works, employment may be found if the heads of these departments can be induced to take the necessary trouble. We shall return to this question in considering the position as regards students who are preparing to take their place in chemical industry.

While the colleges would be deeply indebted to the manufacturers who would cooperate with them in this matter, we need not neglect to represent to these gentlemen that the advantages would not all be on one side. By the cooperation the whole system of the apprenticeship of educated young men would be put on a more businesslike footing, "slackers" and "loafers" would be quickly found out and dealt with or dismissed, and intelligent hard work would be encouraged. I am not blind to the fact that there will be difficulties to be got over and asperities to be smoothed before the arrangement can be got into thorough working order, but none of these need be formidable, and we must expect to encounter little troubles in making any important change of practice.

The training of chemists for industry is a subject which has been much discussed again during the past year. Early in 1908 a subcommittee of the governing body of the newly created Imperial College of Science and Technology made a report on the subject to that body, but as that report has not been published I shall refrain from making any remarks upon it. Some of the provincial sections of the Society of Chemical Industry have also organised discussions on the subject. The first of these took place at the University of Birmingham.

At the British Association meeting in Dublin, Prof. Stanley Kipping made this the subject of his presidential address to the chemistry section. This widespread discussion shows at least that there is a healthy interest in the subject in quite a number of quarters. It occurred to me that the best way to introduce the subject on this occasion would be by a brief narrative of the action taken by the Institute of Chemistry some three or four years ago. The institute is a professional body, and it exacts a very high standard of attainment both in science and in the professional application of chemistry. Its examinations are largely practical, and any chemist who has attained to the associateship must be recognised as fully competent to take charge of all the ordinary chemical work of the laboratory. The full qualification of fellowship can only be attained after the associate has produced satisfactory evidence that he has been in successful practice as a professional or industrial chemist for five years subsequent to his admission to the associateship. The fellowship is therefore a direct guarantee of professional competency.

Some years ago the council of the institute formulated a supplementary scheme for the granting to its associates and fellows a further certificate in chemical technology. This scheme was only formulated after an exhaustive inquiry had been made, more especially as to the views of those chemical manufacturers who were themselves chemists. A practically unanimous opinion was expressed by these gentlemen that an ordinary laboratory training, even of the very thorough kind exacted by the institute, was not of itself a sufficient preparation for those who intended to make a place for themselves in chemical industry. In proceeding to formulate a scheme, the committee did me the honour of taking as their starting point a syllabus of chemical engineering which had been laid before the Society of Chemical Industry by me while I was its president in 1899. This scheme was greatly improved under the free criticism and discussion to which it was subjected by the able and practical men outside as well as inside the committee, and the syllabus which now forms part of the regulations of the institute ought to be regarded by our colleges and universities as a very valuable and authoritative pronouncement on the nature and scope of the study of chemical technology. As this subject had previously been either ignored or hopelessly misunderstood by the great majority of chemical professors and teachers, I think we must agree that the institute has earned the gratitude of all technical institutions by having placed on record this clear and compact synopsis of the subject. I am glad to have this opportunity of directing the attention of the heads of our technical colleges to this matter, and to suggest that those who are sending up students for the associateship of the institute should encourage them to take in addition the supplementary certificate in chemical technology.

During the formulation of this scheme there was considerable discussion on the question of practical works' training for students of chemical technology. This is a question on which there has often been misunderstanding. It has too readily been assumed that the chemical manufacturer who declines to throw open his works to students on the same lines as the mechanical engineer does is necessarily narrow-minded and obstructive. He is told from time to time by various learned persons that his supposed secret operations are a mere delusion, which would at once be exploded and superseded by something infinitely better if he would throw his works and process open to the criticism of the bright young graduates from our universities, yet he obstinately refuses to unlock his doors. I cannot plead guilty to any lukewarmness where the application of science to industry is concerned, but I must confess that I have considerable sympathy with the point of view of the much-abused manufacturer. If he happens to be using a process the conditions of which have been worked out by himself and his staff at much expenditure of time and money, is it at all surprising that he should regard this experience as one of his most valuable assets? Yet, strangely enough, his rights over this asset are only protected by British law if he is in the fortunate position of being able to secure a patent and maintain it against all comers; but in very many cases the prospects of being able to obtain or to maintain a patent are so problematical that he does not care to risk everything upon them, especially as the publication of a patent at once informs his rivals exactly what he is doing. In Germany, on the other hand, though the protection of this kind of intangible property is far from complete, cases of piracy by employees or others can be dealt with under criminal law, and the employer is thus placed in a much stronger position to protect his property.

I quite concede that there are many chemical works which might be thrown open to expert inspection because in their operations there is nothing special to be divulged, and in works of this description there is no intrinsic reason why student apprentices should not be admitted. But the habit of secrecy has become instinctive with the chemical manufacturer, for he is well aware that, though at one time he may have nothing to lose by publicity, yet in the quick changes which occur in this industry he may any day find himself developing the kind of experience which finally becomes a real asset.

From the chemical manufacturer I fear there is not much to be hoped for in the provision of practical experience for our students, but fortunately there is much valuable experience for the young chemist to be obtained outside the chemical works. For him, as for the young engineer, the various departments of municipal enterprise ought to be made available. There is no finer school for the chemical technologist than the gas works which are to be found in every city. In these works the problems of fuel combustion and utilisation can be practically studied, and, in addition, destructive distillation, the handling and purification of gases, and the recovery and separation of by-products. The gas industry is still overflowing with interesting problems, and at the present time various revolutionary changes are looming ahead at no great distance. The gas manager who does not wish to be left behind in the race would do well to organise an experimental department, and to call to his assistance a staff of intelligent young men from our colleges. It may safely be said that there are very few chemical works which could afford so excellent a training ground for the chemist as the gas works might supply.

In what has gone before it cannot be said that the importance of the practical and professional sides of our educational functions has been minimised; I may therefore without fear of misunderstanding on this point seek to spend the short time which remains in putting before you certain views on the place which pioneer work in science and technology may occupy in our colleges.

It has been seriously suggested in certain quarters that the technical colleges should limit their functions to the training of students and craftsmen in the more obviously utilitarian applications of science, and should leave to the universities the cultivation of the higher developments of science. I think you will agree with me that this suggestion is altogether wrong. It is based on a most inadequate conception of what the mutual relations of science and industry ought to be. The heavy emphasis which I have laid on the practical and professional aspects of our work was designed to prepare the way for an equally strong insistence on the still higher functions which are involved in our intimate relations with scientific industry. Our purpose may be single, but it cannot be narrow and restricted, for in its final expression it involves nothing less than this, that our colleges must become, not only centres of light and leading, but also makers of new knowledge. I have spoken of the necessity for the creation in our colleges of an atmosphere of practicality, but we must now, in addition to this, consider the creation of a yet rarer atmosphere of intellectual enterprise and inquiry. These two atmospheres are not incompatible; on the contrary, they ought to stand to each other as complement and supplement in the circle of our educational functions.

In the large number of students who are passing through our hands we have at our disposal an almost ideal gathering ground for the brightest and most intelligent young men from the middle and industrial classes. During their training we have the opportunity of subjecting them to a sifting process, by which they may be broadly separated into classes according to their different kinds and degrees of ability. During this process of sifting it would be surprising if we did not find a few men who are capable of developing into enthusiastic pioneers, a proportion of whom ought ultimately to find their way to the front as real leaders in science and industry. Clearly it is our duty to provide for these men an environment in which they may breathe the vitalising air of intellectual inquiry and enterprise. If we turn this duty round to its other side, we shall see that it is one and the same as our duty to industry, and therefore to the community, for every man whom we can find and inspire in this way will become a substantial asset to the nation as well as to industry.

I do not put forward the plea that research is a necessary and desirable element in the training of *all* students, for I am still unconvinced on this point. Indeed, I am under the impression that many of the less successful students and graduates in science whom I have met have been seriously injured through having been encouraged in the idea that the cultivation of original research is the duty of every student of science. The real pioneering work will never be done by mediocre men. My claim for the recognition and cultivation of pioneering ability is not made in the interest of students at large, but for the sake of the men of exceptional capacity in this respect.

When we turn to the relations of our professors and teaching staff to this question we are faced by considerations which compel us to look very closely into our whole scheme of work in its true proportions and perspective. As we have seen, the duty which bulks most largely is that of providing an adequate technical or professional training for a large number of average young men. These large numbers cannot be adequately dealt with unless the teaching is organised and carried out on the most businesslike lines. This practical side of the question naturally bulks largely in the minds of the heads of our colleges, and we need not, therefore, be surprised that one of the qualities in the teachers which is most appreciated is the capacity for businesslike organisation.

It is fortunate that the combination of these businesslike qualities with high attainments in science is not more rare than it is, so that in our colleges we do find brilliant examples of this combination. Where this is the case the problem of the creation of an atmosphere of inquiry and research is much simplified. It is only necessary that we should ensure, for the men who can use it, a sufficiency of leisure and opportunity for the prosecution of original work. It is to be desired, however, that there should be some recognised organisation within the college for so dealing with the distribution of the routine duties of teaching and examination that this leisure may be obtained in a normal and regular way.

The problem of creating the proper atmosphere becomes more difficult if the regular staff does not comprise within itself men who, by natural endowment and training, are fitted to inspire and to organise the work of a body of research students. So far as I know, few, if any, of our institutions are yet in a position to add to their staff and equipment solely with the object of fostering pioneer work. Yet it occurs to me that this is a direction in which we shall have to move ere long, and the sooner we begin to familiarise our governing bodies with the idea, the better it will be for all concerned.

Returning, however, to the case of those institutions which already have on their staff men with the necessary endowments, we may consider the further needs of the students, of those who have been selected for their special capabilities. While mere pecuniary inducements are in themselves the most unsatisfactory means for the stimulation of the right kind of original work, yet it must be recognised that pecuniary considerations are likely to bulk considerably in the minds of the majority of the students with whom we have to deal. It must be assumed, I think, that the pursuit of research work in any serious sense can only be taken up after the ordinary curriculum has been completed. This means that the selected students must continue their association with the college as research students. It would therefore be necessary to provide scholarships of sufficient value to compensate them for the postponement of their entry into the ranks of the paid workers in industry. In some institutions a beginning has already been made in this direction, and as these experiments grow in magnitude and success we look forward to a wider recognition of the benefit to all concerned.

On the financial side of this question I am tempted to detain you by a very brief digression. In seeking for financial help for schemes of this kind we may find it of advantage to disabuse the mind of the "generous donor" of the idea that the only way in which he can help is by endowing our schemes by large grants of capital. Endowments of this kind are invaluable in certain directions, but there are schemes of a more tentative kind for which all that is required is a guarantee of the expenditure for a very few years. For example, our first research student can start to work so soon as a donor can be found who will guarantee the income of the student for one, two, or three years. The donor might thus provide 100*l.* a year for three years at a total cost of 300*l.* Whereas, if he were asked to endow a fellowship of this annual value he would immediately have to hand over 3000*l*. This method certainly lends itself admirably to the making of untried experiments in educational as well as in other matters. I do not speak altogether without practical experience of the method, and I have therefore ventured to make this digression in order to commend it to your attention.

It is of set purpose that I have discriminated sharply between the functions of the technical college; the training of large numbers of competent craftsmen or professional men, and the development of a smaller class of scientific pioneers. We must admit that the latter function is likely to make the less effective appeal to the general public; indeed, it would be surprising if it were to appeal to more than a select few. I take this to mean that within the managing body we must be satisfied to proceed cautiously in developing this function. There need be no doubt or hesitation as to the *objects* to be attained, but prudence and caution will be required in the application of the means at our disposal. *Men* are of far greater importance than *money*, and I confess to a certain distrust of schemes of scientific research which are splendid mainly because they are splendidly financed. No great research department can develop except by a process which is analogous to organic growth. If the right kind of nucleus can be placed in a suitable environment we may rest assured that nature will do the rest by her processes of cell division and multiplication. It is our part to see that the nucleus is sound and of the right kind, to provide for it the necessary environment, and to weed out all useless and undesirable growths.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. C. Punnett has been appointed superintendent of the museum of zoology in succession to Dr. S. F. Harmer, F.R.S., who recently accepted the keepership in zoology at the British Museum (Natural History).

The Smith's prizes have been adjudged as follows:—H. W. Turnbull, Trinity College, for his essay, "The Irreducible Concomitants of Two Quadratics in *n* Variables"; G. N. Watson, Trinity College, for his essay, "The Solution of the Homogeneous Linear Difference Equation of the Second Order, and its Applications to the Theory of Linear Differential Equations of Fuchsian Type." The names are in alphabetical order.

Dr. McTaggart has been appointed chairman of the examiners for the moral sciences tripos, and Mr. H. O. Meredith chairman of the examiners for the economics tripos.

Sir Victor Horsley has been appointed Linacre lecturer at St. John's College, Cambridge. The lecture will be delivered on Thursday, May 6, the subject being "The Motor Area of the Brain."

LONDON.—Mr. G. A. Schott has been granted the degree of D.Sc. in applied mathematics as an external student, and Mr. G. W. C. Kaye has been granted the degree of D.Sc. in physics as an external student.

The medical college of the London Hospital has recently received a sum of 20,000*l*., which has been placed in the hands of trustees. The yearly income will be spent on the advancement of medical research and the promotion of higher education in medicine. The donor wishes to remain anonymous.

The Senate has taken exception to the terms of reference to the Royal Commission on the University on the ground that the scope of the inquiry is wider than was approved by the Senate at their meeting in December, 1908, and that the Senate has not been given the opportunity to consider extended terms of reference.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting Dr. Sven Hedin for the degree of D.Sc. *honoris causa* on March 2:—"Gaudet profecto et sibi gratulatur Academia nostra dum salutat eum qui sicut Ulixes πολλῶν ἀνθρώπων ἴδεν ἄστεα καὶ νόον ἔγνω, qui Marci Poli, Christopheri Columbi, Alexandri Humboldt æmulus inter insignissimos orbis terrarum exploratores iure numerandus est. Quippe hic ille est Sven Hedin cuius itinera periculosa hodie in ore animoque omnium sunt. Civiles palmas non minus illustres esse quam bellicas aiunt: quod si verum sit, hunc virum tanquam victorem ornare possumus, cum de ipsa Natura faciem novercalem ostendente atque atrocissime minante victoriam reportaverit. Multas hic personas eadem laude gessit, modo exploratoris impavidi qui vel multis comitantibus vel solus secum deserta perlustrat, modo ducis benigni qui nudato pede calceis aqua repletis morientis calonis sitim levat, modo scientiæ cultoris qui labores teterrimos perpessus regiones incognitas pedetemptim recludit. Quam diu ingentes Indiæ fluvii in Oceanum volventur, quam diu Asiæ interioris montes nivibus vestiti et aviæ solitudines manebunt, monumento hic vir non egebit."

M. DELAFOND will on July 1 next succeed M. E. Nivoit as director of the Paris National School of Mines.

THE London Inter-collegiate Scholarships Board will hold a combined examination for twenty entrance scholarships and exhibitions, tenable at University College, King's College, and the East London College, on May 11 and following days. No candidates will be admitted to the examination unless they have passed the London University matriculation or an equivalent examination, and are under the age of nineteen on May 1. The total value of scholarships offered is about 1500*l*. Full particulars and forms of entry may be obtained from the secretary of the board, Mr. Alfred E. G. Attoe, University College, Gower Street, W.C.

ANNOUNCEMENTS have been made in the Press that the Aërial League of the British Empire purposes to establish immediately a national aëronautical college. It is intended that the new college shall provide instruction in the subjects bearing upon aërial flight and navigation. Courses of study will be arranged in the mathematics, dynamics, and mechanics involved in the problem of flight, the laws of air resistance and friction, the stability of air craft, and in the meteorological, physical, and other conditions affecting aërial navigation. Workshops and laboratories, where experiments and tests can be performed, are to be included in the college, and a trial ground is to be procured. The intention is to teach completely the science and art of flying. It is satisfactory to find that the promoters of the scheme appreciate the necessity for founding practice upon scientific knowledge, and it may be hoped that the experiments to be performed will be based upon exhaustive theoretical inquiries into the mathematical principles which underlie the problems it is sought to solve by practical means.

THE annual report on the work of University College, London, shows that the total number of students during the session 1907–8 was 1361, being an increase of 170 on that of the preceding session. Of these, 229 were post-graduate and research students. The principal benefactions during the year were a bequest of 5000*l*. by the late Mr. Thomas Webb, of London and Cardiff, which is to be used for the completion of the new physiology building; a bequest of 500*l*. by Mr. H. A. Kay, to be used for the re-arrangement and re-equipment of the college buildings; a bequest of 1000*l*. by the late Prof. Bunnell Lewis; a bequest of 1541*l*. by the late Madame Hallon, for the foundation of prizes to be known as the "L. M. Rothschild" and the "Hester Rothschild" prizes; a gift by the past engineering students' committee of 410*l*., for the new equipment of the engineering departments; and a donation of 50*l*. by Mr. Yarrow, for the provision of apparatus in the mechanical engineering department. Besides the grants from the Treasury, the India Office, and the London County Council, the college benefited during the past year by grants from the Carpenters' Company for architecture, from the Chadwick trustees for municipal engineering and hygiene, from the Drapers' Company for applied mathematics, and from the Mercers' Company for physiology. Rapid progress has been made with the new buildings for the department of physiology, which will be ready for occupation next month. The re-arrangement and re-equipment of the college buildings involved an expenditure of 5988*l*. In order to assist the deans in the two most complex faculties, those of arts and science, the office of sub-dean has been created to provide greater facilities for giving students advice. The organisation of the arrangements for post-graduate courses and for research has been improved. The report contains lists of original papers that have been issued during the past year. The activity of the department of applied mathematics, under Prof. Karl Pearson, including the Galton Laboratory for National Eugenics, is marked by the issue of twenty-seven publications, and that of the department of chemistry, under Sir William Ramsay and Prof. J. Norman Collie, by the publication of forty original papers. The report closes with a summary of the urgent needs of the college. The need for new buildings for the department of chemistry, at a cost of about 70,000*l*., is placed in the forefront. The Chancellor, the Earl of Rosebery, has intimated his willingness to subscribe 1000*l*. to a fund for the erection of new chemical laboratories. The expenditure for the year was 53,535*l*.

SOCIETIES AND ACADEMIES.

London.

Royal Society, December 10. 1908.—"The Rotation of the Electric Arc in a Radial Magnetic Field." By J. **Nicol.** Communicated by Prof. H. A. Wilson, F.R.S.

It is well known that the electric arc is deflected by a transverse magnetic field. If the electrodes are tubular and the field is radial, spreading from an iron rod lying along the axis of the electrodes, the arc will travel round these continuously. If k_1 and k_2 are the velocities, due to unit electric force, of the ions carrying the charge, the transverse velocity of the arc is k_1k_2HX, so that a measurement of this velocity will give the product k_1k_2.

The measurement was made by placing a slit in front of the arc and allowing the light passing through this to fall on a rotating mirror, which reflected it into a photographic camera. The axis of rotation of the mirror almost coincided with the normal to its surface, and this caused the image of a point source to be a small circle. As the slit was only illuminated intermittently (once during each revolution of the arc) the image on the plate consisted of a number of dots arranged round a circle. Counting these enabled the velocity of the arc to be determined.

Copper arcs 1·8–3·6 mm. long, carrying currents from 2–9 amperes, were used. The magnetic field varied from 35–140 C.G.S. units, and the resulting arc velocities from 200–1100 cm. per sec.

The results of the experiments led to the formula

$$v = H(2{\cdot}55 + 0{\cdot}74\,i)$$

connecting the velocity with the magnetic force and arc current. The values deduced for k_1k_2 lie between $0{\cdot}53 \times 10^7$ cm. per sec. per volt per cm. for a two-ampere arc and $1{\cdot}5 \times 10^7$ for nine amperes.

Langevin has given an expression for k in terms of the mean free path, and the agitation velocity of the particle $k = e\lambda/mu$.

This gives k for a corpuscle $1{\cdot}83 \times 10^4$, and this, combined with the experimental result 10^7 for k_1k_2, gives $5{\cdot}5 \times 10^2$ as the velocity of the positive ion. Since mu^2 is the same for all gases, Langevin's expression shows that $k \propto 1/\sqrt{m}$. Hence in the arc the positive ion is 900 times as heavy as a corpuscle. This mass is about the same as that found by Sir J. J. Thomson for the positive ions in the Kanalstrahlen, but much less than that of the atoms (Cu, N, or O) present in the arc.

February 11.—Sir Archibald Geikie, K.C.B., president, in the chair.—The nerves of the atrio-ventricular bundle: J. Gordon **Wilson.** In the introduction the author refers to the discovery of this muscular bundle and its function by Gaskell, also to the valuable work of his and the important research of Tawara upon the structure of this bundle. He points out that both Tawara and Retzer made definite statements of the existence in the bundle of nerve cells and fibres. The material used for this research was obtained from the pig, calf, and sheep; the technique employed was the methylene blue "vital" method. Conclusions:—I. Anatomically, the atrio-ventricular bundle contains, not only a special form of muscle fibre distinct from the ordinary muscle of the atrium or the ventricle, but also an important and intricate nerve pathway, in which we find:—(1) numerous ganglion cells, monopolar, bipolar, and multipolar, the processes of which may pass (*a*) to adjacent ganglion cells in the bundle, (*b*) to the muscle fibres in the bundle, and (*c*) through the muscle bundle so far as it was examined; (2) abundant nerve fibres running through it in strands, the processes of which may end (*a*) in ganglion cells in the bundle, (*b*) in the muscle plexus, or pass through the part examined; (3) an intricate plexus of varicose fibrils around and in close relation to the muscle fibres of the bundle; (4) an abundant vascular supply with well-marked vasomotor nerves and sensory endings. II. Physiologically it has been shown that the atrio-ventricular band constitutes the pathway which assures the communication of the atrio-ventricular rhythm. When the bundle is sectioned or crushed, the ventricles cease momentarily to beat, though they soon regain pulsation, but with a rhythm much more slow than that of the atrium. Pathological anatomy supports this view; the allorhythmia of Stokes-Adams disease can be explained satisfactorily by lesions involving this pathway. As a result of these physiological experiments, and from these pathological conditions, it has been asserted that the contraction wave must be myogenic. To such a deduction the author's anatomical findings are opposed. They demonstrate that in these experiments and pathological conditions an important nerve pathway is equally involved with the muscle bundle.—An experimental estimation of the theory of ancestral contributions in heredity: A. D. **Darbishire.** The modern experimental study of (bi-parental) inheritance is based on the assumption that the character of an organism is determined by the potentialities existent in the germ cells which produce it, and not by the nature of the parents of that organism or of its more remote ancestors. In other words, according to the former view, the attempt to predict the result of a given mating must be based on some theory as to the characters existent potentially in the germ cells of the two individuals mated, and the characters of the parents themselves and of the remoter ancestry may be left out of account altogether in the attempt to make this prediction. The present paper gives an account of an experiment designed to decide, in regard to a particular character, between these two fundamentally different theories. The result of a cross between a yellow-seeded pea and a green-seeded pea, both of pure race, is already well known. All the first generation (F_1) are yellow, and 25 per cent. of the next generation (F_2), produced by mating these yellow hybrids *inter se*, are green, the rest being yellow. These "extracted" greens, as they are called, are said to be produced, by the yellow hybrids, in the same proportion, in each successive generation (F_3, F_4, . . . &c.), according to a scheme which it is not necessary to give here. An extracted green in F_5, therefore, has a great "weight" of yellow ancestry behind it, inasmuch as no green appears in that ancestry nearer than the great-great-great-grandparental generation, whilst behind that half the ancestors are yellow and half green. The author has made a number of crosses between pure yellow strains and extracted greens in F_5. All the (F_1) hybrids thus raised were yellow, as might have been expected. With regard to the next generation, however, it is evident that if there is any truth in the view that the characters of the parents and ancestors play any part in determining the composition of a given generation, *less* than 25 per cent. green should occur in F_2 from this cross. No such result is obtained. The proportion of greens in F_2 is 24·88 per cent., the number of greens being 34,792 and of yellows 105,045. The probable error of the percentage is $\pm 0{\cdot}078$. The actual deviation from the 25 per cent. expected, namely, 0·12 per cent., is not twice the probable error, and is therefore certainly not significant.—The determination of a coefficient by which the rate of diffusion of stain and other substances into living cells can be measured, and by which bacteria and other cells may be differentiated: H. C. **Ross.** When fresh blood is spread upon a film of agar jelly which contains Unna's stain and certain salts, the stain diffuses into the living cells, and the rapidity of diffusion depends on certain factors. It is accelerated by heat, and, of course, by time. If the jelly is alkaline, diffusion is also accelerated. Acids and neutral salts delay it. It has been found that when one class of cell stains on a given agar film, other classes do not. By slightly altering the constitution of the agar, *i.e.* by adding more alkali, acid, or salts, or by trying a different temperature, &c., that class of cell which previously refused to stain will now absorb it. It has also been found that bacteria and other cells are subject to the same conditions, and by this means it has been possible to differentiate them by their rate or coefficient of diffusion. A simple method is given for the arrangement of the agar jelly; and by measuring in units the factors, heat, alkalies, acids, salts, and time, the coefficients of diffusion can be expressed in numerals with the aid of a simple equation, the staining of the nucleus, or the cytoplasm in unnucleated cells, being the moment by which the coefficient is determined. The staining of the nucleus is coincident with death. Conversely, when the coefficient of diffusion of a cell is known, the equation indicates how to arrange an agar film so as to cause staining of the cell in a given time at a given temperature. Examples are given, and among them is one which shows that the rate of diffusion of substances other than stains also appears to depend on the coefficient of diffusion of the cells. In addition there is a summary, and some suggestions are made as to possible practical applications of the subject considered in the paper.—The origin and destiny of cholesterol in the animal organism, part iii., the absorption of cholesterol in the intestine and its appearance in the blood: C. **Dorée** and J. A. **Gardner.** The authors, as a result of experiments already communicated to the society and a consideration of the work of previous observers, have been led, in the present paper, to formulate the following working hypothesis as to the origin and destiny of cholesterol in the animal organism:—(1) Cholesterol is a constant constituent of all cells, and when these cells are broken down the cholesterol is not excreted as a waste product, but is utilised in the formation of new cells. (2) A function of the liver is to break down dead cells, *e.g.* blood corpuscles, and to eliminate their cholesterol in the bile. (3) After the bile has been poured into the intestine in the process of digestion, the cholesterol is re-absorbed, probably in the form of esters, along with the bile salts, and carried by the blood to the various centres and tissues for re-incorporation into the constitution of new cells. (4) Cholesterol is probably not synthesised in the animal body, and any wastage of cholesterol is replaced by direct absorption from the food. With the view of testing this hypothesis, the experiments detailed in the communication were carried out. On feeding rabbits on food freed from cholesterol or phytosterol, no cholesterol could be found in the fæces. When, however, weighed quantities of cholesterol were added to this food, a certain proportion was always absorbed. Analyses of the blood of these animals showed an increase in the cholesterol content in the case of animals fed with cholesterol compared with those without cholesterol. Similar experiments carried out on dogs showed that cholesterol was also absorbed from their food. —The origin and destiny of cholesterol in the animal organism, part iv., the cholesterol content of eggs and chicks: G. W. **Ellis** and J. A. **Gardner.** This paper contains an account of a number of experiments carried out with the view of obtaining evidence of the truth of the hypothesis recently advanced, that cholesterol is strictly conserved in the animal organism, and that it is not synthesised by the animal, but taken into its organism as food, at any rate in the growing animal. The experiments detailed in this paper consist of a number of estimations of cholesterol in the total unsaponifiable matter obtained from hens' eggs and newly hatched chicks. The estimations were carried out with the greatest possible accuracy, and the results leave no doubt that there is no increase in cholesterol during the change of the ovum into the complex aggregate of cells constituting the newly hatched chick. The results seem to show a slightly lower percentage of cholesterol in the chick than in the egg, but this difference may be due to experimental difficulties in extracting all the cholesterol from the tissues of the chick. The average percentages of cholesterol in eggs and chicks are given in the accompanying table. The percentages of cholesterol in the chicks are given in terms of the weights of the original eggs:—

	Per cent.
6 eggs, analysed together	0·4896
6 eggs, analysed separately	0·4121
Average	0·4508
6 chicks, analysed together	0·4677
6 chicks, analysed separately	0·3633
Average	0·4155
Difference	0·0353

February 18.—Sir Archibald Geikie, K.C.B., president, in the chair.—The osmotic pressures of solutions of calcium ferrocyanide, part ii., weak solutions: the Earl of **Berkeley,** E. G. J. **Hartley,** and J. **Stephenson.** This communication records the observed equilibrium osmotic pressures from 25 to 5 atmospheres, and also the electric conductivities of the more dilute solutions; it is shown that to bring the two sets of observations into accord it is necessary to assume that the salt molecule is associated when in solution. Similar remarks apply to strontium ferrocyanide, and are not inconsistent with the data found for the potassium salt.—The spontaneous crystallisation of monochloracetic acid and its mixtures with naphthalene: Dr. H. A. **Miers** and Miss F. **Isaac.** In this investigation three different modifications (α, β, and γ) of monochloracetic acid are described, and the transformations from one modification to another. The behaviour of aqueous solutions of monochloracetic acid was investigated as the solutions cooled by means of observations on their refractive indices. These experiments lead to the establishment of three supersolubility curves separating the metastable and labile regions, corresponding to the three modifications of the acid. These supersolubility curves have also been verified by an independent method. Aqueous solutions of monochloracetic acid of various concentrations were enclosed in sealed glass tubes and heated until the crystals had completely dissolved. The temperatures at which the solutions re-crystallised spontaneously as either α, β, or γ crystals were found to agree with the temperatures at which the corresponding solutions passed from the metastable to the labile state as determined by the previous experiments. The three solubility curves for the three modifications of monochloracetic acid have also been obtained. The second part of the paper deals with mixtures of monochloracetic acid and naphthalene. These substances Cady describes as forming mixed crystals and possessing a minimum, or eutectic, freezing point (*Journ. Phys. Chem.*, 1899, iii., 127). In a long series of experiments, however, of which an account is given, there has never been any indication of the formation of mixed crystals. The melting and freezing points of a large number of mixtures were carefully determined, but in no case was there found to be any appreciable difference between these points. The study of the crystallisation of these mixtures therefore yields results similar to those obtained for salol and betol (Proc. Roy. Soc., A, lxxix., 1907), a new feature being introduced by the existence of the three modifications of monochloracetic acid. Four solubility curves have been traced, *i.e.* the solubility curve for naphthalene in monochloracetic acid, and the three solubility curves for the modifications α, β, and γ of monochloracetic acid in naphthalene. Each of the latter meets the naphthalene solubility curve in a eutectic point, thus giving three eutectic points. Similarly, four supersolubility curves for these mixtures have been determined, giving the temperatures at which naphthalene and the three modifications of the acid crystallise spontaneously. These curves intersect in three hypertectic points, showing the highest temperature at which naphthalene and each modification of the acid respectively can crystallise spontaneously together. The four solubility and four supersolubility curves when plotted on a diagram show that in a mixture of two substances, of which one exists in three modifications, eight freezing points may be exhibited by a cooling mixture.—An apparatus for measurements of the defining power of objectives: J. de Graaff **Hunter.** The general principle of the method of measurement employed may be stated as follows. The image of a knife-edge formed by a photographic lens, when viewed with a microscope, will no longer appear as a sharp edge; the illumination of the bright portion of the field will only gradually fade away to complete darkness at some position within

the line ideally representing the true image of the edge. The object aimed at is to measure the actual intensity of illumination in the image at different distances on either side of this ideal line. The variation in the illumination with the distance is, of course, very rapid, and the total distance over which it is necessary to carry the measurements is in general extremely small. To isolate the strip parallel to the knife-edge, the illumination of which is to be measured, a narrow slit is placed in the focal plane of the microscope objective, and is thus magnified by the eye-piece. To measure the intensity of the illumination seen through this slit—*i.e.* the illumination along a line parallel to the ideal image of the knife-edge—a special mechanism is employed, whereby this image is made to alternate with light from a constant source, which, however, can be varied in a measurable proportion, so as to become of equal intensity with the illumination to be measured. This equality is judged by the absence of "flicker" when the alternations are made to succeed one another with appropriate frequency.—Best conditions for photographic enlargement of small solid objects: A. **Mallock.** When it is desired to take an enlarged photograph of an object which is not flat, and which cannot, therefore, be in focus in all parts, the question arises as to what form of lens should be used in order to secure the best results. It is shown in the paper that if a certain minimum fineness of definition is required, say, the separation of points the distance apart of which is a_1, then, in the first place, the lens used must be capable of resolving points half this distance apart; and, secondly, that the greatest distance (b_3) of the surface from the focal plane must not exceed $a/2\alpha$, where α is the angular aperture of the lens. The resolving power of a lens being dependent on α and the wave-length, it is shown that if $a=n\lambda$, then $b=n^2\frac{1}{4}\lambda$ nearly. The best that can be done, therefore, in photographing a curved or uneven surface is to use a lens which will resolve half the least distance to be defined in the picture. If this be done, all points which are not within a distance a_1 of one another, and not more than $n^2\frac{1}{4}\lambda$ out of focus, will appear separated in the picture. On the other hand, if b is given, the least distance which will be resolved over the whole picture is $2\sqrt{(b\lambda)}$.

Zoological Society, February 16.—Mr. F. Gillett, vice-president, in the chair.—Fauna of the Cocos-Keeling Atoll: Dr. F. **Wood-Jones.** The work was based on collections made by the author during a stay of fifteen months in 1905 and 1906, and in the case of most orders was believed to be fairly complete.—The anatomy of certain Ungulata, including Tapirus, Hyrax, and Antilocapra: F. E. **Beddard.**—Le Rhinocéros Blanc du Soudan (*Rhinoceros simus cottoni*): Dr. E. L. **Trouessart.**

Institution of Mining and Metallurgy, February 18.—Mr. Alfred James, president, in the chair.—Adjourned discussion on a theory of volcanic action and ore deposits, their nature and cause: Hiram W. **Hixon.**—The following papers were also discussed: An instance of secondary impoverishment: H. H. **Knox.** This paper dealt with deposits on the private estates of Kishtim, in the government of Perm, Russia, in which are occurrences of unoxidised iron sulphides, which have been leached of their copper contents. The mines particularly dealt with were a group comprising the Tissoff, Koniukhoff, and Smirnoff lodes in the Soimonorsk Valley.—"Shrinkage" stoping in Western Australia: F. Percy **Rolfe.** A description of the method of stoping used at the Lake View Consols Gold Mine, and a review of the advantages and disadvantages of the method as compared with the common system of stoping adopted in Western Australia by means of "mullock" or "filled" stopes. The reasons for utilising "shrinkage" stoping in this particular mine were stated, and the details of the method fully explained.

Paris.

Academy of Sciences, February 22.—M. Émile Picard in the chair.—Hertzian waves and Fredholm's equation: H. **Poincaré.** It is shown that several problems relating to Hertzian waves can be reduced to the integration of a Fredholm's equation.—The sex in sea-urchins obtained by experimental parthenogenesis: Yves **Delage.** Two sea-urchins, which had survived their metamorphosis sixteen months, were accidentally killed by a change in their conditions of life. The determination of their sex showed that one was certainly, and the other probably, male. From this the conclusion is drawn that sea-urchins produced by experimental parthenogenesis can be raised to the adult state, characterised by the presence of the sexual elements, and that males can be thus obtained.—Electrical discharges in intense magnetic fields: M. **Gouy.**—The principles of intrinsic projective geometry: A. **Demoulin.**—Some figures determined by the infinitely near elements of a skew curve: B. **Hostinsky.**—The application of the generalised theorem of Jacobi to the problem of Jacobi-Lie: W. **Stekloff.**—The search for roots of certain numerical transcendental equations: R. **de Montessus.**—The statical graphics of the aëroplane: Léon **Lecornu.**—The force and power of propulsion of aërial helices: René **Arnoux.**—The thermal effects of a musical arc; the probable fusion of carbon: M. **La Rosa.** The amount of energy in a singing arc is much greater than in an ordinary arc possessing self-induction, and hence should possess a much higher temperature than the latter. By the action of a singing arc on sugar charcoal masses of graphite have been obtained possessing such firmness and tenacity as to suggest that the charcoal had been fused.—The constitution of subterranean telephone circuits in large towns: M. **Devaux-Charbonnel.** It has been known for some time that the presence of an underground section of a telephone circuit diminishes considerably the intensity of the voice, and particularly affects the distinctness of certain consonants. In the present paper a calculation is given showing the relation between a given length of air line and the corresponding length of underground cable. The most advantageous diameter of wire for the cable is also worked out, and the important advantages possessed by cables of small capacity indicated.—The existence of positive electrons in vacuum tubes: A. **Dufour.** The author has repeated the experiments of J. Becquerel on the existence of positive electrons in vacuum tubes, and has obtained the same experimental results. The author's interpretation of the experiments is, however, different from that given by M. Becquerel, and does not necessitate the assumption of the existence of positive electrons in the vacuum tube.—The atomic weight of potassium: G. D. **Hinrichs.** The author applies his methods of calculation to the recent data of V. Lenher, and concludes that the true atomic weight of potassium is 39·125.—The colour reactions of indol bodies with sugars: Julius **Gnezda.**—The chloralic acids: M. **Hanriot.** The substances obtained by combining chloral with various sugars have been submitted to oxidation; acids, which are called chloralic acids, are produced, the properties of a number of which are described.—Syntheses by means of the mixed zinc organo-metallic derivatives: E. **Blaise** and A. **Kœhler.** This general method of synthesis starts from the ester-acids of the type $CO_2Et.(CH_2)_n.CO_2H$, details being given of the best methods of preparing these acids. These are then converted into the chlorides

$$CO_2Et.(CH_2)_n.CO.Cl,$$

and then submitted to the reaction represented by the equation

$$CO_2Et\,(CH_2)_n\,COCl + R.ZnI = ZnICl + CO_2Et\,(CH_2)_n.CO.R.$$

Symmetrical diketones can also be obtained by a modification of the conditions, and the properties of a number of these are given.—The preparation of indazylic derivatives by means of hydrazo-orthoketones: P. **Carré.**—The nature of the cyano-compounds of Kirsch: X. **Rocques** and L. **Lévy.** The hydrocyanic acid in Kirsch two or three years old exists only partially in the free state, a part being combined with fatty derivatives of high molecular weight.—The coagulation of milk by the ferment of *Carica papaya*: C. **Gerber.**—Some new properties of the oxydases of *Russula delica*: J. **Wolff.**—The colloidal properties of starch with respect to its chemical constitution: Eugène **Fouard.** The rotatory power of a limpid solution of starch, obtained by filtration through a collodion film, is a function of the alkalinity of the liquid. As the amount of potash added is increased, the rotation tends to a limit of 141°; this figure is nearly identical with the specific rotatory power of maltose in dilute solution (140°.4). The conclusion drawn from the whole of these experiments is that starch is a unique chemical species, and is simply a condensation product of maltose.—The maltases of maize: R. **Huerre.**—The digestion of mannanes and galactanes: H. **Bierry** and J. **Giaja.**—A mould in tanning with oil: André **Piedallu.** An account of the appearance of *Monascus purpureus* in various culture media. This fungus acidifies oils, thickens, and colours them brown; it secretes an oxydase, and appears to play an important part in the preparation of chamois leather.—The composition and utilisation of the pulp from sisal hemp after removal of the fibre: A. **Hébert** and F. **Heim.**—Comparison between the commencement of the development of a perennial and annual plant: G. **André.**—A variety of organic iron in plants: P. J. **Tarbouriech** and P. **Saget.** The plant *Rumex obtusiflorus* contains the highest proportion of iron in any plant yet known, and this iron is present in a form not reacting with the ordinary reagents for iron. The iron compound, which contains carbon, hydrogen, nitrogen, phosphorus, and iron (6·36 per cent.), is extracted from the root by alcohol containing 1 per cent. of hydrochloric acid.—Concerning the anatomy of the human thymus: Henri **Rieffel** and Jacques **Le Mée.** A reply to a criticism by M. Cruchet of a former paper by the authors.—The histological structure of the seminal receptacle of *Periplaneta orientalis*: L. **Bordas.**—The dangers of chloroform. Incoagulability of the blood and necrosis of the liver following after chloroform anæsthesia: M. **Doyon.**—The sterilisation of potable water by means of the quartz mercury vapour lamp: Jules **Courmont** and Th. **Nogier.** Potable water containing Eberth's bacillus or *Coli communis* is sterilised in one minute within a range of 30 cm. from the lamp.—Measurements in d'Arsonvalisation: E. **Doumer.**—The treatment of radio-dermatitis by the high-frequency spark: M. de Keating **Hort.**—Diaphylactic centres: Pierre **Bonnier.**—The sense of orientation and topographical memory in *Patella vulgata*: H. **Piéron.**—The study of the geological distribution of the Bryozoa: Ferdinand **Canu.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 4.

ROYAL SOCIETY, at 4.30.—On the Presence of Hæm-agglutinins, Hæmoosonins, and Hæmolysins in the Blood obtained from Infectious and Non-infectious Diseases in Man (Second Report): L. S. Dudgeon.—The Action on Glucosides by Bacteria of the Acid-fast Group, with a New Method of isolating Human Tubercle Bacilli directly from Tuberculous Material contaminated with other Micro-organisms (Preliminary Note): F. W. Twort.—The Effect of Heat upon the Electrical State of Living Tissues: Dr. A. D. Waller, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Geographical Distribution in Mexico: Dr. Hans Gadow, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—Some Vacuum Tube Phenomena: A. A. Campbell Swinton.

LINNEAN SOCIETY, at 8.—A Contribution to the Montane Flora of Fiji, including Cryptogams, with Ecological Notes: Miss L. S. Gibbs.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Some Commercial Aspects of the Management of Central Electricity Supply Stations: R. Borlase Matthews.

FRIDAY, MARCH 5.

GEOLOGISTS' ASSOCIATION, at 8.—On the Sections of Inferior Oolite on the Midford-Camerton Section of the Limpley Stoke Railway, Somerset: L. Richardson.—The Geology of the Paris Basin: F. Dollfus.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Slips in Railway Earthworks: E. G. L. Lovegrove.

SATURDAY, March 6.

ROYAL INSTITUTION, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

ESSEX FIELD CLUB, at 6 (at Essex Museum, Stratford).—Some Essex Well-sections (Part iv): W. Whitaker, F.R.S.—Remarks on a Bone Object found at Braintree, Essex, and Comparison of Similar Objects found elsewhere: Francis W. Reader.—Insect Transformations: F. Enoch.

MONDAY, MARCH 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Central Asia: Dr. M. A. Stein.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Artificial Illumination: Leon Gaster.

TUESDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—The Evolution of the Brain as an Organ of Mind: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Veddas: Dr. C. G. Seligmann.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Concrete and Masonry Dam Construction in New South Wales: L. A. B. Wade.

WEDNESDAY, MARCH 10.

GEOLOGICAL SOCIETY, at 8.—Some Notes on the Neighbourhood of Victoria Falls: Thomas Codrington.—A Contribution to the Petrography of the New Red Sandstone in the West of England: H. H. Thomas.

SOCIETY OF ARTS, at 8.—The Application of the Microscope to the Study of Metals: Walter Rosenhain.

THURSDAY, MARCH 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Note on the Stability of Jacobi's Ellipsoid: Sir George H. Darwin, K.C.B., F.R.S.—On the Wave-lengths of Lines in the Secondary Spectrum of Hydrogen: H. E. Watson.—The Measurement of Dielectric Constants by the Oscillations of Ellipsoids and Cylinders in a Field of Force: Prof. W. M. Thornton.

ROYAL INSTITUTION, at 3.—Recent Advances in Agricultural Science: A. D. Hall.

MATHEMATICAL SOCIETY, at 5.30.—The Kinetic Image of a Convected Electric System in a Conducting Plane Sheet: Prof. J. Larmor.—On an Integral Equation: G. H. Hardy.—The Use of Generalised Line, Surface, and Volume Integrals in Electrodynamics: H. Bateman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Dielectric Strength of Compressed Air: E. A. Watson.

FRIDAY, MARCH 12.

ROYAL INSTITUTION, at 9.—Modern Submarine Telegraphy: S. G. Brown.

PHYSICAL SOCIETY, at 8.—The Effect of Radiations on the Brush Discharge: A. E. Garrett.—On Pirani's Method of Measuring the Self-inductance of a Coil: E. C. Snow.—Exhibition of a High Potential Primary Battery: W. S. Tucker.—On the Least Moment of Inertia of an Angle Bar Section: H. S. Rowell.

MALACOLOGICAL SOCIETY, at 8.—Description of a New Species of Oliva from the Andaman Islands: F. G. Bridgman.—Notes on the Genera Cypræa and Trivia: H. O. N. Shaw.—On the Shell Mound at Sidon: On the Habitat of Certain Species of Clausilia from the Coast of Syria: Rev. H. A. Cooke.—Notes on the Species of Cyclophorus found at Hong Kong: Staff-Surgeon K. H. Jones, R.N.—On the "Conchological Illustrations," by G. B. Sowerby, jun., and the "Descriptive Catalogue of Shells," by J. E. Gray. C. Davies Sherborn.—On the Date of Issue of Sowerby's "Conchological Illustrations": H. O. N. Shaw.

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THURSDAY, MARCH 11, 1909.

MODERN GEOGRAPHY.

Geography, Structural, Physical and Comparative. By Prof. J. W. Gregory, F.R.S. Pp. viii+305. (London: Blackie and Son, Ltd., 1908.)

A Text-book of Geography. By G. Cecil Fry. Pp. xx+406. (London: W. B. Clive, University Tutorial Press, Ltd., 1908.) Price 4s. 6d.

WE learn from the preface to the first of these works that the book is intended for use in schools, and as it is likely to be much read, we take this opportunity of pointing out certain features which, in our opinion, are open to criticism, and might be reconsidered when a second edition is called for. In the first place it does not appear that sufficient care has been exercised in distinguishing between universally accepted generalisations and more or less tentative hypotheses. The frontispiece, only very briefly referred to in the text, is a case in point; it depicts the distribution of land and sea as it existed at some past epoch not specified, and in the absence of a word of warning is only too likely to be mistaken for a truthful record of observations. In reality it is to a large extent imaginary, and to render it a faithful representation of the existing state of our knowledge its bands of colour, so boldly and uniformly washed in, should be diversified by thickly sprinkled notes of interrogation.

The letterpress is divided into four parts, the first of which treats of the structure and the materials of the earth. This would have been an excellent summary had it not been marred by the introduction of doubtful hypotheses and unqualified statements which by their baldness become of questionable truth. Thus in explanation of a new term, "fluidable," invented by the author, we read (p. 5):—

"This term expresses the fact that though the internal material of the earth is rigid in the sense that it resists compression like a solid, it changes shape under pressure as readily as a fluid."

Again, on p. 9 we read, "The earth therefore is not an oblate spheroid. In fact it is not a spheroid at all. . . ." and in the next chapter we pass to the so-called tetrahedral theory of the earth. The speculation this involves is in itself so crude that we fail to understand on what grounds it was selected as the only true representation of the facts, especially as other views had been formulated long previously. The admirable analysis by Prof. Love is referred to in an appendix, but in a manner which awakens a suspicion as to how far the author rightly appreciates its significance.

Part ii. treats of "Earth forms and how they are made." It is extremely sketchy, and contains many doubtful statements. The elevation of a part of New Zealand in 1855 was certainly accompanied by an earthquake, but there is no evidence to show that it was caused by one. The thorny question of isostasy is not a subject for schoolboys, and should be treated more fully or not at all. The diagram of an earthquake wave (Fig. 32) is unintelligible as it stands, that of a volcano (Fig. 33) crude and misleading.

The fragments of topographical or hydrographical charts, introduced as examples of morphological types, are not to be compared with those of some recent American text-books. It is also unfortunate that there seems to be no consistent scheme of graphic representation; in the two adjacent maps on pp. 52 and 53, for instance, the shaded parts represent sea in the one and land in the other; in each isobaths might have been introduced instead of the sporadic numbers, which are confusing even to the eyes of an expert. Part iii. is devoted to climate, including an incomplete account of the winds, but not rain, and ocean currents. Why this amount of meteorology and hydrography should have been introduced and so much of equal importance omitted is not clear; in any case, the little that is given might have been correct; there is a strange blunder on pp. 84 and 85, where the explanation of land and sea breezes is accompanied by two diagrams, in each of which the wind is represented as blowing *into* a region of high pressure.

The bulk of the work is contained in part iv., which includes a laudable attempt to popularise the study of structural geography, based chiefly on the unfinished work of Suess. In the presumed ignorance of geology on the part of the reader, recourse is had to a phrase—"the grain of the land"—which is made to perform a task almost greater than it can bear. Thus the map of the British Isles inserted at p. 102 is scored with red lines, corresponding to various heterogeneous features all of which are to be referred to "the geological grain." Not only the Caledonian and the Armorican folds are thus represented, but the posthumous axis of the Isle of Wight, and even the Cotteswold and Chiltern hills, which are really sculptural rather than structural features.

The simple diagram on p. 128 is of very doubtful utility, and the more elaborate scheme in plate xvi. is open to more serious criticism. The European plain, left white, is shown extending from central Russia through North Germany, Holland, and the middle of the British Isles as far west as county Clare, from which the schoolboy will either infer that the Pennine chain, Snowdon, and the Wicklow hills are negligible inequalities, or else suffer from a confusion of ideas. On the same map, Scotland and Scandinavia are designated the "Archean Plateau of North-Western Europe." Plateau is a term rather oddly applied to either the Scottish Highlands or the mountains of Norway, unless in a very remote palæographical sense. Further south the fragments of the Armorican and the Variscan mountains are coloured differently from the central massif of France, although on the new geological map of France (scale 1 : 100,000) the connection of the trend-lines of Auvergne with those of South Brittany on the west, and, through the gneissose outliers of La Serre, with that of the Vosges on the east, is perfectly evident, and, as is well known, the connection has been confirmed by deep borings. The Spanish Meseta, notwithstanding its family likeness with the other fragments of the Armorican system, is also differently coloured. The manner in which the trend-lines of this area are drawn fails to express the true structure of Spain; as a matter of fact, the Carboniferous basin of the Asturias forms the centre of a nest of Hercynian folds, interrupted to the north by the Bay of Biscay, and diverging to the south-east like confocal parabolic curves. Tertiary lacustrine deposits sometimes obscure the facts, but otherwise they are clear enough.

The Tertiary mountain systems are represented very diagrammatically by thin red lines which are sometimes difficult to interpret, as, for instance, in the neighbourhood of Mont Blanc, where an hitherto unknown syntaxis is shown. The chain of the Apennines is marked in a different colour from its continuation to the west in the Alpes Maritimes, or to the south through Sicily into the Atlas. But by far the most remarkable feature on the map is the trend-line drawn almost straight from Cyprus to Baku. As regards the true structure of Asia Minor, reference may be made to a paper by E. Naumann (*Geographische Zeitschrift*, 1896, vol. ii., pl. i.). The author himself does not seem quite confident as to this line, for in the next structural map (Asia, pl. xix.) it is no longer shown as extending to Baku, but takes a sharp turn to the east and joins the Pontic arc.

A defect in the sense of proportion which is too characteristic of the work is nowhere more manifest than in Fig. 83, a section through eastern Asia, in which the depth of the Tuscarora abyss is represented as at least equal to the breadth of the Manchurian step, and the only reference to scale is the remark that the breadth of Japan is exaggerated.

The illustrations to the anthropological descriptions are of very unequal value; many are very poor, but the worst is probably that of a Polynesian (Fig. 97), which is badly selected, and is not good even as a caricature. The Eskimos are said to be of Mongolian origin, but modified by the arduous conditions of their life in the frozen north. We should like to know more about the influence of the environment, and especially how it came to confer upon the Eskimos their long heads. We are told in equally direct terms that the Australians are Caucasians who have been modified by adaptation to life in the arid region of Central Australia—a statement open to question from more than one point of view.

There is much that is meritorious in this work; it is certainly interesting, and if equally trustworthy would be deserving of high praise.

As regards the work by Mr. G. C. Fry, there is much less to be said; it seems intended to meet the requirements of an examination syllabus, and is probably well adapted to this purpose. The geological sections (Figs. 50 and 51) should be withdrawn, or replaced by better ones, such as almost any geological text-book will afford.

A HANDBOOK OF INORGANIC CHEMISTRY.

Handbuch der anorganischen Chimie. Edited by Dr. R. Abegg and Dr. Fr. Auerbach. Bd. ii., Abt. i. Pp. xiii+867. (Leipzig: S. Hirzel, 1908.) Price 24 marks.

THREE earlier parts of this handbook of inorganic chemistry have already received commendatory notice in NATURE (vol. lxxvii., p. 25). The present one constitutes a further gratifying addition to chemical literature, and calls for the same cordial welcome that was extended to its predecessors. It deals with the first group of elements in the periodic system, the various members being treated individually as follows:—Hydrogen (Baur); lithium (Auerbach and Brislee); sodium, potassium, rubidium, cæsium (Hinrichsen); copper (Donnan); silver (Baur); gold (Wohlwill). In addition to the general treatment of the elements and their compounds by these authors, certain sections are dealt with by separate contributors: atomic weights (as in the preceding volumes) by Brauner, and colloidal chemistry, so far as it concerns the substances coming within the scope of the present volume, by Lottermoser and Donnan; this section is a new feature of the work.

Since the rate of progress has not, so far, quite come up to original intentions, Prof. Abegg has now appointed as co-editor Dr. Auerbach, of the Imperial Public Health Department, in order that the publication of the remaining volumes may be expedited.

Prof. Brauner's contributions are especially important in the case of the present volume; he has elected to deal here, not only with the individual elements included in it, but also, collectively, with the "fundamental" atomic weights—those of the seven elements sodium, potassium, silver, chlorine, bromine, iodine, with oxygen, of course, as standard. This takes up fifty pages of the book, and provides an excellent critical *résumé* of the older as well as the recent work on the subject; the atomic weight of hydrogen, treated separately, is also very fully dealt with.

In the various descriptive sections a vast amount of important matter is collected, and particular prominence is, of course, given to the results of modern physicochemical investigation. This is particularly the case with copper and its compounds; in this section, which is easily the largest, and is in some respects the most important, in the volume, electrical matters naturally bulk largely.

It is impossible to enter more fully here into the many good points of the book; taking these for granted, a few words of criticism may perhaps be allowable. The aim of Prof. Abegg and his collaborators has avowedly been to treat the subject more particularly from the modern physicochemical standpoint, and they have therefore omitted much that one would look for in a handbook of inorganic chemistry which followed the usual lines. One cannot help thinking, however, that in places this process has been carried too far. For example, much more information might surely have been given concerning the reactions involved in the Leblanc soda-process, to which less than a page (p. 297) is devoted. The preparation of salt cake is dismissed in a single equation (which is arithmetically incorrect) as if it took place in one stage only; not a word is said about the formation of acid sulphate, or about the reverse action of hydrochloric acid on sodium sulphate, nor is the matter dealt with under either sodium chloride or the sodium sulphates. Then there is a discrepancy between the statement here, regarding the reduction of sodium sulphate, and that on p. 270; according to the former, the action is represented by the equation

$$Na_2SO_4 + 2C = Na_2S + 2CO_2,$$

and the formation of carbonic oxide is due to the later interaction of coke and calcium carbonate; according to the latter, the reduction of sodium sulphate produces carbonic oxide, though the action is complicated by the formation of some carbonic anhydride.

In connection with the description of processes for manufacturing soda, a curious slip of quite a different kind is made. On p. 298 there occurs the statement:

"Es ist daher wohl nur eine Frage der Zeit, wann dieses Verfahren [ammonia process] den Leblanc-Prozess vollständig verdrängt haben wird."

And then, three lines further down:—

"In neuester Zeit endlich wird auch das Solvay-Verfahren durch die direkte Sodagewinnung aus Kochsalz mittels des elektrischen Stromes in den Hintergrund gedrängt."

There is an undesirable lack of precision about statements such as that on p. 432, that rubidium persulphate has been prepared "by electrolytic oxidation of a saturated solution of the sulphate in presence of sulphuric acid." Here and there, also, there is room for criticism regarding inconsistency in the formulæ used to represent elements in some of the equations. On p. 681, in connection with the action of chlorine on silver nitrate, the chlorine appears in the equation as $3Cl_2$, but on p. 690, in the equation for the precisely analogous action of bromine, this appears as 6Br. In equations to represent actions which involve "nascent" hydrogen, it would be better to avoid using the molecular formula H_2, which appears on p. 91.

Throughout the whole book, however, the occasions for criticism are gratifyingly few in number.

MECHANICAL ENGINEERING.

(1) *Lathe Design for High- and Low-Speed Steels.* By Prof. John T. Nicolson and Dempster Smith. Pp. x+402. (London: Longmans, Green and Co., 1908.) Price 18s. net.

(2) *Mechanics of Engineering.* By Prof. Irving P. Church. Revised edition, partly re-written. Pp. xxvi+854. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 25s. 6d. net.

(3) *Motor-car Mechanism and Management.* Part ii. *Electric and Petrol-electric Vehicles.* By W. Poynter Adams. Pp. x+202. (London: Chas. Griffin and Co., 1908.) Price 5s. net.

(1) THIS treatise is based largely upon two important pieces of research work carried out by the authors at the Manchester Municipal School of Technology—the one on the durability of tool steel, the other upon the cutting forces acting upon lathe tools; these researches have been published already in the form of reports; the practical side of the book is also based upon data and particulars furnished to the authors by machine-tool makers.

The book is, therefore, a successful attempt to supersede the empirical rules which have hitherto governed the design of these machine tools, and to substitute for them methods based upon experimentally ascertained facts; the general adoption of high-heat steel had, in fact, rendered obsolete much of the accumulated data of the tool-maker, and some change in methods of design was therefore essential, and, in offering a solution of this problem, the authors have fully realised that the economic or commercial side of the question must be taken into account as well as the scientific.

The first few chapters are devoted to an account of the authors' experiments, already alluded to, the results being given in tabular form and in the form of curves; the experimental results so obtained are then applied to the design of lathes for high-speed cutting and for low speeds, and for what the authors term compromise lathes also; such problems as greatest and least spindle speeds, number of speeds, and the belt drive are fully discussed.

In chapters xix. to xxi. the principal designs of the fast headstock and its gear arrangements are described, both when the cone is mounted on the spindle and when it is off it, and also when the cone is replaced by a single pulley, and all variations of speed are obtained by gearing. Then follow chapters devoted to the general principles which underlie the choice and design of such fast headstocks, the chapter devoted to the design of power gears and their teeth being an especially valuable one for the designer of machine tools. To the main spindle and its design three chapters are assigned, and every important feature in regard to their construction is fully discussed, especially in regard to frictional losses and the means for reducing them. The feeding mechanism to the saddle, and reversing mechanism for feed motions, are dealt with in a succession of chapters, in which a perfect store of information has been brought together; for a general-purpose lathe, the authors state that four to six turning feeds meet all ordinary practical requirements; this section of the book is followed by that which treats of the feeding mechanism on the saddle, a special chapter being devoted to the problem of such feeds in heavy lathes; all this section of the book is well illustrated with reproductions of photographs of complete lathes, and of working drawings, often fairly fully dimensioned, of the particular part of the mechanism under discussion.

In chapter xxxiv. the application of the experimental data obtained by the authors to the problem of feed mechanism design is fully explained. The design of saddles and rests, the loose headstock, and the lathe bed are all discussed in detail, and in connection with the lathe bed it is shown that the proper form to give the section is the box or circular, the lathe beds of ordinary design being weak to resist the torsional moments to which they are subject. The last chapters are devoted to the cost of machining and the factors which govern it, to the construction of the "characteristic" diagram for any given headstock, and the means of measuring from it the economic value of the design. In the last chapter, by way of illustration, the authors show the application of the torque-speed diagram, and the lathe characteristic to a series of selected lathes built by well-known makers.

The book will be indispensable to the lathe designer, and to the manufacturer who employs large numbers of these machine tools; it is an admirable example of the way in which scientific research in our engineering schools can be applied to advance and improve the great manufacturing industries of the country.

(2) This is a revised edition, in part re-written, of Prof. Church's well-known text-book on the mechanics of engineering. The book is divided into two sections, one dealing with the mechanics of solids, the other with the mechanics of fluids, and a separate index has been provided for each section; the first section is again divided into three parts: the first part treats of statics, the second kinetics, while the third and most important part, covering 320 pages, deals with the subject of the strength of materials.

The chief changes in the subject-matter in this edition are confined to certain chapters on the strength of materials, and to portions of the section treating of the mechanics of fluids. An important new chapter is that devoted to the flexure of reinforced concrete beams, a subject of much interest to engineers engaged in structural design; the author considers that for purposes of practical design it may be assumed that, as in homogeneous beams, cross-sections, plane before flexure, remain plane when the beam is slightly bent; this assumption is only valid if the modulus of elasticity of concrete is constant in value; this is not so, but, as the author points out, it does not vary much in value within the limits of stress to which such reinforced beams are subjected in good design work.

Other useful fresh matter is that contained in chapters xii. and xiii.; in the former the subject of the flexure of simple and continuous beams is treated from the geometrical standpoint; that is, algebraic relations are deduced from the known properties of certain geometrical figures; this leads to a very simple and available form of the three moments theorem; in the latter there is a concise and lucid discussion of the relations between stress and strain in thick cylinders. In the section of the book dealing with hydraulics, the chief additions are those describing new appliances, such, for example, as the Cippolletti or trapezoidal weir, the Venturi meter, and the differential manometer.

Text-books dealing with the mechanics of engineers are constantly being consulted by practical men, who wish to refresh their memory in regard to the theory of some particular problem which they meet with in their professional work, and for this purpose a very complete index is essential. In any further re-issue of this work, it would be a distinct improvement if the indices were made more thorough and complete.

(3) As in part i., this book is divided into two main sections, one dealing with the mechanism of the car, the other with its management, and, in addition, there is a brief general introduction on the subject of electricity. As the book is intended rather for users of cars than for builders, the description of the car mechanism has been written in such a way that any intelligent non-technical reader should have little difficulty in appreciating the important points to which attention must be paid in design, and as to which the buyer must also be able to satisfy himself before deciding to purchase an electric car. In dealing with the management of the car, the author describes two forms of brake suitable for the measurement of the power of the motor, but he does not describe the simpler rope brake, which is much more satisfactory for such tests than the Prony friction brake, especially if, instead of a rope, a thin, hollow, flat band of metal is used through which a constant stream of water can be circulated to absorb the heat generated by the friction.

Special attention has been given to the management of the battery, since success in driving an electric car depends so much upon the manner in which the battery is handled. In regard to the cost of running in London an electric car, fitted with pneumatic tyres, the author estimates that it will average with a good driver 2·92*d*. per car mile, the cost of the electric energy only amounting to 0·12*d*., wear and tear of tyres accounting for 1·5*d*., depreciation of battery for 1·2*d*., the other expenses amounting to 0·1*d*. The last chapter of the book is devoted to petrol-electric vehicles, that is, to vehicles which combine with the motor and controller equipment of an electric car a petrol engine and a dynamo driven by it to supply electricity to the motor; this system possesses certain important advantages, and is being applied with success to commercial vehicles and omnibuses.

As soon as the battery problem is solved, the electric car will, at any rate for town use, rule supreme—but we are a long way yet from solving that problem.

T. H. B.

BIOLOGY FOR TEACHERS.

First Course in Biology. Part i., Plant Biology. Pp. xxv+204, and 302 figures; Part ii., Animal Biology. Pp. 224, and 408 figures; Part iii., Human Biology. Pp. 164+x, and 132 figures. By L. H. Bailey and W. M. Coleman. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 7*s*. 6*d*.

THIS book hails from across the Atlantic, and aims at supplying a course of work intermediate between unorganised nature-study and the formal science of the more advanced courses. The general intention of the authors is:—

"To lay greater stress on the processes and adaptations of life as expressed in plants and animals and men, and to attach less importance to botany, zoology and physiology as such."

It is certainly well that teachers should do their utmost to prevent that study of botany which leaves the student ignorant and indifferent to the plants around him, or of that physiology which does not lead to healthy living. The book appears to be intended for teachers rather than for students; but it is not very conveniently arranged. A certain amount of information is given on each topic handled, but usually not enough for a teacher who has not already considerable knowledge of the subject; and a number of questions is asked, often in a style that is almost irritating: *e.g.* "Which senses are very acute? Why? Dull? Why?"

But apart from matters of taste in style, it would be better to separate the volleys of questions from the descriptive text. The unfortunate teacher attempting to get up his lesson has now to wade through dozens of unanswered queries in order to pick out from them a few morsels of information scattered here and there over many pages of text. On the other hand, the trained and experienced teacher will derive few, if any, new ideas as to method, though he will probably welcome the excellent coloured diagrams.

The plants and animals examined are for the most part those which find place in the elementary courses in vogue in this country; but there are, of course, frequent allusions to American species. Of the three parts contained in the volume we prefer that devoted to human biology. In this part, information and questions are kept distinct, and the standard is just what is wanted for instructing pupils in the healthy working of the human body and for emphasising the importance of cleanly and active habits.

The pages are not entirely free from error. Etymologists will be startled to learn from Mr. Bailey (p. 60, part i.) that "parenchyma = parent + chyma, or tissue." We are tempted to inquire what derivation he would invent for "prosenchyma," and would venture to recommend a study of the Greek prepositions. Similarly, we question whether "batrachia" can be rightly translated "twice breather"; certainly the word is not synonymous with amphibia (p. 127, part ii.). The statements on p. 172, part ii., concerning migration are inaccurate; nor is it correct to state that the ferments (or enzymes) present in the digestive juices are "vegetable substances" (p. 100, part iii.). The figure (219) on p. 116, part ii., is that of a lamprey, not of an eel as stated in the legend.

O. H. L.

OUR BOOK SHELF.

Schlich's Manual of Forestry. Vol. V., Forest Utilisation. By W. R. Fisher. Pp. xii+840. (London: Bradbury, Agnew and Co., Ltd., 1908.) Price 12*s.* net.

WITH the appearance of this edition the whole subject of forest utilisation is brought thoroughly up to date. Prof. Fisher has given to English readers an admirable translation of what may be recognised as the best work on the subject. The German edition is itself based on Gayer's "Forstbenutzung," which was for many years the standard work, but with the lapse of time a new up-to-date edition became necessary to bring the book into touch with modern experience and practice. The task of writing a new edition was undertaken by Prof. H. Mayr, a former pupil of Gayer, and at present his successor in the chair of forest utilisation in the University of Munich.

The volume is divided into four parts. Part i. deals with the principal forest produce, wood, in relation to its harvesting, conversion, and disposal. Part ii. treats of minor forest produce, its properties, utilisation, value, and disposal. In part iii. is considered the utilisation and disposal of the minor produce from the soil of the forest, while in part iv. the utilisation of the components of the forest soil, such as stone, gravel, &c., is given, and at the end we have a very useful index.

The whole work is profusely illustrated, and in this edition the number of illustrations has been increased by 73, making a grand total of 402, together with 5 full-page plates.

Of the several volumes which constitute Schlich's "Manual of Forestry," this one is probably the most complete in the treatment of its subject. The various parts are divided into chapters, and these, again, into sections, each section containing a clear and concise account of the subject or operation with which it deals. The student as well as the practical forester will find this volume a regular mine of information. This work will be found equally useful in Britain, our colonies, and elsewhere, as it deals with forest utilisation in its broadest sense. In fact, the authors have made use of all the available research of the nineteenth century in bringing the work up to date. The German work naturally gives most prominence to German matter, although at the same time taking into consideration that of other countries. The translator has added to this, and based the work on a still broader foundation, in order that it may be applicable wherever the English language is spoken.

This volume is sure to be appreciated by a large number of forest-owners and foresters all the world over, and it can be confidently recommended as the best and most exhaustive work dealing with the important and world-wide industry of forest utilisation.

Parallel Paths: a Study in Biology, Ethics, and Art. By T. W. Rolleston. Pp. xv+299. (London: Duckworth and Co., 1908.) Price 5*s.* net.

THE author contributes this thoughtful book towards "the establishment of a spiritual view of the universe on a natural basis." He believes that there is more in life than chemical and physical forces. The "living machine" that we hear so much about "differs essentially from other machines in not being a machine at all, or anything in the least like one." In support of his vitalistic position, the author refers in a lucid way to the difficulty of giving any chemico-physical interpretations of development and adaptability. "The master-word is nature's will to live." He considers the Lamarckian position and abandons it, noting, for instance, that if bodily characteristics acquired by exercise were transmissible by inheritance, the new-born child of right-handed ancestry ought to show some appreciable preponderance in weight and size of the right over the left limb. But he is not satisfied with Weismann's explanation either, though he admires the brave attempt to steer between the Scylla of Lamarckism and the Charybdis of "metaphysics." All evolution theories assume the responsive powers of protoplasm. But what does it respond to? If, as Weismann says, "the response is only to differences in the amount of nutriment obtainable by the various determinants of the germ-cell, and has only a fortuitous connection with the results attained," then how can we interpret adaptations such as that of the fish, Anableps, with its bifocal eyes? Thus the author is led to "a directive theory of evolution," somewhat like that of the botanist Reinke. Man, the growing-point of progressive life, is conscious of directive control. Is there anything more real and certain to him, and is it not the x factor in all life and evolution? "The master-word is nature's will to live," and as man is not an outside observer of the universe, but an organic part of it, the author goes on to show, in very interesting chapters, that ethics is for life, and that art is man's expression of life. J. A. T.

A Course of Pure Mathematics. By G. H. Hardy. Pp. xvi+428. (Cambridge: University Press, 1908.) Price 12*s.* net.

THE title of this book is rather a misnomer. As a matter of fact, the most interesting part of it is in the last two chapters, which contain an excellent discussion of the logarithmic and exponential functions based upon the definition of $\log z$ as an integral. The preceding eight chapters deal with real and complex variables, limits, convergence of series, and the fundamental theorems of the differential and integral calculus. They are chiefly interesting as an illustration of the fact that there is a growing number of university teachers who are resolved that, if they have to teach elementary calculus, they will do it in the most rigorous way that they can, exposing the fallacies which used to be calmly ignored. There is a large number of examples, many of which show how much more attention has been given of late years in Cambridge to the elements of general function-theory. Mr. Hardy's book is more likely to be regarded as a work on the calculus than anything else; as such, it will be a useful companion to such treatises as those of Lamb and Gibson. M.

Clay Modelling in Manual Training from Plan, Elevation, and Section. By F. W. Farrington. With an Introduction by J. W. T. Vinall. Pp. 47; plates xl. (London: Blackie and Son, Ltd., 1908.) Price 3*s.* net.

Clay Modelling in Manual Training. Scholars' Handbook. (Same publishers.) Intermediate and Senior, plates xl., price 4*d.* net. Junior, plates xvi., price 3*d.* net.

ANY practical pursuit which leads to a scientific training of the hands and eyes of young pupils should receive encouragement in the schools; and modelling in clay can, in the hands of a skilful teacher, become a very useful aid in teaching several subjects. Mr. Farrington indicates how clay modelling may assist school teaching in arithmetic and geography, but hardly develops sufficiently these and similar practical applications of this form of manual work. The books will serve to provide young teachers and pupils with helpful guidance.

Handbook to the Technical and Art Schools and Colleges of the United Kingdom. Compiled from Official Information. With an Index to Courses of Instruction. Pp. xii+140. (London: Scott, Greenwood and Son, 1909.) Price 3*s.* 6*d.* net.

THIS useful directory of some of the most important schools and colleges in the British Isles providing instruction in science, technology, and art gives information as to the governing authority, principal, and secretary of each of the institutions dealt with, and particulars as to the courses of instruction arranged at each centre. Though comprehensive, the directory is not complete, and it may be hoped that the request made by the publishers for data of schools omitted will be complied with by the respective authorities, so that the omissions may be rectified in the second edition.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ionisation in the Atmosphere.

THE apparatus designed by Ebert has been widely used to determine the total charges per c.c. of the positive and negative ions in the atmosphere. Except under unusual conditions, the measurement of the positive charge exceeds that of the negative charge by an amount very variable, which averages perhaps about 20 per cent. Thus the ratio of the charges has an average value not far different from the ratio of the mobilities of the ions or from the ratio of their coefficients of diffusion.

The apparatus consists of a metal cylindrical testing vessel with an insulated axial rod connected with the central system of an electroscope. Air is drawn through the testing vessel at a known speed by a small turbine driven by clockwork. The quantity of electricity received by the central charged rod is determined from a knowledge of the electrical capacity and observations of the loss of potential.

The following simple experiments by Mr. F. W. Bates and the writer led to unexpected results. A large hollow cone of cardboard was placed so that the air entering the testing vessel all passed through the cone, and the air during its passage was strongly ionised by the β and γ rays of radium, or by the γ rays alone. The instrument itself was well screened from the rays, and the radium bromide (14 mg.) was carefully sealed in a test-tube so that no emanation escaped. The position of the radium was varied, so that the number of ions detected in different experiments covered a wide range.

Assuming the value of the ionic charge to be $3{\cdot}4\times10^{-10}$ E.S.U., and supposing that every ion carried unit charge, then the values obtained, after necessary small corrections, gave the following average number of ions per c.c.:—

Series	Positive ions	Negative ions	Ratio
1 ...	37,570	34,300	1·09
2 ...	19,900	10,100	1·99
3 ...	22,320	16,820	1·33
4 ...	14,350	11,850	1·21
5 ...	7,280	5,800	1·25
		Mean	1·39
Without radium	1,280	1,050	1·22

The variation in the ratio may be due to changes in the humidity or to the presence of dust.

The main point is, however, strongly marked. Whilst the γ rays of radium produce equal quantities of positive and negative electricity when they ionise gas in a closed vessel, we find that on ionising air near Ebert's apparatus there appears to be a large excess of positive electricity.

Care has been taken in designing the apparatus to avoid an external field. Since negative ions are under almost all conditions more mobile than positive ions, we should expect the negative ions to be captured more readily than the positive in the testing vessel, unless, indeed, some of the positive ions had a double charge. Again, it is possible that a large number of the negative ions diffuse to the top and sides of the testing vessel before entering it. In that case the diffusion is unexpectedly rapid. Moreover, the ratio, positive to negative, remained unchanged when the air was drawn through an earthed wide-meshed wire cylinder, when the loss by diffusion of the negative ions might be expected to show a relative large increase.

The details require further investigation, but the main and important result seems to be well established, namely, that the Ebert apparatus, and others of like type, are misleading in indicating a large excess of positive over negative electricity in the atmosphere. Thus when observers have recorded the average ratio as 1·2 there may really have existed equality, and the apparent excess may be due to the inequality of the rate of diffusion of the two kinds of ions, dependent on and varying with atmospheric conditions, such as humidity.

The recent interesting work of Townsend proves that under some conditions the positive ion may have a double charge, two negative ions appearing at its formation. Hence it is possible that in the atmosphere a newly generated positive ion may for a short time be the more mobile, and the apparent excess of positive electricity may not improbably be traced to this cause, as some preliminary experiments seem to indicate. Even if that is so, the fact remains that the quantities of positive and negative electricity in the atmosphere do not differ, at least not to the large extent usually recorded. A. S. Eve.

Montreal, February 17.

The Absorption of X-Rays.

The results of experiments that have been made by a number of investigators on the absorption of X-rays, secondary X and γ rays, are so complicated by a variety of conditions that few general conclusions can be drawn from them. It is apparent that a knowledge of the simple laws governing the absorption of X-rays, and the emission of secondary rays, would in many cases enormously simplify the explanations, and save much fruitless labour.

By the use of homogeneous beams of X-rays, and by a study of secondary X-rays, we have been enabled to arrive at the following conclusions:—

Many elements—possibly all—when subject to a suitable Röntgen radiation emit at least one homogeneous beam of X-radiation, which is characteristic simply of the substance emitting it.

When a radiation which is of more absorbable type than the radiation characteristic of a certain substance is incident on that substance, it does not appreciably excite that characteristic secondary radiation.

When the incident radiation is of more penetrating type than that characteristic of the exposed substance, that characteristic secondary radiation is excited.

The absorption of the radiation not sufficiently penetrating to excite the homogeneous secondary radiation characteristic of an absorbing element is governed by very simple laws, the ratio of the absorption coefficients in elements A and B (say) being constant. That is, λ_A/λ_B is approximately a constant for any radiation experimented upon which is not more penetrating than the radiation characteristic of A or B.

When the incident radiation is of more penetrating type, the absorption is greater than would be given by this law, additional absorption being evidently essential to the emission of the characteristic secondary radiation. As the general penetrating power of the incident radiation increases, the intensity of secondary radiation increases, and the absorption by this particular element increases, and finally for more penetrating primary rays the intensity of secondary radiation and absorption of primary rays decrease again in the ordinary way.

The beam emerging from the absorbing plate consists of a weakened primary beam proceeding in its original direction, a little scattered radiation, and a homogeneous radiation uniformly distributed (except for internal absorption). There is no evidence of any other kind of transformation—speaking purely of X-rays.

We may, therefore, by a proper choice of primary radiation and absorbing element observe any of the following:—

(1) Incident and emergent beams of identical penetrating power.

(2) Incident beam, homogeneous; emergent beam a mixture of two homogeneous beams, the ratio of the intensities of which asymptotically approaches a constant value, as the thickness of the absorber increases.

(3) Incident beam, homogeneous; emergent beam a mixture of two, the radiation of incident type ultimately vanishing and leaving a completely transformed radiation.

A homogeneous radiation from an element appears specially penetrating to that element and to elements of neighbouring atomic weight, because it is of less penetrating type, or only just more penetrating than the radiations from these elements.

The change in the character of an ordinary heterogeneous beam of X-rays in transmission through an element is due to (1) the general selection of rays of the more absorbable type; (2) the special selection of those rays of greater general penetrating power than the radiation characteristic of the absorbing substance; (3) the emission of secondary rays, which are more generally absorbable than the radiations which produced them, but which may be more penetrating to the element emitting them.

The energy of primary radiation transformed into secondary rays is so great that the secondary X-rays proceeding from the antikathode of a Röntgen tube constitute a considerable portion of the heterogeneous beam.

Many of Mr. Kaye's experiments on so-called primary rays, for example, are obviously experiments on secondary rays, verifying our previous results. A comparison of the absorption coefficients shows the identity of the two.

A fuller treatment of the subject of absorption will shortly be published. We wish, however, to point out the great simplification that results from the application of these simple laws to many of the phenomena which have recently been described in a variety of papers on X-rays and secondary X-rays. Probably the laws may be extended to include also the γ rays.

C. G. Barkla.
C. A. Sadler.

University of Liverpool, March 5.

The Rays of Uranium X.

In continuation of the work published in a letter to Nature of January 28, p. 366, I have now carried out under more favourable conditions a second series of observations designed to detect the growth, if any, of a feeble α radiation during the decay of the intense β radiation of uranium X. I used the preparations, obtained from 50 kilograms of uranyl nitrate, employed by Mr. Russell and myself in the study of the γ rays (Nature, March 4, p. 7). The preparation was placed 1·6 cm. from the thin aluminium foil, forming the base of an electroscope, in a magnetic field of 10,800 units, so that no β rays with a value for $H\rho$ less than 8640 could enter the electroscope.

Under these conditions, although the β radiation from the preparation was sufficiently intense to show luminosity on an X-ray screen in a fully lighted room, the leak in the electroscope was small enough for accurate measurement. About one-fourth of the leak was due to γ rays, and the remainder to still undeflected β rays. Initially the leak was not measurably altered by covering the preparation with a layer of thin tin foil sufficient to absorb any α radiation. In a few hours after preparation a decided difference was noticed, pointing to a growth of α radiation from the preparation, as the considerations outlined in my previous letter had led me to expect. Instead, however, of this absorbable radiation growing with the time according to the function $1-e^{-\lambda t}$, where λ is the radio-active constant of uranium X, contrary to all expectation the absorbable radiation *very quickly* reached a maximum, and has since remained constant. About one-half the maximum was reached after the lapse of one day, while after 2·5 days no further increase was observed. At this stage the absorbable radiation was about one-fifth of the total.

The observations have now been in progress for one month. These observations and the whole of those previously made indicate that this α radiation remains constant after the maximum is reached over a period of several years. This points to the existence of a new body, presumably somewhere in the uranium series, with a period of the order of one day, the product of which gives α rays, and has a very long period of life.

I have thought it well to record these observations before being in a position fully to explain them, as there has just come to hand the announcement by M. Danne (*Le Radium*, February, p. 42) that, working with 20 kilograms of uranyl nitrate, he has succeeded in effecting the partial separation of the parent of uranium X, which he terms *radio-uranium*. From his description it appears that the new body is very closely allied to uranium in chemical nature. So far as can be judged, it appears improbable that in preparing the uranium X for these experiments any of the radio-uranium was separated. One may conclude at once from M. Danne's results that the period of radio-uranium must be long compared with that of uranium X. Thus M. Danne's discovery neither assists nor makes it more difficult to explain the results recorded in this letter. It is obvious that we have here really a very complex series of changes not capable of immediate interpretation.

FREDERICK SODDY.

Are the Senses ever Vicarious?

It is a prevalent opinion that if a human being is bereft of one sense, one or more of the other senses become more acute, and thus establish a compensation. For example, it is generally believed that the blind have the senses of touch and of hearing, more especially of touch, developed to a degree of acuteness not found in those who see, and that, in this way, the blind find their way about the world with an accuracy that is often surprising. The blind have even been credited with the ability to discriminate colours by the sense of touch, and some have attempted to support this supposition by an appeal to the sense of heat or cold possibly, for physical reasons, associated with a particular colour. A compensating arrangement has also been attributed to the deaf, and more especially to the deaf-blind. Such notions, however, must be abandoned before the evidence of recent investigations.

The question is discussed with much shrewdness in a paper on the physiology of the blind, by M. Kunz, director of the Institution for the Blind at Illzach-Mülhausen. He refers especially to the observations of Prof. Griesbach, made on a considerable number of blind persons in the Mulhausen Institution, and also, for the sake of comparison, on pupils in the public schools of Mülhausen of the same age. The results are somewhat surprising. As regards perception of the direction of sound, there is no difference between the seeing and the blind. The average distance at which sounds could be heard was essentially the same in both classes. As tested by Zwaardemaker's olfactometer, the delicacy of the sense of smell was rather in favour of the seeing. Griesbach used his own æsthesiometer, with parallel pins on springs, instead of the old Weberian method with compasses, in testing the acuteness of touch, with the result that the average minimum distance, say on the tip of the forefinger, &c., at which two points were felt was greater in the blind than in the seeing; in other words, that the seeing had a finer sense of touch than the blind. It is generally supposed that the palp of the forefinger of the right hand, which is used by the blind in feeling the points in Braille's system of teaching the blind to read, must be very sensitive, but this was found not to be the case. Too high a degree of sensitiveness to touch is rather unfavourable to discriminating the points in Braille's type, and it is curious that when, in the blind, the epidermis of the skin covering the right forefinger becomes thickened by manual labour or by laborious practice in "reading," the discrimination of the points becomes easier. It was observed, also, that sometimes in the blind there was a difference as regards receiving impressions between the two forefingers.

There appears to be no evidence, therefore, that blindness, *per se*, increases the sensitiveness of the other senses, but, on the principle that if one sense is defective the others are likely to be also defective, the other senses, in the average blind, are less acute than in the seeing. How, then, are we to explain the wonderful way in which the blind avoid obstacles and find their way about? It has been supposed that by practice the skin of the face, in particular, becomes more sensitive, or, in other words, that the blind habitually pay attention to currents of air playing on their faces, and especially they may be influenced by sensations of temperature. They say that they "know" they are near a wall because they "feel" it, although they do not touch it. It would be interesting to examine the blind as regards the sensitiveness of the hot and cold spots of the skin revealed by Goldscheider and others. The theory of sensitiveness to the direction and temperature of air currents is supported by the observation that the blind do not so readily avoid an obstacle if the face is covered or even if they are blindfolded. This suggests the question: Are all so-called blind people absolutely insensitive to light?

It is also believed that the blind pay an almost involuntary attention to the direction and quality of sounds. The blind man "taps" his stick. When snow is on the ground the blind have difficulty in avoiding obstacles. One must not forget, however, the psychical element that enters into the question. The effort of attention is superadded to the sensory impression. Impressions may reach the sensorium of which we are usually unconscious, but they may be detected by an effort of attention. This was strongly pointed out by Helmholtz. The senses of the blind are not more acute than those of normal people, but the necessities of the case oblige the blind to pay attention to them.

JOHN G. MCKENDRICK.

The Zoological Position of Tarsius.

Two years ago (NATURE, May 2, 1907, pp. 7 and 8) I directed attention to the fact that the recent additions to our knowledge of the Primates would compel us to look upon this order as being composed of three diversely specialised phyla of subordinal rank. It seemed clear that we should have to adopt some such subdivision of the Primates as that employed by Gadow ("A Classification of Vertebrata," London, 1898, pp. 52 and 53), who called the three suborders Lemures, Tarsii, and Simiæ respectively.

The researches of Hubrecht had shown that in respect of certain phases in its developmental history Tarsius differs from the lemurs and resembles the apes, and, as the result of the examination of its brain, I had come to the conclusion that Tarsius is much more primitive, and at the same time distinctly more pithecoid, than the lemurs (Linnean Society's Journal, 1903). But Hubrecht would interpret these facts (see NATURE, December 24, 1908, p. 229) as a demand for the exclusion of the lemurs from the Primates. The memoirs published within recent years by Forsyth Major, Earle, Standing, and the writer have made it perfectly clear that the demonstration of the affinities of Tarsius to the apes does not in any way affect the recognition of the fact that it is at least as nearly related to the lemurs, so that Hubrecht's proposal to restrict the term Primates to Tarsius and the apes lacks any adequate justification.

At the last meeting of the British Association I pointed out that the results of stimulation of the brain in lemurs and the examination of the distribution of the histologically distinct cortical areas by Page May, Wilson, and myself, had revealed a close resemblance to the condition found in the apes. In opposition to the views of Vogt, Brodmann, Halliburton, and Mott, we found that a true sulcus of Rolando—which is peculiarly distinctive of the Primates—showed a tendency to develop in every prosimian family, and that in the lemur Perodicticus the morphology of the cerebral hemisphere is identical in almost every respect with that of the American monkey Pithecia. These facts bear unmistakable witness to the right of the lemurs to be included in the Primates.

In a monograph on the human hair by Friedenthal, a curious distinctive feature of the distribution of the hair in the Simiæ is mentioned. This author states that in man and all the other Primates (among which he does *not* include the lemurs) the sole of the foot is absolutely devoid of hair, not only in the adult, but also in the fœtus, and the line of demarcation between the hairless and the hairy skin runs across the back of the heel; but in the Prosimiæ the posterior part of the sole of the foot is coated with hair. I have examined a series of specimens of Tarsius given to me by Dr. Charles Hose, and find that in the manner of distribution of the hair on the foot Tarsius differs from the apes and agrees with the lemurs. At a time when so much weight is being attributed to facts of relatively slight significance on the other side, it seems worth pointing to this curious straw of evidence, which shows that, as the Primate stream flowed from its source among a group of Tarsius-like mammals, the apes and the lemurs were merely divergent branches of this stream, and that the latter suborder, although definitely specialised in structure, remained nearer to the Tarsii than the apes.

Cairo, February 17. G. ELLIOT SMITH.

Number of Molecules in Unit Volume of a Gas.

THE following is an attempt to calculate the number of molecules of helium in unit volume directly, that is, without assuming Avogadro's hypothesis and the known value of the number of molecules of any gas per unit volume.

Various methods can be adopted leading to the five results given below:—

(*a*) Meyer, in his "Kinetic Theory of Gases," has calculated the molecular free path of helium at 0° and atmospheric pressure to be $L = 24 \times 10^{-6}$ cm. ("Kinetic Theory of Gases," p. 194, second edition).

Now let Q = sum of the diametral sections of the spheres of all the molecules contained in unit volume, then, by the formula

$$Q = 1/4\sqrt{2}L \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

we calculate Q for helium = 7402 sq. cm. nearly.

It is also proved in treatises on the kinetic theory that $S = 6\sqrt{2}\nu L$, where S = radius of the sphere of action of the molecule, ν = space actually occupied by the molecules contained in unit volume or the coefficient of condensation. Now this coefficient of condensation is always less than the ratio E of the densities of the substance in the gaseous and liquid states, so that, putting E for ν in the above formula, we shall get the superior limit to the value of S. We have then $E_{\text{Helium}} = \Delta/\delta$, where Δ, δ are the densities of helium in the gaseous and liquid states. Putting $\delta = 0{\cdot}15$ (Onnes), we have

$$S_{He} = 2{\cdot}4 \times 10^{-7} \text{ cm.} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

(*b*) This value is probably high, and Meyer has shown that a method involving deviations of the gas from Boyle's law is more accurate. Onnes gives the value 0·0007 for *b* in van der Waals's equation for helium (quoted in NATURE, October 22, 1908, p. 635). Accordingly, assuming Maxwell's relation $b = 4u$, where u = co-volume or volume actually occupied by the molecules per unit volume, we get the known formula $S = (3/\sqrt{2})pbL$, where p = pressure in metres of mercury, for which the value of L which is employed holds good. We have, then,

$$S_{He} = 2{\cdot}5 \times 10^{-8} \text{ cm. nearly} \quad . \quad . \quad . \quad . \quad (3)$$

(*c*) Adopting the relation $b = 4\sqrt{2}u$ instead of Maxwell's, we get

$$S_{He} = 1{\cdot}76 \times 10^{-8} \text{ cm. nearly} \quad . \quad . \quad . \quad . \quad (4)$$

This calculation has, it seems, a claim to greater accuracy, since the relation $b = 4\sqrt{2}u$ has been confirmed experimentally by Holborn (Exner's Report, 1891, xxvii., p. 369) and by Sydney (*Chem. News*, 1898, lxxviii., p. 200).

(*d*) Calculating S_{He} by another method, which has been found, in many cases, to give an inferior limit to the value of S from the formula $g = (\mu^2 - 1)/(\mu^2 + 2)$, where g = fraction of the volume containing the gas which its molecules actually occupy, and μ = index of refraction. Hence, replacing ν by g in Loschmidt's formula, we have

$$S = 6\sqrt{2}gL.$$

Taking data from the paper by Cuthbertson and Metcalfe (Phil. Trans., A, vol. ccvii., p. 138, 1907), we get

$$g = \tfrac{2}{3}(\mu - 1) = 37 \times 10^{-6}$$

nearly, whence

$$S_{He} = 0{\cdot}5 \times 10^{-8} \text{ cm. nearly} \quad . \quad . \quad . \quad (5)$$

(*e*) Lord Kelvin found that there must be from 200 to 600 molecules in the volume of one wave-length of the light emitted by the body. Taking the lower limit, 200, the mean distance between molecules is found to be

$$x = 5 \times 10^{-3} \times 5876 \times 10^{-8} \text{ cm}, \quad . \quad . \quad . \quad (6)$$

If N = number of molecules per unit volume, we find

$$\begin{aligned} N_{He} &= 0{\cdot}017 \times 10^{19} \text{ nearly from (1) and (2)} \\ &= 1{\cdot}4 \times 10^{19} \quad \text{,,} \quad \text{(1) and (3)} \\ &= 2{\cdot}8 \times 10^{19} \quad \text{,,} \quad \text{(1) and (4)} \\ &= 36 \times 10^{19} \quad \text{,,} \quad \text{(1) and (5)} \\ &= 4 \times 10^{19} \quad \text{,, Equ. (6)} \, . \, N\lambda^3 = 1. \end{aligned}$$

Comparing these values of N for helium, we see that the value obtained from the density of liquid helium is very low, whereas the refractivity method gives a very high value. Greater accuracy seems to belong to those obtained from van der Waals's equation; of these two, the latter value obtained from $b = 4\sqrt{2}$ is probably the best. Hence, no doubt, it is safest to adopt $2{\cdot}8 \times 10^{19}$ as the value of N. It is interesting to compare with this the value of N as obtained by Rutherford and Geiger from their recent counting experiment (NATURE, November 5, 1908, p. 14), viz. $N = 2{\cdot}72 \times 10^{19}$.

P. GHOSE.

Physical Laboratory, Presidency College, Calcutta, January 14.

An Electromagnetic Problem.

I AM glad to get Mr. Campbell's views (NATURE, January 21) on the electromagnetic problem which I submitted (NATURE, November 19, 1908). His method of going back to fundamental definitions is, of course, in general the only safe way where any doubt may enter.

His remarks, however, considered as an answer to my question, are not quite to the point. As I carefully stated in the original letter, I am not desirous of setting up a conservation of energy paradox, but merely wish to show that apparently *the ordinary expression* for the energy of any electromagnetic field is, in the present case, not in harmony with the first law of energy. The accepted expression for the energy in any electromagnetic field is

$$\frac{1}{8\pi}\int\left(E^2 + H^2\right)d\tau,$$

where E is the force in dynes on a unit stationary test charge, H the force in dynes on a unit stationary "magnetic pole," and $d\tau$ is the element of volume. The test charge and pole are not parts of the system.

This expression for the energy does not appear to remain constant while the sphere of electricity is allowed to expand under the mutual repulsion of its parts, for the magnetic force on the test pole is obviously always zero, while the region of integration for E^2 is constantly diminishing. The difficulty, then, is with this *generally accepted expression* for the energy, and this is the only difficulty to which I refer.

D. F. COMSTOCK.

Institute of Technology, Boston, Mass., February 10.

I AM sorry if I have misunderstood Prof. Comstock, but many others besides myself thought that he maintained that the difficulty vanished in some way if the distribution of the electrification on the sphere was discontinuous. My letter was directed against this contention.

I do not know how the integral expression for the energy is "generally" interpreted, but if it is interpreted with intelligence it will give perfectly accurate results. The system by which Prof. Comstock measures the electrostatic energy is a uniform distribution of "test points" throughout space. When the sphere expands the "region of integration" diminishes, since some of the points pass within the sphere; but the loss of energy, as calculated by the integral due to this cause, is balanced by the amount of work which the sphere does in passing over these points. If we do not neglect to consider this work, the ordinary integral gives the amount of electrostatic energy whether the distribution on the sphere is continuous or not.

NORMAN R. CAMPBELL.

Trinity College, Cambridge, February 24.

The Production of Prolonged Apnœa in Man.

IN NATURE of March 4 Mr. Royal-Dawson recalls a statement of Faraday to the effect that Mr. Brunel, jun., and a companion were able to stay under water about twice as long as usual if they had previously been breathing air at double the normal atmospheric pressure, and he inquires whether a similar relationship might not hold after forced breathing and oxygen inhalation, and so enable the maximum time of 8m. 13s. for which I could hold my breath under such conditions to be doubled. Increased pressure would, as a matter of fact, have scarcely any influence. As I pointed out in my letter of February 18, the essential conditions of prolonged apnœa are a previous removal of as much carbon dioxide as possible from the body by forced breathing, and inhalation of oxygen just before holding the breath so as to prevent the system suffering from oxygen want. Neither of these two conditions would be influenced by doubling the atmospheric pressure, as a few deep breaths of nearly pure oxygen at normal pressure afford one much more oxygen than is needed by the body even during eight minutes.

If air is inhaled instead of oxygen, the duration of the apnœa is naturally increased with increase of the atmospheric pressure up to a certain point, as the total amount of oxygen thereby taken into the lungs, and rendered available for vital processes, rises proportionately to the pressure.

H. M. VERNON.

22 Norham Road, Oxford.

Moral Superiority among Birds.

Two letters have recently appeared in NATURE upon this subject, but they have mainly referred to the relative moral sense of *different* groups of birds.

It may be of interest to note the relationships existing between *allied species*. Amongst Corvidæ, the rook is gregarious, and breeds in rookeries. It always allows the starling (Sturnidæ) and the jackdaw to associate with it, and even to breed in the midst of the same social community as itself. Thus these birds are regarded as on an equality, or at worst as inoffensive satellites. A feasible explanation is found in the fact that all three are social species, and frequent human habitations.

On the contrary, the carrion crow lives at most in pairs, never collecting in a body to feed or to nest. It is a scavenger, a feeder on offal, in a word, an outcast. Compared with the work of the rook or that of the two birds just mentioned, so beneficial to the farmer, the carrion crow's *rôle* is mean and degraded—though necessary. It is sly and cunning, and also addicted to purloining. Thus, compared with the rook, which is industrious and useful, and not usually sly, it exhibits a kind of moral inferiority. Very rarely does the rook suck the eggs of game or kill chicks, &c. (on which see *Shooting Times and British Sportsman*, July 18, 1908). Indeed, the moral inferiority of the carrion crow is proved by the rook's own attitude towards it. The latter will not allow the crow to invade its domains or to feed with it, and if any one of its own species turns to the evil habits of the crow it is ousted by general consent of the community.

The same demeanour is maintained in the relations between the rook and the magpie and jay.

Since psychic as well as morphic characters constitute the sum total of "specific" characters, the study of the moral sense in birds is important. In the animal world its very existence is perhaps best proved by experiment and comparison. Its neglect in biological work is a matter for regret. In the near future it must play an important part.

A. R. HORWOOD.

Leicester Corporation Museum, February 24.

The Dryness of Winter (1908–9).

THERE has been a good deal of surprised comment on the very dry character of this winter, but the season is apparently quite normal in this respect; that is, a very dry autumn tends to be followed by a dry winter. Here is a table showing the ten driest autumns at Greenwich from 1841 to 1907, and the rain-character of the winter following in each case:—

Ten driest Autumns		Rainfall inches	Rainfall Winters following inches	Relation to average (5·27)
(1)	1858	2·80	3·36	−1·91
(2)	1890	3·32	2·38	−2·89
(3)	1851	3·33	5·05	−0·22
(4)	1884	4·12	6·29	+1·02
(5)	1902	4·18	5·00	−0·27
(6)	1897	4·25	3·98	−1·29
(7)	1879	4·54	3·27	−2·00
(8)	1901	4·62	4·46	−0·81
(9)	1900	4·71	3·91	−1·36
(10)	1904	4·73	3·97	−1·30
Average		4·06	4·17	−1·10

Thus in only one case (1884–5) was the winter rainfall in excess.

The autumn rainfall of 1908 (3·94 inches) would come between (3) and (4) of the above list.

The opposite tendency (with a very wet autumn) is also, I think, perceptible, though less pronounced.

ALEX. B. MACDOWALL.

Is there a Vertical Magnetic Force in a Cyclone?

THE discovery of a powerful magnetic force along the axis of a solar vortex will have suggested, no doubt, to others besides myself the possibility of a vertical magnetic force in a terrestrial cyclone. If such should exist, and the electrification of the air be positive, there would be a reduction in the magnitude of the vertical component of the earth's field in the northern hemisphere when the centre of the cyclone passes over the place of observation. As to the magnitude of the effect, an elementary calculation shows that the intensity of the force in C.G.S. units at the centre of a mass of air 100 miles in radius, revolving with a velocity of fifty miles per hour at that radial distance, would be less than $10^{10}\rho$, where ρ is the volume density of electrification in coulombs per cubic cm. Under ordinary atmospheric conditions ρ has been estimated as of the order 10^{-19}, although much larger values have been sometimes obtained, and the magnetic force consequently would be of the order 10^{-9}.

Unless the density of electrification is very large in cyclones, it is not likely that a magnetic effect would be observed. Perhaps a tropical cyclone of great velocity, in an exceptionally highly charged atmosphere, might leave a small trace of its passage on the vertical force record.

Rochdale, March 8.

J. R. ASHWORTH.

THE COAST OF THE CAUCASUS.[1]

M. MARTEL'S description of his journey and observations in the Caucasus forms one of those tall octavo volumes, handsomely printed and superabundantly illustrated, which are published in Paris at about one-third of the price that would be thought necessary in London. It is the outcome of a voyage for geographical study undertaken in 1903 at the request of M. A. S. Yermoloff, Minister of Agriculture to the Russian Government. The war in the Far East has hitherto delayed the publication of the results, which now takes place in this agreeable form rather than in an official pamphlet.

Among the towns that are rising on the eastern shore of the Black Sea, with a view to the attraction of visitors to a new and romantic Riviera, are Sotchi, the favourite of M. Yermoloff, and Gagri, the haunt of wealthy worldlings. Travellers in Russia will know how eager the rich are to get out of it in their weeks of leisure, and at Gagri since 1903 a pleasure station has been devised which may in time, within the limits of the empire, rival Biarritz or Monte Carlo. At present its richly oriental bazaar remains; in the fields behind the town the tombs of Mohammedan occupiers stand amid the lands they loved and tended; and even at the back of a sea-front of luxurious hotels there must always rise the castle wall built by Mithridates, the dark zone of forests, and the limestone plateau of Arabika, 8000 feet above the sea.

M. Martel's passage of the densely wooded ridges on the two flanks of the Arabika (pp. 172–87) supplied more adventure than is usual in a specially conducted tour, and this may have made him tolerant of civilised Gagri, then but a year old. But he is far more attracted towards Sotchi, farther up the coast (p. 90), where isolated villas are to rise on the margins of wooded parks, and where even the Grand

[1] "La Côte d'Azur Russe (Riviera du Caucase)." By E. A. Martel. Pp. 358. (Paris: Ch. Delagrave, n.d.—actually 1908). Price 10 francs.

Hôtel Pension has no licence for alcoholic liquors. "C'est l'équivalent," says M. Martel naïvely, "des *temperance-hotels* d'Irlande."

Near Sotchi, stratified gravels are noted, at times more than 25 metres above the shore, resting unconformably on the shales, and probably indicative of the former extension of the Black Sea in Pleistocene times. Behind the town, gorges extend up into the limestone hills, and here the conquered Tcherkesses may still be found. In a cavern of the Matsesta valley, the author, who cannot keep above the earth when there is a chance of descending into it, nearly lost his life from asphyxia in a hollow filled with sulphuretted hydrogen (p. 119). Only the prompt action of his friends restored him to the scientific world. But he writes of his experiences before fainting and during recovery with more interest in their medical aspect than in his own imminent danger. Rags are hung by the natives at the entrance to the mineral springs, just as at holy wells in Ireland; as the author points out, the cult of medicinal waters probably goes back to prehistoric times.

Travelling in these valleys must at present be done on horseback up the waterways—that is, largely in the streams themselves. Camping out in terrific rains, sometimes lasting forty-eight hours, seems an ordinary affair in September. On the other hand, June and July are not good months for this Riviera. The fine days and the exquisitely varied landscapes seem, however, to atone for everything, and M. Martel gives a special chapter on malaria, so prevalent in the low coastlands, in which he states that he felt touches of fever when coming below an altitude of 200 metres. Yet he experienced no bites from insects, and malaria does not seem to be serious in August, September, and October. He is evidently of opinion that a better water supply, on lines recommended by him for various places, and a higher standard of living, may fortify the coast-dwellers against a disease primarily due to the mosquitoes (p. 334). A fine new road already leads up from Sotchi to Krasnaïa-Poliana for those who would prefer the mountains, and the Alpine climber may use this village as a centre after passing through a noble limestone gorge.

In chapter xiv. we reach the Caucasus itself, and the author's photographs of snowy ranges are worthy of his fine views in the forests. He illustrates antiquities with equal interest, as his castle of Tiflis (p. 243) and the pictures from Ani (p. 289, &c.) show. Ani, a superb creation of Armenian kings in the tenth century, is now within an hour or two of a railway station on the way from Tiflis to Erivan. Ararat rises snow-clad from a great plain on the south, and the plateau on which Ani is built is formed of tuffs and basaltic lavas. M. Martel found in this ruined city, with its churches and mosques, its walls and towers, a combination of Carcassonne, Aigues-Mortes, Pompeii, the Acropolis of Athens, and a good deal else, while the desolate surroundings recalled to him the solitude of the Causses. How many of us know that there is a miniature Ani, also walled and towered, in the Causses, which has survived almost as many centuries—La Couvertoirade, a hospice for those who, like the Armenians, fought against the Moslems in the east?

View of Ararat. From "La Côte d'Azur Russe."

The author brings his geological notes together in chapter xxiv.; but the value of his work lies mainly in the breaking of new ground, on which others will be glad to build. The book should be judged, indeed, as a contribution to social geography, showing how the arts of peace are now bent, under Russian rule, on the completion of the conquest of the Caucasus. It is worthy of a far better map, and surely also of an index.

Grenville A. J. Cole.

THE METEORIC STREAK OF FEBRUARY 22.

REPORTS continue to come in descriptive of this remarkable appearance. It was distinctly visible to 9h. 30m., though it had become faint and diffused, and could still be feebly glimpsed at 10h. The length, as given by a few observers, was

	h. m.	
Bournemouth	7 35	45
Guernsey	7 45	65
Bruton, Som.	7 45	60
Petersfield	7 55	105
Bournemouth	8 0	110
Hereford	8 0	80
Purley, Surrey	8 12	100
Lyme Regis	8 15	110
Petersfield	8 25	120
Weston-Super-Mare	8 30	85
Petersfield	8 55	45

At Bournemouth, 8h. 25m., the whole length, including the bends, "was well over 180°."

The middle portions of the streak apparently moved with greater celerity than the other parts. The drift was decidedly to N.W., and this nearly conformed with the direction of the wind, which was from the E. or S.E. quarter. The rate of motion of the streak is difficult to ascertain exactly, for there is no doubt that its various sections varied in height between about fifty-five and twenty-five miles, and were affected in different degree by wind currents. A mean of the displacement observed in a number of cases gives seventy-five miles per hour as the rate of velocity, while a few of the best drawings would indicate a rather greater speed of eighty or ninety miles per hour.

The delineations and descriptions of observers are very discordant in some cases, and will not admit either of satisfactory comparison or explanation. It is a pity that photographs could not have been secured, but the rapid motion of the streak and its increasing faintness prevented this being accomplished, though the attempt was made at some places.

Several observers noted flashes like very faint lightning during the early period of the projection of the streak. Others allude to the fact that it exhibited bright pulsations, as though the lingering embers were fanned into brilliancy by the breeze. A few of the most careful spectators state that they noticed scintillations of the beam similar to the temporary light-waves which affect the streamers of Auroræ.

At the end of its westerly career the meteor appears to have met some dense air strata, which effectually barred further progress and directed it earthwards. No doubt the force of its initial velocity must have been nearly spent by its long and nearly horizontal flight through the atmosphere.

The meteor was directed from an apparent radiant near β Leonis, situated so far from the Apex of the earth's way that we should not expect the shower to provide meteors with streaks. Ordinarily, it is only the swifter class of objects, such as Leonids, Perseids, and Orionids, which evolve phosphorescent after-glows, and which are so helpful to observers in recording their flights accurately. The slower meteors, such as February Leonids, usually leave trains of yellow or red sparks of momentary duration, and this was a feature of the meteor of February 22, but it also supplied the long-enduring streak which formed its most striking characteristic. In fact, many more observers were attracted by the streak than by the meteor, for comparatively few noticed the latter. This, however, is accounted for by the short duration of the actual flight of the nucleus (about seven seconds) as compared with the persistency of the after-glow.

The meteor had a long way still to travel before it could have reached the earth had it continued its course westwards. Could it have withstood disruption and dispersion, it would have fallen into the sea about forty miles south of the Scilly Isles, and this is about 120 miles E. of the point where it appears to have collapsed, and its material to have been deflected southwards.

W. F. DENNING.

SECONDARY EDUCATION IN ENGLAND.

A DEPUTATION of the Parliamentary Committee of the Trade Union Congress waited upon Mr. Runciman, President of the Board of Education, last week to bring forward a resolution passed at the Nottingham Congress, stating that no solution of the educational problem would be satisfactory that did not give free education from the elementary school to the university, and demanding the immediate abolition of fees in secondary schools and training colleges. It was urged by members of the deputation that the fees at secondary schools were becoming too high for working people to pay, and that in some cases the rule as to the reservation of 25 per cent. free places for pupils from public elementary schools is not observed. In his reply, Mr. Runciman expressed himself in sympathy with the deputation, but was able to show that above half the State-aided secondary schools provided in 1907–8 more than the stipulated 25 per cent. of free places, and the great majority of the whole provided the 25 per cent. He also pointed out that every child is not suitable to enter a secondary school, and that it is necessary to have a fairly good standard of examination for the children who wish to enter.

As the views put forward by the deputation may give rise to misconceptions, and as the position and nature of secondary education in England are not widely understood, it seems desirable to bring together a few facts relating to them.

By the Board of Education's regulations for secondary schools, a uniform grant of 5*l.* is made by the State annually for every pupil between twelve and eighteen years of age, provided that the pupil is not evidently unfit to profit by the education given. The condition under which this grant is made is that 25 per cent. of the places in the school must be offered free to pupils who have for two years immediately preceding been in attendance at public elementary schools. An entrance examination is conducted by the governing body of the secondary school, but it must be qualifying and not competitive, unless the number of applicants is greater than the number of free places. The aim of the Board is "to provide State-aided secondary education in the degree to which, and at the points at which, it is really needed; and to ensure free access to it for children of every class according as the individual is intellectually capable of receiving profit from it."

With these aims most people will find themselves in agreement, and the regulations of the Board show how the desired object may be attained. There are now about 700 secondary schools in which pupils from public elementary schools can claim free places. Grammar schools have sold their birthright for the mess of pottage represented by the capitation grant of 5*l.*; and their doors are now open freely to a number of pupils from primary schools equal to one-quarter of the accommodation available. The result is that, of the 105,000 children attending State-aided secondary schools in 1907, just over 54 per cent. had previously attended public elementary schools, and of these pupils about 45 per cent. were paying no fees at the secondary schools. That is to say, nearly one-half the number of pupils drafted from public elementary schools to secondary schools receive their education in these schools free.

The 25 per cent. of free places in secondary schools, and the liberal distribution of scholarships by local authorities, has, in fact, placed secondary education within the reach of capable children in most districts. The provision of secondary schools in some districts may be inadequate, but a fair part of the school places are filled by children from elementary schools paying low fees or none at all. Indeed, it is scarcely too much to say that secondary education is now practically free to all elementary school children who can derive advantage from it, and whose parents are prepared to let them accept it. If secondary education were made completely free to-morrow, the demand for places in secondary schools by children capable of entering such schools would probably not greatly exceed that at present. As a rule, working-class parents let their children leave school either at the minimum age or a year or so later. There are so many ways in which children from fourteen to eighteen years of age can earn comparatively high wages in unskilled employments that the temptation to their parents to make them immediate wage-earners is very strong. To induce such parents to keep their children at school it is not sufficient, therefore, to make secondary education free; they have to be paid to let their children take advantage of it.

Though the deputation to Mr. Runciman did not ask for maintenance grants for children at secondary schools as compensation for the loss of the immediate fruits of the children's labour, this demand was included in a resolution adopted at the Trade Union Congress at Bath in 1907. It was then resolved, *inter alia*, "That secondary and technical education be an essential part of every child's education, and secured by such an extension of the scholarship system as will place a maintenance scholarship within the reach of every child, and thus make it possible for all children to be full-time day pupils up to the age of sixteen."

It is evident, then, that free education will not satisfy the demands of the organised workers of the country; there must also be maintenance scholarships for all children. Surely a more reasonable demand would be for secondary education to every child who is capable of benefiting by it, and maintenance grants for really poor children of exceptional aptitude. In some places there are more scholarships than children of a sufficient standard of attainment to justify their award. By an examination of scholarship statistics, Prof. Sadler found that in 1906 nearly 12,000 scholarships and bursaries were awarded by local education authorities to enable children to pass from primary to secondary schools, so that, assuming that on an average these scholarships were tenable for three years, this gives a total of 36,000 scholarships running concurrently, in addition to about 10,000 scholarships and bursaries confined to intending pupil teachers. The total amount spent annually by local education authorities on these junior and pupil teacher scholarships is apparently rather more than half a million. Nearly half the total number of scholarships awarded, however, were of the nominal value of 3*l*. or less, so, although they provided free secondary education, they could not be considered as grants for the maintenance of the scholars while at school.

The county scholarships of the London County Council provide a complete scheme under which a boy or girl may proceed by various stages from the public elementary school to the highest grades of education, whether at a university, technical college, or other institution, providing advanced training for a professional career. The junior county scholarships (ages of candidates, eleven to twelve) are awarded to all candidates — about 2000 — who reach scholarship standard; and they provide free education at public secondary schools approved by the Council and a maintenance grant of 6*l*. a year. The intermediate county scholarships, not less than one hundred of which are awarded annually, are open to candidates of ages fifteen to seventeen, give free education at approved secondary schools or technical colleges up to a fee of 25*l*. a year and a maintenance grant of 25*l*. or 30*l*. a year. The senior county scholarships (ages nineteen to twenty-two years), fifty of which are awarded each year, provide a maintenance grant of 60*l*. a year for three years, and tuition and examination fees up to 30*l*. a year. All the scholarships are confined to candidates whose parents have incomes not exceeding 160*l*. a year in the case of the junior scholarships and 400*l*. a year in those of the intermediate and senior scholarships.

The weak point of the scholarship system in general is the disproportion between the numbers of junior scholarships and of those demanding exceptional ability. The scholarship net ought to have a wide mesh, so that only large fish are caught, whereas the reverse is often the case. Prof. Sadler's inquiry showed that the number of intermediate scholarships is only 4 per cent., and of senior scholarships only 3 per cent., of the number of junior scholarships. The result is that a large number of children of average powers are given an education unsuitable to their needs, instead of expending the money upon a few carefully selected individuals of unusual capacity.

Scholarships and free places facilitate the passage from the primary to the secondary school, but statistics show that four-fifths of the pupils who enter such schools leave without completing their course, presumably to enter some trade or industry. A summary of figures relating to State-aided secondary schools in England was published by the Board of Education in 1907. The number of schools dealt with was 600, and the total number of pupils, excluding pupil teachers, was 105,000. About 80 per cent. of this number of pupils were fifteen years of age or under, and the remaining 20 per cent. represented the number of pupils above fifteen years of age in State-aided secondary schools. The same rate of educational leakage is indicated by recent statistics prepared for the London County Council Education Committee to show the ages of pupils attending London secondary schools which receive financial aid from the Council. The number of these schools is fifty, and there are in attendance 9917 boys and 6132 girls. The following table deserves study:—

Age		Boys	Girls
Under	10 years	504	552
Between	10 and 11	517	216
,,	11 ,, 12	1313	812
,,	12 ,, 13	1634	903
,,	13 ,, 14	2010	1131
,,	14 ,, 15	1863	1055
,,	15 ,, 16	1135	683
,,	16 ,, 17	576	409
,,	17 ,, 18	261	233
Over	18 years	104	68
		99·7	6162

The table serves, among other things, to show that even in London the majority of parents who send their children to the county schools regard fifteen as the age at which secondary education should stop, and that comparatively few appear to be able to allow their children to remain at school after sixteen years of age. These facts apply both in the case of boys and girls. The net result is, therefore, whether we consider England as a whole or London in particular, only about one-fifth of the pupils in secondary schools receiving annual grants of 5*l.* per pupil from the State, and supported largely by local rates, are more than fifteen years of age. Our State-aided secondary schools are, in fact, mostly of the nature of higher elementary schools which pupils leave before they are sixteen, instead of being true secondary schools in which students remain until they are eighteen or nineteen years of age. When the majority of pupils remain until this age, the higher work which should be the distinguishing characteristic of secondary education will be possible, but at present it is an euphemism to describe as secondary schools the numerous institutions which merely put a finishing touch upon primary education. Judged by German standards and the ages of the pupils, our secondary schools receiving State grants would for the most part be more correctly described as day continuation schools.

It may be presumed that pupils who leave school at fifteen or sixteen years of age do so in order to begin industrial or commercial careers. The school course of such pupils should obviously differ from that of students who propose to continue their education to a later stage, with the view of entering universities or professional life. Schools which only keep their pupils until sixteen years of age or under ought, therefore, to have a curriculum appropriate to the needs of pupils who will enter offices or workshops immediately they leave. To make such pupils commence a course which has a university examination as its ultimate end is to waste time and opportunity. Only in schools where most of the students remain until they are eighteen or nineteen years of age should a curriculum tending to the requirements of professional careers or universities be adopted.

The necessity for the provision of different types of school for the education of boys and girls above fourteen years of age was urged last year by the Association of Teachers in Technical Institutions, and recommended in the report of the education committee of the British Science Guild, printed in NATURE of January 28. Two types of secondary school should be recognised—one in which pupils leave at about sixteen years of age to enter industrial or commercial life, and the other in which pupils remain to eighteen or nineteen years of age and leave to enter the universities, the professions, or technical institutions of university standard. The former type of school, described variously as a "trade," "preparatory trade," or "craft" school, should prepare definitely for trades, crafts, industries, or commerce. In the words of the British Science Guild report:—"Due regard should be paid in these schools to the continuance of the general education of the pupils, but special provision should be made for sound scientific and technical training in relation to the industries or requirements of the district." The true secondary school may aim at a higher standard on the purely academic side; and its curriculum should be of an entirely different character from that of the craft school. Up to the age of thirteen or fourteen there is really no sound educational reason against the adoption of a single curriculum for all boys and girls—whether in public elementary schools or in preparatory schools. From that point, however, the pupils who do not leave school should be able to continue their education in different schools, according to their needs. To use a metaphor, the train which a pupil will enter at the age of fourteen will differ according to his destination.

In addition to the secondary schools referred to in the foregoing statement, and regarded as efficient by the Board of Education, about thirty technical institutions are recognised by the Board as giving an organised course of instruction in day classes, including advanced instruction in science or in science and art. These schools are attended by about 2700 students, mostly above seventeen years of age, of whom rather more than half attend a full course of instruction. The number of students in evening schools and classes carried on for the education of persons already engaged in some occupation which takes up the greater part of their time is about 700,000. In the case of most of these students, their sole educational training has been in the primary school up to the age of thirteen or fourteen years. At about sixteen years of age or later, they enter the technical schools, after a period of three or four years in which they have received no systematic instruction. The result is that a large part of the work now done in evening classes in technical schools is of a very elementary character. The teachers are capable of giving higher instruction, but the want of the most elementary knowledge on the part of the students will not permit them to do so.

As was stated last year by Prof. W. M. Gardner in a discussion at the annual general meeting of the Association of Technical Institutions, that of a hundred boys passing through elementary schools, and ultimately taking positions as industrial workmen, foremen or managers, probably not more than four or five pass through a secondary school, and not more than three or four attend a day technical school. The great problem is, therefore, that of the boys who leave the primary schools at the ages of thirteen or fourteen, or even earlier, and constitute ninety-five out of every hundred boys of that age. Three courses seem to be open:—(1) to provide for practical instruction to occupy a large part of the time during the latter years of a primary-school course; (2) to pass boys forward from the primary school to specially arranged trade or craft schools for one or two years; or (3) to depend, as hitherto, upon evening schools for technical instruction. The provision of craft schools seems to offer the best solution of the problem. Where the leaving age is low—as it is in most of the State-aided secondary schools—the Board of Education should urge that the schools be of a commercial or industrial type in which practical work, having a direct bearing upon the needs of the district, will occupy at least half the time of the course. The leaving age should determine the scope of the curriculum, and the interests of the district should decide the technical tendency to be given to the practical work in the schools which pupils leave at about fifteen years of age.

As to secondary schools of a high educational type, consideration of the facts available leads to the conclusion that there will have to be many more pupils in schools of this character if the position of secondary education in England is to be comparable with that in Germany. From a national point of view, much of the money expended to secure free places at secondary schools for pupils from public elementary schools is wasted, for the work at the schools leads usually to distaste for an industrial career, and ends in boys taking up some clerical occupation. The only secondary education which will assist the industrial progress of the country is that which results in an increase in the number of highly-trained men to become captains of industry. Any money expended by the State in providing educational facilities for these leaders of men is a profitable investment.

At present, the Government grant to meet expenditure in respect of elementary education is about 11,500,000*l.* annually; and the sum paid in grants for pupils in secondary schools in England and Wales taking an approved course between the ages of twelve and sixteen years is about 340,000*l.* In addition, local authorities expend about 3,400,000*l.* a year on education other than elementary. Of this amount, about 700,000*l.* is expended on secondary schools, 1,200,000*l.* on evening schools and institutions for higher and technical education, and 260,000*l.* upon day schools of similar scope. The State-aid and rate-aid to the seven hundred secondary schools, now accommodating about 113,000 pupils in England and Wales, amounts, therefore, to rather more than one million pounds annually.

This is a modest sum compared with expenditure upon other objects, but little increase can be justified for secondary schools until the demand for secondary education is greater and more real than at present. Free education from the primary school to the university may be within the realm of practical politics, but unless it is accompanied by maintenance grants equivalent to the wage-earning capacities of poor students it will not satisfy the demands of the Trade Unionists. Whether it is desirable to offer this inducement to continued study to all children may be doubted; the nation should be concerned only in providing adequate opportunities for the development of children whose life-work is likely to promote national welfare. The way should be open from the primary school to the university, but a passport should be demanded at each gate to show that the student is capable of making the best use of the new fields to which he is admitted. By this system, and a judicious extension of the number of intermediate and senior scholarships to provide for maintenance, any student of distinguished ability would be able to command the highest educational training this country can offer. R. A. G.

RADIUM INSTITUTES.

THE March number of the *Deutsche Revue*[1] is to contain the announcement by Prof. P. Lenard, director of the Physikalische Institut of the University of Heidelberg, that a radium institute, of the kind already in process of formation in Vienna, London, and Berlin, is to be opened for work in Heidelberg in the Easter of the present year. Owing to the foresight and cooperation of the Senate of the University and the Ministry of the Grand Duchy of Baden, an endowment has been secured, and the Heidelberg Institute will thus be the first of its kind actually to come into existence and to commence work. It is to be known as the Radiologische Institut. The term *Radiology*, which we might also with advantage accept, is used in Germany to connote the newer branches of physics concerned with the study of the invisible radiations, particularly, of course, the kathode, Lenard, Röntgen, and Becquerel rays, but comprising also the older known invisible ultra-violet and infra-red light radiations, their methods of production, their relations to matter, including radio-activity, phosphoresence, and photo-electric action, and their practical applications, for example, in medicine.

Prof. Lenard prefaces his announcement with the remark that the new field of investigation has already proved itself of such fruitfulness that it is quite impossible at the present time to delimit its true circumference. Every day arise new problems, for example, in such fundamental subjects as the constitution of matter, now assailable with hope of success. The cultivation of this field demands special fostering, not only on account of its immediate fruitfulness, but also on account of the costliness of its prosecution—if only in the provision of those rare materials, like radium, which it has brought into recognition—and on account of the necessity for close cooperation between the scientific workers and those engaged in the practical applications of the new knowledge.

The new institute at Heidelberg is to undertake this work. It is to be under the same direction as the Physikalische Institut of the University, and will thus secure full benefit from the whole existing resources of the institute. Provisionally 300 square metres area in the Frederichsbau will be set aside for it. Later it will be housed in a special wing of the new buildings of the Physical Institute. The endowment will ensure the furnishing of the institute with the best equipment that can be secured, while the spring sediments from the neighbouring State of Kreuznach, to be worked up by the Government salt department, will provide a source of radio-active material for clinical and scientific investigation. The institute will provide special instruction in the subjects it deals with, while the clinical work will be undertaken by Herren Czerny and Krehl in their own buildings, but with close cooperation with the Physical Institute, which will ensure that the work rests upon a thoroughly sound scientific basis.

[1] Published by Richard Fleischer, of the Deutsche Verlags Anstalt.

The constitution and work of the Radium Institute to be established in London are described in an official statement published in the *British Medical Journal* of March 6. From this statement we learn that the King has consented to become the patron of the institute. A site has been acquired in Riding House Street, Portland Place, upon which the necessary building will be erected with as little delay as possible. In general terms, it may be said that the institute will be conducted upon the lines of the Radium Institute in Paris. In addition to the superintendent, the assistant to the superintendent, and the director of the laboratory, there will be an honorary medical and surgical staff (not yet appointed). The institute hopes to acquire radium to the amount of 5 grams.

The treatment carried out in the institute will be strictly limited to treatment by radium or other radio-active substances. Treatment of cases by the Röntgen rays, the Finsen light, and by electrical currents will have no place in the institute, as such measures of treatment are already very amply provided for elsewhere.

The building will be in two parts, with separate entrances. One section will be devoted to necessitous patients, and the other to the well-to-do. The former will be treated free; the latter will be required to pay fees on such a scale as the medical and surgical staff may determine. No patient, poor or well-to-do, will be treated in the institute except upon the imprimatur of a qualified medical man.

Demonstrations in the use of radium will be given, and medical practitioners can be advised as to the mode of employment and as to the radio-activity of their own specimens of radium.

THE SUMMER SEASON TIME BILL.

THE debate upon the Summer Season Time Bill, commonly known as the Daylight Saving Bill, in the House of Commons on Friday last, was, for the most part, a pitiful exhibition of the incompetence of politicians to understand any question involving a knowledge of elementary science. Though the proposals in the Bill would dislocate the entire machinery of time-reckoning, less than forty members were present at the opening of the discussion; and the House was only saved from being counted out on two occasions by sufficient members rushing in to form a quorum. The substance of the Bill was given in last week's NATURE. Briefly, it is proposed that at 2 a.m. on the third Sunday in April of each year, all clocks shall be put forward one hour, and shall remain in advance of Greenwich mean time and Dublin mean time by this amount until 2 a.m. on the third Sunday in September, when the hands are to be put back again.

We do not propose to repeat now the substantial arguments against this proposal stated in these columns on July 9, 1908, but we do suggest that the article could be read with profit by the members who voted for the second reading of the Bill, which was for the second time referred to a Select Committee of the House of Commons. During the debate many illustrations were used to convey to the minds of the members some idea of the relation between local time and mean time, and of daylight to business hours. No one pointed out, however, that it would be more reasonable to change the readings of a thermometer at a particular season than to alter the time shown by the clock, which is another scientific instrument. Perhaps it is contemplated to bring in a Bill to increase the readings of thermometers by ten degrees during the winter months, so that 32° F. shall be 42° F. One temperature can be called another just as easily as 2 a.m. can be expressed as 3 a.m.; but the change of name in neither case causes a change of condition.

The argument that inconvenience is not felt by travellers on the Continent changing their watches to mid-European and east-European time, or by the five standard times of America, has little bearing upon the question. The inhabitants of any of these regions use a particular standard time, as we use Greenwich time, but their hours of work and leisure are determined by national custom. The most noteworthy characteristic of life in France and Germany is the earlier hours at which places of business open in the summer compared with those usual in our cities. In Germany many schools open at 7 a.m., and the usual hour is 8 a.m. The people adapt themselves, therefore, to the daylight hours instead of pretending to do so by putting on the clocks by one hour in April and back an hour in September. In all places between the same latitudes as those of the British Isles, the relation of daylight to the time of the standard meridian is the same, so that whatever arguments can be advanced in favour of the proposed seasonal change of time in our country, beyond those of custom, would apply equally to the inhabited zone between fifty and sixty degrees completely round the world.

It is only in a few great cities in England that the waste of daylight described by the supporters of the Bill really exists; and even in these places it is possible for people to rise an hour earlier for work or recreation if they desire to do so. Industries and occupations which can best be carried on in daylight make the fullest use of daylight hours at present, without any legislative compulsion. Agricultural operations begin shortly after sunrise during a large part of the year, and continue until nearly sunset; in the building trades the hours of work vary with the hours of daylight, and the same is true in most engineering shops. But when work or pleasure can be carried on equally well in artificial light, there is a tendency to continue it to the limits of endurance. So it has come about that the bedtime hour in cities has been pushed further and further into the night, and the hour of rising has become later.

All that is needed is for banks, places of business, and schools to open at an earlier hour during the summer months, as they do in most places on the Continent. To introduce confusion into the whole system of time-reckoning because some people in cities have not sufficient strength of mind to make the best use of the daylight hours would be to acknowledge that, as we cannot alter our national habits and customs, Acts are passed by which we pretend to change them while they remain the same.

PROF. JULIUS THOMSEN.

THE two great enrichers of thermal chemistry were Berthelot and Thomsen. Berthelot died in the spring of 1907, at the age of eighty; Thomsen has just left us, at the age of eighty-three. Born at Copenhagen in February, 1826, and educated in the polytechnic there, Thomsen became professor of chemistry in the university of his native city in 1866; he retired from the duties of his post in 1901, but continued to live and work in Copenhagen.

Julius Thomsen devoted his life to the experimental advancement of thermal chemistry. His first memoir on this subject was published in 1853, his last a few years before his death.

The permanent memorial of Thomsen's work is the four volumes of "Thermochemische Untersuchungen," published in the years 1882–86. In the year 1780 Lavoisier and Laplace announced that "all thermal changes . . . exhibited by a system of bodies which changes its state repeat themselves in the opposite direction when the system returns to its original condition." This generalisation was deduced from a theory of heat, and was to some extent verified by experiments. In the years 1839–42 Hess laid the foundations of thermal chemistry, sketched the lines on which the structure should be built, and began the building. Thomsen began his work soon after the appearance of Hess's memoirs. He has formed a stately building—adorned perhaps with too many crockets and pinnacles—resting on the sure foundation of experimentally established facts.

In the preface to his great work, "Thermochemische Untersuchungen," Thomsen tells us that he formed the plan of the whole before he began his experiments, and that he adhered almost rigorously to that plan. When the work was nearly completed, he recognised that the science of thermal chemistry would be benefited by collecting and digesting his materials, and so he published his investigations and his theoretical discussions thereof in the four volumes which have established his fame. In 1905 Thomsen published a *résumé* of his principal experimental results and discussions in one volume. Unfortunately, that book was written in Danish; fortunately for English workers in the field of thermal chemistry, an English translation of it has appeared in Longmans' series of text-books of physical chemistry, edited by Sir William Ramsay.

Thomsen set out with a determination to extend his thermal investigations over the whole field of chemistry. He carried that determination into effect. The first volume of the "Untersuchungen" deals with the thermochemical aspects of the neutralisation of acids and bases. The second volume is devoted to the reactions, and the classification of the affinity-phenomena of the non-metallic elements. The third volume is concerned with measurements of the heats of dissolution in water, with hydration, and with the affinity-phenomena of the metals. The thermochemical investigation of carbon compounds is the subject of the fourth volume.

The most important results of Thomsen's examination of neutralisation were the firm establishment of the constancy of the heat of neutralisation of strong acids by strong bases, the introduction of the conception of the *avidity* of acids and bases, and the working out of a thermal method of measuring avidity. In his investigation of solution and hydration, Thomsen paved the way for future work, cleared away many misconceptions, and put the thermal aspects of the questions on a secure basis. It is not yet time to interpret the thermal data concerning the classification of elements wherewith Thomsen has enriched chemistry; but the data are there, established by a most careful and ingenious experimenter. In speaking of Thomsen's work on the thermochemistry of carbon compounds, one has to distinguish between the data and the theoretical discussion of them. The data are sure. Personally, I think his theoretical conclusions are inadmissible.

The tremendous question of chemical affinity was attacked, thermochemically, by Thomsen with boldness. So long ago as 1854 he announced his much-discussed generalisation:—"Every simple or complex action of a purely chemical character is accompanied by production of heat." In 1882 he was not quite so sure, and modified his dictum, asserting that "the great multitude of chemical processes which are accomplished without the aid of foreign energy, and are free from by-reactions, are accompanied by production of heat." This form of the law of maximum work is surely a sound generalisation, but it is purely empirical. Thomsen never thoroughly analysed the concept *chemical affinity*. Affinity is only one factor of chemical energy, as quantity of heat is only one factor of thermal energy. Thomsen's great contribution to the subject of chemical affinity is the mass of his well-established thermochemical data.

It seems to me that the two marks of Thomsen's experimental work are its soundness and its orderliness. There is nothing haphazard, nothing slipshod about it. He worked on a definite plan; he worked with all his might; his work must remain to his everlasting honour. M. M. PATTISON MUIR.

NOTES.

THE attention of all who are interested in the work of zoological exploration is directed to the expedition which is now being organised by Mr. W. R. Ogilvie-Grant to explore the Charles Louis Mountains of Dutch New Guinea, which form the highest part of the range extending right across the island from east to west. The highest peaks have an altitude of some 17,000 feet. A rich harvest is expected, for until recently the hostility of the natives has frustrated all attempts on the part of European travellers to enter this territory. This hostility, however, has now been overcome, and no effort should be spared by the naturalists of this country to be the first in the field to tap what will certainly prove to be one of the richest zoological regions in the world. Mr. Grant is endeavouring to secure ample funds in order that both the zoology and botany of this region may be thoroughly investigated. If this is to be done, a sum of at least 3000*l.* will be necessary. A considerable portion of this sum has already been generously provided, but more is yet required, and it is hoped that this will speedily be forthcoming. Those who desire to help should send subscriptions to Mr. C. E. Fagan, British Museum (Natural History), Cromwell Road, S.W. The leadership of the expedition has been entrusted to Mr. Walter Goodfellow, who has already done much valuable work in the exploration of New Guinea. To make the more certain of success he will be accompanied by Mr. W. Stalker and Mr. A. F. R. Wollaston, both of whom have done good work in New Guinea, as well as in other parts of the world.

THE executive committee of the British Empire League is organising a movement to provide London with a monument to Captain Cook. Cook was a man of science as well as an explorer; his hydrographical surveys are excellent examples of the scientific work of our navy, and he contributed also to astronomical and medical science. Last November the British Empire League appointed a sub-committee to promote the object and to form a general committee. We have received a list of the names of distinguished persons who have consented to join the general committee, and these include representatives of Australasia, the Colonial Office, the Admiralty, the scientific societies, the shipping industry, and the Cleveland district of Yorkshire—of which Cook was a native. The general committee will later appoint an executive to collect the necessary funds, to determine the character of the memorial, and to select the best available site. It is estimated that, if the monument be in the form of a statue, 3000*l.* will be needed. Fuller particulars can be obtained from the secretary to the British Empire League, Mr. C. Freeman Murray, Norfolk House, Laurence Pountney Hill, E.C.

ON Monday evening Dr. M. A. Stein read before the Royal Geographical Society a paper on his geographical and archæological explorations in Chinese Turkestan in 1906–8. We have from time to time noticed Dr. Stein's discoveries while his expedition was in progress. His lecture on Monday evening strengthened opinion as to the importance of his researches, and brought out very clearly the widespread influence exercised by Indian and classical art on Buddhistic temple worship throughout Central Asia during the early centuries of the Christian era. Dr. Stein told the story of one important discovery about which until now he has kept a discreet silence. He was greatly desirous of examining a secret store of ancient manuscripts which had been accidentally discovered by a Taoist priest in the Caves of the Thousand Buddhas, south-east of Tun-huang. The priest knew nothing about the character and importance of the treasures he was guarding, but it was only after prolonged discussion that he consented to produce some of the manuscripts for Dr. Stein's inspection. These happened to be fine rolls of paper containing Chinese versions of certain Buddhist texts, which the colophons declared to have been brought from India and translated by Hsüan-tsang, the famous Chinese pilgrim, whom Dr. Stein is wont to call his patron saint. Much impressed by what he regarded as a special interposition by Hsüan-tsang on Dr. Stein's behalf, the priest was induced to show the explorer the secret chamber containing his treasures. These were piled up without any sort of order to a height of 10 feet, and comprised not only written documents, but fine paintings on silk and cotton, ex-votos in all kinds of silk and brocade, and streamers in various fabrics. Dated documents showed that the chamber must have been walled up about 1000 A.D., but some of the records dated back so far as the third century A.D. After prolonged negotiations, Dr. Stein was permitted to make a selection from the documentary and other remains, and filled with them twenty-nine cases, which have now been deposited in London. We hope to return to the subject of Dr. Stein's discoveries at greater length on the publication of his paper.

THE death is announced of Senhor J. Barbosa Rodrigues, director of the botanical garden at Rio de Janeiro, and author of several works on Brazilian flora.

THE guarantee fund for the International Aëronautical Exhibition, to be opened at Frankfurt a. M. in July, amounts to 700,000 marks. Count Zeppelin has contributed 10,000 marks to the fund. It is expected that a sum of one million marks will be raised.

INVITATIONS have been issued by the president of the Royal Society, chairman of the general board of the National Physical Laboratory, to meet the general board at the laboratory, Bushy House, Teddington, on Friday, March 19, when the various departments will be open for inspection, and apparatus will be on view.

THE thirty-sixth annual dinner of the old students of the Royal School of Mines will be held on Tuesday, March 30, at the Hotel Cecil. The chair will be taken by Mr. F. W. Rudler. Applications for tickets should be made to Mr. George T. Holloway, hon. sec. dinner committee, 57 Chancery Lane, W.C.

IN the third biennial report of the commissioners of the Connecticut Geological and Natural History Survey, for 1907–8, attention is specially directed to the scientific interest and economic importance of the peat-deposits of that State. At the melting of the great ice-sheet the surface of Connecticut was dotted over with innumerable lakes and pools, many of which have since become obliterated, some by the growth of peat and some by other causes. Most of these peat-bogs have now been carefully surveyed and sounded, so that the amount of their cubic contents can be approximately ascertained. Peat is used in the State not only for fuel and as a gas-producer (for which it is specially suitable), but likewise as a fertiliser, and, incidentally, for various other purposes.

SINCE the importance of "types" to the working systematic naturalist can scarcely be overrated, the authorities of the U.S. National Museum have set a good example to museum curators generally by issuing a catalogue of all the mammalian specimens of this nature preserved in the institution under their charge. This catalogue, which is published at Washington as Bulletin No. 62 of the museum, has been drawn up by Messrs. L. M. Ward and W. H. Osgood, who appear to have discharged a by no means easy task in a thoroughly satisfactory manner. The number of mammalian species of which the museum possesses the types is very large, but it should be borne in mind that, in addition to real types, the list also includes "cotypes," "lectotypes," &c. So far as practicable, all the type-specimens in the collection have been arranged in special cabinets, a plan which may be commended to the best attention of those in charge of other museums.

THE skull and brain of the horned dinosaurs, Triceratops, with notes on the brain-cases of Iguanodon and Megalosaurus, form the subject of a paper by Dr. O. P. Hay, published as No. 1660 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 95–108). Several specimens of the brain-case of the Ceratopsia are available for study, from which casts of the brain itself have been taken, but great difficulty has been experienced in homologising the different parts owing to the fact that the bones of this region of the skull are more or less completely welded together. This has led, in the author's opinion, to several misidentifications, notably in the case of the supra-occipital. The paper is, however, of an extremely technical nature, and without explanatory figures it would be little use discussing the author's emendations and conclusions. Certain amendments are suggested on previous determinations of the component elements of the brain-case in the iguanodon and the megalosaur.

FROM the study of its crinoid fauna, Mr. A. H. Clark in an earlier paper suggested, with some hesitation, that the entire Australian coast, southern as well as northern, should be included in his "Indo-Pacific-Japanese" region. The determination was based on the fact that all the Australian crinoids are tropical forms, the element of hesitation being due to the apparent absence of the South Australian genus Ptilometra from the rest of the region. In a paper on crinoids from the Philippines, published in vol. lii. of the Smithsonian Miscellaneous Collections, the author announces the discovery of the genus in question to the north of the equator, thereby definitely determining the correctness of his earlier suggestion. The new paper is based on a collection of crinoids obtained from Philippine waters by the U.S. Fisheries steam-vessel *Albatross*. This collection includes not only a remarkably large number of new forms, but likewise examples of species previously known only by more or less imperfect specimens.

IN the December (1908) number of the *Annals and Magazine of Natural History*, Mr. R. Kirkpatrick, of the British Museum (Natural History Department), described two very remarkable new types of calcareous sponges, for which he proposed the generic names Minchinella and Merlia. These sponges bear many resemblances to some of the fossil Pharetronids, and are extraordinarily different from any other living forms. The history of the specimens is curious. Minchinella was found in an old bottle of *Challenger* material, still in an admirable state of histological preservation! Merlia was represented by some dry and stony-looking fragments which had been given to Canon Norman, F.R.S., by a Madeiran naturalist. Being anxious to investigate the minute anatomy of Merlia, Mr. Kirkpatrick recently visited a small island near Madeira with dredging apparatus, and after much hard work succeeded in obtaining living specimens, which he preserved in a variety of ways for minute histological investigation, so that we may expect shortly to have a full account of this interesting genus.

IN *Man* for February Mr. H. C. Brown gives an account of a curious device for cheating death practised in Burma. In this case, after a death in the family, one of the survivors was warned in a dream that the death of a child would follow. Accordingly, a bamboo was cut exactly the length of the body of the child, pieces of his hair and nails were enclosed in it, and the whole, as a representative of the child, was solemnly interred. The device failed to produce the desired effect, the mourners on their return from the mock funeral finding the child dead.

DR. G. F. BLACK, of the New York Public Library, has undertaken a useful but difficult task in preparing a bibliography of the literature connected with the Gypsies. The preliminary draft which he has issued, and for which he invites additions and corrections, is intended to include not only separately published books and pamphlets, but also the vast fugitive literature of the subject, papers in the proceedings of learned societies, reviews, and the like. The British Museum Catalogue, the Berlin *Orientalische Bibliographie*, the Leipzig *Geschichte und Sprache der Zigeuner*, and the *Bibliographia* in Colocci's *Gli Zingari* have all been laid under contribution. Even as it stands, this bibliography will be of much assistance to students of the history, sociology, and linguistics of this mysterious race, and it may be hoped that the compiler will receive the hearty cooperation of European and Oriental scholars in bringing it to a successful completion.

MR. SHEPPARD, the energetic curator of the Hull Museum, describes in his annual report for the past year the steady increase of the collections under his charge. Among recent additions in the department of antiquities are a bronze sword, 22 inches in length, found at Leven, near Hull, the largest implement of its class which up to the present has been discovered in that vicinity, and a fine collection of vases of the early English period from the cemetery near South Cave. The order Arachnida has been specially studied by local naturalists, and one of this class, *Erigone spinosa*, from the east Humber bank, is new to Britain. Gifts to the museum of an old pannier saddle and various domestic appliances of the Stuart, Georgian, and Early Victorian periods, now rapidly disappearing, suggest that other provincial museums would be well advised to imitate Hull in forming a special collection of such objects. Mr. Jacobs, chief engineer of the Pennsylvania Railway and Hudson Tunnels Co., New York, has presented to the museum a valuable model, made to scale in brass and steel, of the great tunnel shield used in the excavations carried on under his control. This, in view of a recent scheme for tunnelling the Humber, has proved to be a most attractive exhibit.

MR. E. O. GREENING discusses in "One and All Gardening" annual for 1909 the problem of town gardens for the poor, and describes the experience of the Vacant Lands Association, formed with the object of acquiring waste lands in the metropolis, if only temporarily, to turn into allotments. Thus in Fulham a piece of land comprising seven acres provided space for fifty-eight plots; land was also secured in East London and Balham. The annual also contains a pithy article, by Mr. R. L. Castle, on the French system of intensive cultivation, with a description and illustrations of the gardens worked by women gardeners at Thatcham, in Berkshire.

A SHORT part (vol. xii., part v.) of the Contributions from the United States National Herbarium is assigned to the descriptions, by Mr. H. Pittier, of some new plants from Central America. The most interesting are three new species of Carpotroche, a genus of the Flacourtiaceæ, from Costa Rica. The flowers are characterised by their styles and a winged ovary, and the succulent fruit is produced by the development of pulp from an aril-like outer layer of the seeds. The discovery of these species extends the distribution of the genus, formerly known only from Brazil. Another discovery of two new species of Phyllonoma (Saxifragaceæ), also in Costa Rica, bridges a gap in the distribution of that genus, which had previously been collected in Peru, Columbia, and Mexico.

IN the *Comptes rendus de la Société impériale des Naturalistes de St. Pétersbourg* (vol. xxxix., part i.) two new epiphyllous lichens collected in the Caucasus are described by Messrs. A. A. Elenkin and N. N. Woronichin. The phenomenon of lichens growing on leaves, except in the tropics, is very rare; a former instance from the Caucasus was recorded by Mr. Elenkin some years ago, and in all three cases the lichens were taken on box leaves. Of the two new species, one, in which gonidia of the Chlorococcus type were associated with apothecia, is assigned to the genus Sporopodium; the other was indeterminable, as only pycnidia of the fungus were obtained, and the alga, which was intracellular, is doubtfully referred to Trentepohlia.

DETERMINATIONS of plants collected by Dr. A. Weberbauer in the Andes supply the main item in the first part of vol. xlii. of Engler's *Botanische Jahrbucher*. Numerous additions are recorded for the genera Palaua and Malvastrum (Malvaceæ), Tibouchina and Miconia (Melastomaceæ), Schefflera (Araliaceæ), and Lantana (Verbenaceæ). In connection with the recent discussion at the Linnean Society, attention should be directed to the article by Dr. H. Schenck on the phylogeny of the bryophytes and ferns, in which he presents a carefully prepared argument in favour of a descent from the brown algæ, notably from Dictyota. The antheridia and archegonia of these groups are considered to be homologous with the plurilocular gametangia, while the spore mother-cell is regarded as homologous with the tetrasporangium of Dictyota.

THE Deutsche Seewarte (Hamburg) has published its meteorological year-book for 1907, the thirtieth volume of the series, containing observations and results at ten stations of the second order, and hourly readings at four normal observatories. These carefully prepared tables follow the usual form adopted by all the German States, based upon the international scheme, and we note that the gravity correction is now applied to the barometrical observations. As in former years, statistics relating to all storms which have affected a considerable area of the German coasts are given; these are prepared from observations at fifty-seven storm-signal stations, and furnish very useful data for reference; October was the only month in which no storms were recorded. An appendix gives a summary of the contents of all the German meteorological year-books for the year 1907.

THE meteorological statistics of the Colorado College Observatory for 1907, compiled by Mr. F. H. Loud, have been received. This institution has an exceptionally good supply of self-recording and other instruments, many of which were presented by General W. J. Palmer, who has for some years provided for the expense of reducing and publishing the observations. The tabular results are prepared with great care; *e.g.* the daily means of temperature are obtained from hourly tabulations of a Richard thermograph, and the extremes shown by the maximum and minimum thermometers are checked by the same thermograph. The wind is resolved into four component parts (instead of two), as recommended by Prof. A. von Oettingen, of Yuriev, and others. The mean temperature of the year was 48°·2, no reading being below zero (F.), whereas in 1905 the minimum was −22°. The monthly range was not less than 63° in each of the months February–May; the spring is always a very critical time for cultivation. The rainfall was under 10 inches, little more than two-thirds of the ordinary fall.

AN elaborate series of experiments has been undertaken at the Physikalisch-technische Reichsanstalt, Charlottenburg, the results of which appear in the *Deutsche Mechaniker-Zeitung* for February 1. Altogether 454 single sensitivity tests were made—ninety-six in a water bath at 40° C., 222 in the mouth, and 136 in the arm-pit. By sensitivity is understood the time taken by the thermometers in assuming the constant temperature of the water bath or of the human body. According to the author, Mr. H. F. Wiebe, it would appear possible to increase the sensitivity of clinical thermometers in general, and to manufacture actual minute thermometers to indicate correctly by measurements in the mouth in one or even in half a minute. It seems improbable to make minute thermometers for use in the arm-pit which will take up the temperature of the body in one minute, at least so far as glass thermometers are concerned. In order to obviate errors in this connection, when using clinical thermometers it would be desirable to supply instructions for their use, in which it should be set forth that in taking measurements under the arm the thermometers should be allowed to lie for five minutes before the reading is taken.

MESSRS. SCHEEL AND HEUSE have published in the February number of the *Zeitschrift für Instrumentenkunde* the results of some investigations undertaken by them on the methods of producing high vacua. The tests were carried out on the Gaede pump, the Toepler pump, Reden and Rosenthal's mercury pump, and on charcoal in liquid air used in connection with the air pump. The resultant pressures were measured by the McLeod vacuum gauge, the authors having found (*Verhandlungen der deutschen physikalischen Gesellschaft*, vol. xi., p. 1) that this method could be applied for the measurement of the lowest pressures. The most important result was that obtained by employing charcoal prepared from cocoa-nut shell, and using this charcoal, in liquid air, in conjunction with an air pump (Gaede's), the initial pressure of 0·006 millimetre being derived from the pump. A vacuum of 0·00001 millimetre was obtained and kept up for some time by this method. Complete tables of readings, and a full description of the experiments, are given in the article.

AN interesting report of trials on a complete steam plant at the Greenvale Mill, Littleborough, near Manchester, is given in *Engineering* of February 26. The trials were made under the direction of Mr. G. B. Storie, consulting engineer, of Rochdale, and his report is of special interest on account of the very full results given. The plant includes a Brush-Parsons parallel-flow steam turbine developing 500 kilowatts at 3000 revolutions per minute and 200 lb. per square inch steam pressure. Mr. Storie finds its thermal efficiency at 91·8 per cent. of the rated power to be 18·27 per cent., the efficiency ratio by comparison with the Rankine cycle being 0·579. It is unusual to find a report on a steam turbine containing information regarding the pressure, temperature, and degree of superheat of the steam at the end of each stage of the expansion, and it would be very useful if other experimenters would take Mr. Storie's report as an example in this respect. There has been a tendency to withhold such information in the past. Special attention may be directed to the following table of results showing the importance of maintaining a good vacuum with steam-turbine plants :—

Barometer, 29·29 *inches*.

Steam pressure at entrance to turbine—lbs. per sq. inch	163	163	164	161	162	156	157	158
Steam temperature at entrance to turbine—degrees F. .	524	526	530	530	533	512	528	530
Vacuum—inches of mercury	28·29	27·1	26	25·15	24·05	23	22	21
Kilowatts	275	275	276	275	273	270	270	263
Pounds of steam consumed per kilowatt-hour	18·54	19·63	20·65	21·63	22·34	23·33	23·7	24·25

A PAPER on some recent grain-handling and storing appliances at the Millwall Docks, by Mr. Magnus Mowat, read before the Institution of Civil Engineers on March 2, contained some interesting facts about grain elevators. The installation now provides for the discharge and weighing of 550 tons of grain per hour *ex* ship, and for its delivery either partly or wholly into granary, silo, or barge. The elevators which come in contact with the ship's hold are of the pneumatic or suction type. The granary and silo elevators are of the bucket type, and, like the band-conveyers, are of two-ply woven cotton, impregnated with rubber. These bands have a total length of $2\frac{1}{4}$ miles; they are electrically driven. In the waterway there is a dolphin, alongside which the ship is moored. This is a wooden jetty of greenheart timber, 350 feet by 24 feet, placed 50 feet clear of and parallel with the quay. On its deck are four suction elevators, each of 75 tons per hour capacity, corresponding with the respective holds of the ship. The machinery within the dolphin includes four pairs of exhauster pumps, each 46 inches diameter by 60 inches stroke, which maintain in the grain-receivers on the top of the towers a partial vacuum of 7 inches to 10 inches of mercury. Flexible pipes connect the receiver with the ship's hold, and the grain is elevated to a height of 80 feet by the inrushing air, the proportion of air being controlled by nozzles with adjustable sleeves. The grain separates itself from the air in the receiver, and automatically discharges through "tippers" at the bottom of the chamber into hoppers which feed the weighing machines. These deliver through steel shoots into barges, or connect with the quay by band-conveyers on bridges spanning the intervening water-space. The band-conveyers within the granary and subways under the quay are endless, and are supported at 6-feet intervals by steel rollers on cast-iron standards, tied longitudinally by steel angles on each side; their speed is 552 feet per minute. The bands and elevators form a series for mechanically conveying the grain from the dolphin elevator to the roof of the granary, from which it is distributed to the various floors by gravity through pipes provided with sleeves and doors for housing and delivery to or from any section.

WE have received from Messrs. John Wheldon and Co., of Great Queen Street, London, W.C., a copy of their latest catalogue of geological works, containing particulars of 1761 publications they have on sale. The books concerned include selections from the libraries of the late Prof. Ramsay, Dr. R. Hunt, Prof. J. Percy, Prof. Phillips, Mr. William Topley, and Dr. Flight.

MR. FRANCIS HODGSON has published the sixth volume of the second series of the Proceedings of the London Mathematical Society. The record deals with meetings of the society held from November, 1907, to June, 1908, and the papers read on these occasions, short abstracts of which have appeared already among our reports of societies and academies. The volume also contains obituary notices of the late Lord Kelvin and Mr. C. Taylor.

OUR ASTRONOMICAL COLUMN.

ANOMALOUS REFRACTION AND SPECTROHELIOGRAPH RESULTS.—Having spent some time, in August, 1907, at the Mount Wilson Observatory, and having employed the splendid equipment there in a number of experiments, Prof. Julius has derived further confirmation of his theory that some of the phenomena seen on various spectroheliograms are, at least in part, due to the anomalous refraction which waves from the vicinity of absorption lines must suffer when passing through an absorbing medium of varying densities. The experiments and the results obtained are described and discussed in No. 5, vol. xxviii., of the *Astrophysical Journal*.

By selecting lines at different distances from the sodium, D, lines, and passing the rays through a tube containing sodium vapour, in which the density gradients could be controlled, Prof. Julius was able to obtain photographs showing the effects of anomalous refraction, and he shows that equivalent conditions probably exist in the solar atmospheres. Should the further work which is to be carried out on these lines prove confirmatory, it will no longer be necessary to explain "dark" and "bright" flocculi by the assumption of very marked differences in the absorbing and emitting conditions of a certain gas or vapour in contiguous regions on the sun, for the anomalous refraction caused by the existence in the sun of irregular density-gradients, comparable in magnitude with the vertical gradient in the earth's atmosphere, will explain them efficiently.

THE CONSTITUTION OF THE SUN.—In No. 1, vol. xxix., of the *Astrophysical Journal*, Herr J. F. Hermann Schulz again brings forward the theory that the nucleus of the sun is in a liquid state. This theory, in its earlier forms, was propounded by Kirchhoff, modified by Zöllner, and, about twenty years ago, advocated by Herr Schulz, but the prevailing ideas concerning the sun's temperature then rendered it improbable.

However, in the light of the recent researches of Moissan and others, from which it may be deduced that the mean temperature of the sun is about 5400° C., Herr Schulz believes that a liquid nucleus best explains the observed phenomena, and on these lines he revives his theory. He further argues that various stellar phenomena may be explained on the assumption that many stars, too, are not entirely gaseous. The paper in which the discussion was included was read before the last meeting of the Astronomische Gesellschaft in Vienna, September, 1908, and also appears as an abstract from the *Vierteljahrsschrift der Astronomischen Gesellschaft*, part iv., 1908.

Still another solar theory is expounded in No. 4305 of the *Astronomische Nachrichten*. In this paper M. A. Amaftounsky, of Kichineff, explains the phenomena of sun-spots, metallic and gaseous prominences, sun-spot zones, &c., on the assumption that spots are caused by the outrush of heated vapour from the sun's lower atmosphere, and the filling in of the funnels thus formed by the photospheric clouds. The agreement of observed phenomena with the phenomena which would follow were the theory correct is discussed in detail.

RADIAL VELOCITY OF α PERSEI.—From thirty-seven spectrograms of α Persei, taken by Prof. Küstner and Dr. Zurhellen between August, 1904, and March, 1906, Herr F. Goos has derived values for the radial velocities of the star during that period. Previous observers have found that the variation of the velocity is small or non-existent.

In the present investigation Herr Goos made eight settings, each way of the plate, on twelve iron lines which are taken as standards, and found that the velocity, relative to the sun, varied between −3·65 km. and 0, the probable error for each plate being ±0·40 km. (*Astronomische Nachrichten*, No. 4300, p. 50).

A CATALOGUE OF 1625 SOUTHERN STARS.—Vol. ii. of the "Meridian Observations of the Perth Observatory (W. Australia)" contains the results of the meridian observations of 1625 stars between 39° and 41° south declination. As explained by Mr. Ernest Cooke, the director of the observatory, in the introduction, these results form part of the scheme undertaken by the Perth Observatory to determine, from time to time, the accurate positions of some 8000 stars lying in the zone 31°–41° S. declination. The positions now given are reduced to the equinox of 1900·0 at the epoch of observation, and, when known, the proper motions, for reduction to epoch, are also given.

THE MELBOURNE OBSERVATORY.—Mr. Baracchi's report of the work done at the Melbourne Observatory during the period 1906 December 1 to 1908 April 30 shows that the observatory is, apparently, now well established as a purely astronomical institution, the meteorological work having been transferred to the new Weather Bureau, under the Commonwealth Government, from the end of 1907.

The long-vacant post of chief assistant has now been filled by Mr. J. M. Baldwin, an 1851 Exhibition scholar, who has further qualified for the post by visiting and working at a number of English, Continental, and American observatories.

Mr. Baracchi reports, concerning the astrographic chart work, that, to April 30, 1908, 707 Sydney plates, containing 430,468 stars, and 991 Melbourne plates, containing 318,025 stars, were completely measured. The report concludes with a strong recommendation that, in accordance with the suggestion of the Solar Union, supported by the Royal Society, a solar physics observatory should be founded in Australia, preferably at Adelaide.

SCIENTIFIC AID FOR THE BRITISH TENANT FARMER.

THE various agricultural colleges founded or subsidised by the county councils take a wide view of their functions, and not only give instruction in agriculture to young men wishing to take up this subject, but also carry out field experiments designed to instruct those who are already farming, and who will not or cannot attend lectures. The field experiments are not strictly in the nature of research work, since they do not usually involve any new principles; they are not always arranged to give all the results they might, but, taken as a whole, they serve the very useful purpose of demonstrating to the farmer certain facts which he ought to know, but often does not, and of giving him opportunities of seeing for himself the effect of special manures on crops or of special feeding stuffs on animals.

The results of the field trials are published in pamphlet form by the college or department concerned, and widely distributed among the farming community. Recently the Board of Agriculture started a summary of these reports in its journal, and the idea is a very useful one. The South-Eastern Agricultural College publishes its reports in the form of an annual journal, while the University of Cambridge has periodically brought out full reports dealing with the whole of its experiments in the counties.

In the nature of the case, many of the reports issued are of local rather than of general interest, and do not call for any full treatment here, but a few instances may be quoted to show the type of work being done. Experiments at the University College of Wales, Aberystwyth, have been made to find out what ration will prove profitable for fattening bullocks. The fact that animals require a tolerably large maintenance ration (*i.e.* that they eat a fair amount of food without gaining in weight) renders it necessary that fattening should be rapid, but the difficulty then arises that a large ration gives proportionately less increase in weight than a small one. Up to a certain point an increase in the ration is profitable; beyond this point the profit gradually decreases, and loss arises. Prof. Jones has illustrated these facts very well in the report before us.

The Northumberland experiments deal with pasture problems. It has been demonstrated that basic slag is the most effective manure for economically improving the heavy soils of Northumberland, and a mixture of basic slag and a potash manure is best on the lighter soils. It has also been shown that second, and even third, dressings of slag are quite as effective as the first. The mangel experiments have shown that nitrate of soda gives better results than sulphate of ammonia, that slag is more effective than superphosphate, that sulphate of potash is better than the muriate, and that common salt much increases the crop. Experiments on other crops are also recorded.

Rather different results were obtained in the Scotch experiments on pastures summarised by Mr. Hendrick. Basic slag led to an improvement, but not much, and three or four years elapsed before sufficient return was obtained to pay for the slag. However, the improvement lasts, and can be seen six years afterwards, so that the method is profitable. No other manure was found to give profitable returns. This report gives analyses of the soils, and is therefore much more interesting than those in which soil analysis is ignored.

The West of Scotland Agricultural College has issued reports by Prof. McAlpine. The experiments on varieties of oats made during the years 1902–7 are summarised, and the effect of manures is discussed. Manuring has but little influence on the kernel weight, and only very slightly increases the proportion of kernel to husk.

The Lancashire County Council experiments were designed to test the relative value of limestone and of burnt lime for improving pastures, and the conclusion is drawn that limestone is the more effective, provided it contains 95 per cent. of calcium carbonate and is ground to a sufficiently fine state.

The farmer has not only to produce crops and beasts, but to sell them, and success in one branch of his profession does not necessarily imply success in the other. No amount of field experiments will make the farmer into a successful business man, but there is one way in which he can rely on getting the full value of his produce—by cooperation. Only in this way can the small farmer hope to buy and sell to the best advantage, and to make anything out of market fluctuations that are capable of yielding profit. This question is discussed in the *Quarterly Review* by "Home Counties," whose interesting article deserves to be widely read.

In conclusion, no notice of current agricultural publications intended for the tenant farmer would be complete without reference to the leaflets of the Board of Agriculture, which deal in simple manner with a large variety of important topics. Every effort is made to ensure that these leaflets should reach the men for whom they are intended.

THE BRITISH SCIENCE GUILD.

THE verbatim report of the third annual meeting of the British Science Guild, held at the Mansion House on January 22, has just been issued. We give extracts from the speeches made by Sir William Ramsay and Sir Frederick Pollock.

After referring to the work done by the Guild during the year, summarised in NATURE of January 28, Sir William Ramsay said:—"The greatest danger, I think, from which we suffer is this inherent one in the minds of so many of us, that it is not necessary to prepare beforehand for events which we can perfectly well prophesy will happen. I want to draw attention to one subject which I think a committee of the Guild ought to consider. It is not merely of the utmost importance to ourselves as a race, but it is of the greatest importance taken in connection with any legislative proposals of any Government. Let me give you an example from private life. No doubt most of us, perhaps all, have made our wills. We prepare, in a sense, for death. That is to save our successors from a considerable amount of trouble. Again, if we are well, we safeguard ourselves. We do not go into infected places, we indulge in exercise, we take a reasonable amount of sleep—in fact, we try to keep well; and if we fall ill from any chance we call in a doctor and take other measures to cure ourselves. In other words, we try our best to prolong our lives. Now, it appears to me that one of the duties of the State is to prolong the life of the nation. What does the life of the nation depend on? It depends not only upon the fitness of the people, but upon the amount of natural energy which is available to be used for driving power. We know pretty well from the results of the Royal Commission that our coal mines will not last for an indefinite time. Some say three hundred, others eight hundred years. Let us put it at five hundred. We can turn our minds back to the year 1400. We certainly did not know the people of England in those times, but many of us have a very lively knowledge of the sort of people they were and what they have done for us. They did great things in developing the country, building many churches, carrying out reforms according to their lights. We are now enjoying the benefits of what they did. Is it not only right and natural that we ought to have some consideration for persons living three or five hundred years hence? It does not need many "greats" before "grandson" until that time is reached in the picture of the mind—probably only six or seven. We ought in the present day to have consideration for the generations who will succeed us, and who will either profit by our foresight or regret our stupidity. Now, in this country our water-power is quite insignificant, and, indeed, if it were much larger than it is there is not much to be made of it. It has been calculated that the total water-power of Europe, excluding, perhaps, some few rivers in northern Russia, is equal to 2,000,000 horse-power. Why, we use 100,000,000 horse-power in England, so that even if we possessed the whole water-power of Europe we should hardly be supplying one-fiftieth of what we use from coal. I know there is a popular superstition that in view of the extraordinary inventions which we are witnessing in these days—long-distance telegraphy and so on—something will be discovered in the future which will replace our present source of energy. One cannot say with absolute certainty that that will not happen, but I think any scientific man will say it is in the highest degree improbable. And what else have we to come and go upon? You may say that we might have an apparatus to utilise the tides; but the first storm knocks to bits any apparatus. Or solar heat? Again the first storm plays havoc with any machinery—and that of the costliest. One possibility is to dig a big hole deep enough into the earth and hope to get boiling water. Well, curiously enough, to-day's *Morning Post*, in its "Discovery and Invention" column, describes how Mr. Parsons has considered that very question. He says that to bore a hole twelve miles deep would cost 5,000,000*l*. and take eighty years. If we are going to bore that hole, ladies and gentlemen, it is time we began. Joking apart, without that possibility, there is no other source of energy. Now this points to the economisation of coal. It points to legislation in other directions. Are we going to limit the use of steam engines? Gas engines give us about three times the power for the same consumption of fuel. Are we going to pay attention to the afforestation of the country, so that when coal is done we shall still have wood? Are we going to stop the enormous loss of nitrogen, which is so serious, that it will be impossible after fifty years to get the necessary amount for the growth of our plants? Are we going to utilise our sewage? All these are questions of first importance, and I think the Guild should appoint a committee to see how we can save the waste that is going on, and so give our country a chance of longer life. It would be horrible to look forward to London becoming a fishing village of five to ten thousand people, built on the top of some magnificent ruins and supported by scanty agriculture. But it is only what we should have to look forward to unless something is done. Let us postpone that evil day as far as possible."

Sir Frederick Pollock, in moving that the annual report be adopted, said:—"I have been asked to say a few words on the Patents Act, 1907, and to explain that the new matter in that Act, the only matter which attracts public attention, is not a revolutionary enactment or a breach with any established fiscal policy, but a revival of principles upon which the whole of our legislation for patents started, and on which it has been continued. In the earliest days of grants to inventors, the King exercised the power of granting monopolies at his own will and pleasure. In the course of the sixteenth century strong and well-founded objections were raised to the indiscriminate granting of monopolies, and it came to be accepted as a principle that monopolies ought to be granted to inventors only on condition of their being able thereby to introduce new industries into the kingdom. That was assigned as the consideration for which monopolies were granted. And further, during the early history of this branch of monopolies, which ultimately became the foundation of our modern Patent Law, it was understood that the inventor was bound, not only to work his invention within the kingdom, but to teach the use of it to all who desired to learn it. Those principles continued to be observed until comparatively modern times. But from some time in the latter part of the eighteenth century the principle of effectively introducing the new invention to this country was rather lost sight of, and it was supposed that the rule of publishing the invention, so that any competent person could learn from the specification to make it and work it for himself, would be sufficient for the protection of the public. In recent days it has been found that specification is not enough, for it was discovered that there was such a thing as the "obstructive" working of patents. That might be done in two ways. A man might acquire an invention, not for the purpose of introducing it to this kingdom, but, on the contrary, to stifle it and prevent it from being worked at all. That is a point which has, I think, been rather overlooked in some of the public discussions on this subject. I believe that that mischief existed, and that it was quite proper to put an end to it. The other obstructive way was for foreign manufacturers to take out or buy up a British patent, and so get a practical monopoly by being able to stop anyone from manufacturing the invention here. It is obvious that in both these ways "unfair prejudice" might be created against British manufacturers or against endeavours to establish new industries in this country. Now "unfair prejudice" in the Act does not mean successful competition, a sense in which the word is sometimes used. "Unfair prejudice" is a novel term, but "unfair competition" is now a recognised head of law in all civilised countries, though the words are less familiar here than in America.

"That, so far as I know, is the history of the new provisions of the Patents Act of 1907. If you read Section 24, the operative section, which has really been the text of these few remarks, together with Section 38, you will see that the object of the Act is not the protection of manufacturers against rival producers as producers, but the protection of the public, both producers and consumers, against the evils of excessive monopoly.

"I should like to say one word on the decline of the study of German. For about thirty years we have been in danger of attaching a slightly exaggerated value to German as compared with other modern languages. Now, it appears, there is a reaction in favour of French. So far as the study of French is concerned, I have not a word to say against it, but that the study of German should be declining seems to me, as to the framers of the report—and to my learned friend, if I may still call him so, Mr. Haldane—a matter of serious national importance. I can think of only two reasons why people should prefer French to German. They may suppose French to be easier, or they may suppose it to be more useful. As to being easier—and I must say it dogmatically, because there is no time to give reasons—having given much time to the study of both, I believe French is really the harder language to learn well. As to being more useful, French is certainly very useful indeed. Taking literature and business all round, perhaps one may say that French is more useful for the literary study of our own language and the history of our own civilisation, but when you come to business—and therein I include what is being done abroad in science and the application of science to industry —German is quite as important as French. Finally, it is becoming more and more indispensable to have a knowledge of foreign languages for any branch of life whatever."

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George Bell and Sons.—A School Note-book of Scale and Contour Maps: for the Use of Army Candidates, Rev. P. W. Unwin. *A. and C. Black.*—Descriptive Geography of the British Isles, F. D. Herbertson, illustrated. *The Cambridge University Press.*—The Cambridge County Geographies, edited by Dr. F. F. H. Guillemard, volumes on Norfolk, Suffolk, Wiltshire, Somersetshire, Cornwall, Gloucestershire, Hertfordshire, and Westmorland, each illustrated. *C. Delagrave (Paris).*—Revue de Géographie, Prof. Vélain, second year. *G. G. Harrap and Co.*—The New Outlook Geographies, W. C. Brown and P. H. Johnson, part i., How People Live; part ii., The Home of Man, illustrated. *John Murray.*—The Life of Admiral Sir Leopold McClintock, the Great Arctic Explorer and Discoverer of the Fate of Franklin, Sir C. Markham, K.C.B., F.R.S., with an introductory note by the Archbishop of Armagh. *Sir Isaac Pitman and Sons, Ltd.*—Around Afghanistan, Major de Bouillane de LaCoste, illustrated. *G. P. Putnam's Sons.*—A Canyon Voyage: the Narrative of the Second Powell Expedition down the Green-Colorado River from Wyoming, and the Explorations on Land in the Years 1871 and 1872, F. S. Dellenbaugh, illustrated; The Niagara River, A. B. Hulbert, illustrated. *The Rationalist Press Association, Ltd.*—The History of Geography, Dr. J. S. Keltie. *Smith, Elder and Co.*—Across Persia, from the Gulf to the Caspian, F. B. Bradley-Birt. *T. Fisher Unwin.*—Prehistoric Rhodesia: an Examination of the Ethnological and Archæological Evidences as to the Origin and Age of the Rock Mines and Stone Buildings, with a Gazetteer of Mediæval South-East Africa, R. N. Hall, illustrated; The Panama Canal and its Makers, Dr. V. Cornish, illustrated; Through Uganda to Mount Elgon, with Glimpses by the Way, Rev. J. B. Purvis, illustrated; Conway and Coolidge's Climbers' Guides, 12 and 13, The Bernese Oberland, vol. iv., H. Dubi; part i., From the Grimsel to the Sustenlimmi; part ii., From the Sustenlimmi to the Uri Rothstock.

Geology.

Blackie and Son, Ltd.—The Stone Ages in North Britain and Ireland, Rev. F. Smith, illustrated. *A. Constable and Co., Ltd.*—Radium and Geology, Prof. J. Joly, F.R.S., illustrated. *J. M. Dent and Co.*—Geology, Prof. J. W. Gregory, F.R.S. (Scientific Primers). *Methuen and Co.*—The Natural History of Igneous Rocks, A. Harker, F.R.S., illustrated. *The Oxford University Press.*—The Stone and Bronze Ages in Italy, T. E. Peet. *The Rationalist Press Association, Ltd.*—The History of Geology, H. B. Woodward, F.R.S.

Mathematical and Physical Science.

George Bell and Sons.—Practical Solid Geometry, Rev. P. W. Unwin, part i.; Elementary Mechanics, C. M. Jessop and F. N. Havelock; Mathematical Reports (1902–1908): being the Reports of the Mathematical Association Committee; Bell's New Practical Arithmetic Test Cards, W. J. Stainer; for the second, third, fourth, fifth, sixth, and seventh years. *A. and C. Black.*—Practical Physics, A. McLean, vol. i. *Cassell and Co., Ltd.*—Popular Electricity, W. Hibbert, illustrated. *C. Delagrave (Paris).*—Cours de Physique, Prof. H. Bouasse, vol. vi. *Gauthier-Villars (Paris).*—Leçons de Mécanique céleste, H. Poincaré, Tome ii. (2e partie), Théorie de la Lune, Tome iii., Théorie des Marees; Les Oscillations électromagnétiques et la Télégraphie sans fil, Prof. J. Zenneck, translated by P. Blanchin, G. Guérard, and E. Picot, 2 vols., Tome i., Les Oscillations industrielles, les Oscillateurs fermés à haute Fréquence, illustrated; Tome ii., Les Oscillateurs ouverts et les Systèmes couplés, les Ondes électromagnétiques, la Télégraphie sans fil, illustrated; Lectures de Mécanique, l'Organisation de la Mécanique, Jouquet, illustrated; Les Bases physico-chimiques de la Chimie analytique, Herz, illustrated; La Théorie des Courants alternatifs, A. Russell, illustrated. *Harper and Brothers.*—The Life of the Universe, Prof. Svante Arrhenius. *Longmans and Co.*—Spinning Tops and Gyroscopic Motion, H. Crabtree, illustrated; Electric Furnaces: the Production of Heat from Electrical Energy and the Construction of Electric Furnaces, Prof. W. Borchers, translated by H. G. Solomon, part ii., illustrated. *Macmillan and Co., Ltd.*—Physical Science in the Time of Nero: being a Translation of Seneca's "Quæstiones Naturales," J. Clarke, with notes on the subject-matter by Sir A. Geikie, K.C.B., P.R.S. *John Murray.*—The Interpretation of Radium, F. Soddy (The Progressive Science Series), with diagrams. *The Oxford University Press.*—Elements of Non-Euclidean Geometry, B. J. L. Coolidge. *Kegan Paul and Co., Ltd.*—Music: its Laws and Evolution, J. Combarieu (International Science Series); Periodic Law, A. E. Garrett (International Science Series). *The Rationalist Press Association, Ltd.*—The History of Astronomy, Prof. G. Forbes, F.R.S. *The University Tutorial Press, Ltd.*—Geometry, Theoretical and Practical, section vi., Solid Geometry (Euclid xi.), W. P. Workman and A. G. Cracknell.

MEDICAL SCIENCE.

F. Alcan (Paris).—Le Diabète sucré, Lepine; Les aliénés Voyageurs, Joffroy and Dupouy. *Baillière, Tindall and Cox.*—Differential Diagnosis of Bacteriology, E. P. Minett and R. C. P. London. *Cassell and Co., Ltd.*—Health and Common Sense, W. Hutchinson; Mind and Work, M. H. Gulick; Parenthood and Race-culture: an Outline of Eugenics, Dr. C. W. Saleeby. *A. Constable and Co., Ltd.*—The Fluids of the Body, Prof. E. H. Starling, F.R.S. *John Lane.*—The Medical Diseases of Children, R. Miller. *Methuen and Co.*—Drugs and the Drug Habit: Chapters on the Dynamics of a Remedial Particle, Dr. H. Sainsbury. *John Murray.*—Children in Health and Disease, Dr. D. Forsyth; Problems in Animal Metabolism, J. B. Leathes (new edition). *J. Nisbet and Co., Ltd.*—Injuries and Diseases of the Knee-joint, considered from the Clinical Aspect, Sir W. H. Bennett, illustrated; Movable Kidney, W. Arbuthnot; Hip Disease in the Young, J. Berry; Prostatectomy, J. W. T. Walker; Enuresis, J. H. Thursfield; Some of the Common Affections of the Tongue, J. Hutchinson; Some Clinical Points in the Surgery of the Intestine, F. C. Wallis; The Operative Treatment of Chronic Constipation, W. A. Lane, illustrated. *G. P. Putnam's Sons.*—The Art of Natural Sleep, with Definite Directions for the Wholesome Cure of Sleeplessness, illustrated by Cases Treated, L. P. Powell. *Rebman, Ltd.*—Text-book of Special Pathology, Drs. Beattie and Dickson, illustrated; Text-book of Hyperæmia as Applied in Medicine and Surgery, Prof. A. Bier, authorised translation from the fifth revised German edition by Dr. G. N. Blech, illustrated; Atlas of Clinical Surgery, with Special Reference to Diagnosis and Treatment, for Practitioners and Students, Dr. P. Bockenheimer, English adaptation by Dr. C. F. Marshall, 3 vols., illustrated; Surgery of the Upper Abdomen, Drs. Deaver and Ashhurst, in two volumes, vol. i., Surgery of the Stomach and Duodenum; vol. ii., Surgery of the Liver, Gall Bladder, Pancreas, and Spleen, each illustrated; The Oral Cavities: an Elementary and Practical Treatise on the Diseases of the Pharynx and Larynx, Dr. E. J. Moure, authorised translation by Dr. J. M. Farquharson, illustrated; Clinical Commentaries deduced from the Morphology of the Human Body, Prof. A. De Giovanni, translated from the second Italian edition by J. J. Eyre. *George Routledge and Sons, Ltd.*—The Family Doctor: a Dictionary of Domestic Medicine and Surgery especially adapted for Family Use, Dr. E. Barrett, illustrated; Infant Feeding by Artificial Means: a Scientific and Practical Treatise on the Dietetics of Infancy, S. H. Sadler (new edition), illustrated. *Swan Sonnenschein and Co., Ltd.*—Exercises for Heart Affections, based on the Nauheim Treatment, Dr. J. G. Garson, illustrated. *Williams and Norgate.*—International Archives of Malaria, edited by C. M. Cassel; Epilepsia: being an International Quarterly Review devoted to the Study of Epilepsia and Kindred Diseases from Pathological, Therapeutical, and Social Aspects.

METALLURGY.

Edward Arnold.—The Dressing of Minerals, Prof. H. Louis, illustrated. *A. Constable and Co., Ltd.*—Welding and Cutting of Metals by the Aid of Compressed Gases and Electricity, Dr. L. A. Groth, illustrated; The Precious Metals, Dr. T. K. Rose, illustrated. *E. and F. N. Spon, Ltd.*—Metallurgical Calculations, J. W. Richards, part iii., The Metals other than Iron.

TECHNOLOGY.

A. Constable and Co., Ltd.—The Manufacture of Paper, R. W. Sindall, illustrated. *Crosby Lockwood and Son.*—Marble and Marble Working: a Handbook for Architects, Sculptors, Marble Quarry Owners and Workers, and all engaged in the Building and Decorative Industries, W. G. Renwick, illustrated. *E. and F. N. Spon, Ltd.*—Sugar: Handbook for Planters and Refiners, J. A. R. Newlands and B. E. R. Newlands, illustrated.

MISCELLANEOUS.

F. Alcan (Paris).—La Crise du Transformisme, Le Dantec. *Wm. Blackwood and Sons.*—Studies in European Philosophy, J. Lindsay. *Chatto and Windus.*—A History of Babylonia and Assyria from the Earliest Times until the Persian Conquest, L. W. King; vol. i., A History of Sumer and Akkad: being an Account of the Primitive Inhabitants of Babylonia from the Earliest Times to about B.C. 2000; vol. ii., A History of Babylon from the Period of the First Dynasty, about B.C. 2000, until the Conquest of Babylon by Cyrus, B.C. 539; vol. iii., A History of Assyria from the Earliest Period until the Fall of Nineveh before the Medes, B.C. 606. *Kegan Paul and Co., Ltd.*—The Liturgy of Funerary Offerings, Dr. E. A. W. Budge; The Book of Opening the Mouth, Dr. E. A. W. Budge, 2 vols.; The Book of the Dead, Dr. E. A. W. Budge (new edition), 3 vols. *Sir Isaac Pitman and Sons, Ltd.*—Body and Soul, P. Dearmer, a Study of "Christian Science" and "Faith Healing" from the Psychological and Physiological Aspects. *G. P. Putnam's Sons.*—Beverages, Past and Present: an Historical Sketch of their Productions, together with a Study of the Customs connected with their Use, E. R. Emerson, 2 vols.; The Law of Psychic Phenomena: a Working Hypothesis for the Systematic Study of Hypnotism, Spiritism, Mental Therapeutics, &c., T. J. Hudson (new edition). *Swan Sonnenschein and Co., Ltd.*—A translation of Hegel's Phenomenology of Mind, J. B. Baillie (Library of Philosophy); Thought and Things: a Study of the Development and Meaning of Thought or Genetic Logic, Prof. J. M. Baldwin, 3 vols., vol. iii., Real Logic; The History of Philosophy: based on the Work of Dr. J. E. Erdmann (fifth edition, revised by his son, Dr. W. Bruno Erdmann), W. S. Hough; Valuation: its Nature and Laws, Prof. Urban (Library of Philosophy); Physiological Psychology, Prof. W. Wundt, a translation of the fifth and wholly re-written German edition by Prof. E. B. Titchener, in 3 vols., vol. ii., illustrated. *The University Tutorial Press, Ltd.*—Principles and Methods of Physical Education and Hygiene, W. P. Welpton; The Science of Speech: an Elementary Manual of Phonetics for Teachers, B. Dumville.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Sir E. Ray Lankester, K.C.B., F.R.S., has been invited to deliver the Huxley lecture for the present session.

Dr. David Fraser Harris has been appointed lecturer in physiology to succeed Dr. Rhodes, who has resigned.

CAMBRIDGE.—The Public Orator, Dr. Sandys, spoke as follows on Thursday, March 4, in presenting Dr. Sven Anders Hedin for the degree of Doctor of Science *honoris causa*:—

Scandinaviae filium intrepidum, post tot pericula peregre suscepta denuo Britannis redditum, Academiae totius nomine libenter salutamus. Salutamus quattuor universitatum illustrium alumnum insignem, qui et Persiam et Mesopotamiam et Caucasi montes et regiones trans mare Caspium late patentes olim peragravit, quique postea per annos decem Asiam mediam ter penetravit, ter scientiarum spolia plurima victor reportavit. Quid commemorem camporum praecelsorum longitudines infinitas, quid nivis aeternae solitudines immensas ab eodem perlustratas? Quid grandinis saxeae tempestates intolerabiles fortiter toleratas? Quid montium ignotorum labyrinthos inextricabiles identidem pererratos? Quid Trans-himalayae lacus procellosos, quid fluminum ingentium fontes audacter exploratos? Ibi originem illam tricipitem primus conspexit, e qua rex fluviorum, Brahmae filius nuncupatus, itineris longi cursum Indiam in orientalem dirigit. Idem in eadem regione rupem illam humilem primus detexit, unde Indus ipse exortus Indiam in occidentalem, Alexandri magni victoriarum olim conscius, defluit.

Atqui (ut poëtae verbis utar)

> "Magnus Alexander totum cum vicerat orbem,
> Non potuit sese vincere; maius erat."

Hic autem, et sui ipsius et rerum naturae victor Alexandro felicior, etiam trans Asiam interiorem scientiarum imperium fortiter propagavit. Idem, Alexandro humanior, terram periculis plurimis plenissimam sic obiit, ut in regione tam immensa nullum crudelitatis, nullum inhumanitatis, vestigium reliquerit.

Ergo laurea nostra libenter coronamus virum a Societate Regia Geographica numismate aureo plus quam semel merito donatum, philosophiae doctorem illustrem, Sven Anders Hedin.

The next combined examination for sixty-seven entrance scholarships and a number of exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 7, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. Some of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural science. Forms of application for admission to the examination at the respective colleges may be obtained as follows:—Pembroke College, W. S. Hadley; Gonville and Caius College, The Master; King's College, W. H. Macaulay; Jesus College, A. Gray; Christ's College, Rev. J. W. Cartmell; St. John's College, The Master; Emmanuel College, The Master, from any of whom further information respecting the scholarships and other matters connected with the several colleges may be obtained. The colleges desire it to be known that any candidate for a scholarship may signify in writing his wish not to receive the emolument of the same if elected thereto, and that such candidate may be elected to a scholarship which may be honorary only and without emolument, but shall carry with it all other privileges attached to the position of a scholar. The amount thus set free will serve to increase the number of scholarships or exhibitions open to other candidates.

The syndicate appointed to obtain plans and estimates for the new museum of archæology and ethnology has reported that it has now in hand more than 10,000*l*., more than half of which has been contributed by members of the Foster family in memory of Mr. W. K. Foster. The syndicate is of opinion that leave should be asked of the Senate to commence at once the first portion of a building which will contain, when completed, a museum, lecture-rooms, class-rooms, library, workrooms, and private rooms for the curator and staff. Some of these rooms will be available for the meetings of the Cambridge Antiquarian Society.

The special board for physics and chemistry, and the special board for history and archæology, have issued schedules for the examination in architectural studies under the following headings:—(1) practical mathematics; (2) elementary applied mechanics; (3) strength of materials and elementary theory of structures; (4) descriptive geometry: projection of solids; (5) the principles of surveying; (6) outlines of the history of architecture of Europe and the Near East; (7) outlines of the general history of art; (8) architecture and the allied arts of the Classical period; (9) architecture and the allied arts of the Mediæval period; (10) architecture and the allied arts of the Renaissance and Modern periods; (11) the theory of art in relation to architecture.

LONDON.—With reference to the statement in NATURE of March 4, that "the Senate has taken exception to the terms of reference to the Royal Commission on the University," Sir William Ramsay, as a member of the Senate of the University, present during the whole of the meeting on March 3, requests us to make public the fact that that statement is without foundation. The note did not refer to the meeting on March 3, that being the day on which NATURE went to press; and our correspondent informs us it was based upon the official announcement made in the *Times* and other papers on February 26, though it failed to express exactly the substance of that announcement.

THE issue for 1909 of the "Schoolmaster's Year-book and Directory" is now available. The general character of the volume remains unaltered; the directory has been made much more complete, and the very large amount of information provided has been brought up to date. This annual work of reference continues the most convenient available source of particulars concerning every grade of secondary education for boys, and no schoolmaster should be without a copy.

IT is announced by *Science* that the 40,000*l*. required to secure the gift of 120,000*l*. from Mr. John D. Rockefeller for the Harper memorial library at the University of Chicago has now been obtained. Part of the money has been reserved for an endowment. The president of Western Reserve University announces the completion of a 100,000*l*. fund for the additional endowment of Adelbert College and the college for women. Of this amount 25,000*l*. was offered by the General Education Board, on the condition that 75,000*l*. be raised by the University. Hamline University, St. Paul, Minn., has been offered 15,000*l*. by the General Education Board of New York on the condition that it will raise three times the amount, making a total of 60,000*l*., a large portion of which is to be added to the permanent endowment of the University. The department of engineering of the University of Michigan has received a gift of the library of the late Mr. George Y. Wisner and a rotary engine of the value of 1400*l*. from Mr. J. D. R. Lampson. The University of Virginia has completed an endowment fund of 200,000*l*., of which half has been given by Mr. Andrew Carnegie.

THE Board of Education has now published the second part of "Statistics of Public Education in England and Wales, 1906–7–8." This Blue-book (Cd. 4506) is concerned wholly with financial statistics. It is interesting to find that the net total expenditure during the school year 1907–8 of the Board of Education out of the Parliamentary vote was 13,272,017*l*., and that 11,129,658*l*. was expended on elementary education. Under the headings "secondary schools, pupil teachers, &c.," the amount disbursed was 679,612*l*. To quote the summary of payments, the grants made for "technical institutions, schools of art, day technical classes, art classes, and other schools and classes for further education" reached 456,573*l*. The share of the Parliamentary vote which went to higher scientific education appears very small, as the following items show:—Royal College of Science, London, 24,843*l*.; Imperial College of Science and Technology, 5,783*l*.; Geological Museum and Geological Survey, 21,255*l*.; and Committee on Solar Physics, 1899*l*. These amounts probably do not quite account for the total amount which should be credited to higher scientific instruction, because fractions of the expenditure under "works and furniture" and "museums and circulation of objects for exhibition" were probably devoted to the purposes of education in science.

THERE are many indications that eventually we shall have a science of education, and it is satisfactory to find that the number of persons engaged in educational work who are learning the value of the results of carefully and scientifically planned experiments steadily increases. The training college authorities in different parts of the country are beginning to take an active share in this important work, and the spread of scientific methods in their institutions is reflected in the second issue of the *Training College Record* which has reached us. Among other important articles contained in this excellent magazine we notice that by Prof. Green on experiment in education, in which he gives a helpful summary of the more important educational experiments inaugurated in this and other countries during 1908. Dr. Percy Nunn describes briefly a pedagogical museum which is being arranged at the London Day Training College; the arts of reading and of clear speech are discussed ably by Prof. Wyld and Principal Burrell; and Mr. H. H. Hulbert deals with the teaching of hygiene in training colleges. The other contributions similarly indicate that the age of empiricism and the blind adherence to the *obiter dicta* of departed writers on education is giving place to an attempt to understand by observation and by suitable tests the working of the child mind and the ways in which it is influenced by environment and other conditions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 26, 1908.—"The Proportion of the Sexes produced by Whites and Coloured Peoples in Cuba." By Walter **Heape.**

This paper deals with data contained in publications issued by the chief sanitary officer of Cuba, 1904–5–6, in which are recorded the sex of both legitimate and illegitimate births and still-births for both classes of the population. The totals dealt with amount to 177,704, viz. whites 135,881, and coloured peoples 41,823 births and still-births. It is found:—

(1) That there is a racial difference in the proportion of the sexes produced; for whites, 108·44 males, for coloured, 101·12 males, per 100 females. This result is in close agreement with other published statistics of both races, and shows the influence of heredity.

(2) That for both races, for both births and still-births, there is a consistent variation in the proportion of the sexes produced by legitimate as compared with illegitimate union. For whites, legitimate 109, illegitimate 105·95 males per 100 females. For coloured, legitimate, 107·73, illegitimate 97·91 males per 100 females. Illegitimate unions result in a marked increase in the proportion of females produced, and it is claimed that they are chiefly induced by individual physiological conditions affecting the metabolic activity of the woman.

(3) That both whites and coloured experience two sharply defined breeding seasons each year; sudden, brief bursts of reproductive activity, correlated with marked climatic changes, which tend to increase individual metabolic activity. Again, at these times of greatest fertility the largest proportion of females is produced.

(4) That a considerably higher proportion of females are born in towns than in country districts, where life is associated with greater hardships.

(5) Conclusions: although heredity, in the main, governs the proportion of the sexes produced by these two races, conditions occur under which that proportion is varied, and although different in degree it is similar in character for both races. These conditions are directly associated with forces which affect the metabolic activity of the mother, and suggest the probability that the ripening and production of ovarian ova of different sexes is influenced thereby. Thus it is held that a struggle for existence is always going on among the sexual ovarian ova, and that these extraneous forces influence the result. Speaking generally, this investigation indicates that the greater the metabolic activity of the ovary the more females are produced.

January 14.—"On the Passage of Röntgen Rays through Gases and Vapours." By J. A. **Crowther.** Communicated by Sir J. J. Thomson, F.R.S.

A series of experiments has been made, under comparable conditions, on the behaviour of different gases and vapours with respect to the passage of Röntgen rays through them. The results obtained are thus summarised:—

(1) The amount of ionisation produced by the direct action of the primary Röntgen rays on a gas is simply proportional to the pressure of the gas. No evidence was obtained of the emission of any appreciable amount of soft secondary radiation by the gas, the ionisation being apparently due to the direct action of the primary rays.

(2) The relative ionisation in the different gases, compared with air as the standard, varies considerably with the hardness of the rays. Hydrogen and ethyl bromide show an increase as the hardness of the rays increases. Other gases remain constant or give a diminution. There is no indication of any approximation to a "density law" as the hardness of the rays is increased.

(3) The relative ionisation in a gas follows approximately an additive law. It does depend somewhat, however, on the state of combination, especially for soft rays.

(4) The absorption varies with the pressure according to an exponential law.

(5) The amount of secondary radiation emitted by different gases relative to air is, generally, approximately independent of the hardness of the primary rays. For very hard rays ethyl bromide shows a slight decrease. On the other hand, the values for methyl iodide increase fairly rapidly as the hardness of the rays is increased.

(6) The coefficient of absorption of the secondary rays emitted by a gas, in the gas itself, is not abnormal.

(7) The total ionisation in different gases is not a constant, and the relative values obtained differ with the hardness of the rays.

(8) The amount of energy required to produce an ion in different gases is different, and also varies with the hardness of the rays.

No relationship has been found between the relative ionisation and the secondary radiation, or between either, and any other known property of the gases and vapours, and the explanation of the relatively large amounts of secondary radiation emitted by ethyl bromide and its class compared with air, and of the large relative ionisations in methyl iodide, ethyl bromide, &c., still remains to be sought.

It appears that on the whole less energy is required to produce an ion in the more ionisable gases, but the values obtained do not differ very largely, and are totally inadequate to explain the very large amounts of ionisation in these gases and vapours.

Both the ionisation and the secondary Röntgen radiation follow, at any rate approximately, an additive law. It appears, therefore, that these properties are properties of the atoms themselves, and that an explanation must be sought in their atomic structure.

February 25.—Sir Archibald Geikie, K.C.B., president, in the chair.—The statistical theory of the form of the curve of oscillation for the radiation emitted by a black body: Prof. H. A. **Wilson.** The view adopted in this paper is that the radiation from a black body is an irregular disturbance subject to statistical laws. It is shown that these laws can be deduced from the distribution of energy in the spectrum, and that they enable the character of the disturbance to be described. The disturbance at any instant is taken to be the sum of the displacements in the infinite number of simple harmonic vibrations of arbitrary phases which are obtained when the radiation is dispersed into a spectrum. Expressions are found for the chances that the displacement and its derivatives lie between given limits. These expressions enable the average number of zero values per cm. of the displacement and its derivatives to be calculated. The distribution of maxima and minima is estimated, and a curve has been drawn having approximately the statistical properties deduced. The mean wave-length (λ') of the radiation is defined as $2/n_0$, where n_0 is the average number of zeros per cm. in the displacement curve. If λ_m denotes the wave-length in the spectrum at which the energy is a maximum, it is shown that $\lambda'/\lambda_m = 2{\cdot}5$. It is shown that the number of maxima and minima is about double the number of zero values and about half the number of points of inflection in the curve.—The flight of a rifled projectile in air: Dr. J. B. **Henderson.** The problem is attacked from first principles simply as a case of a moving rotating body meeting with certain resistances due to the air, and it is found that all the known phenomena are accounted for by the precessional motions of the shot, due to the tilting and friction couples which arise from the obliquity of the axis of the projectile to the direction of motion. The complete trajectory in all its details can be thus constructed from the initial conditions and the laws of resistance so soon as these are known. By assuming laws of resistance, the details of portions of trajectories are sketched by the traces which the direction of the axis of the shot and the direction of motion would leave on the celestial sphere.' Mr. Mallock has also studied the physical phenomena of a moving projectile from the same point of view in a paper on ranges and behaviour of rifled projectiles in air (Proc. Roy. Soc., June 6, 1907), and the two interpretations of the phenomena agree in their common portion. Mr. Mallock's object, however, is to obtain an expression for the drift of the projectile, which he does by assuming that the axis follows the tangent to the trajectory. The present paper is concerned with the *details* of the motion, the deviations of the axis from the tangent, and with the method by which the axis approximately follows, on the average, the tangent to the trajectory. It is found that in the details lies the explanation of the horizontal and vertical "drifts."—The cross-breeding of two races of the moth *Acidalia virgularia*: Louis B. **Prout** and A. **Bacot.** The authors undertook extensive systematic breeding experiments with the geometrid moth *Acidalia virgularia* (Hübner) with the view of ascertaining whether there were any "Mendelian" behaviour discoverable in the cross-pairing of two well-marked local races, the dark London form and a white form from the south of France (Hyères). Between the years 1906 and 1908, ten generations were bred and analysed, the number of specimens being between 5000 and 6000. In each generation the two pure strains were maintained, and cross-pairings obtained between them, and many of the hybrids were also carried on to the succeeding generations, although some failed at one point or another. The results were entirely negative so far as Mendelian segregation is concerned. Hybrids of the first generation presented a facies intermediate between those of the parent stocks, and seldom varying materially. Their offspring, and the succeeding generations, showed usually a greater variability and a tendency—though indefinite and unsystematic—to revert to, or towards, the original pure forms, but the intermediate or hybrid forms were scarcely ever "bred out," and intergrades from one extreme to the other were so gentle that attempts to sort out hybrid broods into "darks" and "lights" gave only the merest approximations. A few selected pairings, *e.g.* of light × light *ex* hybrid, resulted in the recovery of nearly pure strains, so far as it was possible to test them, but nothing peculiar to any special theory of heredity was deducible from them. The authors consider that the behaviour of this hybridisation is confirmatory of that of certain races of *Lasiocampa quercus*, on which Mr. Bacot had earlier experimented (*Entomologist's Record*, vol. xiii.), namely, that the bringing together of geographically separated races may be expected to result in the production of blends, and that it will therefore be necessary, in order to obtain segregation of the parental forms in a hybrid race, to pair aberrations inhabiting the *same* geographical area, where it may be assumed that natural selection has, for some reason, virtually eliminated the intermediates. All the recorded instances of this Mendelian segregation with which the authors are acquainted among the Lepidoptera are of this latter class, the forms the pairing of which has produced it being well-defined "aberrations" in the sense in which that word is used by Staudinger, *e.g. Triphaena comes* with ab. *curtisii*, *Xanthorhoë ferrugata* with ab. *unidentaria*, *Abraxas grossulariata* with ab. *varleyata*, *Callimorpha dominula* with ab. *rossica*, &c. Some incidental observations on the inheritance of some minor characters in the wing-markings, or, in one strain, of manifest ♀ sex-predominance, are noted as probably worthy of further attention, though outside the scope of the present inquiry.

March 4.—Sir Archibald Geikie, K.C.B., president, in the chair.—The presence of hæm-agglutinins, hæm-opsonins, and hæmo-lysins in the blood obtained from infectious and non-infectious diseases in man, second report: L. S. **Dudgeon.** *Haemo-lysins.*—It was found that the blood in fourteen cases of typhoid fever showed hæmolysis on nine occasions. Those instances in which hæmolysis occurred when the immune serum was added to normal red cells terminated fatally. In the remaining cases this action was demonstrated when normal serum was added to the immune red cells. Auto-hæmolysis was proved twice, once during an attack of paroxysmal hæmoglobinuria; the other case was tertiary syphilis. Iso-hæmolysis was found several times when normal serum was added to immune red cells, less frequently with immune serum added to normal erythrocytes. *Haem-agglutinins.*—Auto-agglutination was an extremely rare phenomenon. In one instance spontaneous and auto-agglutination occurred. In this case auto-hæmolysis was also proved. Further experience has shown that iso-agglutination occurs in normal blood, but not auto-agglutination. Hæmolytic agglutinins are present whenever hæmo-lysins can be demonstrated. The specificity of hæm-agglutinins has been proved, and the absolute specificity of bacterial and hæm-agglutinins has been completely demonstrated. The agglutination resulting from the interaction of a serum and certain red cells could be completely prevented by previously saturating this serum with the heated (60° C. for one hour) specific red cells. Saturation of the serum with melanin failed to produce any effect. *Phagocytosis.*—Hæmo-phagocytosis was often well marked. The phenomenon usually resulted from the interaction of immune red cells, normal serum, and normal leucocytes. Hæmo-lysins, agglutinins, and opsonins might be present together in a certain sample of serum, or the opsonins and agglutinins together, or opsonins singly. Usually, the agglutinins and opsonins had a distinct relationship.—The influence of glucosides on the growth of acid-fast bacilli, with a new method of isolating human tubercle bacilli directly from tuberculous material contaminated with other micro-organisms, preliminary note: F. W. **Twort.** This investigation was undertaken to test the action of acid-fast bacilli on the glucosides and to see how far any fermentation reactions obtained would differ with the various strains of human and bovine tubercle bacilli tested, and also to obtain, if possible, a better medium on which to isolate and grow tubercle bacilli. In all, forty-three glucosides were tested with acid-fast bacilli, including human and bovine tubercle bacilli, but there was no evidence of fermentation with any of the glucosides. One glucoside, *ericolin*, was found to kill off a large number of species of micro-organisms, especially bacilli of the Colon group and various cocci, but had very little effect on the acid-fast group of bacilli. By means of this glucoside the isolation of tubercle bacilli directly from human sputum contaminated with other organisms becomes quite easy. The glucoside should be made up with distilled water in a 2 per cent. solution; a lump of sputum is then placed into a test-tube containing the ericolin and placed at 38° C. for three-quarters of an hour to one hour; subcultures are then made on to Dorset's egg medium, and pure growths of tubercle bacilli will be obtained in fourteen to twenty-eight days; the tubes are sometimes contaminated with a few other organisms, chiefly tiny colonies of Streptococci and slow-growing colonies of organisms of the Streptothrix group, but they are so few that they in no way interfere with the tubercle colonies, which can be easily subcultured.—The effect of heat upon the electrical state of living tissues: Dr. A. D. **Waller.** *Method.*—The tissue—muscle, nerve, or skin—is led off to the galvanometer by two electrodes, A, B. Warmth is applied by brief glow of a platinum wire under (not in contact with) A or B. *Results* are as follows:—

	A	B	
I. Muscle	←——	——→	Heat
	——→	←——	Excitation
II. Nerve	←——	——→	Heat
	——→	←——	Excitation
III. Skin	——→	←——	Heat
	←——	——→	Excitation

The arrows under A and B indicate the direction of currents in the tissue in response to local warmth or local excitation at A and at B respectively, *e.g.* if muscle led off at A and B to the galvanometer is heated at B, there is current in the galvanometer from B to A, in the muscle from A to B, as indicated by the first arrow under B. The local skin-currents both to heat and to excitation are of reverse direction to those of muscle (and of nerve), *e.g.* if skin, led off by electrodes A and B applied to its external surface, is warmed at B there is a current in the galvanometer from A to B ("ingoing" current at B, or B "negative" to A). If it is excited at B there is current in the galvanometer from B to A ("outgoing" current at B, or B "positive" to A). The internal surface is ineffective. Both surfaces of scalded skin are ineffective. *Conclusion.*—In muscle (and in nerve) where the electrical effect of local excitation is "negative," the effect of moderate heat is "positive." In the skin where the electrical effect of local excitation is "positive," the effect of moderate heat is "negative." Excessive heat, producing injury, gives a "negative" effect in muscle (and nerve), a "positive" effect in the skin. Thus in all three cases—muscle, nerve, and skin—the electrical effect of moderate heat is of the opposite sign to that of excitation.

Royal Microscopical Society, February 17.—Sir E. Ray Lankester, K.C.B., F.R.S., president, in the chair.—The "red snow" plant (*Sphaerella nivalis*): Dr. G. S. **West.**—A German-silver portable microscope made by Powell in 1850: A. A. C. E. **Merlin.**—The measurement of very minute microscopic objects: E. M. **Nelson.**—The transformation of certain insects: F. **Enock.**—The fresh-water Crustacea of Algeria: Mr. **Gurney.**

EDINBURGH.

Royal Society, February 15.—Prof. A. Gray, F.R.S., vice-president, in the chair.—The electromotive force of iodine concentration cells with one electrode saturated with iodine: Principal A. P. **Laurie.** The paper dealt with the question as to what was the distribution between iodine ions and I_3 ions in saturated solutions of iodine and potassium iodide, the strength of the latter being increased up to normal. This was determined by measuring the electromotive force of iodine concentration cells with a known and very small quantity of iodine round one electrode and a saturated solution of iodine round the other, the potassium iodide being of the same strength in both cases. With the view of correcting the error due to contact electromotive force between KI_3 and KI, an intermediate solution of ten normal ammonium nitrate was introduced. The results show that up to a strength of normal potassium iodide there are no higher polyiodides formed beyond KI_3, the increasing solubility of iodine being due to an alteration in the ratio of the dissociation of I_3 into I_2 and I.—The magnetic properties of certain copper alloys: A. D. **Ross** and R. C. **Gray.** The paper was an investigation of the effects on magnetic quality of annealing, quenching, baking, and liquid-air tests on manganese-aluminium bronzes, in which the relative proportion of manganese and aluminium was constant, while the content of copper varied. Comparison was made with similar effects in manganese, manganese bronze, manganese steel, aluminium bronzes, and very pure copper. It was shown that the effects obtained in Heusler's alloy present a suggestive similarity to those in free copper.—Some low-temperature experiments in magnetism: J. G. **Gray** and Hugh **Higgins.** According to Dewar and Fleming, a specimen of steel when magnetised to saturation at room temperature, and then cooled and warmed alternately between $-190°$ C. and $5°$ C., arrived at a reversible condition in which its magnetic moment at $-190°$ was greater than its magnetic moment at $5°$. In the present paper the specimen was magnetised at $-190°$ and subjected thereafter to the same treatment. The reversible condition was arrived at after the first warming, and the percentage increase then brought about by cooling was much greater than that which held for the specimen when magnetised at the room temperature.—Lagrange's equations of motion and elementary solutions of gyrostatic problems: Prof. A. **Gray.** The first part of the paper was a new discussion of the difficulties in applying Lagrange's equations to what are known as non-holonomic systems. The modified form of the equations which can be applied was given. The elementary solutions depended upon the generalisation of a theorem the fundamental nature of which could be indicated by the rule that the normal force on a particle moving in a circle was equal to the momentum multiplied by the angular speed of the radius vector.

PARIS.

Academy of Sciences, March 1.—M. Émile Picard in the chair.—The supposed effect of crystallisation for modifying the properties of the solution of a body resulting from the direct union of two solutions: D. **Gernez.** The author has repeated an old experiment, according to which a solution of the double tartrate of sodium and ammonium, or of sodium and potassium, possesses a different rotatory power according as the substance has been crystallised out or not. This result is not confirmed; the rotatory power of the mixed tartrates is not affected by crystallisation, followed by subsequent solution.—A physico-chemical method of sterilising in the cold and at a distance: A. **Billon-Daguerre.** The ultra-violet rays from an arc lamp kill *Staphylococcus pyogenes aureus* in five or six seconds.—The monogenic function of a hypercomplex variable in a commutative group: Léon **Autonne.**—The hypothesis of positive electrons. Reply to the note of A. Dufour: Jean **Becquerel.** The experiment described by Dufour is not a repetition of the one given by the author. While not supposing that the hypothesis of positive electrons is the only one capable of explaining the observed facts, it is worthy of consideration, since it coordinates and explains a number of magneto-optic phenomena.—Molecular volumes, densities, and atomic weights: A. **Leduc.** From the formula given in a previous paper the densities (oxygen taken as unity) of twenty gases are calculated, and the calculated numbers compared with the experimental figures. The atomic weights deduced from these figures ($O=16$) are:—$H=1{\cdot}0075$, $N=14{\cdot}005$, $C=12{\cdot}004$, $Cl=35{\cdot}463$, and $S=32{\cdot}072$.—Equilibria between the liquid and solid phases in the mixture $NaCl+H_2O$. The fusion of snow: Camille **Matignon.** The complete curve for the lowering of the melting point by the addition of NaCl is given. The eutectic mixture contains 30·7 per cent. of salt, and solidifies at $-21°{\cdot}3$.—The determination of some physical constants of the peptones: L. **Lematte** and A. **Savès.** The peptones used contained 16·8 per cent. of nitrogen and 0·756 per cent. of chlorine as HCl. Solutions of concentrations between 0·9 per cent. and 10 per cent. of peptones were examined for freezing point, density, and refractive index, and the results given in a table.—The action of gaseous hydrochloric acid on amorphous silicon: A. **Besson** and L. **Fournier.** In this reaction the authors have isolated two new products, SiH_3Cl (boiling point about $-10°$) and SiH_2Cl (boiling point about $+12°$).—The ammoniacal iridium sulphates: Marcel **Delépine.**—The action of carbon monoxide upon chromium, nickel, manganese, their oxides and alloys: Georges **Charpy.** At 1000° C. nickel is practically without action on carbon monoxide; manganese gives a mixture of MnO and carbon, and chromium resembles manganese, but the action is slower.—Researches on the occluded gases contained in some common metals: B. **Delachanal.** The metals examined were aluminium, magnesium, zinc, tin, spongy platinum, platinum foil, and platinum-iridium. Analyses of the gases evolved are given.—The condensation of the mesoxalic esters with aromatic hydrocarbons: A. **Guyot** and G. **Estéva.** The condensation of mesoxalic esters with benzene and its derivatives under the action of sulphuric acid takes place in two stages, an aryl-tartronic ester, $X.C(OH).(CO_2R)_2$, being first formed, and then a diaryl-malonic ester, $X_2.C(CO_2R)_2$. Numerous preparations are described showing the generality of the method.—Elaterine and some of its derivatives: A. **Berg.**—The action of semicarbazide on chlorinated aldehydes: André **Kling.** New very sensitive reactions for the detection and identification of glycerol: Georges **Denigès.** The glycerol is oxidised by bromine water to dioxyacetone, and application made of the various colour tests described in a previous note.—The experimental production of white and black tubercles, starting with seeds of pink radish: Marin **Molliard.**—The antagonism of sodium and calcium citrates in the working of the heart and its moderating nerve apparatus: H. **Busquet** and V. **Pachon.**—The course of the oxidation and hydrolysis of starch and its constituents under the action of hydrogen peroxide: Mme. Z. **Gatin-Gruzewski.** There are distinct differences between the modes of transformation of amylose and amylopectin by diastases and by hydrogen peroxide.—The action of light upon milk to which potassium bichromate has been added: A. **Gascard.** Milk samples to which potassium bichromate has been added as a preservative keep much better in the dark.—The sterilisation of milk by the ultra-violet rays: Victor **Henri** and G. **Stodel.** By the use of quartz mercury lamps milk can be completely sterilised in the cold.—Relations between the mode of development of Tetracorallia and that of Hexacorallia: L. **Faurot.**—The volcano of Eglazines, Aveyron: G. **Fabre.**—The modifications of the coast of Poitou: the comparison with other points of the shore of the Atlantic Ocean: M. **Welsch.**—The variations of the distribution of the atmospheric pressure at the surface of the globe: Henryk **Arctowski.**—The laws of the distribution of temperature with height at different latitudes and under different meteorological conditions: L. Teisserenc **de Bort.**

DIARY OF SOCIETIES.

THURSDAY, March 11.

Royal Society, at 4.30.—Note on the Stability of Jacobi's Ellipsoid: Sir George H. Darwin, K.C.B., F.R.S.—On the Wave-lengths of Lines in the Secondary Spectrum of Hydrogen: H. E. Watson.—The Measurement of Dielectric Constants by the Oscillations of Ellipsoids and Cylinders in a Field of Force: Prof. W. M. Thornton.

Royal Institution, at 3.—Recent Advances in Agricultural Science: A. D. Hall.

Mathematical Society, at 5.30.—The Kinetic Image of a Convected Electric System in a Conducting Plane Sheet: Prof. J. Larmor.—On an Integral Equation: G. H. Hardy.—The Transformation of the Electrodynamical Equations and the Laws of Motion: H. Bateman.—The Transformation of the Electrodynamic Equations of Moving Bodies: E. Cunningham.

Institution of Electrical Engineers, at 8.—The Dielectric Strength of Compressed Air: E. A. Watson.

FRIDAY, March 12.

Royal Institution, at 9.—Modern Submarine Telegraphy: S. G. Brown.

Physical Society, at 8.—The Effect of Radiations on the Brush Discharge: A. E. Garrett.—On Pirani's Method of Measuring the Self-inductance of a Coil: E. C. Snow.—Exhibition of a High Potential Primary Battery: W. S. Tucker.—On the Least Moment of Inertia of an Angle Bar Section: H. S. Rowell.

Malacological Society, at 8.—Description of a New Species of Oliva from the Andaman Islands: F. G. Bridgman.—Notes on the Genera Cypræa and Trivia: H. O. N. Shaw.—On the Shell Mound at Sidon; On the Habitat of Certain Species of Clausilia from the Coast of Syria: Rev. H. A. Cooke.—Notes on the Species of Cyclophorus found at Hong Kong: Staff-Surgeon K. H. Jones, R.N.—On the "Conchological Illustrations," by G. B. Sowerby, jun., and the "Descriptive Catalogue of Shells," by J. E. Gray: C. Davies Sherborn.—On the Date of Issue of Sowerby's "Conchological Illustrations": H. O. N. Shaw.

Royal Astronomical Society, at 5.—Observations of the Partial Eclipse of the Sun, 1908 December 23, at Natal Observatory: E. Nevill.—Note on Mr. Franks's Analysis of the Colours and Magnitudes of 3630 Stars: Julia Bell.—The Brightness of Saturn, with Ring Invisible: J. M. Baldwin.—Radial Movement of Sun-spots: J. Evershed.—On the Data employed in Oppolzer's Canon der Finsternisse: E. Nevill.—Comparison of the Ancient Eclipses of the Sun with Modern Elements of the Moon's Motion: Simon Newcomb.—On Correlation and the Characters of Variable Stars: in reply to Prof. Karl. Pearson: H. C. Plummer.—The Recent Pendulum Observations in India: Major Lenox-Conyngham.—On the Relation between the Period and Density of the Algol Variables: Rev. J. Stein.—On a Chinese Planisphere: E. B. Knobel.—Occultations of Planets by the Moon in 1909, visible at British Observatories: A. M. W. Downing.—Note on the Regnal Years in the Elephantine Papyri: J. K. Fortheringham.—Some Notes on Aberration: Prof. H. H. Turner.

SATURDAY, March 13.

Royal Institution, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

MONDAY, March 15.

Victoria Institute, at 4.30.—Legislations of Israel and Babylonia: H. M. Wiener.

TUESDAY, March 16.

Royal Institution, at 3.—The Evolution of the Brain as an Organ of Mind: Prof. F. W. Mott, F.R.S.

Royal Society of Arts, at 4.30.—The Colonial Wool Trade: S. Bank Hollings.

Zoological Society, at 8.30.—Grouse-Disease Committee Reports: (*a*) Ectoparasites of the Grouse; (*b*) The Thread-worms (Nematoda) of the Red Grouse (*Tetrao scoticus*); (*c*) The Tape-worms (Cestoda) of the Grouse. Appendix: Parasites of Birds allied to the Grouse: Dr. A. E. Shipley, F.R.S.—On a Fossil Bird from the Lower Pliocene: W. P. Pycraft.—On a Collection of Mammals from Western Java, presented to the National Museum by Mr. W. E. Balston: Oldfield Thomas, F.R.S., and R. C. Wroughton.

Royal Statistical Society, at 5.

Institution of Civil Engineers, at 8.—*Further discussion*: Concrete and Masonry Dam Construction in New South Wales: L. A. B. Wade.

WEDNESDAY, March 17.

Royal Society of Arts, at 8.—The Musical Aspect of Drums: Gabriel G. Cleather.

Royal Meteorological Society, at 7.30.—Wind Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

Royal Microscopical Society, at 8.—The Optical Examination of a Crystal Section in a Rock Slice: Dr. J. W. Evans.

Entomological Society, at 8.

THURSDAY, March 18.

Royal Society, at 4.30.—*Probable Papers*: An Attempt to Detect some Electro-optical Effects: Prof. H. A. Wilson, F.R.S.—On the Influence of their State in Solution on the Absorption Spectra of Dissolved Dyes: Dr. S. E. Sheppard.—The Ferments and Latent Life of Resting Seeds: Jean White.

Royal Institution, at 3.—Recent Advances in Agricultural Science: A. D. Hall.

Linnean Society, at 8.—The Dry-rot of Potatoes: Miss Sibyl Longman.—The Structure and Affinities of *Davidia involucrata*, Baill.: A. Horne.

Institution of Mechanical Engineers, at 8.—Experiments upon the Forces acting on Twist-drills when operating on Cast-iron and Steel: D. Smith and R. Poliakoff.

FRIDAY, March 19.

Royal Institution, at 9.—Experiments at High Temperatures and Pressures: Richard Threlfall, F.R.S.

Institution of Civil Engineers, at 8.—Some Aspects of Chemical Engineering: C. J. Guttmann.

SATURDAY, March 20.

Royal Institution, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 18, 1909.

NEW LIGHTS ON PROTOPLASM IN PLANTS.

(1) *Einleitung in die experimentelle Morphologie der Pflanzen.* By Dr. K. Goebel. Pp. viii+260. (Leipzig and Berlin: B. G. Teubner, 1908.) Price 8 marks.

(2) *Parthenogenesis und Apogamie im Pflanzenreiche.* By Dr. Hans Winkler. Pp. 166. (Jena: Gustav Fischer, 1908.) Price 4.50 marks.

(1) THE study of botany has passed through many different phases, but it has tended more or less steadily towards the fuller recognition of plants as living beings, to be studied in the whole cycle from their beginnings through their maturity to their decay, including their provision for the continuance of the race despite the death of the individual. For a time the motive for the study of plants was naturally the desire to find out the uses to which they could be put, and the keenest students were usually the physicians in their search for useful drugs. After the awakening of interest in such study for its own sake, it passed necessarily through a period of description of forms previously unknown, followed by efforts to bring order into the knowledge already accumulated, and to discover some system by which the various forms could be accurately identified.

The invention of the microscope and of the methods suitable for its employment as an instrument of research opened up new fields to the student of living things, but the living substance was not recognised as the builder of the framework of cell-walls and vessels until near the middle of last century. The recognition of protoplasm as the "physical basis of life" necessarily directed attention to the importance of gaining a knowledge of its properties, of its relations to its environment, and of its response to stimuli. Improvements in the microscope and in the technique of research, while helping to solve some problems, have opened up new lines of inquiry, and this has been peculiarly the case in recent years. A considerable new literature has grown up dealing with the questions that arise, and it is very desirable to have the lines of inquiry and the results attained presented in a clear and effective form, whether these cover the whole field or relate to only a part of it. The two works named above will be found most useful guides, the first to the knowledge gained by experimental researches into alterations in structure induced by action of external stimuli, or environment, and into regeneration when parts are injured or removed, and the second to the production of new individuals by the processes known as apogamy and parthenogenesis, and the relation of these processes to the normal production of the embryo from the fertilised ovum.

Prof. Goebel speaks with the authority of an adept on all questions of morphology; and in this new book (based on a course of lectures delivered in the winter of 1906, and issued as the first volume of a series of handbooks on the methods useful in the study of the natural sciences and of technology) there is presented a most useful guide towards a clear view of what has been accomplished, along with indications of promising subjects of investigation. The division into lectures has not been adhered to, the clearness of exposition alone suggesting the work of a skilled teacher; and, where desirable, the matter has been treated with greater fulness than would have been suitable in the original form. Numerous footnotes refer the student to all important sources of information.

Vascular plants supply by far the greater part of the material dealt with, mosses and thallophytes being referred to now and again by way of comparison. The necessity of studying the plant throughout its development as a condition of understanding its true nature and affinities is illustrated by examples that show great diversity between the corresponding parts of the young and of the adult, and the differences are traced to causes the action of which can be tested by experiment. The normal course of development is analysed into periods, each with a distinctive character, these being successively *morphological*, during which the members appear and cells are rapidly multiplied, and *physiologico-biological*, when the members attain their full size and maturity, and fulfil their part in the plant's well-being. Experiments prove that the action of environment depends largely on the period during which it has acted, and that the characters of the earlier period may be retained in the normally later stage, or may be reproduced in that stage by the influence of an environment appropriate to the earlier. The *Campanula rotundifolia* ("harebell" of England, "blue-bell" of Scotland) is found to be very well suited for these instructive experiments, the forms of its leaves showing very quickly the influence of changes in environment, and also that similar results may follow apparently very different causes, such as diminished light, lessened supply of water, or increase of the salts in solution in the water. Prof. Goebel is led to the generalisation that these external influences act indirectly by their altering the amount and kind of the food formed by the plant, and required to permit of the normal course of development, the external forms being conditioned by the vital activities of the plants, and by the food-supply to each part of it. Thus also he accounts for the phenomena of regeneration where the injury is not very great, or replacement by new parts of a similar kind if the parts removed were too extensive or too specialised in their structure to be regenerated simply. The same generalisation is used to explain the different behaviour of primary and lateral axes and appendages, when uninjured, and when lateral parts are modified to replace primary members that have been destroyed.

The quality of the food is held to explain the nature of the parts formed. Thus stolons (as in Circæa) are attributed to the amount of organised food, relatively to the inorganic, or ash, supplied to the growing-point of the stolon being greater than that supplied to the leafy shoot. Potato tubers afford very favourable subjects for experiments; *e.g.* if tubers are kept at not

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more than 7° C., few roots or leafy shoots are formed, but new tubers develop readily, though, of course, remaining small. If the parent tubers are then cultivated at 25° C., leafy shoots are freely formed, the younger tubers of the new growth often being continued into leafy shoots at the tip.

The relations between leafy shoots and inflorescences are discussed as conditioned by the relative amounts of organised and mineral supplies to each; and the well-known effects on trees of root-pruning and over-feeding are brought under the general law. Certain plants (*e.g.* *Veronica Beccabunga*) show that their inflorescences may readily be caused to grow into leafy shoots. Space will not permit of more than a passing reference to the very interesting discussion of the changes that can be induced in the colours of certain flowers and the structure of others by alterations of environment and food and of the conditions under which cleistogamous flowers are normally produced. The production of buds in abnormal situations, either as a usual occurrence, as on the leaves of *Cardamine pratensis* in autumn, or following the partial or entire separation of the part from the plant, so largely utilised in the multiplication of begonias, hyacinths, and certain other plants, is treated at considerable length, and is summed up as closely akin to regeneration, both being especially active at the growing-points of axes or leaves; but adult tissue in certain areas may revert to the embryonic state, these areas being along the veins; and the impulse to development, apart from external stimuli, is conditioned by the presence of the necessary constituents of the food, brought about in leaves, when the petiole is cut or broken, by the retention of the leaf's products within itself. The book, though not large, does not lend itself to a brief review, as it is conspicuously free from irrelevant or useless matter. The student will find in it much information of high value, and much to suggest new aspects of the life of plants and of how experimental methods may be usefully employed in the search after the laws that govern them.

(2) Dr. Winkler's work on parthenogenesis and apogamy is one of the excellent monographs that have rendered "Progressus Rei Botanicæ" indispensable in every botanical library. It deals with one aspect of the activity of protoplasm, as manifested in reproduction of the species by methods very different in some respects from the normal, and the possibility of which was scarcely suspected until comparatively recent years. But though of recent development, this field of research has had much attention directed to it, and a copious though rather scattered literature has appeared, rendering this review of the whole field most timely and helpful both in itself and as a guide to the original papers. It is no mere compilation, but is an excellent contribution to a difficult subject. A brief sketch of the history of the discovery of the methods of reproduction in plants up to the recognition of true sexual reproduction as normal in them forms an introduction to the later history of the discoveries that in some plants the sexual method is not followed, that the embryos result from a vegetative growth of some other cell or cells than the ovum, and that the unfertilised ovum may develop as an embryo. These abnormally produced embryos have been studied in their origin and growth in numerous species (from widely different groups of plants) both as they occur naturally and as they result from external stimuli, such as injuries to the parts that produce them, various salts in solution, or differing concentration of food-solutions.

The terminology in use for these methods of reproduction has varied as employed by different investigators, and the terms are reviewed and defined clearly. The methods of production of new individuals are recognised as of three types, viz. *amphimixis*, the embryo resulting from the union of two clearly distinct cells, the ovum and sperm, or their equivalents, this being true sexual reproduction; *pseudomixis*, the embryo being developed, directly or indirectly, from a union of two cells not the equivalents of the ovum and sperm, as has been observed to occur in certain ferns (in which a cell of a prothallus after entrance into it of the nucleus of a neighbouring cell, and union of the nuclei, produces a new fern plant), and probably also in the reproduction of various fungi (while similar nuclear fusions, unconnected with reproduction, have been found to occur as an effect of chemical agents, *e.g.* of chloral on roots of Vicia); and *apomixis*, where the production of the new individual has not been preceded by fusion of nuclei, either sexual or asexual, and is evidently asexual.

The term apogamy was first used by de Bary (in 1878) to signify the replacement of sexual reproduction by any other method, *i.e.* as almost equivalent to *apomixis*; but it has been used by others with meanings a good deal different from this. Dr. Winkler therefore defines his own use of the terms, thus:—Apogamy is the apomictic formation of sporophytes from vegetative cells of the gametophyte; Parthenogenesis is the apomictic formation of a sporophyte from an ovum. Each is distinguished into two types by the number of chromosomes in the nuclei of the cells giving origin to the new plants, viz. somatic with diploid, and generative with haploid nuclei. With these restrictions, the conditions that lead to, or favour, the occurrence of one or other of these modes of reproduction, their relations to the more usual sexual and asexual types, and their biological significance are treated in a very full and thorough manner, supplemented by a bibliography including 239 titles.

Before describing more fully the ascertained cases of apogamy and parthenogenesis, a careful analysis is made of many recorded cases in which the conditions are uncertain, or too insufficiently observed to allow of determining to which type they belong. Among these are examlpes of algæ such as Protosiphon, shown by Klebs to be capable of facultative parthenogenesis, or of union of gametes, under definite changes of food-solution or of temperature, but in which the number of the chromosomes in the plant developed in each case has not been ascertained. Other cases insufficiently determined in this respect are met with among fungi, as in *Mucor racemosus*, possibly among Bryophyta, and in one or two gymnosperms. A considerable number of angiosperms have been recorded as producing embryos otherwise than from the fertilised ova, but in a large proportion of cases doubt exists as to the true origin of such embryos and as to the behaviour of their chromosomes, while other reported cases are much in need of re-investigation of the alleged facts.

Having set aside all doubtful cases, there remain several in which the whole course of formation of the new individual has been followed out and made known in its details. Apogamy was first studied in the outgrowth of a fern plant directly from the prothallus. Occurring in certain varieties of different species, the details of the process have been found to differ widely; *e.g.* pseudomixis prevails in *Lastrea pseudomas*, var. *polydactyla*; somatic apogamy in *Athyrium Filix-foemina*, var. *clarissima*, and generative apogamy in *Nephrodium molle*. Somatic apogamy is not common among phanerogams, but has been shown to occur in *Alchemilla sericata*, one of the helper-cells giving rise to an embryo along with the parthenogenetic ovum, while in *Balanophora elongata* somatic apogamy leads to an embryo being formed from a cell of endosperm.

Generative apogamy is illustrated in the development of embryos from antipodal cells in *Allium odorum*, but it also is in want of further study among phanerogams.

Generative parthenogenesis has been observed among a few algæ (*Spirogyra mirabilis*, *Cosmarium Botrytis*, &c.), chiefly under artificial stimuli, and possibly also among fungi, but not among other plants. Somatic parthenogenesis, on the other hand, has not been proved to exist among the purely cellular plants, while it has been met with in true ferns (*e.g. Ath. Filix-foemina*, var. *clarissima*) and *Marsilia Drummondii*, and in several dicotyledons, especially among Compositæ (*Antennaria alpina* and other species, *Taraxacum*, sps., *Hieracium*, sps.), in *Alchemilla*, sps., in *Thalictrum*, sps., &c. In all these flowering plants the pollen of the parthenogenetic species is ill-developed or useless. Parthenocarpy or the formation of apparently fully developed fruits from unpollinated or unfertilised carpels is a well-known fact, especially among cultivated plants, and has led not infrequently to the assumption of parthenogenesis, but in these cases the fruits are often sterile, as in bananas and other seedless fruits.

The latter part of the monograph is devoted to such speculative questions as whether the parthenogenetic ovum is a somatic or a truly generative cell; whether apogamy and parthenogenesis lead to the suppression of alternation of generations in plants in which it normally exists; the origin and mutual relations in the cycle of the haploid and diploid types of cells; and the possible advantages of their intercalation in the cycle; the causes and explanations of parthenogenesis and apogamy, and the information on these derived from experiments. The discussion of these topics is suggestive and full of interest, but the reader must be referred to the work itself, as it is not possible to summarise fairly the views stated. It may be said that there is still much to be done before the way is clear.

The biological value to plants of parthenogenesis and apogamy is evidently, like that of increase by tubers, stolons, bulbs, and other purely vegetative methods, the multiplication of the species by seeds, or other readily dispersed bodies, in which the embryo is produced without dependence on access of male cells, whether sperms or pollen-nuclei, thus securing the reproduction even from isolated female plants. The disappearance of the pollen-bearing plants in habitually parthenogenetic species is regarded as a consequence, instead of as the cause, of parthenogenesis. It has been observed that among the genera that show the most marked tendency to this condition are several (Hieracium, Alchemilla, &c.) peculiarly rich in closely allied forms, regarded by some as species, by others as varieties; but, on the other hand, other polymorphic genera (Rubus, &c.) show sexual reproduction of the normal kind. There are very evidently many problems in these and other fields relating to protoplasm still waiting to reward research.

ADMISSIONS OF AN ANTI-VIVISECTIONIST.

The Vivisection Controversy. Essays and Criticisms. By Dr. Albert Leffingwell. Pp. vi+251. (London: The London and Provincial Anti-vivisection Society, 1908.) Price 6*s*.

DR. ALBERT LEFFINGWELL is an American doctor who, as we gather from his title-page, has written on the "Morality of London" and on "Rambles in Japan without a Guide"; and who, "having witnessed experiments on animals by some of the most distinguished European physiologists, such as Claude Bernard, Milne Edwards and Brown Sequard, began to contribute to the vivisection controversy twenty-eight years ago." He is contributing still, and he is no exception to the rule that when an anti-vivisectionist arrives at the controversial stage the impression he makes on a logical mind is not a favourable one. That is because anti-vivisectionists, by addressing themselves continually and solely to audiences of convinced sentimentalists, acquire the habits of rhetoric and over-statement, and become incapable of stating any fact regarding the use of animals in experiment except in a controversial relation. Thus Dr. Leffingwell will not allow to experiments on animals any of the credit for antiseptic or aseptic methods in surgery; he denies, as most anti-vivisectionists do, any reduction in diphtheria mortality, or virulence, by the use of antitoxin; he minimises, so far as he can, the use of antitetanus and antivenous serums. He says nothing about bacteriological research in plague, typhoid, Malta-fever, or malaria; but that is partly because the bulk of his essays were published before those researches were undertaken. It is also because the essays are filled so largely with appeals to the emotions, with quotations from Mrs. Barrett Browning's "Cry of the Children," and with long references to the iniquities of the slave trade, that there is very little room even for a controversial consideration of the questions at issue.

This resurrection of obsolete tracts and essays is part of the anti-vivisectionist's stock-in-trade. It enables him to repeat in a book published in 1908 the details of experiments made more than half a century ago, and to quote the utterances of a Mantegazza or a Magendie in a volume dealing with the work of physiologists and bacteriologists to-day. If speaking as avowed vivisectionists we characterised such experiments of Mantegazza, we should admit without hesitation that they were cruel. We have advanced in humanity since those days. Even in England, Boyle and his fellow members of the Royal Society approached the subject of experiments on animals—by asphyxiation—without any suspicion that they were employing cruelty in their methods.

But what have these instances to do with the question of experiments on animals as practised in English physiological laboratories to-day? A remark by Dr. Leffingwell himself may be commended to the attention of the secretary of the anti-vivisectionist society which publishes his collection of essays. In the first essay, Dr. Leffingwell says:—

"In America our physiologists are rather followers of Magendie and Bernard, after the methods in vogue at Paris and Leipzig, than men who are governed by the cautious and sensitive conservatism which generally characterises the physiological teaching of London and Oxford."

That was written by Dr. Leffingwell in 1880.

If the practice of English physiological laboratories was cautious and sensitive twenty-nine years ago, what is the object of re-publishing in England as a contribution to the "Vivisection Controversy" a series of attacks on vivisection as practised in other countries a generation, or more than a generation, ago? What, also, is the object of adding an essay on the "Royal Commission of 1906"—except to give to the book an appearance of being up to date? The only serious argument in the essay is that "A. C. E." mixture—which is commonly employed on human beings as a very good anæsthetic—ought not to be employed in experiments on animals. This essay is in keeping with the rest of the book in being an appeal, not to facts, but to prejudice, and not to humanity, but to ignorance. E. S. G.

STRENGTH OF STRUCTURES AND MATERIALS.

(1) *The Theory and Design of Structures.* By Ewart S. Andrews. Pp. xii+589. (London: Chapman and Hall, Ltd., 1908.) Price 9*s.* net.

(2) *The Strength of Materials.* By Prof. Arthur Morley. Pp. ix+487. (London: Longmans, Green and Co., 1908.) Price 7*s.* 6*d.* net.

(1) THE soundness of this work as regards the theory of the subject is guaranteed by the fact that the methods adopted by the author in dealing with the more difficult problems are based upon lecture notes taken while he was attending the graphics lectures of Prof. Karl Pearson, F.R.S., at University College, London. In the first chapter, which is devoted to the general treatment of the subject of strain, stress, and elasticity, the author deals not only with the case of maximum tensile or compressive and sheer stresses, but also with maximum strain. It is too often forgotten in dealing with complex stresses that the maximum strain does not occur on the same plane as the maximum stress; it is, therefore, advisable to investigate the question of the maximum stress produced in a body when subjected to combined tensile or compressive and shear stress from this point of view. This method of maximum strain, which the author terms the French method, is comparatively little used by engineers in this country, but it is important that designers and students should realise that there is another method of treating the problem other than that ordinarily expounded in English text-books.

In the section of the book which treats of areas and moments, ingenious graphical methods are described for the determination of areas by means of sum or integral curves, and for the determination of centroids and moments of inertia by similar methods. It is perhaps desirable to point out here that throughout this book there is a large number of examples fully worked out by both graphical and analytical methods, and in many cases points which are not, or only briefly, touched upon in the general body of the book are fully discussed when solving some of the problems. These worked problems, therefore, will be found of much greater use to the student than is often the case with the examples published in engineering text-books.

Mr. Andrews, in conjunction with Prof. Karl Pearson, was the author of an original memoir on the theory of stresses in cranes and coupling hooks, and it was only to be expected that the cases where the ordinary assumptions of the beam theory are not allowable would be discussed in this book; it is to be hoped, therefore, that in future, erroneous theories of the stresses in crane and coupling hooks will disappear from engineering text-books. The correct method of solving the problem certainly involves rather more lengthy calculations, but there is no justification for the sacrifice of accuracy in the calculation of stresses in order to simplify slightly the work of the designer, especially when the results given by the simple formula are seriously incorrect.

Three chapters are devoted to the deflection of beams, simple, fixed, and continuous, and the distribution of shearing stresses in them; the author has adopted the ordinary analytical method of dealing with the problems, and also a graphical method based upon Mohr's theorem that a loaded beam will take up the same shape as an imaginary cable of the same span which is loaded with the bending moment curve on the beam, and subjected to a horizontal pull equal to the flexural rigidity. In spite of increased attention given to mathematical studies, many engineers are still unable, though they have a slight knowledge of the principles of the calculus, to reason in its terms, and such men need graphical methods in order that they shall secure a thorough grip of the problem of beam deflections and stresses.

In discussing the strength of struts, the author points out that the chief difficulty in dealing with struts lies in the choice of the safe stresses per square inch for various values of the buckling factor, and the effects of eccentric loading of stanchions illustrate how desirable it is to have the load as central as possible. In the chapter devoted to masonry structures, there is a good deal of matter not usually found in text-books, and a brief reference is given to the recent developments of the theory of stresses in masonry dams, due to the original researches of Prof. Karl Pearson; and, in deducing formulæ for the strength of retaining walls, three theories are explained—the Rankine, the wedge, and the Scheffler.

In dealing with the subject of reinforced concrete, the author points out that a great deal of experimental work is still required in this direction before the principles underlying design shall be established on a sure and certain foundation, and he points out the danger of the uninitiated using data obtained from investigations on materials quite different from those which he proposes to use in his own design. The last three chapters are devoted to designs of steel work for various buildings, roofs and bridges, and a number of excellent practical details are given, and illustrations of recent structural steel work.

This book undoubtedly marks a considerable improvement in the type of text-book which has recently been placed at the disposal of engineering students in connection with the theory and design of structures. There are original methods of dealing with problems, the theory is in all cases unimpeachable, and the numerous examples selected for illustrating these various theories have been chosen with admirable judgment. The book, however, is more than a mere text-book for students; it will be found of considerable use by draughtsmen and engineers who are engaged in constructional steel and iron work.

(2) Though this book has been written mainly for engineering students, and from the point of view of university examinations, it will undoubtedly prove most useful to practical engineers. So many text-books have now been written on this subject that it becomes extremely difficult for an author to embody anything strikingly original. Prof. Morley has, however, devoted considerable attention to several branches of the subject which are ordinarily passed over, or only briefly touched upon in most of the works dealing with the subject of strength of materials.

In chapter ii. there is a *résumé* of the theories which are held as to whether or not, in cases other than simple direct stresses, the breaking down of a bar in a machine or structure occurs for a certain value of the maximum principal stress, for a certain value of the maximum principal strain, or for a certain value of the maximum shearing stress. Throughout the book the first of these theories is generally employed, but its use has to be justified by the choice of a factor of safety which is reckoned on the ultimate and not on the elastic strength of the material, and which must be varied according to circumstances.

In chapter xii., the problems involved in the strength of rotating discs and cylinders are fully investigated, and also the bending of originally curved bars, such as crane hooks, for example. The strength of flat plates is treated in chapter xiii. in a very complete manner by means of the Bernouilli-Euler theory of bending, with such modifications as are required to allow for flexure in other than a single plane. Another useful chapter is that devoted to the subject of vibrations and critical speeds, in which is incorporated the results of Prof. Dunkerley's researches on the whirling speed of rotating shafts. In chapter xvi., Prof. Morley has given descriptions of a number of the special testing machines which have been introduced in recent years for impact and hardness tests, and copious references have been given to the memoirs which have been published dealing with researches and investigations undertaken with the aid of these special machines.

Every chapter contains a number of fully-worked-out examples, and there is a good selection of examples for practice by the student, and, in the form of an appendix, are given tables of logarithms, such as would be required in the working out of these examples.

The book is a valuable addition to the library of the engineer who has to undertake the calculation of the stresses and strains in machinery and structures.

WIRELESS TELEGRAPHY.

An Elementary Manual of Radio-telegraphy and Radio-telephony for Students and Operators. By Dr. J. A. Fleming, F.R.S. Pp. xiv+340. (London: Longmans, Green, and Co., 1908.) Price 7s. 6d. net.

La Télégraphie sans Fil et les Applications pratiques des Ondes électriques. By Albert Turpain. Second edition. Pp. xi+396. (Paris: Gauthier-Villars, 1908.) Price 9 francs.

Jahrbuch der drahtlosen Telegraphie und Telephonie. Vol i., part iv. Edited by Dr. Gustav Eichorn. (Leipzig: Verlag von S. Hirzel, 1908.)

We have already had occasion to review in these columns Dr. Fleming's treatise on "The Principles of Electric Wave Telegraphy," and at the time we expressed the opinion that that treatise not only admirably filled a gap in the literature of the subject, but deserved to rank as the most important, if not the only, book on wireless telegraphy which students need consult. It must be frankly admitted, however, that by writing the present manual Dr. Fleming has performed another service to this branch of electrotechnology, in the exposition of which he stands, certainly in this country and probably in any country, easily first. The former treatise was possibly too exhaustive and in parts too difficult for those who had not the ability or inclination to study the subject thoroughly. It must be remembered that wireless telegraphy has become in recent years a department of applied electricity of great practical importance, offering a steadily increasing field of employment for large numbers of men. The majority of those who are engaged or who seek engagement in this work are hardly to be expected to have any desire to pursue its study into its more difficult theoretical parts; to such the present volume will prove an adequate guide. To others it will serve as a useful introduction to its more comprehensive predecessor.

A *résumé* of the contents is unnecessary; the whole subject is discussed, both in its theoretical and practical aspects, but the treatment throughout is simple, and of such a character that any student with a good grounding in general electrical science and quite moderate mathematical attainments can follow with ease. That the explanations are lucid and the illustrations plentiful and well chosen goes without saying in reference to any book from Dr. Fleming's pen.

Of special interest in the present volume are the passages dealing with the production of continuous trains of undamped oscillations by the method of Duddell's musical arc, and in other ways, as this field was barely touched when the previous treatise was published. For the same reason the final chapter on radio-telephony will be read with particular interest. It is to be noted that articulate speech has been successfully transmitted, in more than one instance, over about 200 miles, and musical sounds about half as far again. As Dr. Fleming says, wireless telephony stands now much in the position in which wireless telegraphy stood ten years ago. Time will show whether it can be developed to be of equal utility and service to man.

M. Turpain's book does for the French student much what Dr. Fleming's does for the English. To attempt an estimation of the relative merits of the two volumes would be an ungrateful task; suffice it to say that the treatment in M. Turpain's book is somewhat less full, but is in all respects clear. In addition, M. Turpain deals with two or three subjects not falling strictly under the classification wireless telegraphy, but closely allied thereto on account of their utilisation of Hertzian waves. These are the application of Hertzian waves to the problems of multiple signalling in ordinary telegraphy with wires; to the control of moving apparatus, such, for example, as torpedoes, from a distance; and to the study of storms and atmospheric disturbances. There are also two chapters dealing with high-frequency currents and their utilisation for electric lighting. The inclusion of these subjects gives the book a special value, as, to the writer's knowledge, there is no other comprehensive *résumé* thereof in existence.

Attention may be directed to the paragraph which closes the first portion of the book which treats of wireless telegraphy alone. The opinion is expressed that wireless telegraphy is not likely to replace any of the existing means of communication, but is destined to find its special sphere in increasing the security—and may one add, the amenity?—of navigation. This view has been frequently put forward in these columns, but as, in the writer's opinion, extravagant claims still continue to be advanced for wireless Transatlantic communication, and large sums of money spent on its development which might be better utilised in less ambitious ways, there can be no harm in its repetition. How wonderfully useful wireless telegraphy has become for the purposes of navigation was strikingly demonstrated for all the world to admire in the case of the wreck of the *Republic* at the end of January.

The fourth number of the *Jahrbuch der drahtlosen Telegraphie und Telephonie* calls for no special comment. Partaking more of the character of a scientific society's journal, reviewing, in the ordinary sense, is more or less impossible. There are a number of original communications on various matters connected with wireless telegraphy, and reports on several practical developments. In addition, the number contains a reprint of the German Act regulating wireless telegraphy according to the international agreement of 1906.

Maurice Solomon.

OUR BOOK SHELF.

Handbuch zur Geschichte der Naturwissenschaften und der Technik. In chronologischer Darstellung. Zweite, umgearbeitete und vermehrte Auflage. Von Prof. Dr. L. Darmstaedter. Unter Mitwirkung von Prof. Dr. R. du Bois-Reymond and Oberst. z D. C. Schaefer. Pp. x+1262. (Berlin: Julius Springer, 1908.) Price 16 marks.

This work is a sort of scientific dictionary of dates, in which all the most important discoveries and inventions in the world are arranged in chronological order from the year 3500 B.C. down to nearly the beginning of the present year of grace. The first important invention noted by the editors is that of the so-called Palmyra books, in which palm paper was first used for writing, the letters being pressed into the leaves by means of a graver or style, and then made visible by being rubbed over with oil and soot. This invention is ascribed to the Hindu Sage Panningrishee, of Arittawarum, on the Ganges. The latest invention chronicled is that of Count Zeppelin's airship which came to grief on August 5 of last year.

It needs 1070 large octavo pages to describe, in the shortest of paragraphs, all the more significant inventions and discoveries which have been made in the space of these 5400 years. Of course, in the earlier years the discoveries and inventions are few and far between, and centuries even elapse before anything can be discovered worth noting, and it is practically only in the beginning of the sixteenth century that each succeeding year is found to produce something sufficiently important to be set down. These great gaps are, of course, due to the imperfection of the records. No doubt many things were discovered, especially in the East, of which all traces have been lost or at least not hitherto detected, for there is good reason to believe that many inventions of later times usually credited to Europeans ought to be ascribed to the people of the East. From the year 1500 onwards practically every year furnishes discoveries and inventions which merit being chronicled.

The plan of the work leaves nothing to be desired as regards simplicity and convenience. The book has a name- and subject-index, but whether the latter is as systematically arranged as is possible is open to doubt. Anyone consulting the work with a view to ascertain the date of a particular discovery must be prepared to do a certain amount of searching, unless he happens to remember the name of the discoverer. Still, the work will be found to be a very useful compilation, and it merits a place in the library of every technologist and man of science.

British Butterflies and other Insects. Edited by Edward Thomas. Pp. vii+127; illustrated. (London: Hodder and Stoughton, n.d.) Price 6s.

This is a pretty book, apparently intended rather as a gift-book or for the drawing-room table than for entomologists. Still, entomologists who wish for a little relaxation from their more arduous labours may take it up and find a series of chatty dissertations on various popular aspects of insect life by well-known writers. Anthony Collett writes on "Some English Butterflies," and G. A. B. Dewar on "The Bee Mind," "Ghost Moth Evenings," "The Railway Embankment," "Butterflies in Bed," "Pearl Skippers," "*Anax imperator*," and "The Sphinx Moth," while Richard South contributes "Field Notes on some English Butterflies," "Day-flying Moths," and "The Entomologist's Methods," and Alfred W. Rees and F. P. Smith, respectively, talk about "Humours of Insect Life in October" and "The Makers of Gossamer." There are about half a dozen coloured illustrations, each representing one or more insects on a flower; perhaps the best is the frontispiece, with two white admiral butterflies perched on honeysuckle, showing the upper and under surfaces of their wings; but why should the chapter on *Anax imperator* be illustrated by a rather clumsy figure of the female of *Libellula depressa*, which is not even mentioned?

A more serious discrepancy is the mention by different authors of two different butterflies under the name of the Large Heath, owing to some entomologists having been sufficiently ill-advised to transfer the name from *Epinephele tithonus* to *Coenonympha tiphon*.

The Oil and Bromoil Processes. By F. J. Mortimer and S. L. Coulthurst. Pp. 96. (London: Hazell, Watson and Viney, Ltd., 1909.) Price 1s. net.

The "oil" process here referred to is a method of making photographic prints that has recently been much appreciated by those who desire to have the opportunity of altering the print during its production to suit their taste. It consists in exposing a bichromated gelatin film under the negative, washing it, and inking it up with a greasy ink. The application of the ink was originally done with a roller, but brushes are now generally used, as these permit of more control over the result. The "bromoil" process is exactly the same in its final stages, but starts with a bromide print, and as this may be an enlargement, there is no need for a full-sized negative. The authors are expert workers in these processes, and here give the results of their experience, with the most detailed instructions for every stage. The volume is issued as a practical guide, and as such is all that can be desired. We might, perhaps, point out the advantage of a little more knowledge of a fundamental or scientific kind to many of even the most able and experienced workers of photographic processes. The statement that dilute sulphuric acid should be freshly mixed, but cool, conveys the notion that the dilute acid changes to its detriment when kept for a few days. But a useless precaution such as this does no harm, and it is better for authors of practical instructions to include one meaningless precaution than to omit one that is essential.

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 intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Suggested Effect of High-tension Mains.

I see in certain American papers a statement that the high-tension mains which convey 14,000 horse-power from the Grand Rapids to Michigan are worked at a voltage of 110,000 over a distance of fifty miles, and it is suggested that both agricultural and other effects may be anticipated from the visible brush discharge from these elevated mains.

I suspect that the brush discharge is most marked in the immediate neighbourhood of the metallic poles or towers which support the insulators, and is weak in between. Nevertheless, some effect might be anticipated if the potential were continuous, or of one sign; but inasmuch as it is sure to be alternating, any expectation of an influence on crops or on fog is almost bound to be disappointed. A negative result is to be expected before hand.

Oliver Lodge.

March 12.

Scientific Societies and the Admission of Women Fellows.

Mr. Atkinson's letter under this heading in Nature of February 25 reveals the fact that the majority of the fellows of the Geological Society, like the majority of the fellows of the Chemical Society, are desirous of following the example of the Linnean Society in admitting women to the fellowship of their respective societies. It is difficult to understand what valid reason the executives of these societies can urge for their continued opposition to the wishes of the greater number of their members. This is surely a matter in which the opinion of the majority should prevail, especially when that opinion in each case has been deliberately invited, presumably with a view to the settlement of the question.

In this connection I desire to direct attention to an utterance by the president of the Society of Public Analysts. In the course of his recent presidential address, Mr. Tatlock said:—"A little commotion has taken place lately on the question of the rights and privileges of women chemists, particularly as regards their admission to the membership of our societies, and a considerable variety of opinion has been expressed—one, I think, to the effect that if women were accorded all these, they might become formidable rivals in an already overcrowded profession. It appears to me that this amounts not only to a confession of weakness on the part of the 'party in power,' but that it is an unconscious admission that the claims of the ladies rest on a firm and solid foundation. It is not the first time, however, that men have been frightened by women. It appears to me that, having granted women the right to join our universities and educational institutions, to pay their fees, to compete with us, and, perchance, to beat us at examinations for diplomas, they are entitled to all the advantages which are, or ought to be, the natural consequences of their application and industry."

Mr. Tatlock thus voices, I believe, not only the general sentiment of the society which he represents, but of the Institute of Chemistry and of the Society of Chemical Industry in this country, and of a number of foreign chemical societies where no difficulty has been raised as to the admission of women. For the council of the London Chemical Society to continue to resist all attempts to admit women as fellows, in face of the declared opinion of the majority of the members that the time has arrived when they should be admitted, cannot, in my judgment, be justified on the ground either of justice or expediency.

I believe this question would be settled once and for all were the council to allow the society to exercise its discretion. They have only to permit the certificate of a woman chemist to go to the ballot in the usual way, and I, for one, would trust to the right feeling and good sense of the fellows to bring about her admission, if, as would be the case, her attainments justified her election. Any objection that might be urged on the ground of the charter is wholly academic, for the society cheerfully admits, unmindful of the provisions of the charter, any alien who chooses to apply, and, as the recent ballot has proved, allows him to exercise the *de facto* rights and privileges of a corporator. A British-born woman may at least plead that she, at all events, is a "loving subject." The conflict of legal opinion has made it abundantly clear that there is no practical value in the doubt that has been raised as to the ineligibility of women, but there is absolutely no room for difference of opinion as to the ineligibility of the alien to act as a corporator. Why, then, should the British-born woman be excluded and the alien be admitted? If the alien may vote, why may not the British-born woman?

T. E. THORPE.

The Isothermal Layer of the Atmosphere.

THE point raised by Mr. R. F. Hughes in NATURE of January 21 and February 11 is one that appears to deserve consideration by the investigators of the upper air. He contends, I take it, that even if the instrument records perfectly the temperature of the metal strip, it does not necessarily tell us the temperature of the upper air, but the temperature which the strip takes up in order to bring about a balance between the heat received and lost by it; and in calculating this temperature it is unfair to neglect, without investigation, the absorption and emission of radiation by the instrument and the balloon.

If we take the case of the balloon, in a night ascent, we may write for the time variation of the temperature T of the gas in the balloon, assumed to be a sphere of radius r,

$$\frac{d\mathrm{T}}{dt} = -10^{-2}v + \frac{\mathrm{I}}{\mathrm{MC}} - \frac{4\pi r^2 f\rho v(\mathrm{T}-\theta)}{\mathrm{MC}} \qquad (1)$$

where v is the upward velocity of the balloon in metres per sec., M is the mass and C the mean specific heat of the balloon and its contents, θ the temperature and ρ the density of the outside air, and f a constant.

The first term represents the rate of decrease of temperature owing to expansion of the balloon.

The second term represents the rate of increase of temperature, assumed to take place uniformly through the balloon owing to the excess, I, of energy absorbed over energy radiated. In the lower layers I is almost certainly very small, and probably negative, but it may not be so at great altitudes.

The last term is an empirical formula to represent the rate of decrease of temperature owing to convection of heat from the balloon by the outside air.

If we assume the atmosphere to be transparent and the earth to be a perfect radiator, and write E for the intensity of its radiation per square centimetre, the balloon receives from the earth energy at the rate $2\pi r^2\mathrm{E}$, of which it absorbs, say, one-half, and transmits the remainder. (A very thin rubber membrane has been found to transmit 75 per cent. of low-temperature radiation.) At the same time, the balloon is radiating in all directions at a rate $\frac{1}{2}.4\pi r^2\mathrm{B}$ approximately, where B is the intensity of radiation of a perfect radiator at the balloon's temperature.

Thus $\mathrm{I}=\pi r^2[\mathrm{E}-2\mathrm{B}]$.

If the temperature of the earth is 280° A. (=7° C.), then E is about 0·55 gm. cal. per min., and is equal to 2B when the temperature of the balloon is 235° A. If the temperature of the balloon falls to 200° A., $\mathrm{B}=\frac{1}{4}\mathrm{E}$ nearly and $\mathrm{I}=\frac{1}{2}\pi r^2\mathrm{E}$.

I know of no measurements of the rate of convection from a rubber balloon, but a considerable number of experiments have been made to determine this rate for metallic thermometers. According to A. de Quervain (*Beiträge zur Physik der Freien Atmosphäre*, vol. i., p. 192), the value of $f\rho v$ for $v=5$ m.p.s, and $\rho=1{\cdot}2\times10^{-3}$ is roughly equal to 0·1 gm. cal. per min.

The equation (1) therefore reduces to

$$\frac{d\mathrm{T}}{dt} = -10^{-2}v + \frac{\pi r^2}{60\mathrm{MC}}\left[\mathrm{E}-2\mathrm{B}-0{\cdot}4\frac{\rho}{\rho_0}(\mathrm{T}-\theta)\right]$$

if $v=5$ m.p.s. and E, B are measured in gm. cal. per min.

Thus if $\rho=\frac{1}{3}\rho_0$ and $\mathrm{B}=\frac{1}{4}\mathrm{E}$, T must exceed θ by more than 2° C. if the effect of convection is to exceed that of radiation.

If we take the balloon to be initially of 100 cm. radius, and assume that the heat capacity of the envelope is one-half that of the hydrogen, we have for MC the value

$$1{\cdot}5\times3{\cdot}41\times\tfrac{4}{3}\pi.10^6.8{\cdot}8.10^{-5}=\pi\times600 \text{ nearly},$$

the specific heat of hydrogen being 3·41.

Also r^2 will be 2×10^4, whence $\frac{\pi r^2}{\mathrm{MC}}=33$, and the first term is therefore comparable with the last two in the equation (1). If the temperature is diminishing at the rate of 6° C. per kilometre, T will diminish at the same rate if it exceeds θ by about 1°·7 C. Even if convection is only one-third as efficient as Quervain found, the temperature excess is not more than 5° C.

The thermometers are of bright metal, and even if they are directly exposed to the earth radiation they will not absorb at a rate as great as one-tenth of the rate we have assumed for rubber.

The equation for the temperature variation would be

$$\frac{d\mathrm{T}}{dt}=\frac{\mathrm{A}[\mathrm{E}-2\mathrm{B}]}{10\mathrm{MC}}-\frac{f\rho v.\mathrm{S}}{\mathrm{MC}}(\mathrm{T}-\theta), \qquad (2)$$

where S is the area exposed to the air current, and 2A the radiating area, which is certainly less than S for a tube thermometer.

If we take Quervain's figures we get A=80 cm.², and $\frac{f\rho v\mathrm{S}}{\mathrm{MC}}=8.\frac{\rho}{\rho_0}$ nearly, for a Hergesell instrument, while $\frac{\mathrm{A}}{\mathrm{MC}}=160$, so that for $\mathbf{T}=200°$ A. we have $\frac{d\mathrm{T}}{dt}=4{\cdot}4-2{\cdot}7\ (\mathbf{T}-\theta)$, and the excess of **T** over θ would be but slightly greater than 2° C.

We may, then, take it as certain that the temperatures recorded in night ascents can be but slightly affected by radiation so long as the upward velocity is as great as 5 m.p.s. The assumptions made as regards radiation and convection are, of course, only approximate, but I think they err on the side of exaggerating the radiation effect.

In conclusion, I may add that I undertook this calculation believing that it might be possible for radiation materially to affect the temperature, at least of the balloon, because I knew that even at night radiation from external sources was not insignificant. The result is, however, a complete justification of the instrumental records. The isothermal region exists, and it exists for the very reason which, in Mr. Hughes's opinion, renders useless the instrumental records—the necessity for the material air also to preserve a balance between heat received and heat lost by radiation.

E. GOLD.

Vienna, February 15.

The Promotion of Scientific Research.

PUBLIC attention was directed to the subject of scientific research by the proceedings at the annual meeting of the trustees of the Carnegie Trust, and especially by the prominence given to the promotion of original research in the speech of Mr. Balfour, reported in NATURE of March 4. The reports of the proceedings may have engendered in some minds exaggerated notions as to the extent to which philanthropic effort may succeed in solving the problem of providing incentives to original research. It will be as well, therefore, to mention, for the information of those who are unacquainted with the regulations under which monies subject to the trust may be applied in the promotion of original research, that the incomes of the beneficiaries under the trust are very limited, and the conditions which are specified in the scheme of the trustees are very restrictive. Mr. Balfour, though he spoke encouragingly of the methods adopted by the trustees, alluded to the difficulty and delicacy of the task of selecting people for original work, and to the "puzzling questions of administration" with which it is surrounded; and it seems impossible, without the aid of legislation, to devise any scheme for the application of monies to research purposes which will succeed in inspiring confidence in research workers and which will not greatly restrict the research work which it may be designed to encourage. Had inventors of patentable inventions been encumbered by conditions similar to those to which research workers who are the objects of private munificence are subjected, the progress of invention would have been immeasurably retarded. The conditions under which the invention of patentable inventions is stimulated do not necessitate an inventor relinquishing the pursuit of any trade, occupation, or profession in which he may be engaged. He is under no obligation to satisfy anyone as to the direction his labours may take, and he is free to devote his talents to the work of invention at such times as he may for himself determine. Moreover, forms of judicial procedure are made available for him by which he can defend his claim to be described as "the true and first inventor" of his invention, whether that be disputed by rival inventors, or opposed on false or fraudulent grounds, or be the subject of official objection.

My scheme for the promotion of scientific research forms the subject of an article in Nature of January 21. The principles of the scheme, which are generally indicated in the article, admit of substantial grants being made out of public monies for discoveries prescribed by Parliament under conditions analogous to those upon which patents for inventions may be obtained, and these conditions would, it is submitted, enlist in research directed to the making of these discoveries many minds possessing the capacity and true genius for this work, which existing methods wholly fail to attract. Allocations of grants may be made, on the conditions specified in the scheme, to discoveries which advance our knowledge of physical and chemical phenomena, and in relation to the more deadly and prevalent of the diseases which afflict humanity.

Allusion is made in the report of the executive committee of the British Science Guild, of which extracts are given in Nature of January 28, to the Duke of Devonshire's Commission, which was appointed about thirty-eight years ago to inquire into the means available for extending scientific knowledge and advancing scientific progress. We stand to-day, so far as the provision by the State of pecuniary incentives to scientific research is concerned, much in the same position as we did at the conclusion of the prolonged labours of that commission. Since that time the practical applications of physical, chemical, and medical discoveries, not of a patentable nature, and for which no rewards can under existing conditions be obtained, have greatly contributed to the advancement of commercial and industrial progress and to the national well-being. The discovery of the electric waves used in wireless telegraphy, and of the conductivity of certain substances in the state of powder or filings when these waves impinge upon them, are examples of such discoveries. By means of these two discoveries it was found possible to construct systems of wireless telegraphy. If we confine our attention to the practical applications of these discoveries alone, we must perceive that, in addition to the more general beneficent purposes that have been thereby already attained, they have been the means of greatly increasing the effectiveness of our naval power.

In face of facts such as these, it is to be hoped that our legislators will awaken to a recognition of the momentous issues involved in the promotion of research in departments of science which have an intimate connection with public interests. Walter B. Priest.

1 Verulam Buildings, Gray's Inn, London, March 3.

The "Daylight Saving" Bill.

May I point out, in addition to the recognised unscientific nature of the proposals of this Bill, that the third Sunday in April for the putting on of the clocks is hardly consistent with the third Sunday in September for putting them back? The length of the day in the third week of April is considerably greater than in the third week of September, and it would be much more consistent if the two equinoctial months March and September were both adopted for the alteration. The fourth Sunday in March, a little after the vernal equinox, has about the same length of day as the third Sunday in September, a little before the autumnal equinox. If it be urged that the temperature of the air in March in this country is too low for summer habits of life, one may reply that it is still too low in April, and even May, despite the long days and high altitude of the sun. L. C. W. Bonacina.

Northwood, March 13.

Fireball of February 22.

The observations of this unusual object are exceedingly numerous, but some of them are discordant, and occasion doubts as to the exact path which the meteor traversed in our atmosphere. The radiant point being inaccurately defined, the direction and height are also to some extent uncertain. Apart from the determination already mentioned in Nature, I have worked out two others, which do not differ very materially except in the elevation at the end. Further descriptions from France of a trustworthy and precise nature will enable the real path over the English Channel to be more certainly ascertained.

Radiant point ...	$=177^\circ+13^\circ$ ...	$190^\circ+20^\circ$
Height at first ...	50 miles ...	56 miles
Height at end ...	26 ,, ...	41 ,,
Length of path ..	155 ,, ...	155 ,,
Velocity per second	25 ,, ...	25 ,,

In the event of the position at $190^\circ+20^\circ$ being the correct one, the meteor was really a Comæ Berencid, and several fairly good observations from France and the Channel Islands indicate that it is entitled to some degree of confidence. W. F. Denning.

Bristol, March 14.

Unusual Condition of Nasal Bones in Sphenodon.

In the osteological collection here there is a skull of Sphenodon with four nasals. In the position of the usual single nasal, right or left, are two bones side by side. As this condition appears to be unusual, it would be interesting to know if any of your readers have come across a similar case. H. W. Unthank.

Birkbeck College, Breams Buildings, E.C., March 15.

ENGLISH EARTHWORKS AND THEIR ORIENTATION.[1]

THIS work is based upon the recommendations of the Committee on Ancient Earthworks and Fortified Enclosures. Though "written expressly to further the Committee's aims, it has no claim to be an authorised representation of the Committee's views." Pending the completion of the task undertaken by the Committee, this work seems to be the best text-book on the subject. Though the author has "restricted himself to the discussion of earthworks with which he is personally familiar," all classes of earthworks, from the earliest period to the time of the Civil War, are dealt with.

We are too grateful to the author for the well-sifted materials he has supplied to judge the whole work by any defects, especially if those defects concern matters which the author may have considered as lying outside his proper scope of work. But there is one feature of the author's work which calls for special notice. It concerns a line of inquiry which the author has almost altogether left untried, apparently, but which, nevertheless, he submits repeatedly to the test of ridicule. Though he refers respectfully enough to Sir Norman Lockyer's work, he indulges in remarks about the astronomical inquiry which are both unwarranted and inconsiderate, without showing any appreciation of the points in question.

Beyond some vague remarks about the orientation of amphitheatres (p. 589, note), the subject of orientation is almost entirely ignored. Most of the 224 plans published in the book have the cardinal points indicated, without ever a word saying whether the bearings are magnetic or true. The student of orientation must decide the matter for himself as well as he can in each case with the aid of a protractor. Nowhere can he find the slightest con-

[1] "Earthwork of England: Prehistoric, Roman, Saxon, Danish, Norman, and Mediæval." By A. Hadrian Allcroft. Illustrated with Plans, Sections, &c. Pp. xix+711. (London: Macmillan and Co., Ltd., 1908.) Price 18s. net.

sideration of the wants of the astronomical inquirer, who cannot but treat uncertified plans, so to speak, as so much waste of labour. Unfortunately, one encounters the same difficulty in most works on archæology, so much so that one wonders why any compass lines are drawn on the plans at all. Undated magnetic bearings are useless, and unexplained bearings are, if anything, still more useless.

Our author, however, employs the whole force of his ridicule in belabouring the very class of fellow-workers in the same field he has so wilfully left unprovided for. An observer ventured to say that a curiously symmetrical work on Firle Hill, Sussex, was a "Stonehenge in earth"—Fig. 181 in the book under notice. It was evidently a mistake to take the corners of the central square as of solstitial significance, that is if the bearings of the plan are true. The author, however, seems not to have noticed even that. The observer's main contention are merely the sites of bygone windmills!" (*ib.*). But elsewhere he notes that "round barrows of large size have been turned to various utilitarian purposes. They were favourite sites for windmills, for example, like the Derry Mount at Nottingham Castle."

A long barrow in Dunstable is called Windmill Hill (p. 531). That the sites about Lewes are such utilised barrows seems to be highly probable; yet the author winds up his remarks upon a subject he betrays no fitness to discuss with the following peroration:—"The millers of the downs are all but gone, and the last of their mills must soon cease to struggle against the competition of steam roller-mills and the modern taste for tasteless bread; but should there come to their dusty shades any intelligence of the matters which vex the minds of men on earth, they must laugh jollily to think of their old haunts translated into temples of the 'dim red dawn of man,' of themselves apotheosised into sapient

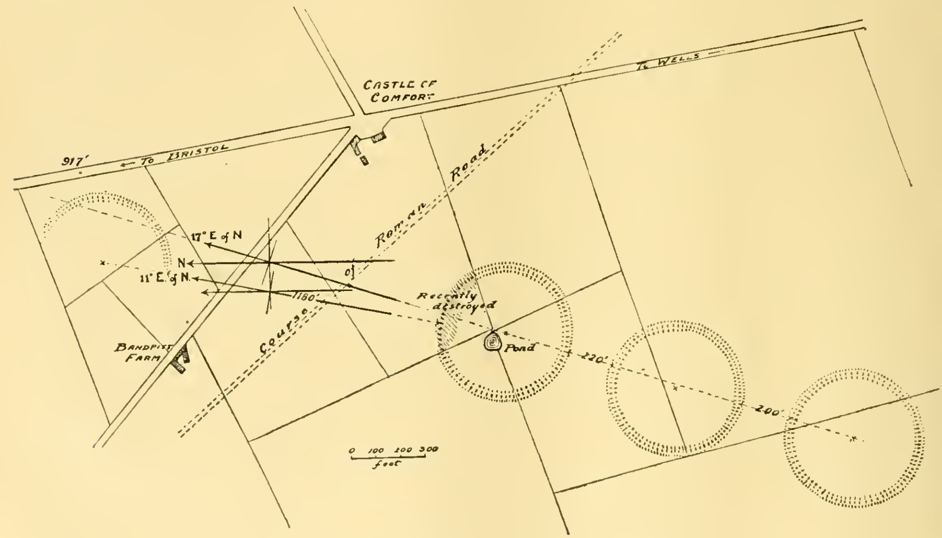


FIG. 1.—Mendip Ringworks, Priddy. From "Earthwork of England."

is fully borne out in the plan that a line across the centre of the three works on the spot indicates a May-day orientation. A similar work on Mount Caburn gives a line at right angles to sunrise on May-day (Fig. 180), as well as an equinoctial line. Again, a similar work on Lewes Down (Fig. 182) gives a line at right angles to sunrise at the winter solstice. But instead of submitting such observations to some scientific test, our author indulges in such remarks as the following:—"Whence it is suggested that the whole is a work (Firle Hill) dating from that 'vastly remote epoch' when the year was accounted to begin in May—an epoch when the South Downs were inhabited by an immigrant race who brought with them astronomical ideas once prevalent in Egypt and Chaldea" (p. 537). "A little further investigation would have revealed to both authorities (Pitt-Rivers and the astronomical observer) that there are quite a number of such cryptic works upon the downs about Lewes, and that, in sober fact, they astronomers, and of the later-day Quixotes so over-read in Druidical lore that they must needs ride a-tilting against windmills! And where shall the student of earthworks find a more homely lesson in all that an antiquary should be?—cautious, and again cautious, and yet a third time cautious" (p. 539). Where, indeed, shall the student find a more homely lesson on incaution than in the author's remarks on oriented windmill sites? One whom the author may have numbered in his list of "later-day Quixotes so over-read in Druidical lore" (for the author has read the present writer's incursions into that land of mystery) may fairly return the compliment and ask, Who is the real Quixote in the case?

The author can hardly refer to anything so-called "Druidical" in a truly scientific spirit. Dealing formally nowhere with the subject of Druidism, he always refers to it in a prohibitive fashion. It is "an obsession with the multitude" (p. 586). It is something that ridicule has killed (p. 691). Nothing new, we are led to suppose, can be learnt on the subject. We should have liked to know what particularly may be the author's conception of Druidism. It must be rather peculiar to produce the remark on Warne's opinion of the Knowlton ring-works, that they were "sanctuaries of Druidic worship." "Had he written 'astronomical' instead of 'Druidic,' his opinion would have perhaps earned more attention" (p. 566).

Little as the author has done consciously for the student of astronomical archæology (and how much he could have done with little trouble!), we are gratified to find in the plans given scores of orientations agreeing with the theoretical conditions for locality. For instance, the mean azimuth of twenty-two earthworks in and about latitude 51°, which were assumed to be oriented to the summer solstice, ranging from 48° to 50°, is 48° 20′.

The author, like other recent writers who are more or less familiar with the astronomical inquiry in the field of archæology, will have it that the spade is the "solitary instrument" of comparative archæology. It is strange that the writers we have in mind have not tried any astronomical methods. There is something suspicious, as well as unscientific, in this assumption of finality, if not infallibility, for the spade.

With regard to many sites, the spade-work is confessedly disappointing. The author notes that the results of some partial explorations "of the Stripple Stones were as 'negative' as they have been at other spots of the kind" (p. 582). Astronomy, however, supplies us with "positive" information. We find there a definite Capella indication, 1250 B.C. ("Stonehenge," p. 293). On the plan given by Mr. Allcroft, we further note definite equinoctial and November alignments.

The series of four circles on the top of the Mendips (see Fig. 1) the author is inclined to think is "perhaps of astronomical character" (p. 564). The circles (Fig. 189) bear a striking resemblance in arrangement to the Hurlers in Cornwall ("Stonehenge," pp. 136–140). There are two definite star alignments, either Arcturus at different periods before 1300 B.C., or Capella at later periods, which we hesitate to say. The site is evidently that of a notable observatory. There is a Roman road running at right angles to the line of sunrise at the summer solstice (N. 41° W.—N. 49° E.). Another road, N. 61° E., points to sunrise on May-day. Meeting the last is still another road, az. S. 51° E., sunrise at the winter solstice.

One excellent result of collating so many plans of earthworks is the establishing of the fact that rectilineal and rectangular camps are by no means exclusively Roman. "The old conviction that all rectangular camps, wherever placed, must necessarily be Roman was completely upset by the excavations of Pitt-Rivers, and is now entirely discredited in England. In Scotland, according to Dr. Christison's view, of a total of more than eighty rectilineal and chiefly rectangular works commonly described as Roman, only seven have furnished any relics to bear out this attribution" (p. 143). The author shows that the "circular plan is the most economical." Why, then, have we straight walls or banks associated with circular works? An examination of the plans discloses the answer. Walls or banks were, of course, erected for defensive purposes, but they were built straight for orientation purposes. More, a straight wall gives the best earthwork orientation. Burrington Camp, Somerset, is a striking illustration in point (see Fig. 2). The only evidence of age the author cites is the finding of flint flakes in some quantity along the edge of the cliff southwards. It is described as "a very curious work, apparently a hybrid between the 'military' and the 'ritual' methods of construction" (p. 582). "Collinson was so perplexed by the oddity of the whole work that he opined it to be 'Druidical,' and to have some unexplained connection with the well-known stone circles at Stanton Drew, eight miles to the north-east" (pp. 583–4).

The plan shows the south bank to be oriented to the equinox. Another bank (B), az. 52°, may be oriented to both sunset at the summer solstice and sunrise at the winter solstice, as there is some height on the north-west. The north-east bank (D), az. N. 17° E., gives us a familiar datum. Collinson was right, and Burrington and Stanton Drew have the same star alignment, which Sir Norman Lockyer has worked out to be Arcturus, 1690 B.C. ("Stonehenge," p. 173). Surely this is another instance where the theodolite has helped the spade, and there

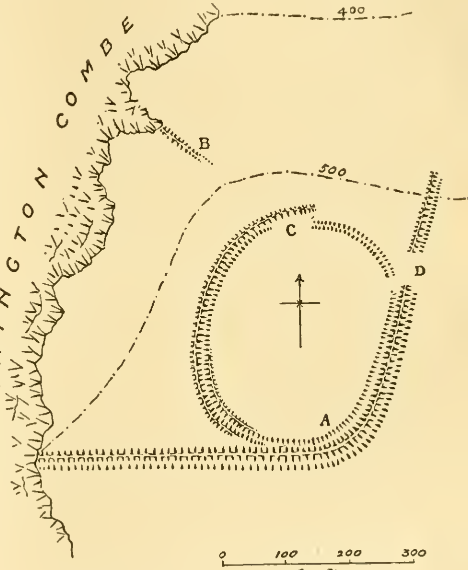


FIG. 2.—Burrington Camp. From "Earthwork of England."

is also something in "Druidism" which has not been reckoned with in Mr. Allcroft's philosophy.

At Arbor Low there seems to be an alignment to Alpha Centauri, the star concerned in our earliest monuments. Here the spade-work also indicates an early period. "The site was explored by Mr. St. George Gray in 1901–2, whose conclusions were that it was a work of the later Neolithic age, but antedating the Bronze age, that it was not intended as a place of habitation, and that, albeit interments were found within it, it did not appear to have been a place of sepulture at a period closely following its construction" (p. 577). The last sentence is most valuable. Well, an "interment" at the centre of the camp is aligned with a south-east entrance to S. 18° E., which may be regarded as Alpha Centauri about, say, 2400 B.C. This estimate is based on analogous cases where the same star is concerned.

"Not unlike this (Arbor Low) is Castle Dyke, near

Aysgarth" (Fig. 195). "At one point in the vallum, on the south-east, a single stone rises slightly above the turf" (pp. 577–8). There is also a gap in the vallum on the south-west, right opposite an entrance on the north-east. Drawing a north-south line between the two southern points mentioned, it is seen that the gap is S. 33° W., the N.E. entrance N. 33° E., and the south-west stone S. 33° E. Taking the north-east outlook into consideration, lat. 54°, dec. 29° 30′, we have an indication of Capella about 2250 B.C. But if we take the south-east stone as a direction point—a safe proceeding—we have Alpha Centauri nearly at the same time that we have it at Avebury, which is well within the fourth millennium B.C. At Maiden Castle (S. 34° E.) we seem to have practically the same datum, and at Muzbury (S. 20° E.) the same star.

Such are a few instances out of about a hundred or so, which the present writer has noted in this valuable book, of the practical value of uniting the spade and the theodolite in archælogical research. If, as one sincerely hopes, there will be a demand for a second edition, the author will surely remove all cause for the adverse comments made above, in fairness to his fellow-workers. The author has no comfort for those who cannot accept the theory that cromlechs are chambers for the living, and only secondarily tombs for the dead, because of the smallness of some of the chambers. "Primitive man was the best judge of his own requirements, and he may have been quite as comfortable in a 4-foot pit as in those exiguous 'mound-dwellings' of Wales and the North out of which the 'Celtic imagination' has evolved the theory of a pygmy race" (p. 253). There is surely something Celtic in an author who ascribes the existence of a pygmy race to "Celtic imagination," but that is a minor detail.

The book is replete with very useful notes on place-names. A very doubtful supposition, which he cites, is that which explains "Ambresbury" as derived from *emrys*, "an enclosure." "The word *Emrys* early became confused with the name Ambrosius" (p. 128). They are doubtless identical.

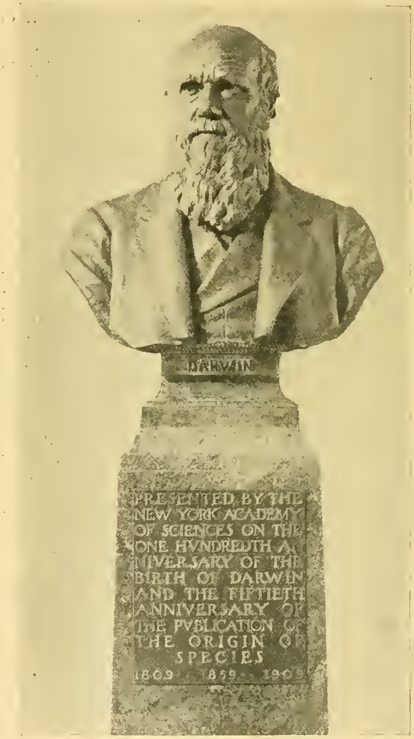
In a reference to the present writer's description of the Gorsedd (p. 593), there is a serious mistake. The older plan was not equinoctial, but May-year, the chief point in question. JOHN GRIFFITH.

DARWIN CELEBRATIONS IN THE UNITED STATES.

THE coincidence of the one hundredth anniversary of the birth of Charles Darwin and the fiftieth anniversary of the publication of "The Origin of Species" in the present year has called forth a series of noteworthy celebrations in the educational and scientific institutions of the United States.

The earliest of these, as recorded already in NATURE, was that held in Baltimore on January 1 by the American Association for the Advancement of Science, which devoted an entire day to the honour of Darwin. A year's preparation had been given to the arrangements for this day, which included a series of ten addresses by the most eminent biologists in the country, who attempted to cover the important fields of Darwin's work, except in geology, which was briefly alluded to in the introductory address by Prof. T. C. Chamberlin, of the University of Chicago, as president of the American Association. Prof. E. B. Poulton was invited from Oxford as the special representative of the English universities, and as the leading exponent of pure Darwinism. His important opening address, entitled "Fifty Years of Darwinism," will be used as an introduction to a volume, now in the press, to be published by Messrs. Henry Holt and Co., New York, which will include all the addresses of this important series. Each of these addresses was partly retrospective and partly related to the progress in the special field of the speaker since the time of Darwin.

A series of tributes to the great naturalist was arranged for his birthday, February 12, in colleges, universities, and various scientific institutions in all parts of the United States. The present writer has especially in mind addresses at Columbia University, Cornell University, University of Chicago, University of Illinois, North-Western University (Evanston, Ill.), University of Missouri, and University of Syracuse.



Other celebrations arranged were those of the Academy of Natural Sciences of Philadelphia on February 16, at which the principal address was made by Prof. E. G. Conklin (now of Princeton University). The coincidence of Darwin's birth with that of Abraham Lincoln suggested in many of the speeches and addresses several striking parallels in the personal character of these two great men: their simplicity, unconsciousness of power, abhorrence of slavery, clearness of expression, singleness of purpose. Repeatedly in Press and pulpit utterances Darwin was referred to as the emancipator of human thought, Lincoln as the emancipator of the negro race. The attitude of the pulpit and clergy everywhere has been one of the most striking evidences of the triumph of the truth as presented by Darwin.

In New York a joint committee of the New York Academy of Sciences, the American Museum of Natural History, and Columbia University arranged a joint celebration for February 12. In the morning the students of Columbia University assembled to hear an address by Prof. H. F. Osborn on the "Life and Work of Darwin," appropriately introduced by the president of the university, Dr. Nicholas Murray Butler. This address was the first of a course of special lectures, extending over nine weeks, entitled "Charles Darwin and his Influence on Science." The topics cover terrestrial evolution, palæontology, zoology, anthropology, psychology, botany, modern philosophy, cosmic evolution, and human institutions. Besides members of the Columbia faculty the speakers included Prof. W. B. Scott, of Princeton, Dr. D. T. McDougal, of the Botanical Research Station, and Dr. G. E. Hale, of the Solar Observatory of the Carnegie Institution.

In the afternoon a large audience assembled in the Synoptic Hall of the American Museum of Natural History, under the auspices of the New York Academy of Sciences. Mr. Charles F. Cox, president of the New York Academy of Sciences, opened the meeting with a sketch of Darwin's life, and closed with the presentation to the American Museum of a bronze portrait bust of Darwin. This bust was executed by the sculptor William Cooper, and is of heroic size, mounted on a polished pedestal of the granite of which the museum is built, with an inscription tablet in bronze. It will stand permanently at the entrance of the Synoptic Hall. In accepting the bust on behalf of the trustees of the American Museum, President Osborn spoke of its three-fold significance — first as a work of art which will be welcomed everywhere as a singularly impressive likeness of Darwin, second as permanently associating the name of the great naturalist with one of the newer exhibition halls which is to be especially devoted to the exposition of the general principles of biology as seen in the structure and embryonic development, the adaptations of colour and form, the marvellous diversity, yet unity, of the animal world, to the true interpretation of which Charles Darwin devoted his life. President Osborn closed by announcing that, in order further to cement the name and spirit of Darwin with the museum, the trustees had unanimously voted to name this hall Darwin Hall, and had prepared and placed at the entrance on the centennial day two bronze tablets as a permanent record of the time and place of this dedication.

Addresses were then given by Prof. N. L. Britton, director of the New York Botanical Garden, on Darwin's contributions to botany, and by Prof. J. J. Stevenson, of the University of New York, on Darwin's contributions to geology, in which it was especially pointed out that modern biology through Lyell and Darwin largely owes its method to geology. The final address was made by Dr. H. C. Bumpus, director of the American Museum of Natural History, in which was outlined a history of the reception of Darwinism in the United States and the early contributions of Gray, of Morse, of Hyatt, of Cope, and of others to the Darwinian theory.

At the close of these addresses the guests passed from the Synoptic Hall to the adjoining hall of North American forestry, where a special exhibition had been arranged to illustrate the principles brought out in Darwin's writings. In the fifteen alcoves of the hall a special exhibit has been arranged to exhibit each of the great principles and subjects treated by Darwin. There had also been brought together temporarily an exhibit of all Darwin's publications, of the first editions of all his works, a series of portraits and autograph letters, as well as a series of photographs of Darwin's contemporaries, chiefly from the unique private collection of Mr. Charles F. Cox, president of the New York Academy of Sciences.

H. F. O.

AN IMPERIAL BUREAU OF ANTHROPOLOGY.

FOR many years past those who have appreciated the practical value of ethnology in the administration of our Empire have realised the necessity of a central organisation for the registration and coordination of data collected by Government officials or others, for the giving of advice to those about to reside or travel in India or the colonies, and to serve as a central office where those at home could obtain trustworthy information concerning the various races and peoples that collectively constitute the British Empire. At the Liverpool meeting of the British Association in 1896, Mr. C. H. Read, of the British Museum, proposed the foundation of a bureau of this nature. In his presidential address to the anthropological section at the Dover meeting, three years later, he announced that the trustees of the British Museum had undertaken the working of the bureau under his own supervision, if the Treasury would make a small yearly grant. Owing to lack of adequate support, very little has been accomplished to render effective Mr. Read's laudable endeavour.

The need for such an establishment has been increasingly felt. Thanks to the zeal of Prof. W. Ridgeway, of Cambridge, the president of the Royal Anthropological Institute, the matter has again been taken up. He drew up a memorial which has been signed by a large number of influential persons in all departments of activity, statesmen, eminent administrators of India and the colonies, members of Parliament, merchants, students of all branches of the humanities, anthropologists, and many others. The memorial refers to the utility of anthropology in other departments of intellectual and practical life; for example, several of our distinguished administrators, both in India and the colonies, have pointed out that most of the mistakes made by officials in dealing with natives are due to lack of training in the rudiments of ethnology, primitive sociology, and primitive religion. Nor is it only for the administrator that training in anthropology and facility for its further study are important. For purposes of commerce it is of vital necessity that the manufacturer and the trader should be familiar with the habits, customs, arts, and tastes of the natives of the country with which, or in which, they carry on their business. The Germans have long since seen the value of such a training; they have spent, and are spending, large sums annually in promoting the study of the ethnology of all parts of the world, and their remarkable success in trade in recent years, not only with primitive and barbaric races, but also in China and Japan, is largely due to this fact.

The training of young officials is a matter of national importance, and there is evidence that some of our leading administrators are fully alive to its value. Recently, Sir Reginald Wingate addressed a letter to the Universities of Oxford and Cambridge in which he asked whether those universities were prepared to give instruction in ethnology and primitive religion to probationers for the Sudan Civil Service; the Oxford Anthropological Committee and the Cambridge Board of Anthropological Studies at once replied in the affirmative, and courses of instruction in those subjects have already commenced. No provision has as yet been made anywhere for the training of schoolmasters and medical officers in anthropometry, to fit them to take measurements of school children and Army recruits. Yet this branch of anthropology is one of the highest importance, not simply for scientific reasons, but because of its practical bearing on the great question of physical deterioration, which has long engaged the attention of anthropologists and the medical profession, and has lately been discussed in Parliament.

The memorial urges the establishment in London of a bureau in which all the distinguished anthropologists of the kingdom could meet on common ground, as do all the leading mathematicians, physicists, chemists, and biologists in the Royal Society. All the elements of such a bureau already exist in the Royal Anthropological Institute of Great Britain and Ireland. This bureau would collect information respecting the ethnology, institutions, arts, religion, and law of all races, especially of those in the British Empire, and it would publish the notes sent in by observers in all parts of the world, issuing these in the form of bulletins. The bureau might confer a diploma on officials, scientific travellers, and others who had submitted to a proper test of their distinction in some branch of anthropology, and it would approve for certificates schoolmasters and others who had shown themselves competent to make anthropometrical observations in the examinations held under the direction of the bureau. In view of the services which such a bureau would render to the nation, "we respectfully petition His Majesty's Government to make an annual grant of 500*l.* to the Royal Anthropological Institute for carrying out the scheme set forth, and also to grant a suitable set of rooms in the Imperial Institute."

It is not proposed that the teaching of ethnology should form part of the work of the bureau. For many years past instruction has been given in the Universities of Oxford and Cambridge in various departments of anthropology. In the University of London are the only two professors of sociology in the kingdom, and instruction has also been given in ethnology for several years, and the University of Liverpool has a professor of social anthropology. Thus, although most of the teaching appointments are financially starved and work under unfavourable conditions, the foundations have been laid for anthropological instruction in several of our universities.

On March 12 the Prime Minister received an influential deputation at the House of Commons, which presented to him the memorial urging the Government to establish an Imperial Bureau of Anthropology in connection with the Royal Anthropological Institute. Prof. Ridgeway pointed out that the science of anthropology could be of the highest possible service to the State in the training of Colonial and Indian administrators, and that it was also a necessity for commercial success. Sir Edward Candy said, in reply to the Prime Minister, that he would make anthropology a compulsory subject.

The Prime Minister said that he entirely agreed that anthropology was becoming every year more and more, not only an important, but an indispensable branch of knowledge, not merely for scholars, but for persons who were going to undertake the work of administration in an Empire like ours, whether in India or in Crown Colonies. While he would hesitate to express anything like a considered and final opinion as to whether anthropology ought to be included as a compulsory subject for examination, he was quite satisfied that it was highly desirable that it should become a regular subject of study, and enter into the normal equipment of young men who went to the outlying regions of the Empire and encountered strange conditions of life. He did not, however, hold out anything like an assurance, or even an expectation, that the pecuniary grant they had asked for would be accorded. Evidently he feared that other learned societies might also urge their claims for Government support, but he did not appear to realise that a grant for a bureau is on a different footing from one merely to a society as such. The need for a bureau of ethnology is urgent, and it should be remembered that to equip a bureau as an independent body would be much more expensive than affiliating it with a society which already possesses the nucleus of the requisite organisation. It is to be hoped that the Chancellor of the Exchequer will be generous to this scheme, which is certainly one of national importance.

An additional argument for the establishment of the bureau is to be found in the Sargent prize essay by the Rev. H. A. Junod, on "The best means of preserving the traditions and customs of the various South African native races" (Report South African Association for the Advancement of Science, 1907 [1908], p. 142). The Rev. H. A. Junod is a sympathetic missionary who is well known for his studies on the ethnology of the Ba-ronga. In this essay he points out how the old lore is passing out of remembrance or becoming modified, and he adds, "What is wanted is a central agency which would receive the materials collected by people on the spot and publish them in a way which would make them available for science at large. There ought to be created without delay a South African Anthropological Commission, which would answer to the need just pointed out." It would be a credit to South Africa if the scheme outlined by M. Junod could be carried out, and all such local enterprises should be affiliated with a central bureau in London.

A. C. Haddon.

NOTES.

Mr. Haldane, Secretary of State for War, will be the guest of the evening at the anniversary dinner of the Junior Institution of Engineers, to be held at the Hotel Cecil on May 1.

The seventeenth "James Forrest" lecture of the Institution of Civil Engineers will be delivered at the institution on Monday, April 26, by Colonel H. C. L. Holden, R.A., F.R.S., his topic being "Road Motors."

The grand gold medal for science has been bestowed upon Dr. Sven Hedin by the German Emperor, and the Berlin Geographical Society has presented him with the Humboldt medal of the society.

The *Times* correspondent at Ottawa states that a Daylight Saving Bill, introduced in the Canadian House of Commons on March 12, was received with laughter and ironical cheering. The Bill proposes that from April 2 to October 2 local time should be observed one hour ahead of the standard time.

We learn from *Science* that the "sundry civil" Bill for the fiscal year 1910, as reported to the House of Representatives last month, provides for a new building in Washington to accommodate the Geological Survey, the General Land Office, the Office of Indian Affairs, and the Reclamation Service, to cost 500,000*l.*, and appropriates 20,000*l.* for preliminary work in construction.

On Thursday next, March 25, Prof. G. H. Bryan will begin a course of two lectures at the Royal Institution on "Aërial Flight in Theory and Practice." The Friday evening discourse on March 26 will be delivered by Mr. A. S. Eddington on "Recent Results of Astronomical Research," and on April 2 by Sir J. J. Thomson on "Electrical Striations."

In a letter to the *Times* of March 15, Prof. Osler directs attention to the useful work which is being done by the Italian Society for the Study of Malaria, founded ten years ago, for the prevention of malarial diseases. The society has promoted legislation for the gratuitous distribution of quinine, has prepared quinine in its most agreeable forms, and has introduced into practice the mechanical measures based on the defence of the habitation and the individual from the bites of mosquitoes. The result is that the mortality from malaria in Italy has declined from 16,000 in 1902 to about 4000 in 1908. Prof. Osler also points out that the growth of our knowledge of the causation and prevention of malaria illustrates the stages through which so many of the great discoveries in medicine have had to pass, and is a striking example of the value of experimental methods in medical research.

The Belgian Legation announces that in the year 1911 the annual prize of 25,000 francs (6250*l.*), instituted by King Leopold in 1874, will be awarded for the best work in French, Flemish, English, German, Italian, Spanish, or Portuguese on "The Progress of Aërial Navigation and the most Effective Means for its Encouragement." In that year foreigners will be permitted to participate in the competition, and the award will be in the hands of a jury nominated by the King, and consisting of three Belgians and four foreigners. The works submitted for competition must reach the Belgian Minister of Science and Art before March 1, 1911.

The *Times* correspondent at Wellington, New Zealand, reports that the Ngauruhoe volcano, which has been quiescent for a year, is in active eruption. On March 8 a quivering of the earth in the neighbourhood of the volcano was felt in the evening, and loud noises were heard. These phenomena were followed by the ejection, first, of a column of steam from the crater, and afterwards of steam and volcanic ashes. The eruption was caused through the blocking of the main vent, which was cleared by the outburst of superheated steam. There was no lava flow, and the volcano remains in the solfatara stage.

The death is announced of Prof. W. C. Kernot, professor of Engineering in the University of Melbourne. From the *Times* we learn that Prof. Kernot was born at Rochford, Essex, in 1845, and was educated at schools at Geelong, and at Melbourne University, where he graduated with honours in 1864. After being engaged on the Geelong and Coliban water-works, he became lecturer on surveying and engineering at the University, and in 1883 was appointed to the chair of engineering. In 1874 he was chief of the photoheliograph party at the Melbourne Observatory for the observation of the transit of Venus. In 1887 he presented to Melbourne University, as a jubilee gift, the sum of 2000*l.* to endow scholarships in physics and chemistry. He also founded a metallurgical department at the University at a cost of 1000*l.* He was president of the Royal Society of Victoria for several years, and was the author of various papers in technical journals.

On the occasion of the celebration of Charles Darwin's centenary in Hamburg last month, Prof. E. Detmer delivered a eulogistic address on Darwin as a botanist, that is published in *Naturwissenschaftliche Wochenschrift* (February 21). Referring to his labours as an investigator, Prof. W. Detmer selected for consideration Darwin's researches on insectivorous plants, cross- and self-fertilisation, and the power of movement in plants; it is pointed out that the first excels in exact and comprehensive elaboration, that the second entailed an enormous amount of work in order to get details on which to base a generalisation, and the third introduces new ideas and problems in the physiology of perception. There follows an appreciation of Darwin's greatest contributions to the domain of natural science, *i.e.* selection and variation.

A correspondent, writing from Freiburg in Baden, sends us an account of a discourse delivered by Prof. Weismann on February 12 last as the commemoration address in connection with the Darwin centenary celebration by the Natural Science Society of Freiburg University. In his oration Prof. Weismann dwelt on Darwin's early shown inclination to the truths and beauties of nature in spite of a dry and dreary education; then on the glories of the welcome voyage, which kept the young student of nature in a state of perpetual rapture; and, again, on the concentration with which Darwin worked in his English country home at the collection of endless facts to construct his theory. Prof. Weismann went on to describe how little impression the Linnæan lecture of 1858 made on the public mind, but how no scientific work has ever made so great a sensation as the "Origin of Species." He himself first read the book two years later, at the period when he had lately thrown up medicine as a profession for zoology, and so was too young in the new subject to have sunk deep into the grooves of the old school, but was freer than most older zoologists, botanists, and other natural sciences to adopt the evolution principles. Prof. Weismann then showed how greatly the evolution theory changed the whole mind of the times, and set new and varied work going in all directions. Men have made progress since 1859 by leaps and bounds in sounding the mysteries of natural sciences, such as embryology, the laws of heredity, and fertilisation. The theory has opened vistas of historical research—such as the history of art and language—in unending perspective. As man has developed from the very simplest beginnings, and has only by degrees reached his present state of high organisation, why should we suppose that we have reached the end and object of the process? The longer the human race exists, the more will it strive for what is higher, purer, and nobler, towards a life dedicated less for selfish and more for general good. Therefore, indeed, do we owe much to Darwin, not alone as a benefactor to science, but as a benefactor to the aims of humanity.

The report of the council of the Ray Society, read and adopted at the annual general meeting on March 11, recorded some interesting facts as to the position of the society and its publications. There has been a decided increase in the membership of the society since the previous report was presented, the numerical strength being now greater than in any year since 1895. One of the volumes for the year, the "British Desmidiaceæ," vol. iii., by Mr. W. West and Dr. G. S. West, was issued in the first week of December last. The publication of the other volume, the "British Rhizopoda," vol. ii., is delayed owing to the death of Mr. James Cash, which occurred on February 20. For the present year a supplementary part of the "British Nudibranchiate Mollusca" is in preparation by Sir Charles Eliot. The forthcoming zoological works are the "British Centipedes and Millipedes," by Mr. Wilfred Mark Webb; the "British Parasitic Copepoda," by Dr. Thomas Scott and Mr. Andrew Scott; the "British Hydrachnidæ," by Mr. C. D. Soar and Mr. W. Williamson; the "British Ixodoidea," by Mr. W. F. Cooper and Mr. L. E. Robinson; and the "Earwigs of the World," by Mr. Malcolm Burr. The only new botanical work promised is one on the "British Characeæ," by Messrs. Henry and James Groves. Lord Avebury, F.R.S., has been re-elected president of the society, Mr. DuCane Godman, F.R.S., treasurer, and Mr. John Hopkinson, secretary.

THE commemoration of the jubilee of the discovery of the source of the White Nile was celebrated by a meeting of the Royal Geographical Society, at which a paper was read by Sir W. Garstin, published in the February number of the journal of the society, entitled "Fifty Years of Nile Exploration, and some of its Results." The paper begins with a good summary of exploration prior to 1898, when the power of the Khalifa was overthrown and the Sudan re-conquered by the Anglo-Egyptian forces. An account is given of the hydrography of the river, and of the measures taken in recent years to develop its water supplies for the irrigation of the Delta. There is also a lucid account of the functions in this respect of the White and Blue branches of the river, which "automatically compensate each other, so that at the time one system is passing on a large volume of water, the other is storing up its discharge, and when the former begins to decrease in volume the stored water takes its place, and makes good the deficiency. The comprehension of these facts is, I consider, one of the most important results of our studies of the Nile since 1898." Another interesting paper in the same issue of the journal is that on the Panama Canal in 1908, by Dr. Vaughan Cornish. The probable total cost of the work is, he says, unknown, but Colonel Goethals has stated in evidence that it will be at least 250, and possibly 500 million dollars. A lively discussion followed, in which Colonel G. E. Church estimated the commerce which would possibly go through the canal, if it were now complete, at less than a million tons. On the question of its strategic value he was equally pessimistic. The monthly bibliography of geographical literature, which is a distinguishing feature of the journal, is as good and as indispensable as ever.

AN interesting work of engineering is being carried out in the construction of a railway tunnel under the river Detroit, which runs between the United States and Canada. There are no fewer than five railways that cross this river between Windsor and Detroit, the service being maintained by means of ferry-boats of such a size that there is room on deck for a complete passenger train or half a freight train. The time occupied in crossing the river, which is half a mile wide, including the loading up of the trains and the crossing, is from thirty to forty minutes for a passenger train, goods trains being often delayed three to four hours. The tedious delays in the transport of passengers and goods occasioned by the crossing of the river have for some time past been the constant subject of complaint, and various schemes have been brought forward to remedy this. A bridge is impracticable, owing to the interference it would cause to the river traffic between the Great Lakes, this being equal in tonnage to that which passes through the Suez Canal. Finally, a scheme was settled for a tunnel, the method of construction adopted being somewhat novel. This tunnel consists of two steel tubes placed 42 feet below the surface of the river, each 16½ feet in diameter, running parallel with each other, but 3 feet apart. For the reception of these a trench is first dredged in the bed of the river, which consists of clay, 48 feet wide at the bottom; as this proceeds piles are driven in the bottom of the trench by a floating pile-driver, and on these is laid a steel and concrete grillage, on which the tubes are bedded. These are made of riveted steel, each 262 feet long, 23 feet 4 inches inside diameter. These weigh 600 tons, and are made at a yard twenty-four miles distant, and conveyed to the site of the tunnel by water. Before launching the ends are plugged by a timber bulkhead. When the tubes are in position, inlet and outlet valves are opened, causing them to sink. Divers are employed to ensure that the diaphragms rest firmly on the grillage. The forward end of each tube has a sleeve 17 inches long, which fits over the end of the tube previously sunk, the flanges being bolted to the one previously laid. The trench in which the tubes are placed is then filled up with cement concrete, completely embedding them. The concrete is lowered through 12-inch tubes from a barge. When completed, the trains are to be worked through the tunnel by electricity.

To the Museum Conference held last year in Ipswich the Rev. J. S. Whitewright contributed a paper on pioneer museum-work in China, which is printed in the February number of the *Museums Journal*. The author, it appears, opened in 1887 a small museum in the city of Ching-chou-fu, in Shantung, with the view of opening the minds of the Chinese and of establishing a basis of common interests. The result was, on the whole, successful. One member of the upper classes was, indeed, inclined to be supercilious, and stated that there could be no such thing as electricity; if there were, the Chinese would have known all about it years ago. An introduction to a magneto-electrical machine convinced the sceptical visitor of his error, and he left the premises a more enlightened, if a sadder, man, with a full conviction of the powers of electricity. The exhibits in the museum consisted principally of maps and globes, diagrams illustrative of elementary physiography, geology, astronomy, and natural history, specimens of natural-history objects and manufactures, electrical apparatus, and models of engines.

A CLASSIFIED and selected catalogue of botanical publications, including a number of rare books, has been received from the publisher and second-hand bookseller, W. Junk, of Kurfürstendamm, Berlin. It contains a list of nearly seven thousand titles; the prices are apparently for new copies where these are obtainable, but in other cases for second-hand copies. The catalogue is intended to be kept for reference purposes, as it is printed on good paper, bound, and furnished with a preface, in which the publisher discourses chiefly on prices.

A CONTRIBUTION by Prof. G. Haberlandt to the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften* (vol. cxvii., part vi.), Vienna, on sense-organs in leaves, is noteworthy because it furnishes a reply to an adverse critic regarding the existence of such devices in a number of common plants. The author takes each species in detail, and finds in every case arrangements of one kind or another which he regards as functional. In *Sorbus terminalis* the arrangement is provided by a cup-shaped depression of the mucilage; the shape of the cells is peculiar in *Chelidonium majus* and *Phyteuma spicatum*, and in *Morus alba* it is maintained that the cystolith, being of a special type, might function as a light collector.

A STUDY by Messrs. W. W. Robbins and G. S. Dodds of the plant distribution on the slopes known as "mesas," near the city of Boulder, Colorado, is published in the University of Colorado Studies (vol. vi., part i.). The "mesa" lies between the lowest range of hills and the plains, in the present instance at an altitude of from 5500 feet to 6500 feet. *Pinus scopulorum* is the chief feature in the landscape; it extends downwards from the hills, especially on the northern slopes of the mesas, where it gives shelter to various bushes until it is checked by grassland. *Berberis repens* and *Yucca glauca* occupy localised positions, and two species of Ceanothus grow on the dry slopes. *Symphoricarpus occidentalis* plays an important part in distribution, as it first colonises embryonic ravines, being followed by roses, currants, and *Rhus trilobata*; but eventually species of Cratægus become dominant in the ravines and gulches.

AN interesting experiment is recorded by Mr. Thornton in the January number of the *Agricultural Journal of the Cape of Good Hope*, which, although in no sense novel, is of considerable technical importance. It was found that the yield both of barley and wheat is much increased by cultivation, and the most thorough cultivation tried gave the largest profit. The use of machinery tends to diminish the cost of cultivation, and it is highly important in a country like Cape Colony, where fertilisers are dear, for farmers to be shown how to increase their crops without at the same time sacrificing any profit.

THE results of several years' feeding trials at Cockle Park are issued as Bulletin No. 12 of the Armstrong College, Newcastle-upon-Tyne. Comparisons are made between several varieties of cake, including Indian cotton cake, earth-nut cake, sesame cake, and niger cake; several other foods were also the subject of experiment. The results are expressed as gains in live weight, and an estimate of the cost is given. There is also a list of equivalent values of food-stuffs, some of which have been established by experiment, while others are only calculated; on this basis several rations for fattening and for milch stock are suggested.

THE question of breeding for milk is one which is attracting considerable attention from practical men, and is of distinct scientific interest. When a deep-milking cow is mated with a bull the dam of which was also a deep milker, it is found that the female offspring yield large quantities of milk, while the males will beget deep milkers. Records of milk yields are therefore useful guides to the breeder; illustrations of their value are not infrequently given in the agricultural Press, and one has lately appeared in the *North British Agriculturist*. On the farm referred to a group of Ayrshire cows has been bred giving the very high average yield of 1144 gallons of milk, containing 3·6 per cent. of fat, during last season, while a group of young cattle are being raised the dams of which averaged 1232 gallons of milk, containing 3·8 per cent. of fat. The sort of variation found in an ordinary Shorthorn herd is shown in Bulletin No. 15 of the Edinburgh and East of Scotland Agricultural College, where the highest and the lowest yields given by cows in the same herd were in the year ending July, 1906, 1505 gallons in forty-seven weeks, and 478 gallons in thirty-nine weeks, and in the year ending July, 1908, 1224 gallons in fifty-two weeks and 438 gallons in twenty-six weeks.

IT has long been known that the Gypsies, like other Oriental races, were acquainted with the use of poisons. According to some authorities they employed preparations of certain fungi or mushroom spores. Borrow and other writers on Gypsy lore have recorded that formerly they were in the habit of poisoning pigs and eating their flesh. One peculiar poison, known to Gypsies under the name of drab, which has never been satisfactorily identified, has recently been studied by Mr. J. Myers, who records the result of his investigations in the January number of the Journal of the Gypsy-lore Society. On apparently fairly good evidence, he identifies it with barium carbonate, known in Shropshire under the names of witherite or water-spar. Prof. Sherrington gives his opinion that the flesh of a pig poisoned with this substance might be eaten with perfect safety provided the entrails were rejected and the parts of the animal which might have come in contact with them carefully washed. It is also remarkable, as Mr. Myers shows, that when Barrow himself was poisoned, an incident in his life of which he gives an account in "Lavengro" (chapter lxxi.), the symptoms which he describes appear to be typical of barium poisoning. Sir H. D. Littlejohn, who was inclined in Borrow's case to suspect a vegetable narcotic, now agrees that a good case has been made out for the use of barium.

THE report of the chief of the U.S. Weather Bureau for the fiscal year 1906–7 has been received. In continuation of the useful plan adopted in 1903–4, the tables contain twice-daily values of the principal meteorological elements for 1906 for twenty-nine stations, selected to cover as nearly as possible all sections of the United States. These are followed by monthly and annual summaries for 189 stations, and by monthly and annual values of temperature, rainfall, &c., with dates of first and last killing frosts for a large number of stations, from the records of both voluntary and official observers, the whole of the tables extending to 402 large quarto pages. The administrative report directs attention to the valuable researches at Mount Weather Observatory, among which we may specially mention solar radiation and the daily investigation of the upper air. With regard to the latter, Prof. W. L. Moore considers that it is the one line of inquiry that at present holds out the greatest promise of immediate utility. In our issue of January 14 we referred to that part of the report that relates to wireless telegraphy; the distribution of weather forecasts and special warnings over the land areas has reached enormous proportions; at the close of the fiscal year, 1633 telephone companies were cooperating with the Bureau in the dissemination of the reports. Meteorological observations for Greenwich noon are collected from various oceans, for which forms and franked return envelopes are supplied, the observers using their own instruments. The number of vessels cooperating during the year was 1216, of which more than half were British; the great majority of the observations refer to the North Atlantic.

IN the Memoirs of the Indian Meteorological Department (vol. xx., part vii.) Mr. J. H. Field gives an account of the kite flights in India and over the neighbouring sea areas during the south-west monsoon period of 1907, in continuation of the useful experiments made in 1906, and described in vol. xx., part ii. (NATURE, July 23, 1908). The work on land, at Belgaum, lasted from July 11 to August 3, but it was only during the first week of that period that successful flights were made. The records were unfortunately few, but the conclusions indicate that at Belgaum (Bombay Presidency) the wind direction, from the surface upwards, showed increasing rotation as the wet weather approached. Temperature gradients during ascents were considerably greater in the lower stratum than the adiabatic rate for unsaturated air, and considerably smaller during descents, later in the day. At levels above 400 metres gradients during descents varied from about $-0°{\cdot}4$ C. to $-0°{\cdot}6$ C. per 100 metres. An upper limit to the humid layer was reached at about 1000 metres only on one day during completely dry weather, but if it persisted afterwards, as the weather changed, it must have been at more than three times that height. In the Bay of Bengal and the Arabian Sea the experiments were made between August 24 and September 4. Over the latter the conclusions show that the following conditions obtained:—(1) The velocity of the wind increased appreciably with height, and the direction became west at 1800 metres, irrespective of the direction of the surface wind. (2) Temperature gradients were very nearly adiabatic up to about 500 metres, and afterwards decreased to about half that rate. (3) Absolute humidity remained fairly constant up to 400 metres, and afterwards decreased to quite low values. The results for the Bay of Bengal, so far as they go, indicate conditions similar to those of (2) and (3); no question of estimating wind velocity or direction arose, for the air was practically calm at the surface.

THE *Physical Review* for February contains a paper by Mr. Willard J. Fisher, of Cornell University, on the variation of the viscosity of a gas with temperature. The gas to be tested is forced to and fro through a capillary tube contained in an electric furnace, the pressures used being read on a mercury manometer, and the temperatures by means of a platinum thermometer. As the result of experiments on air and nitrous oxide, the author concludes that the viscosity of a gas is proportional to the quotient of the 3/2th power of the absolute temperature by a linear function of the absolute temperature. The constants which enter into the expression of this relation appear to vary from gas to gas, and Mr. Fisher hopes, by determining them for a large number of gases, to establish a connection between them and the chemical constitution of the gas.

THE new vessel by means of which the Carnegie Institution of Washington intends to continue the magnetic survey of the world is described in the *Scientific American* of February 20. In order to render this vessel non-magnetic, she is constructed of timber, white oak, yellow pine, and Oregon pine being extensively used. The fastenings consist of locust tree-nails, copper and Tobin bronze bolts, and composition spikes. The only magnetic materials used are the thin cast-iron liners of the cylinders and the steel cams for the valves of the six-cylinder internal-combustion engine with which the vessel is fitted for manœuvring purposes, the remainder of the engine, shaft, and propeller being constructed of bronze. The vessel is 128 feet 4 inches long on the load water-line, and has a displacement of 568 tons with all stores, &c., on board. The auxiliary engine is to be operated by gas from a producer plant using anthracite peas. The vessel is to have full sail-power with a brigantine rig, and is being constructed at Tebo's Yacht Basin, Brooklyn.

WITH the advent of tall buildings, many new problems have had to be considered by the engineer and builder. The solution of some of these problems regarding the foundations of lofty buildings in American practice is dealt with in an exceptionally interesting manner by Mr. Frank W. Skinner in the *Century Magazine* for March. In lower New York the rock extends usually 50 feet below the surface, and is covered to a depth of 30 feet or more with water and quicksand. In addition to the responsibility of founding a new building weighing, perhaps, 50,000,000 lb., and of a height of about 400 feet above the pavement, the engineer is held by law in New York to be responsible for any damage to surrounding property if its foundations are more than 10 feet deep. Very frequently existing buildings rest on such poor foundations that they must be underpinned. The recent practice has been to adopt the Breuchaud method of forcing long steel hollow columns by hydraulic pressure right down to bed-rock. These are then filled with concrete, and finally built over and wedged so as to carry the weight of the existing building. New foundations are often laid on the surface of the sand, which at 30 feet below surface will carry safely 6000 lb. to 8000 lb. per square foot. In modern practice such foundations consist of a layer of concrete a foot or two thick having rows of steel beams bedded on it, and set closely together. The columns of the structure rest on these beams. Settlement is found to be small. Chicago raft foundations, pile foundations, and caisson construction are also clearly explained and illustrated with many drawings and photographs.

BULLETIN No. 75, part iv., Bureau of Entomology, U.S. Department of Agriculture, by Dr. G. F. White, deals in a popular manner with diseases of bees, their prevention and treatment.

WE have received a "Selected Bibliography on Sanitary Science and Allied Subjects," by Prof. Arthur Smith, University of Colorado, which has been prepared with reference to the needs of students pursuing the course in sanitary science at the University. The selection seems to have been carefully made, and includes many British authors (*The Daily Camera*, Boulder, Colorado, pp. 37, price 80 cents).

THE *Annals of Tropical Medicine and Parasitology* for February (ii., No. 4), issued by the Liverpool School of Tropical Medicine, contains several important papers. One, by Prof. Moore and Drs. Nierenstein and Todd, deals with the experimental treatment of trypanosomiasis with anilin colours and various combinations of atoxyl with mercury. As a rule, though life may be prolonged in experimental infections with *Tr. brucei* and *Tr. gambiense*, no method was able to cure a well-established infection.

A SIXTH edition of the second part of the "Elementary Practical Chemistry" by Dr. Frank Clowes and Mr. J. B. Coleman has been published by Messrs. J. and A. Churchill. This section of the work deals with qualitative and quantitative analytical chemistry, and in the present edition additions have been made to the volumetric portion and to the preparation of inorganic compounds.

MESSRS. A. GALLENKAMP AND CO., LTD., have issued a comprehensive catalogue (No. 52) of charts, maps, hygienic and anatomical models, and lantern-slides they are in a position to supply. Both diagrams and slides are available to illustrate most subjects of science, and the detailed summary which the catalogue provides should save teachers much time in looking through the lists of individual publishers.

THE Natural Science Society of Wellington College continues its excellent work in the direction of maintaining the interest of the boys at Wellington in scientific subjects. A copy of the thirty-ninth annual report, which summarises the work accomplished during 1908, has reached us. The majority of the subjects of the Saturday lectures were scientific and refreshingly varied in character. The meteorological data recorded are, as usual, very complete, and indicate the useful part public-school boys can take in scientific observation.

ANOTHER example of the thoroughness with which the work in connection with the Carnegie Institution of Washington is done is afforded by the recently published "Guide to the Manuscript Materials for the History of the United

States to 1783, in the British Museum, in Minor London Archives, and in the Libraries of Oxford and Cambridge." This large volume runs to 500 pages, and has been prepared by Prof. C. M. Andrews, of the Johns Hopkins University, and Miss Frances G. Davenport, of the Carnegie Institution. The volume is but one of a series, of which two volumes have appeared previously, in which the Carnegie Institution proposes to present inventories guiding the student of American history to such manuscript materials as are to be found in the archives and libraries of foreign countries.

OUR ASTRONOMICAL COLUMN.

STELLAR EVOLUTION.—In discussions appertaining to the evolution of individual masses in the cosmos, two hypotheses have received a great deal of attention, the first being that of Laplace, in which masses are thrown off by a condensing nebula, the second, due to Darwin, in which the subdivision is due to fission caused by tidal strains.

In No. 1, vol. xxix., of the *Astrophysical Journal*, Prof. Moulton discards the former, on the lack of evidence, and discusses the probability of the latter theory.

His results are not favourable to the fission theory, and applying them to the members of the solar system it appears unlikely that the planets originated by fission from a parent mass; similarly, he concludes that the moon and earth have not originated by fission from a common parent mass.

Again, in reference to multiple stellar systems, the type of fission discussed by Prof. Moulton appears to be ruled out of court as the factor producing such systems unless the parent nebulæ had originally well-defined nuclei.

Prof. Moulton states that up to the present it has been assumed that evolution took place from the nebulous state to the stars; he suggests that both aggregation and dispersion of matter should now be considered as possible factors in cosmological evolution.

HALE'S SOLAR VORTICES.—In an English reprint of the Proceedings of the Koninklijke Akademie van Wetenschappen te Amsterdam, at the meeting held on January 30, we find a criticism of Hale's theory of solar vortices by Mr. A. Brester, Jz., whose work on periodicity in the sun and variable red stars was reviewed in NATURE for February 11 (p. 431, No. 2050).

Mr. Brester gives reasons for doubting the existence of *material* vortices, and ascribes the varying configurations of the flocculi and the spectral-line displacements to the action of submerged radio-active substances from which issue forth, through spot cavities, β and γ rays, which, in turn, cause the stationary matter of the solar atmosphere to become variably luminescent.

COMET TEMPEL$_2$-SWIFT, 1908*d*.—Observations of comet 1908*d* were made at the Algiers Observatory by MM. Rambaud and Sy on nine dates between October 29 and December 3, 1908. In the 12½-inch *coudé* equatorial the comet was a very feeble, nebulous object with a scarcely perceptible condensation; the coma was round, and of about 2′ diameter (*Astronomische Nachrichten*, No. 4307).

THE CAPE OBSERVATORY.—Mr. Hough's first report of the work done at the Cape Observatory covers the two years 1906 and 1907; owing to the change of directors, consequent upon the retirement of Sir David Gill in February, 1907, no report for 1906 was issued.

The discussion of the azimuth determinations made in 1906 showed that, although the underground azimuth marks themselves were quite stable, there was a persistent systematic difference in the results, apparently depending upon the position, east or west, of the instrument; subsequent investigation showed that this error was due to a loose jewel in the end bearing of the micrometer screw.

An improved system of circulating the air in the prism box has greatly improved the working of the line-of-sight spectroscope. The transit-circle, the heliometer, and the equatorials were in constant use, and brief summaries of the observations made are contained in the report.

The astrographic chart work is well advanced, the total number of plates now measured being 1285, containing some 700,000 star images, corresponding to nearly 300,000 different stars.

During the two years under report, 496 stellar spectra, mostly selected for a spectroscopic determination of the solar parallax, were taken with the four-prism spectrograph attached to the Victoria (24″) telescope. The radial velocities of α Tauri, α Orionis, α Canis Majoris, β Geminorum, α Boötis, α Centauri, and α Scorpii are completely reduced, and await final discussion.

HOURS OF SLEEP FOR CHILDREN.

THAT a child needs proper sleep and longer hours of sleep than an adult is such a well-recognised fact among common-sense people that it seems strange it should still be necessary to preach it to the public. Sir James Paget so long ago as 1857 pointed out the physiological reasons for this necessity, in that organic processes are performed with rhythm, and the habitual alternation of activity and rest is an all-important factor in the realisation of the highest potentialities of the growing child. It is during the hours of sleep that growth due to the building up or anabolic side of metabolism is most in evidence, and anabolism is specially necessary in children, not only to repair the wear and tear of the day's activities, but also because the child is growing. Eminent alienists such as Sir James Crichton Browne and Dr. Clouston have supported these views, and have shown the bad effects want of rest has on the mental as well as the physical well-being of the child. Dr. Rayner, formerly medical superintendent of Hanwell Asylum, in his evidence given last year before the Royal Commission on the Care of the Feeble-minded, said, "I have had normal children brought to me as defective simply as a result of insomnia."

A few years ago Dr. Theodore Acland brought the question before the public, in a letter to the *Times*, in relation to the hours of sleep in boys' public schools. Schoolmasters, as a rule, are extremely conservative, and regard early rising as a useful method of discipline. Dr. Acland was supported by Dr. Clement Dukes, and it is to be hoped that their efforts have been successful in modifying the customs at such schools, and that the means of "hardening" adopted there may be changed in favour of methods which may be less harmful to the physique of the boys.

It is, however, not only in the schools and homes of the better classes that the evil prevails, and the aspect of the question in relation to the poor has been specifically dealt with in an article by Miss Alice Ravenhill (*Child Study*, vol. i., No. 4, January), which deserves wide publicity. Her investigations, illustrated by examples, abundantly prove that this most important time law of regular sleep is heedlessly violated, and the penalties exacted are both far-reaching and heavy. The hours of sleep are curtailed at both ends; late hours of retiring are the custom owing to a failure to appreciate that the child is not an adult; early rising is regarded as a necessity among the poor because the miserable pittances the children earn before school time are held of greater value than their normal development into efficient citizens; the quality of the sleep itself is poor, for few of the mites have a bed to themselves, and sleep often three, four, or even five in the same bed. Miss Ravenhill gives cases where a retirement at 10 p.m. or 11 p.m. at night is followed by rising for milk rounds at 5.30 a.m. or 6 a.m. This frequently occurs in children six years of age, and the proportion of early risers increases as the children reach the errand-boy age of ten or eleven. There are further exceptional cases where rising for market at 3 a.m. or 4 a.m. is mentioned.

The returns for girls are not so complete as for boys, but the evidence is abundant that the suffering is widespread in both sexes, and the range of occupations pursued is almost incredibly various.

This is a matter which a great nation should speedily rectify. The facts are collected and are indisputable, action ought to be immediate; parents must be instructed on this and other points of elementary hygiene, and legislation on the subject appears imperative.

MAGNETIC RAYS.

THE complex phenomena that occur at the kathode of a vacuum tube in the presence of a magnetic field have given rise to numerous researches since the time of

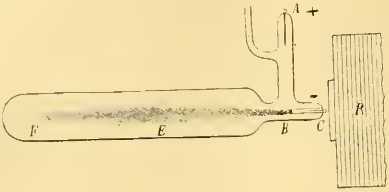


FIG. 1.

Plucker, and a great number of the effects observed still await an explanation.

Birkeland has shown that if a cylindrical discharge tube is placed in a longitudinal magnetic field of gradually increasing strength, there is at a certain value of the field an abrupt fall in the potential at the terminals. Almy has connected this with a sudden change in the appearance of the discharge. Willows has found that a transverse field causes the discharge to pass more readily below a certain value of the gas pressure; according to Peck, this effect is not found if the kathode fall of potential is greatly reduced by the use of a hot lime kathode. Broca has discovered that, in addition to the kathode rays which go in helices round the lines of force, there is produced a second species which follow the lines. Villard calls these magneto-kathode rays, and has shown that they are deflected by an electrostatic field, but in a direction *perpendicular* to the latter. By directing them into the interior of a Faraday cylinder, he has been unable to prove that they carry a charge; the experiment is, however, not conclusive, because the conducting power of the surrounding gas may be sufficient to disperse any charge so collected.

FIG. 2.

FIG. 3.

In a recent paper by Righi (*Accad. d. Sci., Bologna*, May, 1908) the hypothesis is made that these rays are electrically neutral doublets, more or less unstable, consisting of an electron and a positive ion rotating round each other. On account of its larger mass, the latter may be looked upon as stationary while the electron moves in an orbit around it. If the plane of rotation is perpendicular to the field, the force acting on the electron, arising from this field, will be radial, and the doublet may have stability conferred upon it. If the plane of rotation is inclined to the field, the electron, and hence also the doublet, will tend to move up or down the lines of force. Such doublets he calls magnetic rays, because the magnetic field is necessary to their stability. Fig. 1 shows one form of tube used by Righi in his efforts to demonstrate the existence of such rays. A is the anode, C the kathode, R an electromagnet; the source of current is a Holtz machine. Figs. 2 and 3 show the appearance of the tube when the discharge is passing, while the magnet is off and on respectively. The part BE (Fig. 1), according to the author, consists of the rays in question; to the left

FIG. 4.

of E the field is too weak to confer stability on the doublets. The luminosity, EF, behaves, to a magnet, like the positive column of the ordinary discharge, but with E as anode and F as kathode. Fig. 4 shows the effect of a transverse magnetic field on this column. In order to obtain the magnetic rays the field has to exceed a certain value, depending on the gas pressure, and when this value is reached the discharge becomes intermittent, as may be shown by a rotating mirror or telephone. The period increases with the field. The paper contains numerous photographs and measurements of the discharge under different conditions, and there is no doubt of its interest and suggestiveness, although it cannot be said to have demonstrated the actual existence of the hypothetical rays. R. S. W.

PRIZE SUBJECTS FOR SCIENTIFIC RESEARCH.

AT the annual meeting of the Société Batave de Philosophie expérimentale de Rotterdam, a series of forty-eight questions, or proposed researches, were put forward for the coming year. Amongst these are the following: an exact critical review of the present state of knowledge of the volcanoes and volcanic phenomena in the archipelago of the East Indies, and an explanation of the origin of these volcanoes based upon these data or upon the author's own researches; an experimental research on the cause of phosphorescence, especially in animals of a lower order; an experimental research on the electrical properties of some metallic alloys; an exact determination of the indices of refraction at different parts of the spectrum of substances possessing anomalous dispersion, and a discussion of the bearing of these observations on the theory of dispersion of light; experimental determinations, carried out with the greatest care, of the atomic weight of at least one element, the value of which is at present uncertain; a critical discussion of the theories of flight and of the experimental researches which form the base of such a discussion; a theoretical and experimental examination of the causes of the deviations from Ostwald's dilution law; exact direct measurements of the osmotic pressure of solutions, not showing electrolytic dissociation, especially in view of the determination of the limit of concentration at which the deviations from the laws of Boyle and Gay-Lussac begin to be felt; a research on the origin and physiological signification of the green colouring matter in the bodies of articulated green animals; an experimental research on the electrolytic dissociation of substances dissolved in different mixtures of water and alcohol; a determination of the diminution of the vapour pressure of solutions in water of the chlorides of sodium, potassium, calcium, and magnesium between the temperatures 0° C. and 100° C. for at least six different concentrations, the molecular conductivity, the lowering of the freezing point, and the rise in the boiling point are to be determined for the same solutions, the whole to be discussed from the point of view of the theory of Arrhenius and the criticisms of Kahlenberg; a quantitative research on the radiation of two simple gases in a magnetic field; new quantitative determinations on the distribution of radium in the earth's crust; a study, as complete as possible, of the structure and development of one species of the genus Trypanosoma, *Tr. lewisi* for preference.

The gold medal of the society (or its value) is offered for the best paper received in answer to one of these questions. Replies should be written in Dutch, French, English, German, or Latin, not signed by the author, but bearing a motto, accompanied by a sealed letter containing the same motto and the author's name, and addressed to Dr. G. J. W. Bremer, the secretary of the society, at Rotterdam, before February 1, 1910.

PAPERS AND REPORTS ON INSECTS.

BULLETIN No. 3 of the Sleeping Sickness Bureau is devoted to the life-history of the tsetse-fly, *Glossina palpalis*, a species which appears to have been originally obtained in Sierra Leone, but is now known to have a very wide distribution, including Angola, Nigeria, the Congo State, the lake region, the Egyptian Sudan, Uganda, and north-eastern Rhodesia. After referring to the peculiar mode of propagation of tsetses, the author discusses the influence of external conditions on the distribution and numbers of the species under consideration, referring particularly to shade, altitude, season, temperature and humidity, forest, water, and food-supply.

A number of new species and one new genus of American mosquitoes are described by Messrs. H. C. Dyar and F. Knab in vol. lii. of the Smithsonian Miscellaneous Collections, as a preliminary to a monograph now in course of preparation by Dr. L. O. Howard and the authors of this paper. The new genus, Dinanamesus, is allied to Dinocerites, from which it differs by a reduction in the length of the second joint of the antennæ.

In the report of the entomologist of the U.S. Department of Agriculture for 1908, Dr. L. O. Howard refers to the work done during the year in connection with the Mexican cotton-boll weevil, a species which continues to inflict much damage on growing cotton. It has been found that parasites are year by year becoming much more effective in controlling the ravages of this weevil, a fact promising favourable results in the efforts of the Bureau to encourage and spread the former. During the season under review the average parasitism is shown to have been doubled in Texas and trebled in Louisiana. Special attention was also directed during the year to insects injurious to forests, and it is satisfactory to learn that the efforts of private owners and the forest officials to check and control the alarming outbreaks of the Black Hills beetle in the neighbourhood of Palmer Lakes and Colorado Springs, as well as in the adjoining Pikes Peak National Forest, have proved a complete success.

The whole of vol. xxxi., No. 1, of Notes from the Leyden Museum is devoted to a monograph, by Dr. H. W. van der Weele, on the Mecoptera (scorpion-flies) and Planipennia of "Insulinde." The latter name is taken to denote the Dutch colonies in the Malay and Papuan archipelagoes, but the paper, which is illustrated by five plates, includes descriptions of species from those parts of Borneo and New Guinea which do not belong to Holland. A number of new species and subspecies, and three new genera, are named and described in the course of the paper, while some interesting particulars are given with regard to the life-history of one of the species of "antlion" (Myrmeleon).

EXPLOSIVE COMBUSTION, WITH SPECIAL REFERENCE TO THAT OF HYDROCARBONS.[1]

IT is hardly necessary to remind you that the subject of my discourse will be ever associated with the illustrious name of Davy. Davy turned his attention to the phenomena of flame in the year 1815, in response to an urgent appeal on the part of a committee formed in the north of England, to investigate the causes of accidents arising from the explosion of fire-damp in coal mines, and to devise means for their prevention. The perennial interest of his researches, however, lies not so much in their immediate practical success, great as this undoubtedly was, as in the broader theoretical issues which were disclosed, and brought within the region of experimental inquiry, by so splendid an exercise of genius.

Davy insisted on the necessity of considering flames in all cases "as the combustion of an *explosive mixture* of inflammable gas, or vapour, and air," and he defined flame as "aëriform, or gaseous matter, heated to such a degree as to be luminous." For the starting and propagation of a flame in an explosive mixture, he showed that each successive layer of gas must be raised to a certain definite temperature, called the "ignition point," and he investigated both the ignition temperatures and the explosion limits of a large number of the commoner combustible gases. He then proceeded to his famous discovery that, notwithstanding the extremely high temperatures of flames, which, in the case of cyanogen, he estimated to be "above 5000° of Fahrenheit," they can be readily extinguished by contact with a cooling surface of sufficient area and heat-conducting power, and that for this purpose metal surfaces are by far the most efficient. How he developed and applied this discovery to the construction of his "safe-lamp" for miners is a matter of history.

In experimenting upon the ignition temperatures of explosive mixtures, Davy made the important observation that combustible gases combine with oxygen at lower temperatures without any appearance of flame whatever. He emphasised the importance of a complete investigation of the chemical aspects of this flameless combustion, and he himself was led to ask whether, seeing that the temperatures of flames far exceed those at which solids become incandescent, a metallic wire can be raised to incandescence by the slow combustion of two gases "without actual flame, but producing heat enough to keep the wire ignited." In this way he discovered the remarkable property of platinum and other metallic wires of inducing surface combustion, and in the course of his further experiments on this subject he made two notable observations respecting the burning of compounds containing carbon and hydrogen. He found "much carbonic oxide" produced when a platinum wire was kept incandescent by the slow combustion of a mixture of ethylene and oxygen, rendered non-explosive by an excess of the hydrocarbon, and in a similar experiment with ether vapour he recorded the appearance of "a pale phosphorescent light" accompanied by "the formation of a peculiar acrid volatile substance possessed of acid properties."

Finally, in speculating upon the difficult and thorny subject of the luminosity of hydrocarbon flames, he was

[1] Abridged from a discourse delivered at the Royal Institution on Friday, Febrary 28, 1908, by Prof. W. A. Bone, F.R.S.

"led to imagine" that it "might be owing to the *decomposition* of part of the gas towards the interior of the flame where the air was in smallest quantity, and the deposition of solid charcoal, which, first by its *ignition* and afterwards by its *combustion*, increased in a high degree the intensity of the light." It is important to observe that not only did Davy rightly attribute the luminosity of a hydrocarbon flame to the presence therein of incandescent carbon, but also that he avoided the error of attributing the separation of carbon to a supposed preferential burning of hydrogen.

In considering the propagation of a flame through an explosive mixture of gases, it is necessary to distinguish between two well-defined conditions. When such a mixture is ignited, the flame travels for a certain limited distance (a few feet only) at a fairly uniform slow velocity, which in the case of a mixture of hydrogen and oxygen in their combining ratios is approximately 34 metres (38 yards) per second. This initial stage of the combustion is called "*inflammation.*"

After traversing a few feet, however, the flame begins to vibrate, and alters in character. The vibrations become more and more intense, the flame swinging backwards and forwards with oscillations of increasing amplitude. Then one or other of two things happens; either the flame is extinguished, or it goes forward with an exceedingly great and constant velocity, producing the most violent effects. The new condition thus set up is termed "*detonation*," and the forward movement of the flame is called the "*explosion wave.*"

The discovery of "*detonation*" in gaseous mixtures was made simultaneously by M. Berthelot and MM. Malard and Le Chatelier in the year 1881; Berthelot proved that the velocity of the explosion wave is independent of the length of the column of gas traversed, and that for the same gaseous mixture under given physical conditions it always has a constant value. In this connection I must mention Prof. H. B. Dixon's exhaustive researches on the "*rates of explosion*" of gaseous mixtures, which have extended in so many ways our knowledge of explosive combustion.

Experiment I.—Perhaps the best illustration of the outward difference between ordinary "*inflammation*" and "*detonation*" is afforded by the case of a mixture of carbonic oxide and oxygen in their combining ratios. When ignited in an open tube 4 or 5 inches long, the mixture burns quietly with the familiar blue flame. Far otherwise is it, however, when a long column of the mixture is fired in a leaden coil, where the brief initial period of *inflammation* is succeeded by the *explosion wave*, which dashes onwards through the gases at a rate of 1700 metres (about a mile) per second with shattering effect.

Another notable feature of "*detonation*" is the extremely short duration of the flame. In the course of some experiments carried out under Prof. Dixon's direction, it was found that the duration of luminosity in each successive layer of gas in the detonation of electrolytic gas does not exceed 1/5000th part of a second; but, short as this time is, it is something like a million times longer than the interval between successive molecular collisions in a gaseous mixture.

The question of how a hydrocarbon burns, that is to say, precisely how it is attacked by the oxygen, has been the subject of much discussion during the past fifteen years. The main points in dispute may be conveniently summarised under three heads.

(1) During the greater part of last century the belief prevailed that the hydrogen is much the more combustible of the two elements of a hydrocarbon, and that consequently when combustion occurs in a limited supply of oxygen, the hydrogen is preferentially burnt, as follows:—

$$C_2H_4 + O_2 = 2C + 2H_2O.$$

Who was the author of this view, or what was originally its experimental basis, is not quite clear, but it received the active support of two such eminent authorities as Thomas Graham and Michael Faraday, and for fifty years it was regarded as one of the most certain articles of chemical faith. It was finally overthrown by Dixon and Smithells in the year 1892.

(2) The second theory originated with Kersten in 1861, who, as the outcome of experiments on the explosion of a mixture of ethylene and electrolytic gas, asserted that "before any portion of the hydrogen is burnt, all the carbon is burnt to carbonic oxide, and that the excess of oxygen then divides itself between the carbonic oxide and the hydrogen." In other words, Kersten attempted to substitute the idea of the preferential burning of carbon for that of the preferential burning of hydrogen. His views, however, received no serious attention until they were revived by Dixon and Smithells.

The chief experimental basis for this theory is the behaviour of ethylene and acetylene when exploded with their own volume of oxygen. More than a century ago Dalton found that a mixture of equal volumes of ethylene and oxygen yields mainly carbonic oxide and hydrogen on explosion, without any separation of carbon, in conformity with the equation

$$\underset{1\text{ vol.}}{C_2H_4} + \underset{1\text{ vol.}}{O_2} = \underset{2\text{ vols.}}{2CO} + \underset{2\text{ vols.}}{2H_2}$$

This fact, after being overlooked for nearly eighty years, was re-discovered by Dixon in 1891; moreover, a few years later, when it was proved that acetylene behaves in a precisely similar manner,

$$\underset{1\text{ vol.}}{C_2H_2} + \underset{1\text{ vol.}}{O_2} = \underset{2\text{ vols.}}{2CO} + \underset{1\text{ vol.}}{H_2},$$

the advocates of the theory were able to claim a considerable body of evidence in support of their case.

(3) But the idea of a "*preferential*" combustion, whether of carbon or of hydrogen, seemed repugnant to well-established principles concerning the nature and conditions of chemical interactions in gaseous systems. Moreover, whilst the assumption of a *direct* passage from an initial system of ethylene and oxygen, $C_2H_4 + O_2$, to the system carbonic oxide and hydrogen, $2CO + 2H_2$, implied a simple transaction from the kinetic standpoint, an extension of the idea to the case of such a hydrocarbon as propylene,

$$2C_3H_6 + 3O_2 = 6CO + 6H_2,$$

would at once raise serious difficulties.

It therefore remained to consider whether the solution of the problem might not lie in the assumption of an initial *association* of the hydrocarbon and oxygen forming an unstable "oxygenated" molecule, which subsequently rapidly decomposes. Thus, for example, the changes involved in the explosive combustion of an equimolecular mixture of ethylene and oxygen might conceivably be represented somewhat as follows:—

$$C_2H_4 + O_2 = \underset{\text{unstable}}{[C_2H_4O_2]} = 2CO + 2H_2$$

Many years ago, indeed, Prof. H. E. Armstrong suggested that the combustion of a hydrocarbon takes place under the conjoint influence of water and oxygen, and involves the successive formation of intermediate "*hydroxylated*" molecules, which at high temperatures rapidly decompose into simpler products. Little notice was taken of his suggestion at the time, but recent researches have shown that "*hydroxylated*" molecules are probably formed, even in flames, although I think it doubtful whether water vapour is an essential factor in the process.

The researches recently carried out at the Manchester University have covered the entire range of conditions under which hydrocarbons can be burned, from the slow, flameless combustion discovered by Davy right up to the extreme conditions of detonation. An exhaustive study of the slow combustion of methane, ethane, ethylene, and acetylene, at temperatures between 250° C. and 400° C., afforded decisive evidence against the preferential burning, whether of carbon or of hydrogen. Large quantities of aldehydic intermediate products were isolated, and the balance of evidence was decidedly in favour of the "*hydroxylation*" theory, with the proviso, however, that the oxygen is directly active.

With the extension of the research to the conditions existing in hydrocarbon flames and explosions, it became increasingly evident that the mechanism of combustion is essentially the same above as below the ignition point. I do not mean, of course, that the phenomena observed at low temperatures, in slow combustion, are exactly reproduced in flames, but rather that the result of the initial molecular encounter between the hydrocarbon and oxygen is probably much the same in the two cases, namely, the formation of an "oxygenated" molecule. At the higher temperatures of flames, secondary thermal decompositions undoubtedly come into operation at an earlier stage, and play a more important *rôle* than in slow combustion, but they do not precede the onslaught of the oxygen upon the hydrocarbon, but arise in consequence of it.

Having thus explained the main issues, I propose to perform a series of experiments on the explosive combustion of acetylene, ethylene, and ethane, some of which are crucial as regards the rival theories under discussion.

Experiment II.—I have here three cylindrical bulbs of stout borosilicate glass (capacity = about 60 c.c.), fitted with firing wires, hermetically sealed, and containing respectively equimolecular mixtures of each of the three hydrocarbons with oxygen, that is to say, mixtures corresponding to $C_2H_2+O_2$, $C_2H_4+O_2$, and $C_2H_6+O_2$, respectively.

Now, according to the theory of the preferential combustion of carbon, these mixtures should on explosion yield nothing but carbonic oxide and hydrogen, without any separation of carbon or formation of steam, as follows:—

		p_2/p_1*
(*a*)	$C_2H_2+O_2=2CO+H_2$	1·5
(*b*)	$C_2H_4+O_2=2CO+2H_2$	2·0
(*c*)	$C_2H_6+O_2=2CO+3H_2$	2·5

* The symbols p_1 and p_2, used in this and subsequent tables, denote the initial and final pressures of the *cold* original mixture and gaseous products (dry) at constant volume and at the same temperature.

On firing the mixtures, it is at once evident that something very like this does happen in the cases of (*a*) and (*b*). There is absolutely no deposition of carbon, and no appreciable condensation of steam in the cold products. Far otherwise is it, however, in the case of the bulb containing the mixture $C_2H_6+O_2$. A lurid flame fills the vessel, accompanied by a black cloud of carbon particles, and a close inspection of the cold bulb will reveal a considerable condensation of water. The pressure ratio p_2/p_1 is approximately 1·5, and an analysis of the gaseous products would prove the presence of about 10 per cent. of methane. The bulb will now be opened, rinsed out with water, and the formation of aldehydic products demonstrated by means of Schiff's reagent. It is clear that these results are wholly inconsistent with the theory of the preferential burning of carbon.

Did time permit, I could easily demonstrate to you by other similar experiments that the *outward* difference here revealed between the burning of ethylene and that of ethane extends to all the other gaseous olefines and paraffins; that is to say, whereas mixtures of olefines and oxygen corresponding to $C_nH_{2n}+\frac{n}{2}O_2$ on explosion yield mainly carbonic oxide and hydrogen, without separation of carbon, mixtures of paraffin and oxygen corresponding to $C_nH_{2n+2}+\frac{n}{2}O_2$ yield carbon, oxides of carbon, methane, hydrogen, and steam, all in considerable quantities. Are we then to conclude that there is some peculiarity about the constitution of an olefine which induces a preferential burning of its carbon, whilst the corresponding paraffin is burnt in an entirely different way? The following experiment will show that such a view cannot for a moment be entertained.

Experiment III.—I will now fire a bulb containing a mixture of 60 per cent. of ethylene and 40 per cent. of oxygen (*i.e.* $3C_2H_4+2O_2$). As might be expected, the flame is accompanied by a large deposition of carbon, but what is of greater importance still is the fact that a considerable amount of water is also formed. The full significance of this experiment may be gathered from the following data:—

Original mixture $\begin{cases} C_2H_4=59\cdot65 \text{ per cent.} & p_1=562\text{mm.} \quad p_2/p_1=1\cdot45 \\ O_2=40\cdot35 \quad ,, & p_2=816 \quad ,, \end{cases}$

Gaseous products $\begin{cases} CO_2=2\cdot5,\ CO=37\cdot2,\ C_2H_2+C_2H_4=6\cdot4,\ CH_4=6\cdot5, \\ H_2=47\cdot4 \text{ per cent.} \end{cases}$

	C	H	O
Units in original mixture	670	670	227
Units in gaseous products	482	572	172
Difference	188	98	55

I think it will be now admitted that such an experiment as this completely destroys the foundations of the theory of the preferential burning of carbon. As I have already stated, the original experimental basis of the theory was the behaviour of an equimolecular mixture of ethylene and oxygen, yet here is proof that on closer examination the behaviour of ethylene is inconsistent with the theory, which must, therefore, be abandoned.

Experiment IV.—The next experiment is designed to illustrate the infinitely greater affinity of acetylene and ethylene as compared with that of hydrogen for oxygen at the high temperatures of flames. I have here two bulbs containing mixtures of each of these hydrocarbons with hydrogen and oxygen corresponding to $C_2H_2+2H_2+O_2$ and $C_2H_4+H_2+O_2$ respectively, and I will ask you to contrast the behaviour of these with that of the equimolecular mixture of ethane and oxygen, $C_2H_6+O_2$, which was exploded a few minutes ago. It should be noted that whilst all three mixtures contain the same relative proportions of carbon, hydrogen, and oxygen, they differ in respect of the proportions between the combined carbon and hydrogen. Asking you to bear in mind how the equimolecular mixture of ethane and oxygen on explosion gave rise to a black cloud of carbon and a considerable formation of water, I will now fire the other two mixtures. You will observe that in neither case has there been any deposition of carbon, and an inspection of the cold bulbs will show that little or no steam formation has occurred. In fact, the hydrocarbon has been burnt to carbonic oxide and hydrogen, leaving the hydrogen absolutely untouched by the oxygen.

These experiments have an important bearing on the chemistry of flames. Hydrogen is usually considered as one of the most combustible of gases, but here we see it pushed to one side by the all-powerful hydrocarbon as though it were so much inert nitrogen. This at once raises another question which has lately been occupying my attention. Ever since Davy's experiments on flame, the combustibility of hydrogen has been considered to be superior to that of methane; this, however, cannot be true in regard to slow combustion, for it can be easily proved that between 300° C. and 400° C. methane is oxidised at a far faster rate than hydrogen [1] in the absence of surfaces, such as platinum or palladium, which readily occlude hydrogen.

It does not, I think, impose too great a strain on the imagination to picture the probable mechanism of combustion in hydrocarbon flames, and for this purpose ethylene and ethane may be taken as typical examples. It may be assumed that the affinity of a hydrocarbon for oxygen is so great at high temperatures that the initial stage of its combustion takes precedence of all other chemical phenomena in flames. This is probably true of the propagation of flame through explosive mixtures of hydrocarbons and oxygen. In the special case of a stream of a hydrocarbon burning in air, partial decomposition may occur in the innermost regions of the flame, where the supply of oxygen is very limited, before combustion begins; but, in general, whenever the hydrocarbon and oxygen are brought together at high temperatures, their mutual affinities will prove superior to any disruptive forces which would otherwise break down the hydrocarbon. It is probably not so much the original hydrocarbon as its hydroxylated molecule which decomposes in flames; the sudden increase in the internal energy of the hydrocarbon molecule, consequent upon its initial association with oxygen, would render the resulting hydroxylated molecule extremely unstable, and, in default of its immediate further oxidation, it would

[1] Since the above was written, it has been proved experimentally that even in explosive combustion at high initial pressures the affinity of methane greatly exceeds that of hydrogen for oxygen

speedily decompose. The explosive combustion of ethylene may, therefore, be represented by the following scheme:—

$$\overset{0}{\mathrm{H_2C{:}CH_2}} \longrightarrow \underbrace{\mathrm{HO.}\overset{1}{\mathrm{CH}}\mathrm{{:}CH_2}}_{\left\{\begin{matrix}\mathrm{C_2H_2+H_2O}\\ \mathrm{2C+H_2+H_2O}\end{matrix}\right\}} \longrightarrow \underbrace{\mathrm{HO.CH{:}}\overset{2}{\mathrm{CH}}\mathrm{.OH}}_{\mathrm{2CH_2O=2CO+2H_2}}$$

In a sufficient supply of oxygen, the transition from the original hydrocarbon to the *dihydroxy* state is probably so rapid that no breaking down of the ethylenic structure occurs in passing through the initial *monohydroxy* stage. Indeed, it is conceivable that under the extreme conditions of detonation the passage from 0 to 2 may be effected in a single molecular impact. The *dihydroxy* derivative would at once break down into carbon monoxide and hydrogen, *via* formaldehyde.

But when the oxygen supply is reduced below the equimolecular proportion, it is evident that the initial *monohydroxy* derivative cannot all be oxidised to the *dihydroxy* stage; some of it would, therefore, decompose partly into acetylene and steam and partly also into carbon, hydrogen, and steam, together with some methane.

In a similar manner the combustion of ethane would involve the rapid passage through *ethyl alcohol* to *acetaldehyde*, and *steam*, with subsequent decomposition of the aldehyde into carbon, hydrogen, methane, and carbonic oxide, with the proviso that a reduction of the oxygen supply below the equimolecular proportion would bring about in some measure the decomposition of the alcohol into ethylene and steam, &c., at stage 1.

$$\overset{0}{\mathrm{H_3C.CH_3}} \longrightarrow \underbrace{\mathrm{CH_3.}\overset{1}{\mathrm{C}}\mathrm{H_2OH}}_{\left\{\begin{matrix}\mathrm{C_2H_4+H_2O}\\ \mathrm{2C+2H_2+H_2O}\end{matrix}\right\}} \longrightarrow \underbrace{\mathrm{CH_3.}\overset{2}{\mathrm{C}}\mathrm{H(OH)_2}}_{\underbrace{\mathrm{CH_3.CHO}}_{\left\{\begin{matrix}\mathrm{CH_4+CO}\\ \mathrm{C+2H_2+CO}\end{matrix}\right\}}\mathrm{+H_2O}}$$

But the cases of ethane and ethylene are typical of all other hydrocarbons, so that it may be said that, in general, the mechanism of explosive combustion involves (1) the initial formation and subsequent decomposition of hydroxylated (or "oxygenated") molecules; (2) in a sufficient supply of oxygen, the independent oxidation of the decomposition products; (3) in an insufficient oxygen supply, the subsequent breaking down of unsaturated hydrocarbons, interactions between carbon and steam, or between oxides of carbon, hydrogen, and steam, the final system depending on the amount of available oxygen, the temperature of the flame, and the rate of cooling.

Experiment V.—The influence of different rates of cooling of the flame on the final system may be illustrated by firing an equimolecular mixture of ethane and oxygen in two glass vessels having approximately the same volume but widely different surface areas. For this purpose I have selected (1) a tube about 1 metre long and 2 cm. internal diameter, and (2) a globe of 8·5 cm. internal diameter. Both these vessels have the same volume (about 300 c.c.), but the surface area of the tube is very nearly three times that of the globe. It is therefore to be expected that, in consequence of the more rapid cooling of the flame, there will be a greater accumulation of the primary combustion products in the case of the tube experiment. On comparing the results of the two explosions, it is at once evident that more water and less carbon have been produced in the case of the tube; moreover, the pressure ratio p_2/p_1 is 1·45, as compared with about 1·75 in the globe experiment, and an examination of the products would show that the lower ratio is accounted for by the much greater survival of acetylene, ethylene, and aldehydic products in the tube experiment. These facts, which are set forth in the following table, are in complete harmony with the hydroxylation theory.

Experiment VI.—The experiments I have so far shown you refer more particularly to the initial period of "*inflammation*" in explosive combustion, that is to say, to the conditions ordinarily prevailing in hydrocarbon flames. The question may be asked whether or not the views I have advanced are applicable to the extreme conditions of "*detonation*" or of explosions under high initial pressures. This question can best be answered by a consideration of the behaviour of an equimolecular mixture of ethane and oxygen under these extreme conditions.

Inflammation of an Equimolecular Mixture of Ethane and Oxygen.

—		A In Long Tube			B In Large Globe		
	p_1	701 mm.			685 mm.		
	p_2	1018 ,,			1187 ,,		
	p_2/p_1	1·45			1·73		
% Composition of Gaseous Products	CO_2	4·20			3·40		
	CO	34·80			36·10		
	C_2H_2	5·00 } 7·65			} 0·15		
	C_2H_4	2·65 }					
	CH_4	8·85			7·25		
	H_2	44·50			53·05		
		C	H	O	C	H	O
Original mixture		694	1041	354	678	1017	346
Gaseous products		643	738	220	558	805	255
Difference		51	303	134	120	212	91
% Difference		7·6	29	37·8	18	20	27·5

It is difficult to set up detonation in this mixture; the gases must be fired at an initial pressure of about 1½ atmospheres in a stout leaden coil of about 1-inch internal diameter. Even then it is necessary to start the explosion wave in a special firing piece containing electrolytic gas under pressure. I therefore regret that, owing to the special arrangements requisite for success, it is not possible to make the experiment to-night. I will, however, carry out an experiment on the explosion of the gases at an initial pressure of 15 atmospheres.

The cylindrical steel bomb on the table is part of an apparatus recently installed in the fuel and metallurgical laboratories of the University of Leeds for investigations on gaseous explosions under high pressures. The bomb is about a foot long with an external diameter of 4 inches, and the central cylindrical explosion chamber is 8 inches long by 1 inch in diameter. It has been tested by hydraulic pressure up to 1000 atmospheres, and has been repeatedly used for experiments with mixtures of hydrocarbons and oxygen at initial pressures of as much as 40 atmospheres. The bomb is now connected, through a valve at the top, with a standard Bourdon gauge, and contains an equimolecular mixture of ethane and oxygen at a pressure of 15·8 atmospheres. The valve will now be closed, and the mixture fired by means of an electrical arrangement in the special firing piece.

All that is audible of the explosion is a sharp click, and on opening the valve connecting with the gauge again the final pressure of the cold products of explosion is recorded. After applying the necessary correction for the "dead space" in the gauge connections, the final "corrected" pressure is as nearly as possible 30·8 atmospheres, corresponding to a ratio $p_2/p_1=1·93$. I would now direct your attention to the tabulated results of a similar bomb experiment carried out a few weeks ago at Leeds at an initial pressure of 25 atmospheres, and also at the same time to those of another experiment in which the gases were detonated in a lead coil at an initial pressure of 1½ atmospheres.

In both these experiments carbon was deposited, and it is evident also that steam was formed. The ratio p_2/p_1 was as nearly as possible 2·0 instead of the 2·5 required by the theory of the preferential combustion of carbon. Moreover, a notable feature of the results is the presence of as much as 7 per cent. of methane among the products of the experiment at 25 atmospheres; the fact that so much methane survived when all other hydrocarbons were battered to pieces during the explosion (no traces of either acetylene or ethylene being found in the products) is a remarkable testimony to its relatively great stability at the highest temperatures of explosion flames. There is no evidence in these experiments of any real discontinuity between the chemical phenomena of ordinary "*inflammation*" and those of "*detonation.*" The higher temperatures and more violent conditions in "*detonation*" are responsible for the more complete breaking down of unsaturated hydrocarbons and a greater "unburning" of steam by carbon, but there is probably no difference as regards the mode in which the hydrocarbon is attacked by the oxygen in the two cases.

Results of Explosion of an Equimolecular Mixture of Ethane and Oxygen under High Pressures.

—	A Detonation in Lead Coil			B Explosion in Steel Bomb		
p_1	1180 mm.			25·2 atms.		
p_2	2240 ,,			51·7 ,,		
p_2/p_1	1·90			2·05		
Composition of Gaseous Products: CO_2	1·80			2·6		
CO	39·10			37·2		
C_2H_2	0·90 } 1·40			} *nil*		
C_2H_4	0·50 }			}		
CH_4	7·70			7·0		
H_2	50·00			52·2		
	C	H	O	C	H	O
Original mixture.	1186	1779	587 mm.	25·35	38·0	12·55 atms.
Gaseous products	1151	1507	488 ,,	24·50	34·6	11·05 ,,
Difference . .	35	272	99 ,,	0·85	3·4	1·5
Difference .	3	15	17	3·4	9	12·0

I therefore believe that, so far as our present knowledge goes, the views I have put forward afford a simple and consistent interpretation of hydrocarbon combustion, whether it be the slow flameless kind discovered by Davy or the more complex phenomena of ordinary flames so wonderfully expounded by him, or, finally, the extreme conditions of temperature and pressure characteristic of the explosion wave.

SUPPLEMENTARY LIST OF FORTHCOMING BOOKS OF SCIENCE.

IN addition to the books referred to in NATURE of last week, the following works are announced:—

ANTHROPOLOGY.

G. Fischer (Jena).—Die paläolithischen Funde von Taubach in den Museen zu Jena und Weimar, Dr. G. Eichhorn, illustrated. *Hodder and Stoughton.*—New Impressions of Primitive Man, E. Clodd; The British Race, J. Munro. *Elliot Stock.*—Folk Lore and Folk Stories of Wales, M. Trevelyan, with introduction by E. S. Hartland; Indian Folk Tales, E. M. Gordon (cheap edition).

BIOLOGY.

W. Engelmann (Leipzig).—Geschichte der biologischen Theorien, Prof. E. Radl, 2 Teil; Der Vegetation der Erde, xi. Band, Die Vegetationsverhältnisse der Balkanländer, Prof. L. Adamović, illustrated; xii. Band, Botanical Survey of the United States of North America, Prof. J. W. Harshberger, illustrated; Prantls Lehrbuch der Botanik, new edition, illustrated; Vorträge und Aufsätze über Entwicklungsmechanik der Organismen, edited by Prof. W. Roux, vi. Heft, Über chemische Beeinflussung der Organismen durch einander, Prof. E. Küster; vii. Heft, Der Restitutionsreiz, Dr. H. Driesch. *G. Fischer (Jena).*—Recueil des Travaux botaniques Néerlandais, publié par la Société botanique Néerlandaise, vol. iv., illustrated; Histologische Beiträge, Prof. E. Strasburger, Heft vii., illustrated; Zoologisches Wörterbuch, edited by Prof. H. E. Ziegler, Lief. iii. *Hodder and Stoughton.*—Germ Life: Bacteria, H. W. Conn. *T. Werner Laurie.*—The Garden Booklets:—The Rose Garden; The Rock Garden; The Bulb Garden; The Formal Garden; The Water Garden; The Fern Garden. *G. Philip and Son, Ltd.*—School Gardening, W. E. Watkins and A. Sowman.

GEOGRAPHY AND TRAVEL.

Hodder and Stoughton.—Camps and Cruises of an Ornithologist, F. M. Chapman, illustrated; The Story of Geographical Discovery, J. Jacob. *Hutchinson and Co.*—The American Egypt: a Record of a Sojourn in Yucatan and other Parts of Mexico, C. Arnold and F. J. Frost, illustrated. *G. Philip and Son, Ltd.*—A Guide to Geographical Books and Appliances, J. F. Unstead and N. E. MacMunn, edited by A. J. Herbertson; A Rational Geography, E. Young, part ii.; Our Own Islands, H. J. Mackinder; and a new edition of L'Estrange's Junior Course of Comparative Geography, revised and entirely rearranged, with maps in black and white.

GEOLOGY.

W. Engelmann (Leipzig).—Das Salz, dessen Vorkommen und Verwertung in sämtlichen Staaten der Erde, Dr. J. Buschman, 2 vols.

MATHEMATICAL AND PHYSICAL SCIENCE.

W. Engelmann (Leipzig).—Tafeln für Maschinenrechnen, Prof. O. Lohse. *Harper Brothers.*—The Ether of Space, Sir Oliver J. Lodge, F.R.S. *T. Werner Laurie.*—Everyday Electricity, F. Broadbent, illustrated; Everyday Astronomy, H. P. Hollis, illustrated. *T. Murby and Co.*—Hobbs's Electrical Measurements (new edition). *G. Philip and Son, Ltd.*—Practical Elementary Science, T. Samuel and H. Foxcroft, three parts; A Handy Book of the Stars, Captain W. B. Whall (new edition). *S. Rentell and Co., Ltd.*—New editions of the Telegraphist's Guide; The Telegraphist's and Telephonist's Notebook; and Questions and Solutions in Telegraphy and Telephony: being Solutions to the Questions set by the City and Guilds of London Institute in the Ordinary Grades of Telegraphy and Telephony for the Years 1904–8, H. P. Few.

MEDICAL SCIENCE.

W. Engelmann (Leipzig).—Die aphasischen Symptome und ihre corticale Lokalisation, Dr. N. von Mayendorf, illustrated; Die basedowsche Krankheit, Prof. H. Sattler, 1 Teil, Symptomatologie, illustrated; Anleitung zur Präparation und zum Studium der Anatomie des Gehirns, Dr. E. Villiger. *G. Fischer (Jena).*—Handbuch der Anatomie des Menschen, Erster Band, Skeletlehre, illustrated; Ländliche Hygiene, Dr. E. Roth, Zwanzigster Band.

TECHNOLOGY.

W. Engelmann (Leipzig).—Die Gasmaschinen, A. von Jhering, in 2 Teilen, 2 Teil, Geschichtliche Entwicklung und Beschreibung der Gasmaschinen, illustrated; Vorlesungen über Ingenieurwissenschaften, Prof. G. Mehrtens, 1 Teil, Statik der Baukonstruktionen und Festigkeitslehre, Erster Band, illustrated (new edition).

MISCELLANEOUS.

W. Engelmann (Leipzig).—Die mnemischen Empfindungen in ihren Beziehungen zu den Originalempfindungen, Prof. R. Semon (Mneme, ii. Band). *Hodder and Stoughton.*—Thought and Feeling, F. Ryland.—*The St. Bride's Press, Ltd.*—Lectures on Sanitation, W. D. Scott-Moncrieff; The Polar Planimeter: How it is Used and How it Operates, F. J. Gray.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student commencing residence at Cambridge as a member of Emmanuel College in October. The exhibition will be awarded at the beginning of October.

LONDON.—The governors of the Imperial College of Science have decided to purchase a section of freehold property in Cornwall giving free access to a mine for the practical study of surveying in connection with the course in mining. Prof. E. W. McBride, F.R.S., of McGill University, Montreal, has been appointed chief assistant in the zoological department of the college. The title of "Professor Emeritus" has been conferred upon Prof. Tilden, F.R.S., in recognition of his long services as dean of the Royal College of Science and professor of chemistry.

M. Paul Langevin has been appointed professor of general and experimental physics at the Collège de France in succession to the late Prof. Mascart.

The Scottish Meteorological Society offers for competition among matriculated students or graduates of the four Scottish universities, including University College, Dundee, a prize of 20*l.* for the best essay on a meteorological subject. As an indication of the kind of essay the council is prepared to consider, the following subject is mentioned:—"A discussion of the extent to which the heat set free when water vapour is converted into the liquid state influences the temperature of the atmosphere, with special reference to the climatology of different parts of Scotland." An essay on any other subject will, however, be equally eligible. The essays must be lodged with the secretary to the Scottish Meteorological Society, 122 George Street, Edinburgh, on or before March 31, 1910.

Several further gifts to colleges and universities in the United States have been announced. *Science* states that at the recent commemoration of the founding of Johns Hopkins University, which opened thirty-three years ago, it was reported that the gift of Mr. Henry Phipps, of New York, for the psychiatric clinic was considerably in excess of 200,000*l.* A gift of 40,000*l.* to the University of Pennsylvania from an anonymous donor has been announced. The sons and daughters of the late Mr. and Mrs. F. C. A. Denkmann, of Rock Island, Ill., have promised to give a library building to Augustana College, Rock Island, the building to cost not less than 20,000*l.* By the will of Dr. Gordon W. Russell, of Hartford, Trinity College receives 1000*l.* for the natural history department and a collection of books on that subject.

The Estimates for Civil Services for the year ending March 31, 1910, show an increase compared with the grants in the 1908 session. The provision made for universities and colleges shows an increase of 15,000*l.* for university education in Wales, and among increases under the heading "scientific institutions, &c.," are 2000*l.* for the National Museum of Wales and 4500*l.* for the National Library of Wales. A building grant of 20,000*l.* is made in aid of the building fund of the University College, Bangor. The estimates for the Board of Education show an increase of 60,986*l.* The total estimates for the British Museum are 127,935*l.*, and for the Natural History Museum, South Kensington, 60,543*l.* It is interesting to notice under the estimates for the Board of Education an increase of 23,550*l.* available for grants for secondary schools and the instruction of pupil teachers, and of 20,000*l.* for grants for technical institutions and evening schools.

On Friday evening, March 12, at the South-Western Polytechnic Institute, Chelsea, the certificates and prizes were distributed by Dr. H. A. Miers, F.R.S., principal of London University. The principal of the polytechnic read a report which showed that the institute had been very successful in the university and other examinations. After the distribution Dr. Miers delivered an address. He said that twenty years ago he had taken a class in electricity at an evening recreative centre under the old School Board in Chelsea, and he felt on this account that his visit to Chelsea was particularly appropriate. His great-grandfather, Francis Place, also had taken a leading part in founding some of the original polytechnics. He said that the great object of education should be to stimulate intellectual effort, and he knew no better way than by studies in science and art. In both it was always possible to discover or to produce something new, provided the student had the seeing eye. He himself had been led to researches and discoveries by chance observations. At a lecture at the Royal Institution one of his experiments on crystallisation had acted differently from his expectation, and this had led him to a year's successful research. It was the seeing eye, educated by scientific study, which enabled discoveries to be made, and the more alert a student was the more likely he would be able to seize the opportunity when it came. Many discoveries had been made in this way, of which he gave examples. The interest of scientific and artistic studies was to him akin to the sporting instinct, which is merely a sense of expectation and curiosity of what was about to happen. All teachers should try to stimulate the spirit of research.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 14.—"On the Velocity of the Kathode Rays ejected by Substances exposed to the γ Rays of Radium." By R. D. **Kleeman.** Communicated by Sir J. J. Thomson, F.R.S.

Part of the kathode radiation from a plate exposed to the γ rays of radium consists of very soft rays which are absorbed in 1 cm. or 2 cm. of air.

The softness of the radiation is practically independent of the thickness of the radiator, and previous sifting of the γ rays through a thick screen.

The radiation appears to be considerably softer on the side of the radiating plate where the γ rays emerge than on the side where they enter.

Measurements of the softness of the radiation for radiators of different materials on the side where the γ rays entered showed that it is practically independent of the nature of the material of the radiator.

The soft radiation produced by the β and γ rays of radium together is of a more penetrating character than that produced by the γ rays alone.

The penetrating kathode rays produced directly by the γ rays have been shown to possess different velocities. It was found that the penetrating power of the kathode radiation from a plate decreases with the increase of absorbability of the γ radiation which produces it.

The velocity of these secondary rays as a whole is, as a first approximation, equal to that of the β rays of radium.

March 11.—Sir Archibald Geikie, K.C.B., president, in the chair.—Note on the stability of Jacobi's ellipsoid: Sir G. H. **Darwin.**—The wave-lengths of lines in the secondary spectrum of hydrogen: H. E. **Watson.** A great deal of work has been done by numerous investigators, with the object of discovering the causes which produce two hydrogen spectra, the view for which there appears to be most evidence being that the primary spectrum arises from atomic hydrogen, and the secondary spectrum from molecular hydrogen. On the other hand, information as to the wave-lengths of the lines is very scanty, the only measurements of the red and yellow lines being those of Hasselberg about the year 1883. The results are based on Ångström's scale, and were made with a prism spectroscope, so that they are not very trustworthy. As it seemed highly important to have accurate information on the subject owing to the frequent necessity of eliminating hydrogen lines from a spectrum, the present work was undertaken. About 800 of the lines in the spectrum were measured by means of a Rowland concave grating, the error in the case of the stronger lines being probably not greater than 0·03 Ångström unit. Many of the lines are very weak, and can barely be photographed even with prolonged exposures. No lines have been detected which are less refrangible than the C line, and very few appear to exist beyond the theoretical limit of the primary series according to Balmer's formula. In fact, of those which were seen in this position, the majority appear to be due to water-vapour, and it does not seem unlikely that the remaining ones are not due to hydrogen. A remarkable feature is an apparently continuous spectrum, which extends from the extreme ultra-violet almost to the visible region. A list is also given of the wave-lengths of thirty-three mercury lines which were seen in the spectrum, and measured with particular care in two orders.—The measurement of dielectric constants by the oscillations of ellipsoids and cylinders in a field of force: W. M. **Thornton.** The method used was to suspend by a quartz fibre in an alternating field of force very accurately formed ellipsoids or cylinders of the substance to be tested. The field had an intensity of about 300 volts per cm., and made sinuous alternations at a frequency of 80 a second. The polarisation couple upon the specimen was found by measuring the periods of small swings with and without the field. From these, and the dimensions of the body, the dielectric constant was calculated. The values so found for quartz and flint-glass ellipsoids, carefully made by Messrs. Hilger, agree to one part in a thousand with those calculated by the Sellmeier-Ketteler formula from optical data, and with Hopkinson's values for glass. Substances which could be moulded were formed in a split lead mould, using a steel ellipsoid, also by Hilger, as a matrix. In order that cylindrical specimens could be used, the longitudinal reaction coefficient N was found for a series of cylinders of known dielectric constants. Liquids were measured by enclosing them in thin paper cylinders suspended in a saddle of silk thread. The air in the testing vessel was thoroughly dried over phosphoric anhydride, and the drying was continued in each case until the period reached a steady value. Quite invisible traces of moisture on the surface of the specimens caused them to behave as conductors, and in the case of water the conductivity of the surface masked the polarisation effect completely. The following values were obtained:—Quartz, parallel to optic axis, 4·606; perpendicular to axis, 4·548. Flint-glass, $\Delta=4{\cdot}65$, 10·64; $\Delta=4{\cdot}12$, 8·52; $\Delta=3{\cdot}30$, 6·98. Paraffin wax, 2·32. Beeswax, 4·75. Shellac, 2·49. Sealing wax, 4·56. Gutta-percha, 4·43. Chatterton's compound, 3·98. Ebonite, 2·79. Amber, 2·80. Ivory, 6·90. Canada balsam, 2·72. Resin, 3·09. India-rubber, 3·08. Sulphur, 4·03. Olive oil, 3·16. Heavy paraffin oil, $\Delta=0{\cdot}885$, 2·55.

Linnean Society, February 18.—Dr. D. H. Scott, F.R.S., president, in the chair; afterwards Lieut.-Colonel Prain, C.I.E., F.R.S., vice-president.—Alternation of generations in plants: discussion opened by Dr. W. H. **Lang.** After some introductory remarks and reference to some examples of well-marked alternation of generations, and the nuclear difference between the two generations, the author adduced the ontogeny of organisms without alternation of generations, the concept of a specific cell corresponding to each specific form. The concept of the specific cell must be applied to organisms with alternation; the bodies of the two alternating individuals in the life-history may be similar or dissimilar. Two alternative explanations of the differences between the two generations in the complete life-history were stated:—(*a*) that the differences are due to the different state of the specific cell in the spore and zygote respectively; (*b*) that they are due to different environmental conditions acting on equivalent germ-cells. The mode of reproduction—sexuality or spore-production—appears to be necessarily associated with the state—haploid or diploid—of the specific cell. While the possibility of the different states of the specific cell in the spore and zygote having some causal influence on the difference of the resulting individuals must be borne in mind, it is suggested that this ontogenetic theory of the nature of the alternation seen in Bryophyta and Pteridophyta may prove a useful working hypothesis, that it will lead to work on new lines, and that it is to some extent open to experimental test.

March 4.—Dr. D. H. Scott, F.R.S., president, in the chair.—A contribution to the montane flora of Fiji, including cryptogams, with ecological notes: Miss L. S. **Gibbs.** The Fiji group consists of 200 islands, only eighty of which are inhabited; Viti Levu is about 4100 square miles in area, with forest-clad mountain ranges, the highest point being Mt. Victoria, 4000 feet in height. The botanical history of the group begins with the visit of H.M.S. *Sulphur* in 1840, and in the same year the Wilkes expedition touched at the islands. The *Herald* called in 1856, and Dr. Seemann visited the group in 1860–1, and embodied his results in his "Flora Vitiensis." Mr. Horne, director of the Botanic Gardens at Mauritius, spent a year collecting in the late 'seventies of last century. Thanks to these investigators, the flora of the lower parts of the chief islands are fairly well known. The author therefore decided to confine her investigations to the region lying at 2900 feet and above, and the three spring months of August, September, and October were spent at Nadarivatu, the highest inhabited point. From the collections the flora may be described as Indo-Malayan. They contain about forty new species and many new records. Thus, of the eight species of Piper, Mr. C. de Candolle found five to be new, and of Peperomia all seven proved novelties. The introduction concludes with some observations as to the origin of the flora, and is followed by a systematic enumeration of the whole collection.

Physical Society, February 26.—Dr. C. Chree, F.R.S., president, in the chair.—A laboratory machine for applying bending and twisting moments simultaneously: Prof. E. G. **Coker.** The paper describes a machine built by students of the City and Guilds Technical College, Finsbury, in which uniform bending and twisting moments can be applied simultaneously over the whole length of the specimen, and in any desired proportion to each other. The principle of the design is to suspend a rod at two intermediate points by wires depending from a fixed support. The equal overhanging ends of the rod are loaded by weights W, so that the applied couple between the points of support is uniform and of amount Wa, where a is the length of the lever-arm. The rod is also twisted by weights W_1 attached to equal arms of length b, so that there is a uniform twisting moment of amount W_1b between the points of suspension. The two systems of loading are independent, and their ratio can be adjusted to any value desired.—The self-demagnetising factor of bar magnets: Prof. S. P. **Thompson** and E. W. **Moss.** This paper consists of three parts:—(1) a discussion of the significance and definition of the self-demagnetising factor of magnets in general, and of bar magnets in particular; (2) a re-determination of the values of the self-demagnetising factor for bar magnets of circular section; (3) determination of the values of the self-demagnetising factor for bar magnets of rectangular cross-section of various proportions. It is shown that, in general, for every bar magnet there is a self-demagnetising action, the value of which at the middle of the bar depends, for a given intensity of magnetisation, on the length of the bar relatively to its cross-section, on the permeability of its parts, and on the distribution of its surface-magnetism. Owing to the circumstance that with every kind of steel the permeability is neither constant nor stands in any simple relation to the flux-density, any calculation of the actual polar distribution for rods and bars is impracticable. The only form of magnet that is practicable for calculation is that of the ellipsoid, the properties of which are that for any and every value of the permeability, and in any uniform field, the surface magnetism is so distributed that the magnetic force which this distribution exerts in the interior is uniform at every point within, and therefore the internal demagnetising force everywhere within is constant.

Zoological Society, March 2.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—The development of the subdivisions of the pleuro-peritoneal cavity in birds: Miss Margaret **Poole.**—The growth of the shell of *Patella vulgata*, L., E. S. **Russell.** The breeding season of this limpet extends from July to January. Sexual maturity is reached at a length of 20–25 mm. An average size for a limpet of the last season's brood in January or February is 10 mm.; at the end of the first year it may be 29 mm. Probable sizes at the end of the second and subsequent years are 38 mm., 44 mm., 48 mm., 53 mm. Shells more than 50 mm. may be considerably more than five years old. Sexual maturity is reached in the first year, and when the limpet is only half-grown. The rate of growth decreases with age and maturity, and is slower during the colder months of the year. Considerable changes take place in the ratios of the shells' dimensions during growth, being probably in large part the expression of "laws of growth," and not due to natural selection.—The life-history of the agrionid dragon-fly: Frank **Balfour-Browne.**—Growth stages in the British species of the coral genus Parasmilia: W. D. **Lang.**

Mathematical Society, March 11.—Prof. W. Burnside, vice-president, in the chair.—The transformation of the electrodynamical equations and the laws of motion: H. **Bateman.** The paper is occupied with the development of some ideas introduced into the subject by Minkowski.

The transformations, which leave the electrodynamical equations unaltered in form, are obtained by considering the invariance of two integral forms of which the coefficients are the components of the electric and magnetic vectors. In obtaining these transformations use is made of a pair of integral formulæ which have been used as equivalents of the electrodynamic equations by R. Hargreaves.—The transformation of the electrodynamic equations of moving bodies: E. **Cunningham.** The equations for moving media have been deduced from the general electrodynamic equations by Lorentz by the use of a method of averaging. The question discussed in the paper is that of the changes produced in the equations for moving media by those transformations for which the electrodynamic equations are invariant.—The kinetic image of a convected electric system formed in a conducting plane sheet: Prof. J. **Larmor.** The question arises in connection with recent observations of the magnetic fields in the neighbourhood of sun-spots. It appears that such fields are confined to thin layers, and this effect is traced to the action of conducting layers in screening the magnetic fields due to moving charges. The details of the screening action are worked out by adapting the method used by Maxwell in the discussion of the effects produced by a magnetic pole moving in the neighbourhood of a conducting disc.—An integral equation: G. H. **Hardy.** The paper is occupied with functions defined by an integral formula which is a generalisation of Fourier's integral theorem.—Term-by-term integration of oscillating series: Dr. W. H. **Young.**—Further researches in the theory of elimination: A. L. **Dixon.**

CAMBRIDGE.

Philosophical Society, February 22.—Prof. Sedgwick, president, in the chair.—The alleged influence of lecithin on the determination of sex in rabbits: R. C. **Punnett.**—Observations on the changes in the common shore crab caused by Sacculina: F. A. **Potts.** Giard first showed that the association of the parasitic cirripedes, the Rhizocephala, with crustacean hosts is the cause of sexual modification in the latter. In the spider crabs, the male, at the moult after infection, takes on all the external characters which are associated with the female. These changes are associated with the suppression of the gonads. In the common shore crabs the modification is of a much lower grade. In a single character the parasitised male becomes intermediate between normal male and female. The female, as in the case of the spider crabs, seems incapable of change toward the male type. The male gonads may still remain in reproductive activity under the influence of the parasite, though the female is restrained from producing mature eggs.—A so-called "sexual" method of forming spores in bacteria: C. C. **Dobell.** The paper was an attempt to show that the process which has been described as a "conjugation" in certain disporic bacteria (*Bacillus bütschlii* and *B. flexilis*) should really be interpreted quite differently. From a study of the spore-formation of *Bacillus spirogyra* and *Bacterium lunula*, n.sp., the author was led to conclude that the "conjugation" represented really an abortive cell-division, and hence that no "sexual" phenomena exist. The bearing of these observations upon the problems of the sexuality of the Protista and the affinities of the bacteria were briefly indicated.—The migration of the thread-cells of Moerisia: C. L. **Boulenger.** The thread-cells of the oral battery of the Egyptian medusa *M. lyonsi* do not develop *in situ*, but are formed in the more proximal parts of the manubrium, whence they make their way through endoderm and structureless lamella to the ectoderm of the mouth region. Similarly, the thread-cells on the tentacles develop in the eye-bearing tentacle-bulbs and migrate to the batteries when completely formed.—A note on a specimen of Pelagothuria from the Seychelles: J. C. **Simpson.** This pelagic holothurian was first discovered off the Pacific coast of America by Agassiz in 1880. Since then it has been taken in the Indian Ocean by the *Valdivia* expedition, and in the North Atlantic by the Prince of Monaco. The present specimen was taken by Mr. Stanley Gardiner in 750 fathoms of water in the Indian Ocean north of the Seychelles. The general features of its anatomy conform fairly closely to the published descriptions of previous specimens, with the exception of the characteristic swimming membrane, which in this case is composed almost entirely of a sponge, which is evidently living commensally with the holothurian.—The study of discontinuous phenomena: N. R. **Campbell.** A further study of von Schweidler's theory of radio-active "fluctuations," which has been applied experimentally by Kohlrausch, Meyer and Regener, and Geiger. The theory is put in a somewhat more general and complete form, and its application to the interpretation of observations with actual instruments considered at some length. Finally, the validity of the experiments mentioned is discussed.

DUBLIN.

Royal Irish Academy, February 8.—Dr. F. A. Tarleton, president, in the chair.—Theorems on the twisted cubic: M. J. **Conran.** It is shown that the three diameters of a cubical hyperbola are situated *in* the "plane of centres," and are the medians of the triangle formed by the "points" of the curve in that plane. The intersection of the diameters is the centre of the "locus of centres," and is also the centre of the hyperboidal locus of poles of planes parallel to the plane of centres with respect to the conic sections of the developable. It is, moreover, proved that the osculating planes touch this hyperboloid, and that the points of contact lie on a second twisted cubic with the same plane of centres and the same three diameters. A theory of correspondence is developed from which a number of metrical theorems are deduced. Finally, the geometrical interpretations of some of the invariant and covariant forms of the general equation are given.—Proofs of generalised Fourier sum theorems in trigonometrical and in Bessel functions: Prof. W. McF. **Orr.** Proofs are given of expansions in some respects more general than any which the writer has seen rigorously treated. Any function, $\phi(x)$, subject to Dirichlet's conditions, is expressed between the limits a, b, in the form

$$\sum_{\mu}(\mathrm{A}e^{\mu.x}+\mathrm{B}e^{-\mu.x}),$$

where the admissible values of A, B, and μ are determined by the equations

$$\mathrm{AF}_1(\mu)e^{\mu a}+\mathrm{BF}_2(\mu)e^{-\mu a}=0,\quad \mathrm{AF}_3(\mu)e^{\mu b}+\mathrm{BF}_4(\mu)e^{-\mu b}=0,$$

the F's denoting polynomials. A similar expansion in Bessel functions is established which includes that employed in the treatment of problems in vibratory motion in the space between concentric cylinders and spheres. The method is that of contour integration previously used by Carslaw and others. The nature of the convergence and the possibility of term by term differentiation is discussed to some extent. The statement in a previous paper (see NATURE, December 24, 1908, p. 240) of an integral theorem analogous to Hankel's, involving the derivatives of Bessel functions, is a blunder.—The limestone caves of Marble Arch, Co. Fermanagh: H. **Brodrick.** Several streams descending from the sandstone uplands sink when they reach the limestone, reappearing at intervals at the bottom of pot-holes or cliff-walled depressions, and returning to the open after a distance of about a mile. The course of the stream was determined, so far as practicable, with the aid of rope-ladder work in the pot-holes and a good deal of wading and swimming in the caves. Complete plans were submitted of the water-courses surveyed.

Royal Dublin Society, February 23.—Prof. W. F. Barrett, F.R.S., in the chair.—Mechanical stress and magnetisation of iron: W. **Brown.** In this paper are given some quantitative results obtained from experiments with iron wires by varying the following four qualities:—longitudinal magnetisation, longitudinal stress, circular magnetisation, and the cross-sectional area of the wire. The results so found are given in tables and curves.—The quantity of the alkaloid taxine in yew: Richard J. **Moss.** The leaves of common yew grown in south county Dublin were found to contain 0·082 per cent. of taxine, calculated from the weight of the leaves immediately after gathering. The leaves of the variety known as Irish yew or Florence-

Court yew (*Taxus baccata*, var. *fastigiata*), growing at the same place, contained 0·323 per cent. of taxine in one tree and 0·623 per cent. in another. In the fruit taxine was found in the seed only, 0·079 per cent. and 0·082 per cent. in two specimens of Irish yew. The wide variation in the quantity of taxine in the leaves of yew accounts for the very contradictory statements made from time to time about their toxic properties.—A proposed analytical machine: Percy E. **Ludgate.** The paper gives an account of a portable machine designed by the author to evaluate automatically any algebraic function for given values of the variables. Mathematically it is closely allied to the projected analytical engine of Charles Babbage, but it rests on different mechanical principles. The machine is guided in the development of any given function by a perforated "formula-paper," which is specifically prepared for that function. A single "formula-paper" can be used for an infinite number of algebraically identical calculations, the numerical values of the variables for any particular case of the general formula being communicated by a key-board to the machine, which inscribes them in type-carrying shuttles. The shuttles are compactly stored in two coaxial cylindrical shuttle-boxes. The fundamental operations of the machine, which take place under the guidance of the "formula-paper," are the multiplication of the numbers inscribed in any two shuttles, and the inscription of the product in one or two shuttles. Important features of the machine are the use of a slide-rule method for multiplication, and the adaptation of the binomial theorem to provide a converging series for division. It is claimed that a new rapid method of mechanically performing the carrying of tens is embodied in the machine.

PARIS.

Academy of Sciences, March 8.—M. Bouchard in the chair.—The *rôle* of the septic tank in the biological purification of sewage: A. **Müntz** and E. **Lainé.** Whilst the utility of the septic tank in the biological treatment of sewage is generally admitted, there is no general agreement as to whether its chief function is that of a depositing tank or whether the fermentative processes which take place are really an essential step in the purification. According to the authors' experiments, the deposition of the material in suspension is practically all that happens in the septic tank.—The evacuation of tubercle bacilli by the bile in the intestine in animals affected with latent lesions: A. **Calmette** and C. **Guérin.** A portion of any tubercle bacilli introduced into the circulatory system may be eliminated by the hepatic gland and evacuated with the bile in the intestine. Owing to the bile acting on the envelope of the bacilli, the latter are more easily absorbed by the healthy intestinal membrane, and hence re-infection may easily take place.—The determination of conjugate systems: S. **Carrus.**—The generalisation of a theorem of Poisson: Th. **De Donder.**—Certain systems of differential equations: E. **Goursat.**—The multiform integrals of algebraical differential equations: Pierre **Boutroux.**—The thermal effects of the musical arc: M. **La Rosa.** From the sugar carbon heated in the musical arc, an experiment described in an earlier communication, small crystals possessing some of the properties of diamonds have been isolated.—Electrocapillary actions and discharge in rarefied gases: G. **Reboul.**—The unsymmetrical effect produced by a continuous current in chains of aqueous solutions of electrolytes possessing a common ion: M. **Chanoz.**—The part played by impurities in the photoelectric effect with liquids: Eugène **Bloch.** The effects have been traced to a superficial layer of grease. Water carefully purified, and placed in a vessel freed from all traces of grease, does not show the Hertz effect, but simply stirring with the finger is sufficient to make this water strongly photoelectric.—The hypothesis of the existence of positive electrons in vacuum tubes. Reply to the note of M. J. Becquerel: A. **Dufour.** The author strongly denies the necessity of the hypothesis of the existence of positive ions to explain the phenomena described by M. J. Becquerel.—Spectrophotometry with a monochromatic field: J. **Thovert.**—The influence of impurities on the thermoelectric power and resistance of aluminium: H. **Pécheux.** The amounts of iron and silicon were determined in three specimens of aluminium, and measurements made of the resistance and also of the electromotive forces of Al/Cu thermocouples.—Researches on the coefficient of diffusion of the actinium emanation: G. **Bruhat.** The actinium emanation was shown to behave like a gas, since the coefficient of diffusion was found to vary inversely as the pressure. Measurements of the rate of diffusion into carbon dioxide and into hydrogen were then made, leading to 70 as the approximate molecular weight of the actinium emanation.—Observations on spontaneous crystallisation: René **Marcelin.** The hypothesis of the preexistence of crystalline nuclei in the solution does not accord with the experimental facts given in this paper; on the other hand, the supposition that particles of dust in suspension form the starting points of the crystals appears to be very probable.—The nature of the metatungstates and the existence of rotatory power in crystals of potassium metatungstate: H. **Copaux.**—The phosphides of tin: Pierre **Jolibois.** By heating together phosphorus and tin under atmospheric pressure, the phosphide, Sn_4P_3, is the only definite compound capable of isolation in the pure state. Heating in a closed tube under pressure the compound SnP_3 was obtained. Chemical and microscopical examination confirmed the existence of these compounds; ingots containing tin and phosphorus in other proportions were shown to be heterogeneous, and hence such phosphides as Sn_5P_2, Sn_2P, Sn_3P_2, SnP, and SnP_2, described by earlier workers, have probably no real existence.—Experiments on an old vitrified glass which had become violet coloured under the influence of the sun's rays: M. **Delachanal.**—A new method for determining the constitution of the sugars: M. **Hanriot.** This method is based on the formation of a chloralose, by the addition of chloral, and subsequent oxidation to a chloralic acid. It applies to any C_5 or C_6 aldehydic sugar, but fails with the two ketones (levulose and sorbose) examined.—The preponderance of temperature in direct decompositions: the case of the benzoic and salicylic esters: Albert **Colson.**—The transformation of pinonic acid into 1 : 3-dimethyl-4-phenylacetic acid: Ph. **Barbier** and V. **Grignard.** This unexpected intramolecular change, in which the tetramethylene ring is opened up and a hexamethylene ring formed, takes place under the action of bromine and water at 100° C. The yields are good, and a crude pinonic acid may be used in the preparation.—The preparation of the anhydrides of cyclic and acyclic acids: A. **Béhal.** A study of the action of benzenyl chloride upon the fatty acids.—The normal heteromerism of *Phlox subulata*: Paul **Vuillemin.**—The experimental determination of the effective doses of the X-rays retained by the tissues of the organism: H. **Guilleminot.**—The action of the quartz mercury vapour lamp on the toxin of tetanus: Jules **Courmont** and Th. **Nogier.** After a long exposure to the mercury lamp the activity of the toxin is slightly diminished.—The action of d'Arsonvalisation on the peripheral circulation: E. **Doumer.**—The constitution of the macronucleus of the ciliated infusoria: E. **Fauré-Frémiet.**—The interstitial granulations of striated muscular fibres: Cl. **Regaud** and M. **Favre.**—The structure acquired by the seminiferous canal of the common mole (*Talpa europaea*) after the period of reproduction: A. **Lécaillon.**—The discovery of a Danian horizon with echinids in the basin of Seybouse, Algeria: J. Dareste **de la Chavanne.**—The physico-chemical variations of sea-water on the coast at Concarneau: R. **Legendre.**

CALCUTTA.

Asiatic Society of Bengal, February 3.—On the correlations of areas of matured crop and the rainfall and certain allied problems in agriculture and meteorology: S. M. **Jacob.** Apart from the fact that the data of this paper differ from those considered by Blanford, the special object has been to find equations which will predict within certain limits of error the amount of a crop from the rainfall on which it depends. These equations are the well-known regression equations, and in forming them the author believes that at any rate a first approximation to scientific prediction is attained. In each case diagrams are given from which the probable extent of a crop can be found from the antecedent rainfall for the localities considered. In this part of the paper there is also a theoretical discussion of the way in which the regression equations are modified by errors of measurement such as certainly occur for agricultural statistics, and to a less extent in rainfall data. In part ii. the distribution of rainfall, a fundamental problem both for agriculture and meteorology, is considered by the method of curve fitting developed by Prof. Karl Pearson.—Mosquito-larvæ-eating propensity of the genus Haplochilus: B. L. **Chaudhuri**. A note suggesting that fish of this genus are useful in keeping down mosquitoes, and saying that further observations will be made.

Göttingen.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), No. 4, for 1908, contains the following memoirs communicated to the society:—

July 11.—The uniformisation of given analytical curves, iii.: Paul **Koebe**.

October 31.—The valency between metals and oxygen, and its dependence on temperature: W. **Blitz**.

December 19.—The kinetics of dissociation-equilibrium and reaction-speed: F. **Krüger**.—The conformal representation on a circular lamina of a solid angle determined by the intersection of a finite number of regular analytical surfaces: Paul **Koebe**.

DIARY OF SOCIETIES.

THURSDAY, March 18.

Royal Society, at 4.30.—An Attempt to Detect some Electro-optical Effects: Prof. H. A. Wilson, F.R.S.—On the Influence of their State in Solution on the Absorption Spectra of Dissolved Dyes: Dr S. E. Sheppard.—The Ferments and Latent Life of Resting Seeds: Miss Jean White.

Royal Institution, at 3.—Recent Advances in Agricultural Science: A. D. Hall.

Linnean Society, at 8.—The Dry-rot of Potatoes: Miss Sibyl Longman.—The Structure and Affinities of *Davidia involucrata*, Baill.: A. Horne.

Institution of Mechanical Engineers, at 8.—Experiments upon the Forces acting on Twist-drills when operating on Cast-iron and Steel: D. Smith and R. Poliakoff.

FRIDAY, March 19.

Royal Institution, at 9.—Experiments at High Temperatures and Pressures: Richard Threlfall, F.R.S.

Institution of Civil Engineers, at 8.—Some Aspects of Chemical Engineering: C. J. Guttmann.

SATURDAY, March 20.

Royal Institution, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

MONDAY, March 22.

Royal Society of Arts, at 8.—Steam Turbines: Gerald G. Stoney.

Royal Geographical Society, at 8.30.—The Colorado Canyon: Some of its Lessons: Prof. W. M. Davis.

TUESDAY, March 23.

Royal Institution, at 3.—The Evolution of the Brain as an Organ of Mind: Prof. F. W. Mott, F.R.S.

Mineralogical Society, at 8.—On a Stage-goniometer for Use with the Dick-pattern of Microscope: Prof. H. L. Bowman.—On the Electrostatic Separation of Minerals: T. Crook.—On the Identity of Guarinite and Hiortdahlite: Dr. F. Zambonini (with Chemical Analyses by Dr. G. T. Prior).—Note to a Paper "On the Comparison of Refractive Indices of Minerals in Thin Sections": Dr. J. W. Evans.

Royal Anthropological Institute, at 8.15.—Exhibition of Flint Implements of the "Older Series" from Ireland: Miss N. F. Layard.—Melanesians and Polynesians: Rev. Dr. Brown.

Institution of Civil Engineers, at 8.—Construction and Wear of Roads: A. Mallock, F.R.S.

WEDNESDAY, March 24

Geological Society, at 8.—Glacial Erosion in North Wales: Prof W. M. Davis.

Royal Society of Arts, at 8.—Afforestation and Timber Planting in Great Britain and Ireland: Dr. J. Nisbet.

THURSDAY, March 25.

Royal Society, at 4.30.—*Probable Papers*: Liberation of Helium from Radio-active Minerals by Grinding: J. A. Gray.—On *Sphaerostoma ovale* (*Conostoma ovale* et *intermedium*, Williamson) and *Crossotheca Grievii*, the Ovule and Pollen-synangium of *Heterangium Grievii*: Miss M. Benson.

Royal Institution, at 3.—On Aërial Flight in Theory and Practice: Prof. G. H. Bryan, F.R.S.

Institution of Electrical Engineers, at 8.—The Electrical System of the London County Council Tramways: J. H. Rider.

Royal Society of Arts, at 4.30.—Native Man in Southern India: Edgar Thurston.

FRIDAY, March 26.

Royal Institution, at 9.—Recent Results of Astronomical Research: A. S. Eddington.

Physical Society, at 5.—Note on the Production of Steady Electric Oscillations in Closed Circuits and a Method of Testing Radio telegraphic Receivers: Prof. J. A. Fleming, F.R.S, and G. B. Dyke.—The Effect of an Air Blast upon the Spark Discharge of a Condenser Charged by an Induction Coil or Transformer: Prof. J. A. Fleming and H. W. Richardson.—On the Action between Metals and Acids and the Conditions under which Mercury causes Evolution of Hydrogen: Dr. S. W. J. Smith.

SATURDAY, March 27.

Royal Institution, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 25, 1909.

TIDAL RESEARCHES.

Manual of Tides. Part V., Currents, Shallow-water Tides, Meteorological Tides, and Miscellaneous Matters. By Rollin A. Harris. Appendix No. 6: Report for 1907 of U.S. Coast and Geodetic Survey. Pp. 231–545. (Washington: Government Printing Office, 1908.)

THE author is to be congratulated on having brought to completion in the present volume a full and exhaustive study of existing knowledge relating to tides and tidal phenomena, previous instalments of which have appeared in similar form from time to time since 1894. The subject-matter dealt with is of a miscellaneous character, summarising those parts of the subject which could not be previously introduced without undue diversions.

The early chapters deal with the nature of the horizontal flow in steady streams or pipes, and seek to establish simple laws governing the action of friction in such streams. Various formulæ are derived or quoted which appear to accord well with the results of observation, and in which for the most part the action of the cross-eddies set up is found to be well represented by a term proportional to the square of the velocity of flow of the main current.

In applying these results to tidal phenomena, doubtless the direct action of viscosity is insignificant, and it is through the medium of such cross-eddies that friction is chiefly effective. If, however, this is the case, it would appear that the sensible effects of friction in modifying ocean tides would be localised in those regions where the configuration of the land or of the ocean bed gives rise to a magnification of the tidal flow large enough to be accompanied by such eddies, and that the principal phenomena of the tides in the open ocean will suffer practically no disturbance from frictional causes other than those which may be attributed to pure viscosity. We are thus unable to accept the author's conclusion, arrived at in the second chapter, as to the paramount effects of friction in determining the phases of ocean tides, a conclusion based on wholly unwarranted assumptions as to the quantitative effects of friction (*e.g.* "Suppose $\mu'=\frac{1}{2}$," p. 281), and, further, on an almost complete disregard of its laws of action as exemplified in the preceding chapter. The author, in fact, reverts to the analogue of the simple pendulum subject to purely viscous dissipation.

The conclusions, as we have elsewhere pointed out, are of vital importance [1] for the establishment of a theory of the tides put forward by the author in previous volumes which has not proved acceptable to ourselves, and, in our opinion, has vitiated much of the otherwise excellent work presented. Fortunately, the influence of this defective theory does not appear to extend further into the present volume, which contains much for which students of the tides, whether from a practical or a theoretical aspect, will be grateful.

In the theory of river tides the author follows Airy's treatment, which, while admittedly inadequate, serves to elucidate some of the more pronounced phenomena indicated by observation, and draws interesting conclusions with regard to the form and dimensions of estuaries.

The chapters relating to the distribution of tidal currents in various phases throughout the world constitute perhaps the most important contribution contained in the present volume. Besides giving a comprehensive summary, amply illustrated by diagrams, from all available records, the author has included much material dependent on observational data specially worked up for the present publication.

Among other matters dealt with, we may refer to the subject of seiche oscillations in lakes, the general circulatory system of the ocean, and many matters which will prove of interest to marine engineers.

In relation to a work where so much is praiseworthy, it is with reluctance that we have felt it again necessary to emphasise these points on which we differ from the author. Were the work addressed to mathematicians alone, this would not have been considered necessary, but a word of warning seems to be desirable to a large class of readers to whom it will appeal who, without following out the intricate mathematics involved, might otherwise be disposed to accept the results as authoritative. The work as a whole can scarcely fail to stimulate further researches into the more recondite problems connected with tidal phenomena.

S. S. H.

[1] NATURE, vol. lxxiii., p. 249. "Of course it may be contended that in the case of the tides the conditions necessary to render friction the controlling factor exist, but this contention is nowhere put forward explicitly by the author, and we are of opinion that it could not be substantiated."

THE MORPHOLOGY OF ASIA.

The Face of the Earth. Vol. iii. By E. Suess. Translated by H. B. C. Sollas. Pp. vii+400; 7 plates, 23 figures. (Oxford: Clarendon Press, 1908.)

THE Oxford translation of the third volume of Suess's great geomorphology will be welcomed as warmly as its predecessors, though this part of his work is perhaps of less educational value and a smaller proportion of it interesting to general readers. Most of this volume is occupied by a detailed account of the stratigraphy of central and northern Asia. Much of the literature is so inaccessible that Prof. Suess's summary of the researches of the Russian surveyors will be of permanent value as a work of reference, and as he interprets and correlates the facts with his usual genius, the work is of the highest value as an original contribution to the tectonic geology of Asia. It is accompanied by a most valuable map of the structural geography of Central Asia.

The main thesis of this volume is Suess's statement of the essential structure of Asia and of its relations to Europe. He maintains the fundamental unity of Eurasia, and shows that it has been built up, around, or upon a vast sheet of ancient rocks, which form the Russian platform of Poland and south-western Russia, and most of Scotland and Scandinavia; the old rocks are buried beneath recent deposits in Western Siberia, but they reappear and form the surface of wide areas in central and eastern Siberia. This northern section of Eurasia forms Prof. Suess's primitive "Scheitel." It forms the foundation of Asia, and is bounded along its southern edge by concurrent mountain chains. The Ural mountains might be considered the western member of this peripheral series, but Suess regards it as a mountain line lying on this continental block which extends beyond them into western Europe; and he describes the Variscan Mountains of southern Germany and the Armorican Mountains, the worn down fragments of which form the hills of Belgium, Brittany, Devonshire, Cornwall, and southern Ireland, as the westernmost preserved parts of the marginal chains. It is, therefore, obvious from the broken ends of the Armorican Mountains that Eurasia must once have extended far westward into the Atlantic. Scotland and Scandinavia, however, are now the westernmost portions of this ancient continent. Prof. Suess briefly re-describes them, in reference to the great overthrusts that have been demonstrated during the past twenty-five years; and he considers why the overthrusting was westward in Scotland and eastward in Scandinavia. This section of the book even now requires revision, since Björlykke's monograph shows that Scandinavian opinion is not as unanimous as to the existence of the overthrusting as is represented, while the trend of opinion in Scotland for some years past has been against the view that the Scottish schists include altered Silurian rocks.

The second fundamental element in the structure of Eurasia was the long inland sea, the Tethys, that once separated northern Eurasia from the lands to the south. The Tethys is still represented in the western area by the Mediterranean; but in Asia it has been drained by uplift.

The third constituent of Eurasia is the fragments of Gondwanaland left in the Asiatic peninsulas. The union of the ancient continent to the north with the southern peninsulas by the disappearance of the eastern Tethys has formed the existing continent of Asia.

Even more care has been taken over the translation of this volume than of its two predecessors, and the accurate translation by Dr. Hertha Sollas has been revised by a group of distinguished geologists as a tribute of respect for Prof. Suess. The whole was then revised by Prof. Sollas. The French translation of this volume has the advantages of a fuller series of maps and sections which M. de Margerie has added to the rather scanty series supplied with the original; and the geographical terms in its sections are translated. A student might easily be confused by seeing Wasserschiede, Pass, and place-names in German transliterations all on the same section. It would have been an advantage to English-speaking students if the proper names had been given in English instead of in German forms, as it is sometimes difficult to identify them in British atlases or indexes. With this mass of foreign names occasional misprints are inevitable; thus, on p. 393, Sjörgen appears instead of Sjögren, and the Ekne schists are said to be possibly of Devonian instead of Caledonian age.

British geologists will be so grateful for this scholarly translation that they will be little disposed to criticise the rendering of Suess's geological terms; but it would be convenient if the original term were sometimes, as in the French translation, given in a footnote. Thus what Suess calls the "Scheitel" is translated the vertex, a term of doubtful suitability for an area extending from Scotland to eastern Siberia and from the Arctic Ocean to the Black Sea. Occasionally we find the other extreme and a German word retained where there appears to be an established English equivalent. Thus we read of a Garbenschist as if that were an accepted English petrological term.

The translation of the next volume is promised at the same time as the publication of the German and French editions, and as in it we may expect the general summary of Prof. Suess's conclusions, it will be eagerly awaited. J. W. G.

INFANTILISM.

On Infantilism from Chronic Intestinal Infection, characterised by the Overgrowth and Persistence of Flora of the Nursling Period. By Prof. C. A. Herter. Pp. v+118. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1908.) Price 4s. net.

IN a monograph of a hundred odd pages, the author presents a detailed study of five cases of severe nutritional disorder occurring in children. He regards them as typical examples of a distinct pathological condition, which he calls intestinal infantilism. He claims that this is a definite disease, distinct from, although sometimes associated with, other nutritional disorders, such as rickets, anæmia, marasmus, &c.

The patients were children between the ages of four and seven. They were all healthy at birth and during infancy, but in the second or third year of life they developed symptoms of intestinal disturbance, accompanied by failure of nutrition, which culminated in a state of complete arrest of physical growth for periods of months or years.

When they came under observation, a year or more after the onset of symptoms, these patients exhibited a striking clinical picture. Children of five, seven, or eight years of age weighed less than normal children of two. A boy (case 1), at the age of eight, weighed 31 lb., his development having been arrested since the age of three. Associated with their physical condition, the patients showed a chronic and very marked degree of muscular fatigue, a moderate grade of anæmia, and in some of the cases slight rickets. Their mental powers were retained to a very great extent, although naturally they were backward in comparison with normal children who were able to play games and to go to school.

The disturbance of intestinal function was shown by absolute intolerance of carbohydrates and great difficulty in the digestion of fats and earthy salts. The appetite remained ravenous, but the patients were unable to digest or assimilate food. The stools were pale, bulky, with abundance of undigested fat, and showed evidence of putrefactive changes. In the fæces and stools obtained by calomel catharsis from the upper intestine, the normal bacilli, viz. gram-negative forms belonging to the *B. coli communis* and *B. lactis aerogenes* group, appeared absent, while the bacterial elements belonged to the gram positive group, the most constant being one which the author named *B. infantilis*.

As improvement set in there was a gradual return to normal bacterial conditions. The author says that the relation of *B. infantilis* to the genesis of infantilism must be left open, but it is certain that in its most extreme form intestinal infantilism is associated with the persistence and dominance of types of intestinal flora which belong to the period of infancy, and the persistence of which, in the third to eighth year of life, must be regarded as pathological.

The author believes that the cause of arrested development is due to serious defect in the power of absorption and digestion of food-stuffs. In treating these cases he found that drugs, purgatives, and intestinal antiseptics, gave little help. With careful hygienic and dietetic supervision the intestinal disturbance was checked, and gradually, although often with the utmost difficulty, an increase of weight followed.

The observations on which this study is based were of a purely clinical nature, and the deductions cannot be accepted as conclusive, but they are suggestive and interesting, and are presented by an investigator of experience. L. G. A.

PLASTICITY IN PLANTS.

The Heredity of Acquired Characters in Plants. By the Rev. Prof. George Henslow. (London: John Murray, 1908.) Pp. xii+107; 24 illustrations. Price 6*s*. net.

THE object of Prof. Henslow's book is "to prove that evolution—so far as plants are concerned—depends upon the inheritance of acquired characters." "This was Darwin's contention." See, for instance, the summary statement on p. 424 of the sixth edition of the "Origin of Species"! "Present-day ecologists who study plants in nature are all at one in accepting the fact that evolution in plants is the result, not only of a natural response to the direct action of changed conditions of life, by means of which they evolve new structures in adaptation to their new environments, but that these acquired characters *can* become hereditary." The author calls this, for some strange reason, "the true Darwinism." His general argument, which is backed up by many very interesting facts, may be illustrated by taking the following instance:—"A certain plant of a Trichosanthes, happening to have its tendrils touching the wall of the glass frame in which it grew, instantly developed a number of minute pads which adhered to the wall, though such a structure is not known to exist in the cucumber family at all." A common sea-weed, *Plocamium coccineum*, makes similar pads if a tip happen to press against another sea-weed. Mere mechanical force produces through response hereditary structures. In the American Virginia creeper the tendrils form adhesive tips when they touch the wall. These are not hereditary, but the power to form them is. In the Japanese Virginia creeper they are partially developed before there is any contact with the wall. "They are hereditary, but quite useless until contact has taken place, when they at once begin to develop into perfectly adaptive structures. Such is obviously a result of a response with adaptation to a purely mechanical contact of the soma with the wall, and before any reproductive germ-cells exist." As the author says, "botanists have this great advantage; they have *facts* to deal with, and no theories whatever to maintain."

Prof. Henslow's book is of much value in giving fine examples of the plasticity of plants under external stimulus, *i.e.* of the appearance of new features in unwonted conditions. But it is difficult to decide how far the observed change of structure in an individual plant is a direct result of the environmental influence, and how far it is due to the liberation or inhibition of constitutional possibilities established long ago. The author thinks the first view is the correct one, and he points out that similar modifications are exhibited in similar conditions by many quite unrelated plants. As to the heritability of modifications the individual occurrence of which is recognised by all, Prof. Henslow admits that changed plants may at once begin to change back again when the novel stimulus is withdrawn, but he maintains that the acquisition may last long enough to show that it was hereditary. This is a crucial point, and should have been worked out more precisely. The author gives cases like the following:—Lesage made plants, such as garden-cress, succulent, by watering them with salt water; plants raised from seed of the somewhat succulent salted plants were still more succulent in the following year.

The general conclusion of Prof. Henslow's book is that "the origin of species is due to the joint action alone of the two great factors of evolution—*Variability* and *Environment*—without the aid of natural selection; although we are, and are likely to remain, profoundly ignorant of the mysterious process (of *Response*) within the organism by which it is effected."

AGRICULTURAL CHEMISTRY.

Elementary Agricultural Chemistry: a Handbook for Junior Agricultural Students and Farmers. By Herbert Ingle. Pp. ix+250. (London: C. Griffin and Co., Ltd., 1908.) Price 4*s*. 6*d*. net.

TEACHERS at agricultural schools and colleges are placed in the difficult position of having to teach a branch of applied chemistry to pupils who have little time, and often less inclination, to study pure chemistry. The best method of procedure has probably not so far been found, nor has agricultural chemistry as yet fallen into the hands of the text-book writer to anything like so complete an extent as its parents on both sides. It is, however, pretty clear what the agricultural student ought to be able to do. He should have a good working conception ot chemical change, and be able to trace out the broad outlines of the great natural cycles involved in the synthesis of plant substances from carbon dioxide, water, &c., and their decomposition in the animal system or the soil with production once more of carbon dioxide, water, and other bodies. He should study the factors concerned in plant growth, the soil in its relation to the plant, and the plant, considered as food, in its relation to the animal; and, as the subject has a commercial side, he must be able to interpret the analysis of a feeding stuff or manure, and to make simple calculations involving a knowledge of the chemical composition of a few common substances. The scheme of teaching must take account of the rather special nature of the student. A young man commonly chooses agriculture as a profession because he loves the outdoor life of the farm and is of a keenly practical turn of mind, and this temperament is generally incompatible with systematic study of a subject for its own sake; he will work, however, and work hard, when his studies obviously subserve a useful end and fit in with the central idea of his life.

The book before us shows how Mr. Ingle teaches agricultural chemistry, and the record of one teacher's methods and experiences cannot fail to be interesting to others who are engaged in the same work. The student is supposed to have gone through a course of inorganic and organic chemistry, but by way of recapitulation an introductory chapter deals with general chemical conceptions, and another with the composition of the atmosphere. We then pass on to a study of the soil, the plant, manures, feeding, and dairy work. The author tells us in the preface that the book was written whilst he was in touch with South African agriculture, and the illustrations are drawn sometimes from English, sometimes from South African practices.

The chief defect of the book is that it fails to present the subject as a whole, and successive chapters seem to have little connection one with the other. There is no systematic discussion of the relationship between one branch of the subject and another, and the reader gets a sense of much detail but no general principles. In the mass of detail certain things have got left out which certainly ought to have gone in. Chief of these is the physical composition of soil as shown by mechanical analysis, concerning which not a word is spoken, in spite of its fundamental significance in soil work. No mention is made of the loss of nitrogen from soils by aërobic bacterial action. There is also, and perhaps necessarily, a lack of proportion; thus the grasses get no more space than the sweet potato, notwithstanding their enormously greater technical importance.

Indeed, the book is not so much an elementary textbook as a short reference book, and from this point of view it will be found very useful for class work. There is a great collection of data from many sources, the compilation of which must have involved an enormous amount of labour, and for which the teacher will have much cause to be grateful to Mr. Ingle.

E. J. Russell.

TIMBER.

Timber. By J. R. Baterden. Pp. ix+351. (London: Archibald Constable and Co., Ltd., 1908.) Price 6*s*. net.

THIS popular manual undoubtedly contains interesting and miscellaneous information about the uses, preservation, and strength of timbers. The author, who is an engineer, occasionally refers to useful matter in engineering publications, and has compiled extensively from the reports of the forest officers of the various British colonies and of the United States. It is unfortunate, however, that he has attempted to write a general treatise. He is confessedly ignorant of botany; and his account of the structure and origin of the numerous species dealt with is usually meagre and defective, and in many instances almost puerile. His frequent descriptions of trees in the living state are out of place in a small manual, the subject of which is timber, and not forestry. The same remark applies to many of the illustrations, which are irrelevant. Hackneyed pictures of the common oak, beech, larch, &c., growing in the isolated state, only serve to show (but Mr. Baterden and his publisher are unaware of this) how trees ought not to be grown, if they are to be regarded as producers of timber of proper shape and quality.

European timbers, which should have been fully treated, on account of their great importance to the home grower and consumer, are dismissed by Mr. Baterden in a short chapter, which contains some singular errors and omissions. The bibliography at the end of the volume does not include the *Quarterly Journal of Forestry* and the *Transactions of the Scottish Arboricultural Society*, journals from which much useful material might have been extracted. Only three lines are devoted to the cricket-bat willow, the wood of which is the most costly produced in England. No allusion is made to native species, like the whitebeam and the service tree. A more glaring omission occurs in the account of home-grown poplars, where nothing whatever is said about the black Italian poplar (usually referred to *Populus canadensis*), which is the most common species in cultivation and the fastest in growth. Nobody will be much the wiser by reading the following article:—"Plum, which is somewhat similar to pear, is also used for turnery. Weight about 40 lb. per cubic foot." The durmast is erroneously considered to be something different from *Quercus sessiliflora*, with which it is identical. The timber of the Turkey Oak, which every forester knows to be of poor quality, is said to be suited for the same class of work as the common oak.

The timbers of North America are dealt with at great length; and Lebanon cedar appears amongst them. The Atlas cedar is never mentioned, though, both on account of its valuable timber in Algeria and its successful cultivation in England, it deserves an extended notice. The beautiful yellow cedar of British Columbia and Alaska, which may be seen growing with great vigour in many of our parks, is described, on p. 91, as *Thuya excelsa*, a name unknown to botanists. The author is unaware that it is already described in the preceding page under its correct name, *Cupressus nootkatensis*. The note on p. 77 about Douglas fir is misleading. The two kinds of this timber, which are distinguished by the Western lumberman, are "red fir" and "yellow fir," the colour and quality varying with the rate of growth of individual trees of the same species. The statement that only 500 Wellingtonia trees are now living is quite inaccurate, as this species occurs in countless numbers in the southern part of its area in the Sierra Nevada.

Many more instances might be given of the carelessness with which this compilation has been made. These errors detract seriously from the value of the book to the student. The price is cheap, only six shillings for 350 pages and 54 illustrations; and the practical man, for whom the work is intended, may find it worth the money, in spite of its inaccuracies.

OUR BOOK SHELF.

Biology and its Makers; with Portraits and other Illustrations. By Prof. W. A. Locy. Pp. xxvi+469. (New York: Henry Holt and Co.; London: G. Bell and Sons, 1908.) Price 10*s.* 6*d.* net.

THIS is a carefully executed historical introduction to the study of biology, and should prove very useful to students. Its aim is to sketch the broad features of biological progress, "and to increase the human interest by writing the story around the lives of the great leaders." Prof. Locy has shown shrewd judgment and a praiseworthy restraint in his selection of subjects, the result being that the student can get from this book a general view of the development of biology, yet with enough concrete illustration and biographical information to be vivid. The author has evidently gone to the original documents, and he has had his reward; he has given us a book full of fresh interest and suggestion. In the course of years Prof. Locy has made a large collection of interesting portraits of biologists, many of which adorn the walls of his laboratory at Evanston, and point a moral too. Of this collection he exhibits a fine sample in this volume. Some of the rarer ones are unfamiliar even to biologists, and have been discovered only after long search in libraries.

The book is divided into two sections. "In the first are considered the sources of the ideas except those of organic evolution that dominate biology, and the steps by which they have been moulded into a science." The succession of chapters is as follows:—Aristotle and his foundations; Vesalius and the overthrow of authority in science; Harvey and experimental observation; the introduction of the microscope and the progress of independent observation; the progress of minute anatomy; Linnæus and scientific natural history; Cuvier and the rise of comparative anatomy; Bichat and the birth of histology; the rise of physiology—Harvey, Haller, and Johannes Müller; Von Baer and the rise of embryology; the cell-theory—Schleiden, Schwann, and Schultze; protoplasm the physical basis of life; the work of Pasteur, Koch, and others; heredity and germinal continuity—Mendel, Galton, and Weismann; and the science of fossil life (a bad title). The second part of the book deals with the evolution theory, and the last chapter contains an interesting retrospect and prospect.

It is difficult to avoid misprints when dealing with many names and titles; we may note in illustration the title of Leydig's treatise of 1864 (p. 102), Weissmann (p. 109), Fleming (p. 256), Carl Pearson (p. 318), Neumayer (p. 352), Downs as Darwin's home (p. 426). Is it the case that Darwin spoke of "incredibly dull lectures" at Cambridge? We doubt if it can be said that Lamarck was the first to use a genealogical tree to express relationship of types, for was not Pallas earlier? But these are trifling blemishes in a wholesome and interesting book, and we offer Prof. Locy our congratulations. J. A. T.

Psychologie als Grundwissenschaft der Pädagogik. Ein Lehr- und Handbuch unter Mitwirkung von Seminardirektor Dr. K. Heilmann, herausgegeben von Direktor Dr. M. Jahn. Fünfte verbesserte und vermehrte Auflage. Pp. xii+527. (Leipzig: Verlag der Dürr'schen Buchhandlung, 1907.) Price 7.50 marks.

"THE psychological principles useful to the teacher could be written on the palm of the hand." This dictum of the psychologist who is himself the most brilliant teacher of his subject to the English-speaking world rises in the mind by force of inevitable contrast as one takes up this portentous volume.

Five hundred and six large and well-filled pages are the space which Dr. Jahn demands for the exposition of the psychology that he and his colleague regard as the necessary scientific foundation for the professional studies of German pedagogues—and their estimate has been endorsed by their public to the extent of five editions. No one—at least in this country—could pretend that the knowledge of all that is contained between these covers is necessary to professional salvation. As Mr. Benson has said, "A brisk, idle man with a knack of exposition and the art of clear statement can be a scandalously effective teacher." But if we are to have practitioners of the art of teaching comparable in point of professional culture with our engineers, our architects, and our medical men, there is no doubt that the topics discussed in this volume must become much more commonly studied among us than they are at present.

To the student who reads German with fair facility and is not in a hurry, Dr. Jahn's book may be warmly recommended. It is lucidly, though not brilliantly, written; it is clearly and sensibly arranged, though it preaches no strongly individualised doctrine; it is encyclopædic in range, and abreast of the present development of the subjects it touches. The notes at the end of each section, and the select bibliography at the end of the book, will be found a very useful guide to more extended reading—though the English and French works recommended appear to be confined to those that have been translated into German.

A Brief Course in Elementary Dynamics for Students of Engineering. By Ervin S. Ferry. Pp. xi+182. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 5*s.* net.

A WORK on elementary dynamics written especially for engineers gives one reason to expect something rather different from the usual text-book on purely mathematical lines, but the present work does not appear to have any particular interest for an engineering student. We are asked to consider the usual problems of blocks sliding down inclined planes, particles moving in circles, ladders leaning against walls, and, in fact, we find all the usual paraphernalia which the mathematical schoolmaster has invented for teaching the subject.

The work must therefore be regarded quite apart from the special function which it claims by its title.

It appears to be an orderly, well-written account of the principles of dynamics, but rather over-burdened with formulæ, as, for instance, where a whole page of mathematics, in small print, is devoted to proving that the reading of a weigh beam of an ordinary platform scales is not affected by the position of the load.

Apart from these minor blemishes, and under the limitations mentioned above, the work is a favourable specimen of the American college text-book.

E. G. C.

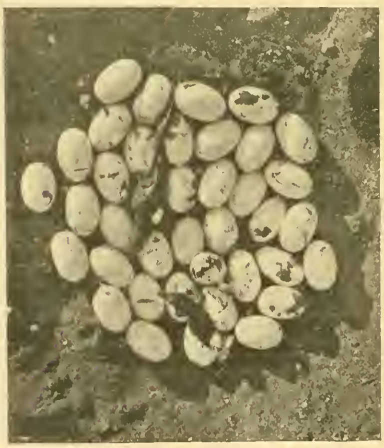
LETTERS TO THE EDITOR.

[*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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Crocodile's Nest.

THE accompanying photograph was taken in the bed of the river Rahad, south-west of Gallabat, and only a few miles west of the Abyssinian frontier, in May, 1907. This tributary of the Blue Nile begins to come down in flood in about June, continues to flow until the beginning of winter, and after this the bed is left dry, with the exception of a series of pools in the sandy river-bed.

I came across the nest through finding a depression in the sand about 4 feet above the level of a neighbouring



pool, and a number of sinuous tracks leading down to the water's edge at once suggested a crocodile's nest. The hollow was about 1 foot deep, and the eggs were 2 inches or 3 inches below the sand at the bottom of it. My guide soon pulled out a number of eggs and young crocodiles, which were quite willing, though not powerful enough, to sample one's fingers. The find was of interest, and next evening, on returning to photograph it, I was surprised to find another depression about a yard further along the bank, and, covered with sand at the bottom of this, we found the eggs and crocodiles shown in the picture. The eggs were of the usual cylindrical shape, and about 3 inches long. The crocodile on hatching is about 10 inches long, perfectly formed, and makes a noise like the croaking of a frog. There is generally a blood-like stain about the place that would correspond to the navel in higher animals. For the purpose of photography the eggs were taken out of the sand and laid in the hollow. A crocodile is seen just hatching out, and another is resting on the eggs. The shells are hard, and the dark patches on some of them are due to adhering sand.

About a yard away, again, the presence of another nest was made evident by the croaking of young crocodiles beneath the sand, and it would appear that this enables the parent to know when to release its young by excavating a hollow to such a depth that only a thin covering of sand is left over the eggs.

The first nest of eggs was not counted; a number of crocodiles had already escaped into the water, about eight were hatching out, and there were a good many eggs besides. In the second nest there were thirty-nine eggs, as the photograph shows, and the first probably contained about the same number. The third nest was not uncovered. There is no definite evidence for ascribing all three to one parent, but in view of their being so close together, and the young hatching out within two days in the different nests, there is a strong presumption in favour of doing so. If this is the case, the total number of eggs laid by one individual can hardly have been less than a hundred, and among the two batches seen only one egg was found to be addled.

I do not know whether nesting is confined to a particular period of the year, but in the case of a variable river like the Rahad there is a considerable risk of the eggs being either washed away or left at a distance by the retreating water, except during the late winter and spring months.

Young crocodiles, up to about a yard in length, appear to be far more active than the older ones. They leave the pools, climb out of the river channel, and may be met at a distance of fifty yards away. They are able to run at a considerable pace. The older ones are generally seen floating about or lying on the banks close to the water.

Khartoum, March 3. G. W. GRABHAM.

A Winter Retreat for Snails.

SOME of the reaction phenomena of *Helix aspersa* would probably account for the presence of thirty-seven specimens in an empty tea-pot as described by Prof. McKendrick in NATURE of March 4.

This species is, as is well known, *negatively phototropic* —"seeks" dark places—and is also, especially at hibernation, *stereotropic*, "attracted by surfaces."

The empty tea-pot lay on its side by an herbaceous border, where many snails would be hidden from view. In November, when preparing to hibernate, these snails would wander restlessly, and by the combined reactions would find their way "with mechanical certainty" into the dark cavity of the tea-pot, and there come to rest. The number collected together in the tea-pot would increase, as, on arriving in the cavity, movement in each individual would cease; and, moreover, the individuals would cling together.

As a result, the tea-pot would act like a trap in which the snails were caught, and where they would remain until metabolic changes in their own bodies made them restless and compelled them to move about.

W. HOSKYNS-ABRAHALL.

The Golden Fleece.

IN the review of Dr. Bowman's book on "The Structure of the Wool Fibre, &c." (NATURE, March 4), there occurred the statement that the introduction of the domestic sheep into Greece was "probably enshrined in the legend of the golden fleece." Strabo, however, long ago gave a plausible explanation of this legend in stating (Book xi., ii, § 9): "The Soanes occupy the heights of Caucasus above Dioscurias" (the present Iskuria, at the mouth of the Kodor in Abkhasia). . . . "In their country the winter torrents are said to bring down even gold, which the barbarians collect in troughs pierced with holes and lined with fleeces; and hence the fable of the golden fleece."

FELIX OSWALD.

Nottingham.

THE BOTALLEK CIRCLES.

BORLASE, in his "Antiquities of Cornwall" (p. 199), published in 1769, refers to what he terms "the curious cluster" of circles at Botallek,

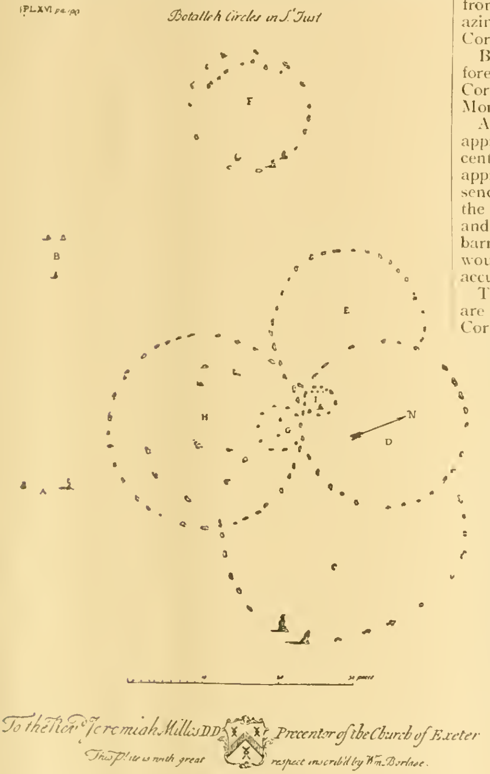


FIG. 1.

the seeming confusion of which led him to write "I cannot but think that there was some mystical meaning, or, at least, distinct allotments to particular uses."

Fortunately for science, he accompanies his account with a plan, evidently carefully prepared (Fig. 1), which is now the only thing that remains; every stone has been utilised in building an engine house, or in other ways. Only the site is shown on the ordnance map.

As the "cluster" of circles exceeds in elaboration anything of the kind with which I am acquainted, it was of great interest to see if anything could be made of it in the light of other researches in Cornwall, and I propose now to state the result in a very abridged form. Fuller details I have communicated to the Royal Society.[1] The first point of inquiry concerned the N. point given on the plan—whether it was true or magnetic. A perusal of Borlase's volume showed that he was fully acquainted with the necessity of referring in such descriptions to the true north, instead of, as he says, "such an inconstant and fluctuating index as the declination of the needle, which is not only different in different places, but varies also at different times in one and the same place" (p. 115).

When this point was settled, it became evident at once, when the circles were completed and lines drawn from centre to centre, that approximately the same azimuths were in question as those met with in other Cornish circles.

Borlase does not give the heights of hills. I therefore asked Mr. Thomas, an active member of the Cornish Society for the Astronomical Study of Ancient Monuments, to observe them for me.

Among the azimuths were two, the first from the approximate centre of the circle F to the approximate centre of E, N. 83° E., and the second, from the approximate centre of F to that of H, S. 66° E. In sending his results to me Mr. Thomas remarked that the former line passes over the Carn Bean barrow and the latter passes $2\frac{1}{4}$° to the N. of the Goon Rith barrow; thus the azimuth of the Goon Rith barrow would be S. $63\frac{3}{4}$° E. This enabled me to check the accuracy of Borlase's N. point.

The two alignments to two still existing barrows are common to Botallek and other monuments in Cornwall. On the assumption of identity of object, Borlase's orientation was true, and not magnetic, and, also, was not far from the mark.

The next step was to make a very careful determination of the centres of the circles, and it was found that the line, centre of F to centre of H, coincided with the line S. 63° 45′ E. from the former to the Goon Rith barrow. In other words, the difference between the azimuth we had provisionally determined from the circles and that of Goon Rith barrow was due to an error of centring, and no doubt was left that the line between the centres of F and H was really directed to the barrow. Similarly the line N. 83° E. joining the centres of F and E was directed to the Carn Bean barrow. Both these lines were recognised as familiar, giving, approximately, the November sunrise and the heliacal rising of the Pleiades in May respectively. In the case of the S.E. azimuth there is an alternative explanation of the sight-line. Both in Cornwall and Wales we have found that azimuth-marks (barrows, &c.) were sometimes erected so that they gave the direction of sunrise a fortnight or three weeks before the critical date. I therefore decided to adopt the

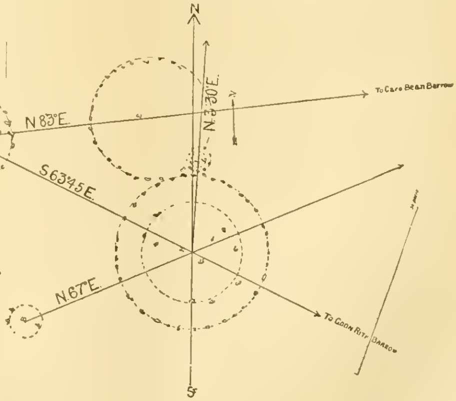


FIG. 2.

Pleiades azimuth, N. 83° E., as the fundamental line by which to fix the N. point, and it followed

[1] Proc. Roy. Soc., March, 1909.

that Borlase's N. point was less than 3° to the west.

Working on this basis, I joined up the centres of the circles, as shown on the plans (Figs. 2 and 3), and carefully measured the resulting azimuths. These I sent to Mr. Thomas, asking him if the slight modifications of azimuths that I had introduced had sensibly altered his values for the corresponding angular elevations. After a second series of observations, he replied that the elevations were the same for the modified azimuths as they were before.

It at once became obvious that the alignments divided themselves into two groups—one erected for the observations of the May-year, the other for solstitial phenomena—and with each group there is associated a clock-star which affords a means of determining the approximate date of each group. For this reason I give two separate plans (Figs. 2 and 3) showing the separate groups of alignments, and two separate tables giving the respective results. I will deal with the May-year circles first, table I. (Fig. 2).

These results agree with the May-year results previously obtained from the study of other Cornish circles, and to illustrate this I bring together a selection of the results previously published (table II.).

An examination of Fig. 2 shows that the azimuths given in the table are exactly those obtained by joining up the centres of the circles and adopting the N.—S. line derived from Mr. Thomas's two measures of direction. The results justify the 3° change of the orientation of Borlase's plan.

The Solstitial Year.

Joining up the centres of H, G, D, and C, as shown in Fig. 3, we obtain the results given in table III.,

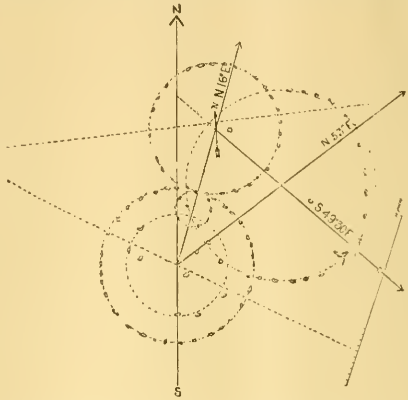


FIG. 3.

results which are obviously connected *inter se* and with the solstitial year.

I.—*May-year Alignments at Botallek* (*lat.* 50° 8′ *N.*).

Alignment	Azimuth	Hill (Mr. Thomas's) measures	Declination	Object	Date
Centre of circle B to centre of circle H	N. 67° 0′ E.	3° 0′	16° 31′ N.	May sun	May 6 ; Aug. 7
Centre of circle F to centre of circle H to Goon Rith barrow	S. 63 45 E.	2 44	14 43 S.	November sun (possibly a warner)	Nov. 2 ; Feb. 10
Centre of circle F to centre of circle E to Carn Bean barrow	N. 83 0 E.	3 35	7 2 N.	Pleiades (warning May sun)	1680 B.C.
Centre of circle H to centre of circle I	N. 3 30 E.	0 0	39 14 N.	Arcturus (clock-star)	1730 B.C.

II.—*Similar May-year Alignments in Cornwall* (*for comparison*).

Monument	Lat. N.	Alignment	Azimuth	Hill	Declination	Object	Date
Merry Maidens...	50° 4′	Circle to Fougou	N. 64° 0′ E.	0° 30′	16° 21′ N.	May sun	May 5 ; Aug. 7
Boscawen-Un ...	50 5	,, stone	S. 66 30 E.	1 0	14 32 S.	Nov. sun	Nov. 2 ; Feb. 10
The Hurlers ...	50 31	S. circle to N.E. stone ...	N. 78 47 E.	0 12	7 23 N.	Pleiades	1610 B.C.
Trippet stones ...	50 33	Centre of circle to Rough Tor	N. 15 0 E.	1 30	39 1 N.	Arcturus	1700 B.C.

III.—*Solstitial Alignments at Botallek* (*lat.* 50° 8′ *N.*).

Alignment	Azimuth	Hill (Mr. Thomas's) measures	Declination	Object	Date
Centre of circle H to centre of circle C	N. 53° 0′ E.	1° 45′	23° 41′ N.	Solstitial sun (summer)	
Centre of circle D to centre of circle C	S. 49 30 E.	1 35	23 44 S.	Solstitial sun (winter)	
Cent. of circ. H to cent. of small circ. G	N. 16 0 E.	0 0	37 28 N.	Arcturus (clock-star)	1420 B.C.

IV.—*Similar Solstitial Alignments in Cornwall* (*for comparison*).

Monument	Lat. N.	Alignment	Azimuth	Hill	Declination	Object	Date
Boscawen-Un ...	50° 5′	Circle to Fine Menhir ...	N. 53° 30′ E.	2° 23′	23° 59′ N.	Solstitial sun (summer)	
The Hurlers ...	50 31	N. circle to S.E. stone ...	S. 50 50 E.	1 18	24 17 S.	Solstitial sun (winter)	
Tregeseal	50 9	Longstone to Chûn Castle...	N. 23 30 E.	1 35	37 9 N.	Arcturus	1350 B.C.

As before, I give a selection from previous results, showing that the alignments we are now dealing with have become familiar by reason of their occurrence at the Cornish monuments investigated earlier (table IV.).

From the results given above it is evident that in this "curious cluster" of circles at Botallek we have an epitome of the chief sight-lines used in Cornwall. May-year sun, clock-star, warning-star, and solstitial sun are all represented.

The May-year group was the first, by something like 300 years, to be erected, and it should be noted that the date for the Pleiades circle E is coincident, within our probable error, with the date of the clock-star alignment H—I.

Borlase's plan (Fig. 1) affords us evidence on this point, for it shows that the circles F, H, and I are associated by being made up of two concentric rings of stones.

NORMAN LOCKYER.

WESTERN TEACHING FOR CHINA.

THE meeting which was held in the Mansion House last week, and presided over by the Lord Mayor, shows that at last an interest is being taken in this country in the education of China in Western science and literature. Further proofs of the same interest are given by the movement promoted by Sir Frederick Lugard, the Governor of Hong Kong, for the foundation of a university in that colony, and of another by the German authorities in the province of Shantung. The larger question of Chinese university education, already undertaken by the Chinese authorities, is at present under the consideration of a joint committee of members of the universities of Oxford and Cambridge, so that it looks as if the Chinese are not likely to want for advice and assistance in carrying out the educational development of their country.

The four schemes which have been mentioned in no way conflict with each other, and if there are sufficient means there are no reasons why they should not all be carried out. Their success and usefulness will depend, in great part, on the spirit which animates the work which they do. The interests of China must always be the chief object in view. If the proposed university at Hong Kong be looked upon simply as a means of advancing British interests, and that at Shantung of advancing German interests, they may at first have a certain amount of success, but they would be doomed to failure before long, as nothing touches the spirit of Eastern people so much as any attempt to thwart their legitimate national aspirations. The success of the Japanese has been in great part due to the fact that while they have taken advantage of Western assistance, all their institutions have been moulded according to Japanese ideas, and with the object of enabling Japan to take her due place among the nations of the world. Other causes have been added as things developed, but this has been the fundamental one. No attempt must be made to mould the Chinese into Eastern Britons or Germans.

The medical colleges proposed by the China Emergency Committee are very much needed, as was fully shown at the Mansion House meeting by the present writer's fellow-student of forty years ago, Dr. J. Campbell Gibson, of Swatow, who was supported by Dr. J. B. Paton, of Nottingham. They pointed out

"that the importance of the steps suggested was not measured by the possibilities of the four colleges which were proposed, for the time will come—let us hope speedily—when the Chinese Government must itself take up medical education; and the presence, as models, of institutions on Western lines will then be decisive as to the scientific principles on which the State action must proceed. The cry in China of 'China for the Chinese' will thus be satisfied in the best possible way."

The proposed university at Hong Kong is intended—at least, to begin with—chiefly to train medical men and engineers. Already useful work in the way of training medical men has been done by the Hong Kong Medical College, founded in 1887, and a beginning has been made in technical education in the so-called "Technical Institute," which gives opportunities for instruction in various subjects, but especially engineering and its allied subjects. The proposed university would therefore be a development of existing institutions, and there can be no doubt that Hong Kong would offer many facilities for the practical sides of the studies. Sir Frederick Lugard has pointed out that

"Its dockyards and electrical and other works will afford practical instruction which can hardly be rivalled in China for very many years; while the location of the university in a British colony will, on the one hand, form an attraction to students who desire to obtain opportunities for colloquial English and to acquire something of the Western atmosphere as well as the mere dry bones of knowledge, and, on the other hand, to professors who might less willingly accept an exile in China. In the medical faculty more especially, Hong Kong can offer facilities for practical anatomy in the dissecting-room which Chinese prejudice, at present at any rate, precludes in China."

Of course, other subjects and degrees would be added as circumstances permit, notably an arts degree. The preparation for that, however, should not proceed strictly on the lines of British colleges, but should comprise international law and treaties, geography, comparative history, and, not least, Chinese literature and classics, so that there may be no reproach of dissociating Chinese students from their national sympathies and language.

The colony of Hong Kong will soon be connected with the main railway system of China, so that the university would appeal to a very large area, as the Chinese will not be slow to recognise that here are to be obtained the advantages of Western education at a smaller cost, and under more desirable conditions in various ways, than by sending their sons to the West. More than thirty years ago, when I was in Japan, as principal of the Imperial College of Engineering, Tokyo, I very often discussed projects of this kind with the first Chinese Minister to Japan, and when I suggested a duplicate of our college in China, he said that "the streets of Peking were too narrow for such an institution." This, of course, was simply his way of saying that he did not think China was yet ripe for a fully developed scheme of technical education.

Much has happened since then, and the students of the Imperial College of Engineering have been important factors in the making of New Japan, a fact which has been recognised by the Chinese, and now there are large numbers of Chinese students in Japan and considerable numbers in Europe and America. In Glasgow, for instance, they are almost as numerous as the Japanese students, but, of course, there is not the same necessity for the latter coming here as formerly, as they have such good facilities for study in their own country.

My Chinese friend was a philosopher in his way, and was not unacquainted with the very difficult political, economic, and social problems which were to be found in the countries of the West, and he had very great doubts whether it was wise to bring the same problems into China by the introduction of Western science and methods. The Chinese now see that they cannot isolate themselves from the other countries of the world, and they are anxious to accept from them sufficient, at least, to preserve their national integrity, but the forces behind them will make it impossible to draw a limiting line.

For many years I have been watching with interest the great evolution which is going on in the countries bounded by the Pacific area. Japan led the way, and now China follows, probably, however, at a slower rate; but, as my Chinese friend sometimes said to me, "I wonder where you people of the West think you will be as regards trade and industry, as well as other things, when China is fully awake?" This opens up a wide vista for speculation, and I merely mention it in the hope that those who are proposing what seem to be small things may consider their future possibilities and their results on the civilisation of the world.

HENRY DYER.

THE ROYAL SOCIETY OF ARTS AND THE LONDON INSTITUTION.

IN NATURE of April 6, 1905, attention was directed to negotiations that had commenced between the Society of Arts and the London Institution having for their object the amalgamation of the two institutions. A special meeting of the promoters of the London Institution was about to be held to consider the scheme, which was supported by a joint committee of the two institutions; and whilst it was recognised that some opposition on the part of members of the London Institution would have to be reckoned with, it was assumed that amalgamation would be brought about. This expectation was not realised. Whilst there is reason to believe that the members of the Society of Arts would have been practically unanimous in their support of amalgamation, a vigorous minority of the London Institution opposed, with the result that the scheme was never voted upon. It was shelved, and for the time being no more was heard of amalgamation. After the failure to bring about union between the two institutions, no attempt was made to vitalise the London Institution. It remained, as it had been for some years, practically moribund.

Impressed with the undesirability of allowing matters to continue as they are, and as convinced as ever that amalgamation would be for the advantage of both institutions, those members of the London Institution who moved in the matter in 1905 have now renewed their efforts to bring about an amalgamation of the two institutions. They first tested the feeling of members by means of a postcard ballot, which resulted in 526 supporting the proposal for amalgamation and 84 voting against, some 400 remaining neutral. This was a sufficiently decisive vote to warrant the managers of the London Institution in approaching the Royal Society of Arts, but before that could be done certain members of the institution, strong opponents of amalgamation, moved in opposition, with the result that there was a special meeting of members of the institution, and a ballot taken. This ballot resulted in 322 voting in favour of amalgamation, and 218 against it, leaving between 400 and 500 who preferred to be neutral. The managers of the London Institution did not consider that this vote was sufficiently decisive to warrant them in approaching the Royal Society of Arts without further consideration, and accordingly a meeting was arranged for March 10 to consider the position. The result of that meeting has not been made known to the public, but it is understood that it disclosed considerable hesitation in proceeding with the scheme unless, and until, the minority, or some of them, could be induced to waive their opposition.

So the matter stands. It would be rash to predict the upshot. There is no reason to suppose that the members of the Royal Society of Arts are not as willing as they were three years ago to support a scheme of amalgamation approved by the secretary, Sir Henry T. Wood, and the committee. Nor do the arguments of the minority of the London Institution seem very convincing. One of their objections is that, under the proposed scheme, the institution would be moved from the City to somewhere "east of Charing Cross and west of Chancery Lane." We can understand this objection having considerable weight fifty years ago. Founded in 1805 by merchants and bankers of the City of London, the object of the London Institution was to maintain, in what was then a central position, an extensive general library of reference, and to promote the diffusion of knowledge by lectures and *conversazioni*; for at that time, and for many years afterwards, the City contained a large residential population. This population has now practically disappeared, and the number of proprietors who use the institution is small, and every year becomes smaller. To remove the institution to a building just outside the City boundaries, at or near the east end of the Strand, would not be inconsistent with the objects for which the institution is intended. The dissentient minority urge again that the Corporation of the City of London ought to take action to amalgamate the institution with the Gresham Trust. But whatever may be said in favour of this proposal, it means that the Corporation would have to endow the London Institution, and that, there is good reason for believing, they would not do.

The arguments in favour of amalgamation seem to us very strong, and we hope that in the end they will prevail. The history of the Royal Society of Arts has been a highly creditable one. It is under sagacious control. Its financial position is sound, and its services to the community great. Amalgamation with the London Institution would mean for it some sacrifice of sentiment, but the union would be advantageous to it in certain ways. It would give it the permanent local building that it lacks. The site of the London Institution is estimated to be worth at least 150,000*l*., and this would be amply sufficient to provide an adequate building, and might, indeed, supply accommodation for several other societies disposed to join in the scheme of building. The library of the London Institution, joined to that of the Royal Society of Arts, would make one of the best reference libraries in the metropolis, and the combined revenues would enable much more to be done in the interests of science, and provide a better knowledge of scientific work and methods than is possible at present. On the whole, the arguments seem greatly in favour of amalgamation between the two institutions on terms equitable to both, and it may be hoped that when the dissentient minority of the London Institution realise more fully than they seem to do at present that the Corporation of London is not prepared to subsidise their institution, their objections to amalgamation with the Royal Society of Arts will not continue to be pressed.

AGRICULTURAL EDUCATION.

THERE is abundant evidence that the report of the Departmental Committee on Agricultural Education is receiving the attention it deserves. The Farmers' Club has issued a memorandum on the subject, and we learn from the *Times* of March 1 that the County Councils Association proposes to discuss various matters arising out of the report at its conference at the end of this month. The Central and Associated Chambers of Agriculture are also interesting themselves in the matter. On March 9 a deputation waited on the President of the Board of Education and the President of the Board of Agriculture for the purpose of directing attention to the need for reform in agricultural education.

It will be useful to recall the conclusions and recommendations of the report. The Committee considers that a satisfactory foundation has been laid for a national system of agricultural education, although much remains to be done in the development of details. In particular the facilities for lower-grade agricultural instruction and for itinerant instruction are very inadequate. There is a shortage of teachers and of experts for higher work, but it is considered that existing institutions could make up the deficiency if only they were better equipped. Increased provision is needed for research work. More money, in fact, is wanted all round. A system of dual control is recommended. The Board of Education should look after elementary and secondary school instruction; the Board of Agriculture should, as now, deal with college and university instruction.

The Farmers' Club agrees with practically all these conclusions, and its memorandum is a most interesting document, showing, as it does, the value set by practical men on agricultural education. The club would probably not claim to represent the whole of the farming community, but it includes many of the best men, and its views may be taken as identical with those of the most enlightened agriculturists of the day. Great stress is laid on the fact that more money is wanted, and must be forthcoming. Winter schools are asked for, where the sons of small farmers may attend for about three months, to leave better equipped for their work. The schools must be staffed by the right sort of men. Itinerant instructors of the right kind are needed to get hold of the little farmer and show him where his methods can be improved. Men are wanted to carry out research work. In some of the existing schools and colleges the standard of the teaching requires raising, but the writers of the memorandum

"cannot attempt to lay any blame on those responsible, for they have made the best use of the small funds at their disposal, and cut their cloth in accordance with their means. The salaries offered are in many cases almost an insult to an educated man, and it is frequently found that no sooner has an instructor settled down in a college, institute, or county than he is offered a better post (generally abroad), and someone else has to be found at the same miserable salary with like results."

All this is beyond dispute. The real difficulty is the lack of men. The agricultural colleges ought to be able to supply all the men needed, but they do not, and no one will deny that the committee of the Farmers' Club has discovered the correct reason. There is small inducement to go on to the teaching staff of the ordinary agricultural college, and still less to remain there. The result is a frequent change and loss of the best men, which is unsatisfactory now and unpromising for the future. Meanwhile, there are not enough of the right men either for the home or the colonial appointments. One of the best of the colonial agricultural departments has been staffed in part by Americans, because competent men were not available here; and it is much to be feared that some who have gone out to colonial appointments as the best we could send have not given a particularly satisfactory impression. This is a subject which demands very serious consideration.

The contentious part of the report is that relating to the control of agricultural education in the various technical schools and colleges which deal with agriculture alone. The Departmental Committee favours a dual control, and the Farmers' Club agrees. It has been said that the Board of Education desires to control the whole system from start to finish. We gather from the *Times* that this question will be dealt with at length by the County Councils Association Conference. Undoubtedly, the ideal arrangement is to have the whole system under one Board, properly coordinated, with no break anywhere from the elementary school to the agricultural college of university rank. But the fact must be recognised that the Board of Agriculture is, and has been for some years, in possession of the field, and it has, on the whole, the confidence of the farming community, some of its officials being actually known to the farmers. The Board of Education, on the other hand, is not in touch with them, and until a few years ago had no official of agricultural standing. The Farmers' Club fears that under the Board of Education agricultural education would never be more than a "side show," and this they most emphatically do not want. Of course, if the Board of Education were prepared to do the big thing, it would no doubt be best for it to take entire control, but if not, the dual arrangement suggested certainly seems more satisfactory. In any case only a few institutions are concerned; the universities and university colleges with chairs of agriculture are, and should remain, outside the sphere of action of either Board, except in so far as they accept grants for the upkeep of the department or farm. It is gratifying to learn, from the replies given to the deputation of March 9, that the two Boards are considering means by which they can have better organisation, and each is prepared to cooperate heartily with the other in finding the solution of the difficulty.

THE AIR OF COTTON MILLS.[1]

THE latest report on the subject of humidity and ventilation in cotton mills adds considerably to our knowledge of this difficult question, complicated as it has become since about 1870 by the introduction of artificial humidity by means of "steaming." Previous reports have shown that the ventilation of most sheds was far from satisfactory, and that the health of the workers suffered from excessive steaming. As a result an Act was passed in 1901 which prescribed, among other things, the amount of fresh air to be supplied per hour for every person employed, the amount of humidity permitted, and that the amount of carbon dioxide should not exceed nine volumes in 10,000 of air. Experiments carried on in 1906 show that the relative humidity is highest in the morning (79 and 80), and diminishes as the day advances, falling to 70 and 71, also that the common supposition that the relative humidity inside the shed is less than that outside is true only for the winter months.

The table of humidity in the Act of 1901 begins at a wet-bulb temperature of 35° F., and ends with a wet-bulb temperature of 91° F.; but weaving cannot be carried on at the lower temperature, and the operatives cannot endure the higher temperature. There is a

[1] Report of the Departmental Committee on Humidity and Ventilation in Cotton Weaving Sheds. (London: Wyman and Sons, Ltd.)

consensus of opinion among medical men that the wet-bulb temperature should not exceed 70° F. to 75° F., and that operatives should not be called on to work above this limit.

In regard to ventilation, some surprise will be expressed that the report recommends an increase in the permissible amount of carbon dioxide to 12 volumes in 10,000 instead of nine as formerly. Considering the researches of Parkes, Pettenkofer, Angus Smith, Carnelley, and others, all of whom recommend a much lower limit, it is not surprising to find that the committee brings forward a considerable amount of evidence in support of what it evidently considers may be regarded as a reactionary proposal, and it must at once be admitted that there is a good deal to be said in its support. The evidence submitted to it shows that in coal mines the average amount of carbon dioxide is 35 volumes in 10,000, and such air does not appear to have an injurious effect on the miners. No doubt this is explained by the fact that this carbon dioxide is formed by oxidation of carbon, and is not mainly due to respiration as it is in weaving sheds.

Eminent medical authorities, both in this country, in America, and on the Continent, concur in stating their belief that the ill-effects in crowded rooms are due to excessive heat and humidity rather than to the amount of carbon dioxide. Direct experiments by Haldane and Lorrain-Smith showed that the condensed vapour from respired air, when injected into animals, produced no injurious effects, and their further experiments are "distinctly against the theory that a volatile poison, other than carbonic acid, exists in expired air." Flügge has made an elaborate series of experiments on this subject, and comes to the conclusion that "Temperature, humidity and movement are of enormously greater importance for our comfort and health than the chemical composition of the air." Valuable confirmation of these scientific results comes from the practical experience of the operatives in cotton mills. Thus in one mill, where both dry and wet sheds were under the same roof, the health of the workers was equally good in both, but there was a general desire to transfer to the wet shed, in which the carbon dioxide in the air varied between 34 and 41 volumes in 10,000.

Another point to which the attention of the committee was directed was the quality of the water used for the supply of steam. If from an impure source, injurious organic matter may be introduced, and it is suggested that water used for this purpose should be of a certain legal standard of purity. The other recommendations of the committee may be surmised from what has been said already.

RETURN OF THE BRITISH ANTARCTIC EXPEDITION.

THE British Antarctic Expedition ship *Nimrod* has returned to New Zealand with Lieut. E. H. Shackleton and the other members of the landing party safe on board. A long despatch received from Lieut. Shackleton by the *Daily Mail* reports that he himself, with three other members of the expedition, started on an attempt to reach the South Pole from Ross Island, at the western end of Ross's Great Ice Barrier, on October 29 of last year. Ross Island was reached again at the beginning of this month, the explorers having achieved in the interval—122 days—a journey of 1708 statute miles, in the course of which they reached a point in latitude 88° 23′ S. and longitude 162° E., or only about 111 miles from the South Pole.

Pushing beyond the most southerly point reached by members of the National Antarctic Expedition on board the *Discovery* (82° 16′ 33″ S.), Lieut. Shackleton found the high mountains of South Victoria Land trending in a south-easterly direction across his route, and was obliged to ascend a long glacier leading up to a high tableland, on which the explorers eventually reached an altitude of 10,500 feet. Lieut. Shackleton concludes that the South Pole is doubtless situated in this plateau region. The motor-car, though proving useful for transport purposes in the neighbourhood of the winter quarters, was not employed on the southern journey, but the Manchurian ponies were of great assistance.

Another party, under Prof. Edgeworth David, F.R.S., professor of geology in Sydney University, journeyed from the winter quarters northwards along the coast of South Victoria Land to Terra Nova Bay, in about 75° S., and then ascended to the high plateau-land which stretches inland, and journeyed at an altitude of more than 7000 feet to the south magnetic pole, the position of which was fixed, in the neighbourhood of latitude 72° 25′ S., longitude 154° E.

On the return voyage, Lieut. Shackleton caught sight of the mountainous northern coast of South Victoria Land, stretching at least forty-five miles south-west and west of Cape North, the previous limit of observation.

Throughout the expedition numerous and varied scientific observations were recorded.

Special interest promises to attach to the geological studies of Prof. David, the biological work of Mr. James Murray, and the meteorological and magnetic observations. We shall hope to return to these when more detailed reports have been received. In some fresh-water lakes near Cape Royd, Mr. Murray found abundant microscopic life. Rotifers were found of remarkable vitality, capable of living for years in the ice of the lakes. Large sheets of a fungus-like plant were found in the lakes, and the vegetation on Ross Island included many lichens and a few mosses. Systematic records were kept of all the appearances of the Aurora australis. An ascent was made of Mount Erebus, 13,120 feet high, by a party under Prof. David, and the old crater of the volcano, which was reached at an altitude of more than 11,000 feet, was found to be filled with large felspar crystals, pumice, and sulphur. The south magnetic pole seems to have been located with much exactness.

Judging from the interesting communication to the *Daily Mail*, a large amount of valuable work has been accomplished. Lieut. Shackleton and the other members of the expedition are to be congratulated upon their remarkable achievements.

UNIFORMITY IN MATHEMATICAL NOTATION AND PRINTING.

THE subject of establishing a better understanding between mathematical workers and printers has for some time engaged the attention of the council of the Royal Society. It is desirable that the amenities of printing should be considered by authors, so that when there are several ways of writing a formula that one should be employed which is easiest printed and looks best in the published work. It is especially undesirable that different ways should appear at random in the same volume, or even on the same page.

In his anniversary address to the Royal Society on November 30, Lord Rayleigh incorporated a memorandum on this subject, drawn up in the first instance by Prof. Larmor, as an appendix. After recounting earlier efforts in this direction made by a committee of the British Association in 1875, the paper offers the following suggestions, which are here reprinted with a view to their being of use in a wider field :—

Recommendations regarding Mathematical Notation and Printing.

Always,
instead of

$$\frac{x}{3} \quad \frac{a+b}{2} \quad \frac{a+\frac{b}{2}}{\frac{c}{3}+\frac{d}{4}} \quad \frac{a}{b+\frac{c}{d}} \quad \sqrt{x} \quad \sqrt{-1} \quad \frac{1}{x} \quad \frac{1}{x^n}$$

write

$$\tfrac{1}{3}x \quad \tfrac{1}{2}(a+b) \quad \frac{a+\frac{1}{2}b}{\frac{1}{3}c+\frac{1}{4}d} \quad \frac{a}{b+c/d} \quad \sqrt{}x \text{ or } x^{\frac{1}{2}} \quad \iota \text{ or } i \quad x^{-1} \quad x^{-n}$$

instead of

$$x.\overline{x+a} \qquad \sqrt{x-y} \qquad e^{\frac{n\pi x}{a}} \qquad \int_0^{\frac{\pi}{2}} \qquad \lfloor\underline{n}$$

write

$$x(x+a) \qquad \sqrt{(x-y)} \text{ or } (x-y)^{\frac{1}{2}} \qquad e^{n\pi x/a} \qquad \int_0^{\frac{1}{2}\pi} \qquad n\,!$$

In current ordinary text,
instead of

$$\frac{x}{a} \qquad \frac{a+b}{c+d} \qquad \frac{x}{y+\frac{t}{2}} \qquad x/y+\frac{a}{b+c}$$

write

$$x/a \qquad (a+b)/(c+d) \qquad x/(y+\tfrac{1}{2}t) \qquad \frac{x}{y}+\frac{a}{b+c}$$

Excessive use of the slanting line, or solidus, is, however, undesirable; it may often be avoided by placing several short fractions or formulas, with the intervening words if any, on the same line, instead of setting out each one on a line by itself. The last of the examples given above illustrates an improper use, in which symmetry is spoiled while nothing is gained; either both fractions should be written with the solidus, as $x/y+a/(b+c)$, or else neither as above.

The solidus should be of the same thickness as the horizontal line which it replaces; in some founts of type it is too thick and prominent.

Irregularities in the spacing of letters and symbols in the formulas as printed are often the cause of a general unsatisfactory appearance of the page.

For centimetres, millimetres, kilometres, grams, kilograms, the abbreviations should be cm., mm., km., gm., kgm. (not cms., &c.), and so in similar cases. Present custom is against the use of the signs $\therefore$ and $\because$

Symbols which are not provided in the usual founts of type are, as a rule, to be avoided. Compounded symbols such as $\dot{a}$ or $\bar{a}$ usually involve justification, and are thus liable to become deranged or broken. The two examples here given have, however, become so essential that separate founts should be provided for them.

The use of a smaller fount for numerical fractions is now customary; thus always $\frac{1}{3}a$ instead of $a/3$. The use of negative exponents often avoids a complex fractional form: as also the use of the fractional exponents, such as $\frac{1}{2}$ and $\frac{1}{3}$. In the latter case $x^{\frac{1}{2}}$ is usually preferred to $x^{1/2}$, notwithstanding that the latter is more legible.

Much is often gained in compactness and clearness by setting out two or more short formulæ on one line, instead of on consecutive lines; in that case they should be separated by spaces, indicated by the sign # on the MS. This would apply with even greater force to expressions such as $x=a, \ =b, \ =c$.

In the preface to his "Mathematical and Physical Papers," vol. i., 1880, the late Sir George Stokes successfully introduced the limited use of the solidus notation, obtaining the assent and support of Lord Kelvin, Prof. Clerk Maxwell, Lord Rayleigh, the editors of the *Annalen der Physik*, and many other mathematicians. He defined its use as restricted to the symbols immediately on the two sides of it, unless a brace or stop intervenes; thus $\sin n\pi x/a$ is to mean $\sin(n\pi x/a)$; but $\sin n\theta./r^n$, in case it is used, would mean $(\sin n\theta)/r^n$.

NOTES.

PROF. CLEVELAND ABBE, of the U.S. Weather Bureau, Washington, Dr. J. R. Sutton, of Kimberley, South Africa, and M. Léon Teisserenc de Bort, of Paris, have been elected honorary members of the Royal Meteorological Society.

AT the meeting of the Royal Geographical Society on April 5, Sir Harry Johnston, who has just returned from his journeys through the southern States and the West Indies, will give a lecture on the scenery of Cuba, Haiti, and Jamaica, with many illustrations from photographs taken by himself.

THE death is announced, at the age of sixty-four years, of Prof. J. W. Moore, professor of physics in Lafayette College at Easton, Pennsylvania, since 1872.

SIR ROWLAND BLENNERHASSETT, whose death at sixty-nine years of age we announce with great regret, was not only distinguished in his political career and historical studies, but also by his influence upon education in Ireland. For about seven years he was H.M.'s Inspector of Industrial and Reformatory Schools in Ireland. From 1897 to 1904 he was president of Queen's College, Cork, and in 1905 he was appointed a visitor of the college. He was a senator of the Royal University of Ireland in 1897, and was a member of the standing committee of the Senate. He was also one of the Commissioners of National Education in Ireland, and took an active part in the administration of that department down to the time of his death.

IT should have been mentioned last week in the article on the Imperial Bureau of Ethnology (p. 73) that the Sirdar, Sir Reginald Wingate, is so impressed with the necessity of a thorough study of native conditions as the basis of good government that he has provided a grant for an investigation of the ethnology of the Sudan, especially from the sociological side. This work, which will extend over at least two winters, has been entrusted to Dr. C. G. and Mrs. Seligmann, who have recently made a joint investigation on the Veddas. Some of our colonial Governments also appreciate the value of such studies. For example, the expedition of the Seligmanns was financed by the Ceylon Government, and Mr. N. W. Thomas has been appointed Government ethnologist to Southern Nigeria, and is at the present time engaged in collecting information concerning the sociology and religion of that district.

THE honorary secretaries of the Zoological Society of Scotland (42 Frederick Street, Edinburgh), which has recently been founded, inform us that the society has been formed for the purpose of establishing a living zoological collection and garden at Edinburgh. The garden will be arranged on the system adopted by Herr Hagenbeck, of Hamburg, and will be conducted on scientific lines. When the society has developed sufficiently, it is within its scope to establish branch gardens in the other large towns in Scotland. In addition to this—its main object—lectures of a popular nature by eminent zoologists will be arranged. The headquarters of the society, and the first and principal garden, will be at Edinburgh. To obtain the necessary capital a garden fund has been opened, to which donations are solicited. The annual subscription is 1*l*. 1*s*., but members who join the society during 1909 pay 10*s*. only for that year. This will entitle members to all the privileges usual in such a society. The aim of the promoters is to build up a strong society with a large membership, so that a considerable part of the annual sum required for the upkeep of the gardens will be ensured from subscriptions, and less dependence will require to be placed on the receipts from the public for admission.

In a lecture given at the Bradford Technical College on science and the textile industries, Mr. W. P. Dreaper suggested the formation of central trade laboratories to deal with the pressing need for technical research. The laboratories were to be established privately, and subsidised by the trade concerned, any associated firm being at liberty to bring forward technical problems for solution. The plan proposed appears only to be practicable in the case of a highly organised trade, since there would be great difficulty in inducing individual firms to support such a scheme, which they would think might easily be to the advantage of their competitors rather than of themselves. On the other hand, when a trade becomes highly organised and centralised its interests tend to become so amalgamated that a central laboratory will be established almost as a matter of course, and there are already several examples of such a development. Any suggestion for widening the basis of technical research is, however, welcome, and we hope that further discussion and inquiry may show Mr. Dreaper's scheme to be feasible.

The sixty-second annual meeting of the Palæontographical Society was held in the rooms of the Geological Society, Burlington House, on March 19, Dr. Henry Woodward, F.R.S., president, in the chair. The report of the council referred to the completion of the monograph of Cretaceous star-fishes, and to the satisfactory progress of the monographs of Cretaceous lamellibranchs, Chalk fishes, Cambrian trilobites, and British graptolites. Many offers of new monographs had been received, but the council had decided, so far as possible, to complete the works in progress before entering on new undertakings. Sir Archibald Geikie, P.R.S., was elected a vice-president in succession to the late Mr. W. H. Hudleston, and Prof. E. J. Garwood, Mr. C. Fox Strangways, and Mr. F. R. Cowper Reed were elected new members of council. The officers were re-elected, Dr. Henry Woodward as president, Dr. G. J. Hinde as treasurer, and Dr. A. Smith Woodward as secretary.

Much interest has been aroused in Sussex by the discovery of the greater part of a skeleton of a mammoth (*Elephas primigenius*) on the shore of Selsey Bill. The remains were found below high-water mark in the estuarine or fresh-water deposit of black clay, which underlies the raised beach and coombe rock on that part of the Sussex coast. The thick mass of shingle, which usually covers this deposit, was temporarily removed during the recent stormy weather, and the teeth and broken bones were found projecting from the clay. Probably the whole skeleton was originally present, but when found the bones were already much eroded, and they were scattered over an area about 30 feet square. Both upper and lower molar teeth were recovered, and their condition shows that the animal was immature and of small size. Fragmentary remains, both of the mammoth and of *Elephas antiquus*, have been found at various times in the same deposit in Bracklesham Bay, some of these specimens being now in the British Museum. Indications of complete skeletons are rare. They seem to have been recorded only twice in England, the first in the brick-earth of Ilford, Essex, the second in a corresponding deposit at Ealing, Middlesex.

Towards the scientific exploration of Spitsbergen no nation has contributed in a greater degree than Sweden. During the last half-century no less than twenty-four Swedish expeditions have visited it and the adjacent islands, at a cost of at least 75,000*l.*, to which another 25,000*l.* must be added if the expense of publishing the results be reckoned. Signs are not wanting, however, that much of the valuable work accomplished by the Swedes is unknown to the scientific men of other countries. To remedy this, Profs. A. G. Nathorst and G. de Geer, and Dr. J. Gunnar Andersson, have just published in *Ymer* (1909, Häft i.) a brief English summary of the work, occupying ninety pages, and have distributed reprints. This comprises a historical sketch by Prof. Nathorst, illustrated by maps and views of the Swedish stations; a list of men of science, physicians, and officers who have taken part in the expeditions; a classified and annotated bibliography by Mr. J. M. Hulth, containing 376 items; and a list of sixty maps by Prof. de Geer. In 1908 it was 150 years since the first Swedish naturalist, A. R. Martin, instigated thereto by Linnæus, set foot on Spitsbergen; but the true foundation of Swedish exploration was laid by Sven Lovén, when in 1837 he undertook a two months' voyage thither on his own initiative and at his own expense. The subsequent record is one of which any country might be proud, and English geographers and naturalists in particular should thank their Swedish colleagues for abandoning their habitual modesty so far as to publish this concise account.

With great regret we have noticed the announcement of the death of Senhor Joas Barbosa Rodriguez, director of the Botanic Garden and professor of botany in the university at Rio de Janeiro. Barbosa Rodriguez was born in the State of Minas Geraës in 1842. After a varied career as secretary, drawing master, traveller, manager of a chemical factory, and director of a museum at Mañaos he was, in 1889, appointed director of the Botanic Garden at Lagos de Rodrigo de Freitas, near Rio de Janeiro, a post which he held until his death. Numerous and extensive journeys took him over a great part of the Amazon basin, and later on also the southern States, Uruguay and Paraguay. One might have expected that large collections would have resulted from those expeditions; but his artistic inclinations—he handled pencil and brush with considerable facility—and his predilection for studying plants on the spot and from life led him rather to fill his portfolios with sketches and analyses and his note-books with descriptions from the living material. His favourite plants were Orchidaceæ and Palmæ, and his publications on them will always rank among the most valuable contributions to our knowledge of those families, even if we admit the disadvantages of his method, which involved a certain neglect of the documentary evidence accumulated in the herbaria of Europe. He was a fertile writer, and his publications extend beyond botany into the domains of archæology, palæontology, ethnography, and the Indian languages. He intended to publish a complete iconographia of the Orchidaceæ of Brazil. To that end he amassed a large collection of drawings, all from life and by his own hand; however, their publication was beyond his means. Only a volume of descriptions appeared, whilst with great magnanimity he placed his illustrations, amounting to between 500 and 600 sheets, at the disposal of Prof. Cogniaux, who had undertaken to elaborate the family for the "Flora Brasiliensis." He was, however, more fortunate with his great work on the palms of Brazil. Congress having passed a special vote for its publication, it appeared in two huge folio volumes (pp. 140 and 114, with 91 and 83 chromolithographs) in the following year. In him Brazil has lost a good botanist and a man of many accomplishments.

A letter from Mr. Edgar R. Waite, curator of the Canterbury Museum, Christchurch, New Zealand, asking for information as to the length of skeletons of great whales preserved in museums, was published in NATURE on November 26 last (vol. lxxix., p. 98). It will be remembered that a blue whale cast on to the beach at Okarito, on the west coast of South Island, New Zealand, was measured by Mr. Waite and found to be 87 feet in length. A reply to this letter has been received from Mr. F. A. Lucas, curator-in-chief of the museum of the Brooklyn Institute of Arts and Sciences, New York, in which he states that in 1903 he measured a number of blue whales taken off the coast of Newfoundland. Of twenty-six whales measured, only six reached a length of 74 feet, from the tip of the nose to the notch of the fluke, the tape-line being carried along the side of the body. The six whales ranged in length from 74 feet 4 inches to exactly 75 feet. Adding to this the under-hang of the lower jaw, which is 1 foot 4 inches, and the depth of the fork of the flukes, which is 2 feet 6 inches to 3 feet, a total length for the largest whale of a little under 80 feet was obtained. Mr. Lucas points out that the measurements taken from a mounted skeleton are of little value, as the inter-vertebral cartilage is made too thick almost invariably. Mr. Lucas's letter was submitted to Mr. Waite, who, in his reply, says he is at present unable to give the exact length of the skull of the Okarito whale, but the length of the ramus of the lower jaw in a straight line is 20 feet 8 inches, and round the outer curve 22 feet 6 inches. Respecting the statement that there is the skeleton of a whale in Copenhagen 150 feet in length, Mr. Waite adds he has received a private letter from Prof. Jungersen saying the largest whale in the Copenhagen collection measures 75 feet.

WE have received a copy of the report of the Maidstone Museum, Library, and Art Gallery for 1908. As regards the museum, the year has seen an important advance in the arrangement and display of the collections, more especially those of minerals and fossils. In response to an appeal for providing cases for the Kent county room, the amount available for that excellent purpose is now just more than 174*l*.

A STRONGLY endorsed appeal has just been issued at Berlin for the purpose of obtaining funds for the fitting up of the Phylogenetic Museum recently established by Dr. Ernst Haeckel at Jena. Preparations, models, and diagrams for the proper illustration of phylogeny are urgently needed, and for this purpose a sum of 5000*l*. is required, in addition to the funds already expended or in hand. The appeal is backed by a number of the leading German professors and teachers.

IN vol. xcii., part ii., of *Zeitschrift für wissenschaftliche Zoologie*, Dr. F. Fritz, of Stuttgart, describes the carpal vibrissæ and underlying structures situated on the under surface of the lower part of the fore-arm of the cat. These vibrissæ are connected with a dermal sinus supplied by a relatively large branch of the ulnar nerve. Beneath the sinus occur structures of the so-called "lamellen Körperchen" type, and the vibrissæ themselves contain minute sweat-glands. The whole organ, the details of which are fully described in the paper, is evidently sensory in function. It is suggested that the presence of such vibrissæ in most Carnivora and their absence in Ungulata is connected with the active functions of the claws of the former. In the introduction to his paper the author mentions that these vibrissal organs have an important bearing on the nature of the callosities on the limbs of the horse, and it may be inferred, although this is not definitely stated, that he regards the latter as the degenerate representatives of the former. Several papers on the nature of the equine callosities are quoted, but no reference is made to one by Mr. Lydekker, in which these structures are regarded as degenerate glands—an interpretation not far from the one apparently adopted by the author.

THE advice given by Mr. G. G. Lewis in the *Amateur Photographer*, that tree outlines provide a suitable study for the landscape photographer in spring, can be thoroughly endorsed, but it will be apparent from the snapshots reproduced that photographs should be taken of the whole tree where possible. All the trees mentioned can be found in or around London. With regard to the specific outlines of different trees, it should be the aim of the photographer to evolve these from his own prints.

THE spit of land known as Wilson's Promontory has been reserved by the Government of Victoria as a national park, and the authorities of the Victorian National Herbarium have been deputed to make a botanical survey of the area. The first report by Prof. A. J. Ewart regarding the plants collected on an expedition in 1908 is published in the *Victorian Naturalist* (January). The list consists of 350 phanerogams and ferns, including a dozen naturalised aliens. The rarest species are *Fieldia australis* and *Xanthosia tridentata*. The reserve contains many fine trees, amongst which are specimens of *Eugenia Smithii*, the bright flowering *Coirea speciosa*, *Banksia serrata*, *Prostanthera lasiantha*, *Acacia melanoxylon*, *Hedycarya Cunninghami*, *Eucalyptus globulus*, *E. amygdalina*, and *E. obliqua*.

UNDER the title of "Flora von Paderborn," Dr. M. P. Baruch contributes to the *Verhandlungen des naturhistorischen Vereins der preussischen Rheinlande und Westfalens* (part i, 1908) an account of the general features of the vegetation, and a list of plants collected in the north-east of Westphalia. The scene is a sandy and marshy tract forming part of the Münster inland "bay," where *Scleroderma verrucosa*, *Polytrichum piliferum*, and *Racomitrium canescens* are typical cryptogams in the sand-dunes, and *Myrica gale* grows by the streams. In the neighbourhood of Salzhotten, where salt is worked, *Aster Trepolium*, *Samolus Valerandi*, *Triglochin maritimum*, and other halophytes may be collected. *Aconitum bycoctonum*, *Thalictrum flavum*, *Galium boreale*, and *Serratula tinctoria* are noted as rare plants in the district. The ridge known as the Haarstrang provides chalky soil where many calciphilous plants are to be found.

THE subject of the latest issue—a double number—of the *Vegetationsbilder*, published by Gustav Fischer, Jena, is the volcanic region of Java and Sumatra, including the adjacent island of Krakatau, for which Dr. A. Ernst has supplied the material. The first set of illustrations represents the strubby vegetation in the craters of extinct volcanoes, where the composite *Anaphalis javanica* takes a prominent place. The vegetation of the sulphur and hot springs is too diverse to be discernible in a photograph, but an expanse of *Acorus calamus* on a crater lake is depicted. The next topic is the colonisation of land that has been devastated by eruptions. The photographs taken on Mount Gunung Guntur, the scene of eruptions in the years 1840 to 1847, show masses of *Imperata arundinacea* and *Saccharum spontaneum* in which a few bushes are gradually forcing their way. The last illustrations taken from the island of Krakatau indicate the remarkable growth made since the eruption in 1883. The littoral formation of *Ipomoea pes-caprae* is well established, and behind rises a belt of trees. The author states that he collected 92 phanerogams and 16 ferns; of the former he estimates that about 55 per cent. were sea-borne, 25 per cent. wind-borne, and about 15 per cent. were introduced by birds.

It is well known that the common crow is omnivorous, and occasionally preys on young birds; two instances are recorded in the report of the Rhode Island Agricultural Experiment Station, where serious losses were caused to poultry-keepers by crows. During the three and a half months from April 1 to July 10 no fewer than 100 chicken are said to have been taken from one farm. The larger ones, some of which were a pound in weight, were killed and eaten where they were caught; the smaller ones were carried away. On another farm 180 ducklings out of 205 were killed. The only effective way of stopping the damage was to shoot a crow and hang up the dead body.

Messrs. Fagan and Allan recently issued as Bulletin No. 16 of the Edinburgh and East of Scotland College of Agriculture a useful list of analyses of brewers' and distillers' grains, materials which are largely used as feeding-stuffs in farm practice. The analyses usually quoted in text-books are old, and were probably made before the practice of using light, husky barleys for brewing became common. The average results were as follows:—

	Brewers' grains						Distillers' grains	
			3, 4 Limits of Variation					
	1 Old average	2 26 recent samples	Max.	Min.	5 Wet grains	6 Dried grains	7 Wet	8 Dry
Oil	7·72	4·99	7·00	2·70	1·20	4·56	1·42	5·45
Nitrogenous matter	22·76	20·61	23·12	17·56	4·98	18·85	4·48	17·15
Nitrogen free extract	46·77	48·87	53·22	43·30	11·83	44·74	13·02	49·77
Fibre	17·56	21·03	23·40	17·61	5·08	19·24	4·23	16·18
Ash	5·19	4·50	5·50	3·70	1·08	4·11	0·77	2·95
Water	—	—	—	—	75·83	8·50	76·08	8·50

Nos. 1, 2, 3, and 4 show the composition of the dry matter, Nos. 5 and 7 represent the average of a number of samples as received from the brewery or distillery, and Nos. 6 and 8 show what these samples would contain if sold as dried grains with 8·5 per cent. of water.

In the March number of *Man* Dr. Seligmann gives an interesting account of a curious series of canoe ornamental carvings from south-eastern British New Guinea. They are known at Murua under the name of *munkuris*, and represent in one series the reef heron, the wings of which are joined to support a specimen of a variety of fish said to be found in mangrove swamps. In others the cockatoo, with its crests well defined, or the tern is the subject of the carving. The reef heron and the cockatoo are well-known totems in this district; but this is not the case with the tern. The supposed efficacy of these carvings cannot, then, be ascribed to totemism. It looks rather as if this were one of the many cases of mimetic magic. The carving of the fish may denote a desire that the canoe may glide with safety through the water; it is to swim over the surf with the grace, ease, and rapidity of the reef heron or the tern. Needless to say, these things are highly valued, and the specimens collected in the Daniels expedition, which are now in the British Museum, are of exceptional interest.

It has been asserted by M. L. Sainéan in his "L'Argot Ancien" (Paris, 1907) that we have no knowledge of any artificial language in Europe before the fifteenth century. This view is contested by Prof. Kuno Meyer in the January number of the Journal of the Gypsy-lore Society. He points out that most of the processes in the manufacture of artificial language are described minutely and with examples in the commentary, dated in the eleventh century, on the Irish composition called "Amra Choluimb Chille," a eulogy on St. Columba composed in the ninth century. Much later than this we have another artificial Irish language called Ogham, of which he gives an interesting example in facsimile from the original in the library of Trinity College, Dublin. Of the two living secret languages current in Ireland, one, Shelta, discovered by Mr. G. G. Leland, has been proved by Mr. J. Sampson to be a deliberate and systematic modification of Irish Gaelic at an early period of its growth. Of the second, known as Béarlagar na Saor, the information is still scanty. It seems to be mainly confined to Cork and Waterford, where a few sentences are known by most masons, though they cannot always explain the words. It is to a large extent a borrowed tongue, from genuine archaic Irish, Irish words used in a figurative sense, from foreign languages, such as Hebrew, and it has added many words modified by back spelling. Prof. Meyer promises a further discussion of this question, interesting both to the philologist and the student of social history.

The Bulletin of the Sleeping Sickness Bureau (No. 4, February) contains abstracts of recent papers on trypanosomiasis and its treatment, notably one by Ehrlich on chemotherapy.

Several important contributions to medical science appear in the *Philippine Journal of Science* for November, 1908 (iii., No. 5). Messrs. Marshall and Teague discuss the precipitin and complement fixation reactions, especially in their forensic application in the recognition and differentiation of blood stains, and Mr. Garrison describes a new intestinal trematode parasite of man (*Fasciolètta ilocana*), for which a new genus is created.

Dr. F. Eredia has sent us a copy of his laborious discussion of the temperature at Rome for the fifty years 1855–1904, being an extract from vol. xxviii. of the Annals of the Central Meteorological Office of Italy. The tables exhibit for each of those years (1) ten-day means; these show that the warmest epoch is the third decade of July, the mean being 77°·4 F., the coldest being 43°·7, in the second decade of January. (2) Mean values of maxima and minima for each decade; the epochs agree with those above mentioned, being respectively 87°·6 and 38°·3. (3) Mean monthly and yearly values; the warmest month is July, average 76°·6, the coldest, January, average 44°·1. The mean annual temperature is 59°·7. (4) Absolute extremes for months and years, with dates of occurrence; maximum, 104°·2, July, 1905, minimum, 20°·8, February, 1885, giving an extreme range of 83°·4 F. The author has grouped the values in various ways to find any relation between them and the frequency of sun-spots, but with a negative result. The discussion contains many interesting details to which special reference cannot be made here.

The *Geographical Journal* for March contains a very useful paper by Mr. G. B. Williams on the mean annual rainfall of Wales and Monmouthshire. The map which accompanies the paper shows the geographical distribution in that locality in greater detail than in any map hitherto published, and gives the areas having an annual rainfall below 30 inches, and those for each additional 10 inches up to 100 inches, the localities with 100 inches to 150 inches and above that amount. It has been prepared chiefly from the data given annually in "British Rainfall" for a period of thirty-five years, viz. 1872–1906 in North Wales, and 1868–1902 in South Wales and Monmouthshire. A large number of short records had to be "standardised" by comparing them with those of long and trustworthy means. The isohyets, or lines of equal rainfall, bear obvious relationship to the contour lines, but it is by no means a constant one, owing to the positions of the mountains and the local air currents. The wettest parts include the portion of the Carnarvon mountains within a radius of about two miles from the centre of Snowdon, in which area the average fall is more than 150 inches per annum; at Glaslyn, on the lee side of the summit, and within the Snowdon crater, the mean rainfall is apparently 197 inches. An area of about 167 square miles on these mountains has a rainfall of more than 100 inches per annum. In South Wales, at the Bwlch Pass, the mean is about 130 inches. Over the whole country, the fifteen years 1872–86 had an average annual fall of 110·14 per cent., and the fifteen years 1887–1901 had 91·44 per cent., of the mean. Many localities are still poorly provided with rain-gauges; no record appears to be kept on Cader Idris.

THE *Electrical Review* for March 5 devotes three pages to reports of the discussions at London, Manchester, and Dublin of the paper on the use of large gas engines for the generation of power, read last month before the Institution of Electrical Engineers by Messrs. L. Andrew and R. Porter. In a leading article on the subject it points out how little has been done in this country to make gas engines of more than 1000 horse-power a success, and attributes this state of affairs to a tendency of our fellow-countrymen to leave other countries to do the pioneering work, and to hope to take up the subject when the main difficulties have been overcome. In its condemnation of this practice the *Electrical Review* has our cordial support.

PARTS viii., ix., and x. of vol. xliv. of the Proceedings of the American Academy of Arts and Sciences consist of papers by Mr. P. W. Bridgman, of the Jefferson Physical Laboratory of Harvard University, dealing with high hydrostatic pressures. The first describes a primary mercury gauge in which the pressure of the mercury on a piston, kept in rotation to minimise friction effects, is balanced by weights. By means of this gauge pressures up to 7000 kilos. per square cm. may be determined to an accuracy of one-tenth per cent. The second describes a gauge in which the change of the electrical resistance of mercury under pressure is utilised to determine the pressure. The author finds that at 7000 kilos. per square cm. the resistivity of mercury is reduced to 0·83 of its value at atmospheric pressure. In the third paper the apparatus used in the measurement of the compressibilities of certain solids and liquids is described. For solids, a bar of the material is enclosed in a strong cylinder of steel, and is pressed against one end of the cylinder by a spring. The other end of the bar carries a brass ring which is in contact with a shoulder in the cylinder. When the bar is compressed the ring is forced along it, and the extent of the motion gives the difference between the changes of length of bar and cylinder. The latter is measured by microscopes outside the cylinder. In this manner the compressibilities of steel, aluminium, and glass have been determined by Mr. Bridgman.

A PAPER on hydroplanes, or skimmers, was read by Sir John I. Thornycroft, F.R.S., at the Model Yacht Club on March 4. Any vessel which greatly reduces its displacement at high speeds is generally called a hydroplane, but as the gliding surfaces are not always plane, skimmer is a more appropriate term. Steady gliding on the surface of water is difficult to secure; this may probably be obtained by the use of a number of planes, but at the expense of more power. Mr. Froude was of opinion that a single plane was best, but this must maintain a particular angle to the water surface. In a boat intended for skimming there are a number of elements to be considered, which, unfortunately, do not all lead to the same proportions of design. The lifting force depends on the amount of surface and the speed, while the friction for a certain amount of surface decreases with the length. Again, the speed at which skimming will commence increases with the length; naturally this limit should be kept as low as possible. Below a certain velocity the formation of large waves causes bad performance in skimmer models; this difficulty may be lessened by extending the amount of supporting surface or by reducing the weight of the vessel, the surface remaining the same. A boat very wide and short in shape leads to excessive air resistance—an important factor at speeds of thirty miles per hour. The author gives the results of much of his experience with models. The complete paper, together with the lines and a photograph of the successful motor-boat *Gyrinus* at full speed, the latter, built by the author's firm, having won the International Race for 8-metre boats last year, will be found in *Engineering* for March 12.

IN the issue of NATURE for February 11 last (vol. lxxix., p. 438) a note was published dealing with the general report on the operations of the Survey of India administered under the Government of India during 1906–7. A remark in the note concerning the pendulum experiments carried out states that "the results obtained have been found to agree with those obtained by Prof. Hecker in 1905." Major Lenox Conyngham points out to us that this remark is calculated to give the impression that the Survey of India had merely been going over ground already traversed by Prof. Hecker, whereas the reverse was the case. The words of the report are:—"The results of Prof. Dr. Hecker's observations at Jalpaiguri in 1905 have been received and found to agree perfectly with those of Major Lenox Conyngham."

IT will be remembered that the centenary of the Geological Society of London was celebrated in 1907. Articles dealing with the celebration proceedings appeared in the issues of NATURE for August 1 and October 3, 1907 (vol. lxxvi., pp. 317 and 569). Messrs. Longmans, Green and Co. have now published for the Geological Society a detailed account of the varied meetings, held from September 26 to October 3, 1907, in honour of the occasion. The volume, which runs to 166 pp., and costs 2*s*., has been compiled by the senior secretary of the society, Prof. W. W. Watts, F.R.S., and includes an exhaustive account of the excursions, the reception, the congratulatory letters and addresses, the presidential address, the social functions, and the visits of the guests of the society to the Universities of Oxford and Cambridge. An excellent portrait of Sir Archibald Geikie, K.C.B., president of the Royal Society, forms the frontispiece to what is in every way an interesting memorial of an important celebration.

A FIFTH edition of the late Mr. Catchpool's "Text-book of Sound" has been published by Mr. W. B. Clive. The work has been revised and enlarged by Mr. John Satterly. The revision has consisted more of additions than of alterations, and these include many instructive experiments, with descriptions of apparatus and manipulation.

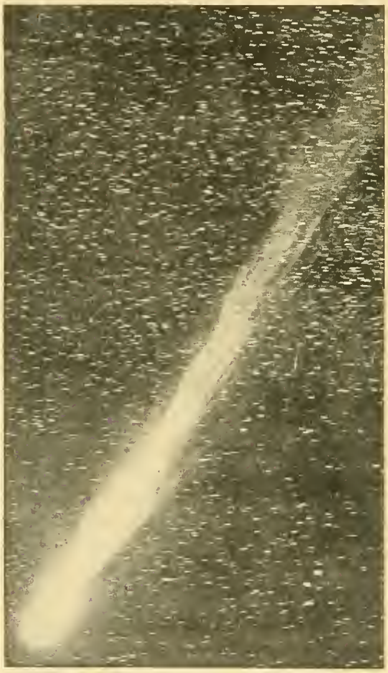
AMONG the forthcoming publications of the Society for Promoting Christian Knowledge are:—"The Spectroscope and its Work," by Prof. H. F. Newall, F.R.S., and "English Wild Flowers," by Prof. Henslow, with more than 200 coloured illustrations of plants, natural size, drawn by G. Layton.

OUR ASTRONOMICAL COLUMN.

PHOTOGRAPHS OF MOREHOUSE'S COMET, 1908*c*.—Four excellent photographs showing remarkable details in the structure of comet 1908*c* are reproduced on two plates accompanying Circular No. 148 of the Harvard College Observatory.

These photographs are selected from a series of fifty-three taken, between September 3 and November 29, by the Rev. Joel Metcalf at Taunton, Mass. The instruments employed were two photographic doublets, one of 12 inches aperture and 87·5 inches focal length, the other of 5·8 inches aperture and 20 inches focal length, both constructed by the observer.

As the nucleus of this comet was too indefinite to be "followed" successfully, Mr. Metcalf employed the method by which he has obtained such remarkable success in the photography of minor planets. This consisted in following on an adjacent star and moving the cross-wires, with a micrometer screw, every minute by an amount sufficient to compensate for the comet's theoretical motion as indicated by the ephemeris.



Comet Morehouse (1908*c*), 1908 November 21, 10h. 32m.—11h. 48m. (G.M.T.)

The photographs are reproduced in half-tone from double-contact prints, thus intensifying the fainter details of the tail, although some of the finer structure of the more exposed head has been lost in the process. On the photograph of 1908 November 15, 11h. 6m. (G.M.T.), the main tail presents a twisted appearance more marked than on any other photograph we have yet seen. The second photograph shows a remarkable waviness of the stronger northern edge of the tail with curious interlacings, and, as seen from the configuration of the surrounding stars, it is a connecting link between the November 16 and 18 photographs reproduced by Prof. Barnard in the January number of the *Astrophysical Journal*.

The photograph which we here reproduce was taken with 76 minutes' exposure on November 21, the time of mid-exposure being 11h. 10m. (G.M.T.). It will be noticed that, in addition to that contiguous to the nucleus, there are two constrictions in the main tail, apparently indicating two separate outbursts of activity on the part of the nucleus in the ejection of tail matter; the approximate position of the centre of the plate is 18h. 58m., $+1° 30'$.

For the benefit of other observers who wish to make a detailed study of comet 1908*c*, Prof. Wolf publishes in *Astronomische Nachrichten*, No. 4311, a list of the photographs taken with ten different objectives at the Heidelberg Observatory.

Between September 6 and November 27, 1908, 147 plates were taken on thirty-three different nights, and the present list gives the date, time, and duration of each exposure, with a note as to the instrument employed.

RELATION BETWEEN THE MAGNITUDES AND COLOURS OF STARS.—In No. 4312 of the *Astronomische Nachrichten* (p. 249) Herren Muller and Kempf discuss the relationship which holds between the magnitudes and colours of the stars of the Potsdam Photometrischen Durchmusterung.

The number of stars included in the discussion is 14,172, and these are tabulated, in tenths of a magnitude from 0·0 to 9·9, under four divisions of colour, viz. white, yellowish-white, whitish-yellow, and yellow, the last-named including the few orange and red stars. A summary table shows that by far the greatest number (6324) of the stars considered are classified as yellowish-white, a little more than half this number are whitish-yellow, whilst the "white" and the "yellow, &c.," stars are equal, 2043 in each case. In another table, showing percentages, the white stars show a tendency to increase as the fainter stars are reached, and this increase is more marked in the yellowish-white class. In the whitish-yellow class the percentage decreases in both directions from the seventh magnitude, although the deficiency is more marked towards the fainter stars. The most striking variation is in the "yellow, &c.," class, where the percentages rapidly decrease between magnitude 4·5 to magnitude 9·0.

A second part of the discussion deals with the relation between colours and magnitudes and the galactic latitudes of the stars. The results show, *inter alia*, that the maximum of the brighter white stars occurs in galactic latitudes $-11°$ to $-30°$, whilst for the fainter white stars the minimum is not at the galactic pole, but in galactic latitudes $+30°$ to $+50°$.

A REMARKABLE PROMINENCE.—No. 2, vol. xxxviii., of the *Memorie della Società degli Spettroscopisti Italiani* contains an account of two remarkable prominences observed by Father Chevalier at the Zô-sè Observatory on July 30 and 31, 1908.

Both prominences were observed in about position-angle 80°, and were evidently connected with the fine spot groups which appeared round the limb at the beginning of August last. Their changes of form and their general shapes are shown by a series of drawings given on a plate accompanying the paper, and it is seen that both formed well-marked arches; but it is to the spectrum observations that the greatest interest is attached.

On July 30 not only were C, D_3, and F seen reversed, but also the lines of helium at λλ 6678·2 and 7065·5; none of the metallic lines was bright, but between *b* and F two bright lines, probably helium λ 5016 and λ 4922, were found.

In addition to the bright lines, however, there was a continuous spectrum, due to the prominences, strong enough to efface, or weaken, the atmospheric spectrum on which it was superposed. A similar phenomenon was observed on August 3, 1872, by Young, who attributed its appearance to an abnormal pressure on the gases emitting it. In the present case it is difficult to see how pressure could operate, and Father Chevalier is inclined to attribute the bright continuous spectrum to heated solid particles condensed from the metallic vapours carried up by the rush of gases.

A strange bright line at about λ 5872·50 was also seen both on July 30 and 31, and on the latter date a similar, but weaker, line was seen on the other side of D_3 at about λ 5879·9.

THE NATIONAL PHYSICAL LABORATORY DURING 1908.

THE annual meeting of the general board of the National Physical Laboratory was held at Teddington on the afternoon of Friday, March 19, when the report of the executive committee for the year 1908 was formally presented, and the various departments of the laboratory were thrown open for inspection. The fifth volume of the "Collected Researches," which is now ready for issue, was also laid before the general board, and includes the results of the more important investigations recently carried out at the laboratory.

In connection with this year's gathering, the absence of Lord Rayleigh from the meeting cannot be allowed to pass without remark. Lord Rayleigh has always taken the warmest interest in the development of the laboratory; he has been from the first, and is still, chairman of the executive committee, though during his temporary absence abroad his duties have been undertaken by Sir John Wolfe-Barry, and this is the first occasion on which he has been prevented from being present at the annual inspection. His absence was deplored by none more than the staff, by whom his appreciation and his ready counsel on innumerable matters of detail are especially valued. Sir Archibald Geikie, as president of the Royal Society, acted this year as chairman of the general board.

The report of the executive committee gives some particulars as to the expenditure during 1905–8 on new buildings. These comprise buildings for electrotechnics, including photometry, for metrology, and for metallurgical chemistry, as well as an extension of the engineering building. They have been erected at a cost of about 25,000*l.*, and an additional 8000*l.* has been spent on equipment. This latter amount, however, does not include what has been provided out of annual income, nor the many gifts of apparatus. Of the total thus expended, 25,000*l.* has been provided by the Treasury. The grants promised by the Treasury for building purposes have, however, now come to an end; no new buildings have been added during 1908, the funds available being devoted to equipment, which is still by no means complete.

There is thus, unless funds are provided from other sources, no immediate prospect of any considerable extension of existing departments, though the rapid development of the work has shown clearly that the need of further accommodation must shortly become urgent. The department of metallurgy, which is doing work of the greatest value in connection with the most important of British industries, is at present quite inadequately housed in the old kitchen and a few scattered rooms in the basement of Bushy House. Plans have already been prepared for a new building, which would be an extension of that devoted to the Indian railway test-work, but the committee is unable at present to do more than commend the importance of such a department to the attention and generosity of those to whom metallurgical research is of interest and value.

The only development of first-rate importance immediately in prospect is thus the experimental tank for investigations on ship models, building operations for which will be commenced in the spring. The construction of the tank has been rendered possible by the munificence of Mr. A. F. Yarrow, who has placed 20,000*l.* at the disposal of the Institution of Naval Architects for the erection at the laboratory of a tank of the most modern type, under the proviso that a sufficient sum be found to provide for maintenance during the first ten years. The guarantee fund has now reached a total sufficient to warrant the work being begun, and another department of great public interest and utility will thus be added to the laboratory.

Turning now to the details of the work carried out during the year by the several departments, reference may first be made to the re-organisation of the thermometry division of the physics department. Arrangements have been made for transferring to Teddington some of the thermometer testing at present undertaken by the observatory department, and at the same time it has been found necessary to provide increased facilities for the rapid and accurate verification of high- and low-range thermometers, as well as of standards and thermometers of special types.

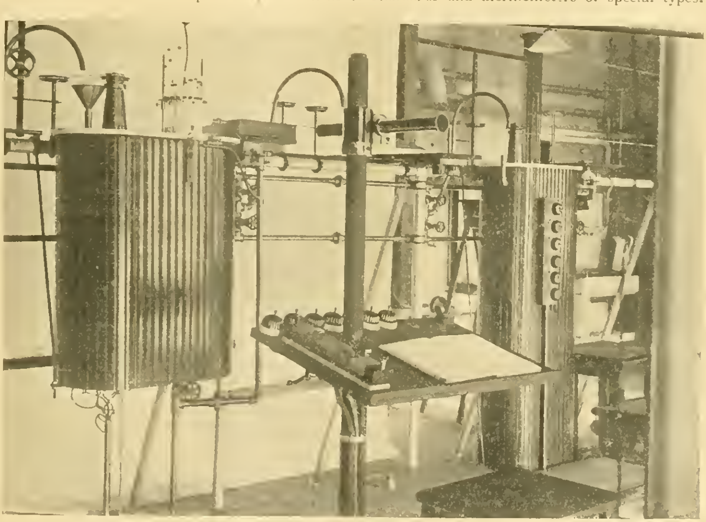


FIG. 1.—Comparison Baths for Verification of Ordinary and Standard Thermometers.

For this purpose the old chemical laboratory, vacated by the transfer of the chemical work to the new building for metallurgical chemistry, has been re-fitted with a new and special equipment for the testing of mercury thermometers, designed by Dr. Harker and Mr. W. A. Price, a description of which is given as an appendix to the report. The chief requisites in connection with baths for thermometer comparisons are efficient stirring, convenient and rapid heating, and satisfactory temperature regulation, with arrangements for avoidance of emergent stem errors. At the same time, suitable provision must be made for the rapid recording of observations. The type of bath and the general arrangements adopted are shown in Fig. 1. The containing vessel of the apparatus consists of two flat boxes of cast brass, the larger containing the thermometers to be tested, while the smaller is occupied by the stirrer above and the electric heating appliances below. The stirrers in all the baths are driven with endless cord and pulleys from an electric motor. The heating is effected by means of special resistance units, each of 400 watts capacity, constructed of "Eureka" strip. The baths are well lagged, and the temperature can be run up very quickly to any desired point. A desk is provided for the observer, above which is the telescope for taking the readings, while a series of switches allows of temperature regulation. By means of a handle on the left of the desk, connected by a flexible shaft to the cage carrying the thermometers, the cage can be rotated so as to bring the thermometers successively into the field of view.

The bath on the right in the illustration is reserved for the comparison of standards. It is of the same general type as above described, but is being fitted with a telescope carried on a traversing support fixed to the bath itself, giving greater rigidity, and thus allowing the employment of a higher magnification. In addition there are a bath for very long thermometers, oil and nitrate baths for the higher temperatures, zero-point apparatus for ordinary and standard thermometers, and steam-point apparatus. The steam-point apparatus for standard thermometers is of the form designed by Chappuis, and is shown in Fig. 2. The upper part can be turned into a horizontal position, so that observations can be made with the thermometer either horizontal or vertical, as required for determination of pressure coefficients. A second steam bath of similar form, but not arranged to tilt, serves for ordinary work.

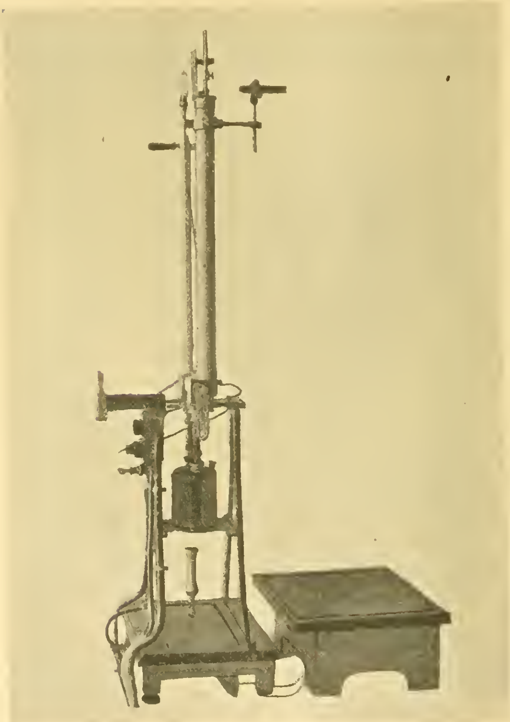


FIG. 2.—Steam Point Apparatus for Standard Thermometers.

The work of the thermometry division has also included the equipment, for work at very high temperatures, of the new electric furnace room. Much attention has been given to the perfecting of furnaces, and some interesting figures are printed in the report showing the increased efficiency obtained in the ordinary platinum-foil wound type with improved construction and lagging. The power required to maintain a temperature of 1350° C. has been reduced from 3300 watts to 1400 watts, the new furnace being at the same time of greater internal capacity than the old. A new type of spiral carbon-tube furnace has been devised, of which a description will be published shortly, and much preliminary work has been done with a view to the greatly needed investigations into the different methods employed in measuring temperatures up to 2000° C.

The chief item of research work completed during 1908 was an investigation, in which Mr. F. P. Sexton assisted, into the effect of pressure on the boiling point of sulphur.

In the electrical standards division much time was spent in intercomparison of standards with those of other laboratories, and the excellent work accomplished by Mr. F. E. Smith was of great value in connection with the International Conference on Electrical Units, held in London in October. The papers published during 1908 include an account of the secular variations in the laboratory standards of resistance, and of the effect on manganin resistances of atmospheric humidity. Vol. v. of the "Collected Researches" contains also a paper describing an improved procedure for setting up mercury standards of resistance. In addition to this work, good progress has been made in the construction of the Lorenz apparatus for the determination of the ohm in absolute measure, which is being presented to the laboratory by the Drapers' Company in memory of the late Prof. Viriamu Jones.

Mr. Campbell has continued his work on self- and mutual-inductance standards. Of special interest is the method he has devised for the direct comparison of a mutual inductance and a resistance, from which may be made a determination of the ohm in absolute measure. A preliminary account of the method has been published in the Proceedings of the Royal Society, and it seems possible that in the further experiments to be made a high degree of accuracy in the absolute determination may be attained. Valuable work has also been done in setting up standards for the determination of oscillation frequencies in wave telegraphy.

From the optics department, a paper by Mr. Hunter describing an apparatus for determining the intensity curve for the image of an "edge" formed by an optical system was recently read before the Royal Society. Of general interest also is a new apparatus for testing the speeds and efficiencies of photographic shutters, the method consisting in photographing a spot of light reflected from the mirror of one of Mr. Campbell's vibration galvanometers. The time is determined from the known frequency of the galvanometer, and a satisfactory trace is obtainable even for very high shutter speeds, which can thus be determined with considerable accuracy. Work which has been in progress for some time on the standardisation of oculists' cases of trial lenses was completed during the year, and the testing and certifying of such trial cases is now regularly undertaken by the laboratory. The testing of microscope objectives is also under consideration.

In the electrotechnics building the chief addition to the equipment is a 100,000-volt transformer by the Westinghouse Co., which was recently installed, and is now working satisfactorily. This will be employed in the continuation of a research on insulating materials, while an investigation into the dielectric strength of ebonite of various compositions is already in progress. A large amount of test work on alternating-current instruments was dealt with during the year, and the equipment for such work has been greatly improved. A new electrostatic wattmeter, constructed in the laboratory workshop, deserves special mention, as well as a series of manganin water-cooled tube resistances with a device for bringing the voltage drop at their terminals into phase with the current passing through them.

In the photometry section, also, good progress has been made, especially in the arrangements for life tests on glow lamps. Life-test frames, designed for dealing with large numbers of lamps, have been constructed in the laboratory; the racks can be tilted, so that the lamps may be burnt at any angle, and resistances are provided for each lamp to bring the voltage on the terminals to the value at which the lamp will run initially at the standard watts per candle. A new specially designed photometer bench, by Alex. Wright and Co., is employed for rapid candle-power measurements of lamps under life test.

Following upon a suggestion made by Dr. Glazebrook at the British Association meeting in Dublin, agreement has been arrived at with the standardising laboratories of some other countries in regard to the adoption of an international light unit, and it is hoped that from an early date it may be possible to express light measurements in terms of the international candle. The matter is engaging the attention of the International Electrotechnical Commission.

The metrology division has been much occupied during the year in transferring apparatus to the new building completed in 1907. A special feature of the building is the long gallery, in which 50-metre surveying tapes can be verified, whether on the flat or in catenary. Special apparatus for the measurements has been constructed by the Cambridge Scientific Instrument Co., and the installation is now nearly complete.

One of the rooms in the metrology building will be devoted to the apparatus for ruling diffraction gratings which belonged to the late Lord Blythswood, and which has been placed on loan at the laboratory by Lady Blythswood. After some alterations which were contemplated by Lord Blythswood, the apparatus will be capable of ruling gratings up to a length of 8 inches.

As in previous years, the division has undertaken a considerable amount of work in connection with the Engineering Standards Committee, and in particular diring 1908 important work has been done on the measurement of screws and screw gauges.

In the engineering department Dr. Stanton is still continuing his very valuable and interesting researches with regard to wind pressure. His paper relating to the wind pressure on structures in the open, and discussing the difference in the resultant pressure on large and small plates, is included in vol. v. of the "Collected Researches." The question considered during 1908 has been the possibility of inferring the maximum pressure on a large area during a gale from the maximum pressure registered at a single point of the area. The attempt to measure the mean pressure over a large area of 1000 square feet was made by means of pressure tubes distributed over the area, and some interesting theoretical results were obtained when a self-recording apparatus was set up to register the mean pressure from more than two such tubes. At present continuous records are being taken of the mean pressure at two points 40 feet apart, and will no doubt furnish information of value. Dr. Stanton has also been investigating the resistance of plates and models in a uniform current of water. Some of the results obtained are included in a communication to be made to the Institution of Naval Architects. A research on the heat transmission and resistance of air currents in pipes is also in progress.

The important work on the behaviour of materials under repeated stresses has been very considerably advanced. An ingenious machine has been devised to make a combined abrasion and bending test under conditions approximating to those of a steel rail in practice; the conditions may be varied from pure abrasion to pure bending. A paper on the resistance of materials to impact was read before the Institution of Mechanical Engineers, and Mr. Bairstow has completed a research on the elastic limits of material under alternating stress.

The work on superheated steam has been continued, and in connection with this a research has been carried out on the loss of heat from steam-pipe flanges.

In both branches of the work of the department of metallurgy and metallurgical chemistry material progress has been made. A paper on cooling curves was read by Mr. Rosenhain before the Physical Society; a paper entitled "Eutectic Research, No. 1, the Alloys of Lead and Tin," was presented to the Royal Society and printed in the Philosophical Transactions, and the research on the copper-aluminium-manganese alloys for the Alloys Research Committee of the Institution of Mechanical Engineers was carried on continuously throughout the year. A report on the first section of this work will shortly be communicated to the institution. In addition, a considerable number of important cases of failure were investigated in cooperation with the engineering department, and some account of this work was given in a paper on the study of breakages, read before Section G of the British Association at Dublin.

In the section of this department devoted to metallurgical chemistry, special attention has been given to the improvement of the equipment and to the organisation of the work. The methods of steel analysis and the apparatus employed were described in a paper read by Mr. Rosenhain before the Iron and Steel Institute, which is reprinted as an appendix to the laboratory report. Of special interest are the silica-tube combustion furnaces for the estimation of carbon, a new type of electric muffle furnace, and the apparatus for electrolytic deposition. New methods of analysis have been investigated, and an improved procedure for the estimation of phosphorus, especially in phosphor-tin, has been described by Messrs. Gemmell and Archbutt.

The work done at the observatory department under Dr. Chree, and the allied work at Eskdalemuir under Mr. Walker, are of special character, and cannot properly be dealt with here. Dr. Chree has completed a monumental piece of work in the reduction and analysis of the magnetic records obtained by the *Discovery* Antarctic Expedition, while in addition he has discussed the magnetic observations of the *Scotia* and the temperature and pendulum observations of the *Discovery*. His work on the Kew records has been continued in a paper, "Magnetic Declination at Kew Observatory, 1890 to 1900," Phil. Trans., A, vol. ccviii., 1908, reprinted in vol. v. of the "Collected Researches"; a similar discussion of the horizontal force curves is in progress. Much attention is also being given to the improvement of methods of meteorological observation.

The new observatory at Eskdalemuir was occupied in May, 1908, and the work of installing apparatus was at once commenced. Regular meteorological observations are now proceeding, and the seismographs have been running since September, but the magnetographs have not yet been erected. The delay has been due chiefly to difficulties with damp in the magnetograph houses, which, however, it is hoped are now finally overcome. Absolute magnetic observations have been made three times weekly since October.

The past year has been marked by steady and continuous progress in all branches of the work of the laboratory rather than by any new development of first-rate importance. The construction of the experimental tank will add to the laboratory a new department of special interest, and it is to be hoped that in the near future means may be found of providing the much-needed extensions of existing departments.

THE AËRO AND MOTOR-BOAT EXHIBITION.

THIS exhibition, which opened at Olympia on March 19 and will close on March 27, is the first of its kind to be held in this country. The exhibition has been organised by the Society of Motor Manufacturers and Traders, Ltd., of which Mr. E. Manville is president, and is under the management of Mr. H. A. Blackie. The society has had the cooperation of the Aëro Club, and has succeeded in presenting a valuable collection of models of aëroplanes, several full-sized complete machines, together with ordinary and dirigible balloons, and motor-boats.

Probably the most striking object in the hall is the inflated Wellman dirigible *America*. This airship, in which Mr. Wellman proposes again to attempt to reach the North Pole this year, is about 184 feet long, 52 feet in diameter, and about 70 feet from the top of the envelope to the bottom of the basket. The ship is suspended from the roof of the hall, and has a capacity of 300,000 cubic feet. The car is 125 feet long, the base forming a petrol tank of two tons capacity. Provision is made for three explorers, a pack of dogs, two sleds, a boat, &c., and, when completely equipped, the ship weighs about five tons.

Owing to the few opportunities of inspecting aëroplanes in this country in the past, these machines at Olympia are easily first in public interest. Included among them is the aëroplane, of French make, used by Mr. J. T. C. Moore-Brabazon, who was one of the first two Englishmen actually to fly. The machine is a bi-plane, *i.e.* two planes one above the other, built by Voisin, there being 2 metres' distance between the planes, and it is fitted with an eight-cylinder E.N.V. engine. Three flights of from one to two kilometres, and about a dozen flights of from one to five kilometres, at a height up to 50 feet, have been made with this machine.

The Société Commercial des Automobiles Gobron-Brillie show an unfinished Breguet aëroplane of the bi-plane type. This machine is fitted with means of warping the planes differentially, which is intended to produce automatic balancing, to facilitate turning, and to act as an elevating rudder.

A British-made aëroplane, designed by Mr. Weiss, is shown by Handley Page, of Woolwich. The machine is a monoplane, having a span of 34 feet and an area of 150 square feet. There are two propellers driven by a 12 horse-power three-cylinder motor, air-cooled. Steering is effected by means of two flaps placed at the back of the main plane.

The Miesse Petrol Car Syndicate show a machine having wings, which are given a bird-like movement by an ingenious mechanism. Messrs. Short Brothers, of Battersea, show a bi-plane, and also an inflated balloon of 11,000 cubic feet capacity constructed for the Hon. C. S. Rolls. A bi-plane designed by W. Windham, of St. John's Hill, is shown, but, like several of the other machines, has not yet been tried. The Continental Tyre and Rubber Co., of Clerkenwell Road, show an inflated passenger balloon of 49,000 cubic feet capacity.

Mr. Howard T. Wright, of Marylebone, shows a beautifully constructed bi-plane, the main planes being 40 feet wide and 6 feet 6 inches deep. There are two propellers running in opposite directions driven by a 20 horse-power motor. Vertical steering is provided for by a double rudder in front of the main planes, and horizontal steering by a vertical rudder in the tail. Messrs. Lamplough and Son, Ltd., of Willesden Junction, show a compound lifter plane and glider. The design is the first of its kind, and awaits trial.

Mr. Frederick R. Simms shows a Simms-Voisin bi-plane of the type used by Farman, Delagrange, and Fournier in their flights. The main planes are 32·8 feet long, 6·5 feet wide, 5 feet space; the rudder cell or tail is 8·5 feet wide, 5 feet space, and contains a vertical rudder for horizontal steering. Vertical steering is secured by a horizontal rudder in front of the main planes. The total length is 37·8 feet; the weight complete is 1500 lb. The 50 horse-power motor has six cylinders, and weighs 528 lb. complete with water and petrol for a two hours' run. The propeller is 7 feet 5 inches diameter, 5 feet pitch, and weighs 33 lb.

An R.E.P. monoplane is shown by the Établissement Robert-Esnault-Pelterie. This machine won third prize for 200-metre flight last year, the wind having a speed of 6 metres to 8 metres. A Delagrange bi-plane, by Voisin, is shown by the Mass Cars firm. The Cody war kite is on view by permission of the War Office. Messrs. Willows show a dirigible balloon built at Cardiff. Conspicuous among the exhibits of motors are those of the Wolseley Tool and Motor Car Co., Ltd., and also those of Messrs. John I. Thornycroft and Co., Ltd. It is unfortunate that no machine used by the Wright brothers is on view, although a small model of one may be seen.

The exhibition is well worth a visit, and shows that manufacturers in this country are alive to the potentialities of recent developments in France and other countries, and are taking steps not to be left behind in the race for the conquest of the air. It will assist in arriving at a proper estimation of the value of the exhibition if the fact is realised that all is as yet in the experimental stage, even in the case of the most successful of the machines shown.

HIGHER EDUCATION IN THE UNITED STATES.

The report of the U.S. Commissioner for Education for the year ended on June 30, 1907, has been received from Washington. This is the first report issued by Dr. Elmer E. Brown, who succeeded Dr. William T. Harris as commissioner on July 1, 1906. The two volumes, which together run to 1214 pages, deal exhaustively with every branch of American education, and in addition include valuable reviews of educational progress in many European and other countries.

The carefully arranged and remarkably complete tabulated statistics of the 606 universities, colleges, and technological schools of the United States, contained in the second volume, shows what valuable assistance our own Board of Education could render students and administrators of education if it would provide similar conspectuses concerning British institutions of higher learning.

From this part of the report we learn that the total value of all gifts and bequests reported by the 606 institutions referred to, as having been received during the year under review, amounted to 4,574,000*l.* Of this amount about 1,540,000*l.* was given for buildings and improvements, and 2,540,000*l.* for endowment. The remaining amount was for current expenses. Forty-two institutions each received 20,000*l.* or more. The six institutions which benefited to the largest extent in this way were the University of Chicago, which received some 1,189,000*l.*; the Rensselaer Polytechnic Institute, of New York, with its 215,400*l.*; Yale University, 198,000*l.*; Cornell University, 156,000*l.*; Princeton University, New Jersey, 153,000*l.*; and Harvard University, 139,000*l.*

The report shows that the Washington Bureau of Education received full particulars for the year which ended in June, 1907, from 606 universities, colleges, and technological institutions in the United States. Of these institutions, 150 are for men only, and 330 are open to both men and women. The teaching force of the whole of the institutions aggregated 24,679—an increase of 729 teachers of different grades over the preceding year. The total enrolment of students was 293,343. Leaving out colleges for women only, and dealing with the remaining 480 institutions, tables are provided in the report which show that, in the session 1906–7, 3,399,000*l.* was received by students' fees, 782,000*l.* being for board and other non-educational purposes.

The amount received from productive funds was 1,955,000*l.*; the receipts from State or city for increase of plant were 755,000*l.*, for endowment 45,000*l.*, and for current expenses 1,628,000*l.* From the United States Government certain of the institutions, including agricultural and mechanical colleges, received 533,000*l.* The grand total of the receipts of these 480 colleges from every source was 13,616,000*l.* Exclusive of amounts for endowment purposes, the total sum available for current expenses, improvements, and building was 11,083,000*l.* These institutions had in the year under review in their libraries 12,472,530 volumes, valued at about 3,613,000*l.* The value of their scientific apparatus, machinery, and furniture was 5,639,000*l.*, and of grounds and buildings 48,816,000*l.*, while their productive funds reached 50,238,000*l.*

Some aspects of higher education in the United States are dealt with in an article by Prof. R. C. Maclaurin, president-elect of the Massachusetts Institute of Technology, which appeared in the *Revue scientifique* of January 16 under the title "L'Enseignement technique supérieur aux États-Unis." After referring to the interest taken in France in the progress of technological education, Prof. Maclaurin remarks that the European suspects an excessive development of the utilitarian spirit across the Atlantic, and thinks that America's enthusiasm for her own institutions too often displays some lack of the critical faculty; but it is maintained that a good deal of the right spirit is at work, and that the problems of education in America are being attacked with seriousness and strength of purpose. Referring to the better technological institutions in the United States, the article points out that, judged by French standards, the expense of conducting them is very great. It is not generally known that all the better institutions are developing so rapidly that their large revenues are inadequate.

It is often thought that in America there is an excessive expenditure on buildings and grounds, but this expenditure has been greatly exaggerated, and as to equipment, many American institutions are far behind the best of those in Europe. The number of professors is large, and in many cases this fact arises from excessive teaching or too much specialisation. In the best schools, however, it is due to an effort to encourage close relations between teacher and student. The administrative side of American institutions is highly developed, and, in fact, in matters of organisation and administration American institutions differ markedly from those in other countries. In the best schools a strong effort is made to avoid an excess either of "theory" or of "practice." The length of the course is usually four years, with a tendency to establish fifth-year courses for post-graduate study. Great importance is attached to means for keeping the schools in close touch with industry. One means of effecting this is the custom of encouraging professors to take an active part in the practice of their profession.

The Massachusetts Institute of Technology is described in detail. The property of the institute is valued at about 800,000*l.*; its annual expenditure is about 100,000*l.* There are about 1500 students, and the annual fee is 50*l.* The teaching staff consists of about two hundred men, of whom nearly half are professors. The programme of studies involves thirteen different courses, each leading to the degree of Bachelor of Science. The student is free to choose whatever course he names, but in any given course most of the work is prescribed, although there is always a considerable number of options. The studies are not purely "professional"; a certain amount of modern languages, literature, history, and even of political economy is provided for. Prof. Maclaurin directs attention to special features of the institution, such as the facility offered for researches in chemistry, physics, and sanitary science. For this research work special laboratories are provided. The chemical laboratories are planned to hold about a thousand students. The chemical department occupies forty-five rooms, including twenty-five laboratories, four lecture-rooms, a library, three rooms for weights and measures, and so on. The laboratory of chemical research occupies six separate rooms, and the chemical library has 10,000 volumes.

Prof. Maclaurin doubts the wisdom of separating science and technology. He thinks that a properly managed institute of technology should be an admirable training ground even for the man destined to devote his life to the advancement of "pure" science. It would avoid that separation of head and hand that is so bad for both. Science is sometimes in danger of becoming preoccupied with abstractions; its detachment from practice deprives it of a much needed stimulus, and makes for the detriment both of science and technology.

SOME BIRD-PAPERS.

OBSERVATIONS made in the neighbourhood of Tunbridge Wells have led Messrs. C. J. and H. G. Alexander to conclude that in the case of many of our migratory species of birds, each pair occupies a definite and restricted area during the breeding-season, into which other pairs of the same species do not intrude. This has led to the formulation of a scheme for mapping the individual distribution of such migratory birds in their breeding-haunts, the details of this plan being explained by the authors in the March number of *British Birds*. In noting on the map the nesting-area of any particular pair of birds, the authors generally relied upon the singing of the cock in one special spot. A reproduction of the Ordnance Survey map on the 6-inch scale of a small district in the neighbourhood of Tunbridge Wells, on which have been marked the nesting-areas of the individual pairs of migratory birds, serves to illustrate the plan.

To vol. vi., part v., of *Annotationes Zoologicae Japonenses*, Mr. M. Ogawa contributes a hand-list of the birds of Japan, arranged on the same plan as the British Museum "Hand-list of Birds."

In a paper on the kingfishers commonly known under the generic designation of Pelargopsis, published as No. 1657 of the Proceedings of the U.S. National Museum (vol. xxxv., p. 657), Mr. H. C. Oberholser proposes to abolish that name, on account of insufficient definition, and to replace it by Ramphalcyon of Reichenbach. If the innovation be adopted, it may be hoped that the spelling of the name will be amended, and also that ornithologists will not follow the author in using the absurd designation *Ramphalcyon capensis capensis* for the typical race of a species restricted to the Malay Islands. Ornithologists have generally considered the sexes of these kingfishers to be externally indistinguishable, but this Mr. Oberholser points out is incorrect, the females being generally larger than the males, with the back and wings, and sometimes also the tail, duller and browner or greener in colour.

The January number, vol. viii., part iii., of the *Emu* contains the second part of a paper, by Mr. A. H. E. Mattingley, on the mallee-fowl (*Lipoa ocellata*), which is largely devoted to the eggs, young, and nesting-mounds of these remarkable birds. The Lipoa does not commence to lay until two years old, and during the first half of the breeding-season the eggs are laid regularly every third or fourth day, after which the intervals between the deposition of the eggs increase according to the disposition of the individual birds and the amount of food available. Hot and dry seasons have a noticeable effect on these birds, which under such conditions lay fewer eggs than usual. Laying usually commences early in September, but may be deferred until December is well advanced, and the total number of eggs laid by the individual hens in a season varies from one to a score. The eggs have unpolished shells of a delicate salmon-pink or pinkish-red colour when first laid, but soon fade to earthy-brown. They are laid in the mound in tiers, with four in the basement tier; between each tier is a layer of sand 3 or 4 inches thick, and the eggs in the same time are separated from one another by from 6 to 12 inches of the same material, and placed near the solid wall of decaying vegetable matter bounding the egg-chamber. The eggs are always placed with the narrow end downwards, so that when hatching the head of the chick, which occupies the larger end, will be uppermost.

In the *Times* of March 3 Mr. P. McKenzie announces the shooting in the Polela district of Natal of a white stork, which bore on one leg a metal band with the inscription "Ornith. Köspont, Budapest, Hungaria, 209." To this letter there appeared in the same journal for March 17 a reply from Dr. O. Hermann, director of the Royal Hungarian Central Bureau for Ornithology, stating that the bird in question was liberated in Transylvania in July, 1908. This, taken with another event of the same nature, serves to settle the disputed question whether European storks cross the equator on their winter migration.

To the February number of the *Victorian Naturalist* Mr. A. J. Nuth contributes notes on the habits of Australian bower-birds. After alluding to the fact that the species of the genera Ptilonorhynchus and Chlamydodera adorn their bowers chiefly with bones, next to which come shells, stones, berries, and fragments of metal, while Prionodura uses flowers alone, and thus approaches the Papuan gardener-bird (Amblyornis), the author points out that the tooth-billed *Scenopoeetes dentirostris* forms a connecting link, in the matter of habits, between the more typical bower-birds and the cat-birds (Æluredus). In place of constructing a bower, the tooth-billed species merely clears a space, which it decorates with leaves, usually placed with the under surface uppermost; cat-birds, on the other hand, neither build a bower nor clear a space. Special attention is directed to the bowers of Newton's bower-bird (*Prionodura newtoniana*), some of which are stated to be more than 8 feet in height, and are decorated with flowers, generally orchids. At the larger bowers males alone are usually seen during the nesting-season, as the females are engaged elsewhere.

SCIENTIFIC WORK OF THE SMITHSONIAN INSTITUTION.[1]

Explorations and Researches.

THE resources of the Smithsonian Institution are at present too limited to permit of large grants for extensive explorations or investigations, but, so far as the income allows, aid is given in various lines of research work, and it is sometimes found possible to engage in expeditions likely to accomplish important results.

Through the National Museum, the Bureau of American Ethnology, and the Astrophysical Observatory, the institution has been enabled to carry on various biological, ethnological, and astrophysical researches during the year covered by the report.

Studies in Cambrian Geology and Palaeontology.

In the last report reference was made to studies of the older sedimentary rocks of the North American Continent which Dr. Walcott has been carrying on for the past twenty years. This work was continued in the Canadian Rockies during the field season of 1907. Early in July a camp outfit was secured at Field, British Columbia, and work begun on Mount Stephen. Subsequently sections were studied and measured at Castle Mountain, west of Banff, Alberta; at Lake Louise, south of Laggan, Alberta; and on Mount Bosworth, on the Continental Divide near Hector, British Columbia. Upward of 20,000 feet of strata were carefully examined and measured, and collections of fossils and rocks made from many localities. It was found that the Cambrian section included more than 12,000 feet of sandstones, shales, and limestones, and that the three great divisions of the Cambrian—the Lower, Middle, and Upper—were represented in the Bow River series and the Castle Mountain group. Characteristic fossils were found in each division.

Aërial Navigation.

Within the past year there has been a renewed interest in experiments in aërial navigation, to which the institution, through Dr. Langley, made notable contributions. Toward the end of the year the demand for literature on the subject so entirely exhausted the supply of papers on hand that a special edition of some of Dr. Langley's more popular memoirs was issued. It is gratifying to be able to say that his pioneer work in heavier-than-air machines, resulting as it did in the actual demonstration of the possibility of mechanical flight, has now received universal recognition.

Besides numerous popular papers, Dr. Langley wrote two technical works relating to the general subject of aërodromics, which form parts of an incomplete volume of the Smithsonian Contributions to Knowledge. The record of his experiments from 1893 to 1905 was kept by him partly in manuscript form and largely in the shape of voluminous notes and waste-books. These have been turned over to his principal assistant in this work, Mr. C. M. Manly, who has been for some time engaged in preparing them for publication and adding such necessary information, especially on the engineering side, as comes within the immediate purview of Mr. Manly's work.

Meteor Crater of Canyon Diablo, Arizona.

An investigation of the remarkable crater-like depression at Coon Butte, near Canyon Diablo, Arizona, was made in 1907 by Dr. G. P. Merrill, head curator of geology in the National Museum, aided by a grant from the Smithsonian Institution. An article upon studies of this crater by other geologists appeared in NATURE of September 13, 1906. The "crater" is some three-fourths of a mile in diameter and 500 feet in depth in a region of undisturbed sedimentary rocks and remote from volcanoes. The object of the study was to determine, if possible, whether the crater was caused by volcanic action, as assumed by some investigators, or due to the impact of a mass of meteoric iron, as asserted by others.

From the available evidence Dr. Merrill concluded that the crater could not have been formed by volcanic action, all the observed phenomena being of a superficial nature. Some 300 feet of overlying limestone and 500 feet of sandstone have been shattered as by some powerful blow, and the quartz particles in the sandstone in part fused, indicating a very high degree of heat. The deeper-lying sandstone, however, is entirely unchanged. These facts absolutely preclude the formation of the crater by any deep-seated agency, and forces the conclusion that it resulted from the impact of a stellar body.

No record has been found of a meteoric fall comparable with this, the largest known meteorites, such as that from Cape York, Greenland, and the enormous irons from Oregon, having fallen under such conditions as scarcely to bury themselves. The nearest approach to the Canyon Diablo occurrence was that at Knyahinya, Hungary, where a 660-lb. stone penetrated the ground to a depth of 11 feet. No meteoritic mass of sufficient size to have made this enormous crater has been brought to light, but it is thought there still remains the possibility of its having become dissipated through the heat developed by its impact while travelling at a speed of many miles a second.

In his report Dr. Merrill goes very thoroughly into details. He has secured many specimens of the meteoritic irons and their associations from the locality, which are deposited in the U.S. National Museum. The specimens include a hitherto unrecognised type of meteoritic iron and a peculiar form of metamorphism in the siliceous sandstone of the region.

Mining operations carried on in the crater afforded special opportunity for this research. These operations were discontinued during the winter, but their resumption in May, 1908, presented a second opportunity for the observation of the unique phenomena at the crater, and Dr. Merrill was authorised to proceed again to Arizona to be present during this second, and probably final, series of drillings. The greatest depth reached during his stay at the crater was 842 feet, and the results of the examination of the ejectamenta thus secured confirmed the former conclusion.

Alaskan Expedition.

In the last report mention was made of an expedition to be made to the Yukon country in Alaska for the collection of the remains of large extinct vertebrates, particularly mammals. A Smithsonian expedition had been made to this region in the summer of 1904 by Mr. Maddren, the results of which were published by the institution in 1905. The present expedition of 1907 was in charge of Mr. C. W. Gilmore, of the National Museum. The results of the explorations have been published in the Smithsonian Miscellaneous Collections.

Mr. Gilmore was not successful in finding what was most desired, a fairly complete skeleton of a mammoth, but the expedition was by no means barren of results. He found that scattered remains of Pleistocene animals occur throughout the unglaciated region of Alaska and adjacent Canadian territory in the black muck accumulated in gulches and the valleys of the smaller streams, in the fine elevated clays of the Yukon silts and Kowak clays, and in the more recent fluvial and alluvial deposits. Some of the specimens are so well preserved that they could not have travelled far from the original place of interment, while many bones are broken, abraded, and waterworn. Mr. Gilmore gives a list of the various genera and species of extinct vertebrates thus far reported from Alaska, followed by a brief review with a number of illustrations. He believes that when more perfect material is available it will be found, probably in all instances, to be quite distinct from the living forms. The skull of an Ovibos was found sufficiently complete to warrant its separation from the living form *O. moschatus*, to which nearly all musk-ox material from this region had previously been referred.

Geology of the Alps.

The investigation by Mr. Bailey Willis of the current theories of Alpine structure, under the grant approved in 1907, was successful in offering opportunities for consultation with leading European geologists, among whom were Rothpletz, Suess, Lugeon, Margerie, and Saccord. In cooperation with several distinguished students of the great problems of the Alps, Mr. Willis made detailed studies of critical districts, and was thus enabled to compare opposing theories by object-lessons on the ground. Mr. Willis's full report is expected early in 1909.

[1] From the Report of the Secretary of the Smithsonian Institution, Dr. C. D. Walcott, for the year ending June 30, 1908.

Absolute Measurement of Sound.

Dr. A. G. Webster announces the approaching completion of his research on the measurement of sound, which has been in progress for two years past. The investigation comprises an exhaustive treatment of the theory of the production of sound, with a description of a standard source, the transmission of sound through the air as modified by the effect of the ground, and its measurement by a receiving instrument. A description of experiments confirming the theory of Dr. Webster will be included in his finished report, with several practical applications, such as the examination of the sounds of speech, the diagnosis of deafness, the improvement of fog signals, and the testing of materials for the insulation of sound.

Re-calculation of Atomic Weights.

In February, 1908, Prof. F. W. Clarke, chairman of the International Commission on Atomic Weights, was authorised to begin the preparation of a third edition of his work on that subject, with the aid of a grant from the Smithsonian Institution. The second edition of Prof. Clarke's "Atomic Weights" was published in 1897, since which time the data on this subject have so largely increased as to render a new edition desirable. Some time will necessarily elapse before the completion of the work.

Properties of Matter at Temperature of Liquid Air.

In October, 1907, a Smithsonian grant was approved on behalf of Prof. E. L. Nichols, of Cornell University, for the continuation of his experiments on the properties of matter at the temperature of liquid air. Reports of the progress of this research are to be made from time to time in the recognised journals of physics, and, at the completion of the research, a memoir describing the investigation will be submitted to the Smithsonian Institution for consideration as to publication. It is believed that the prompt announcement of results in the way mentioned will be an immediate advantage to students, and that their publication as a whole by the institution will also prove of great service.

Flow of Air at High Pressure through a Nozzle.

The inquiry to determine the cooling effect of the nozzle expansion of air for large pressure differences, which has been conducted by Prof. W. P. Bradley, of Wesleyan University, with the aid of a grant from the Hodgkins fund of the institution, is announced as nearing completion. The investigation was intended specifically to determine whether the cooling process is due to the Joule-Thomson effect or to the performance of external work by the expanding air in pushing back the atmosphere from before the nozzle. The results of the inquiry make it clear that pressure is an important factor, and that the cooling effect increases very rapidly indeed as the initial temperature falls. Prof. Bradley is now engaged in an exact mathematical discussion of this research.

As to the apparatus employed, an interchanger of the Hampton type was so constructed, in vertical sections, that the amount of interchanger surface in actual use could be varied at will, from nothing to more than enough to induce liquefaction. In this manner it was possible to maintain the initial temperature constant, within one-third of a degree, at any desired point between $+20°$ and $-120°$, and the final temperature similarly constant between $+20°$ and the temperature of liquefaction. The temperatures were measured by resistance thermometers placed close to the valves in the high- and low-pressure circuits. The pressures employed range from 500 lb. to 3000 lb. The expansion was exclusively to one atmosphere.

The inquiry is of interest as related to the functioning of air liquefiers in which the air is throttled by a valve and expands without performing external work, in the usual sense of that expression.

Study of the Upper Atmosphere.

A further grant from the Hodgkins fund was made to Prof. A. Lawrence Rotch, director of the Blue Hill Meteorological Observatory, to aid in the completion of his experiments with *ballons-sondes* at St. Louis. This was accomplished in October and November, 1907, under the direction of Mr. S. P. Fergusson.

The object of these latest ascensions, twenty-one in number, was to supply data for the high atmosphere during the autumn, a season when there are few observations, and also to establish a comparison with the results obtained simultaneously in Europe on the international term days in October and November. Prof. Rotch reports that all but two of the instruments used in these ascensions were recovered, and an examination of the record sheets indicates generally the presence, at an altitude exceeding eight miles, of the isothermal, or relatively warm stratum, which was found somewhat lower in summer. For example, on October 8 the minimum temperature of 90° F. below zero was found at a height of 47,600 feet, whereas at the extreme altitude reached, namely, 54,100 feet, the temperature had risen to 72° F. below zero. Similarly, on October 10 the lowest temperature of 80° F. below zero occurred at 39,700 feet, while 69° F. below zero was recorded at 49,200 feet, the limit of this ascension, showing that the temperature inversion had come down about 8000 feet in two days.

The prevailing drift of the balloons during the autumn of 1907 was from the north-west, while in previous years they travelled more from the west. A description of the methods employed in launching seventy-seven *ballons-sondes* from St. Louis, and a discussion of the results obtained, will soon appear in the Annals of the Astronomical Observatory of Harvard College.

Air Sacs of the Pigeon.

For several years there have been in progress under the general direction of Prof. von Lendenfeld, of the University of Prague, aided by grants from the Hodgkins fund, various investigations bearing upon animal flight. The results of one of these investigations, on the air sacs of the pigeon, by Bruno Müller, was published during the past year in the Smithsonian Miscellaneous Collections. The author summarises the conclusions of his studies as follows:—

I do not consider the air sacs, including the air cavities of bones, as organs having a positive and special function, but rather as a system of empty interspaces. Their value lies in their emptiness—that is, in their containing nothing that offers resistance or has an appreciable weight.

Flying is the highest form of locomotion, and as such only possible to a body of high mechanical efficiency. Our most effective machines are by no means compact and solid, but composed of parts as strong as possible in themselves and arranged in the most appropriate manner. The interspaces between the parts are left empty and taken up by air.

The Sauropsida, at the time they obtained the power of flight, became adapted to its mechanical requirements, and thereby similar to the efficient machines mentioned above; they divested themselves of all superfluous material, filling the body spaces thus obtained with air sacs. While the body wall, adapting itself to the mechanical requirement, became a compact, hollow cylinder serving as a support for the organs of movement, the mobility of the parts was assured by surrounding them with air sacs.

The lengthening of the neck, produced by quite a different adaptation, made necessary an increase in the quantity of air moved during respiration. This demand was met by air currents generated through a rhythmical change in the volume of the air sacs. The connection of the air sacs with the lungs is a consequence of their phylogenetic development, which is repeated in their embryological development, and has no physiological significance other than that the air sacs assist in renewing the air in the trachea.

Preservation of Archaeological Sites.

Attention has been directed previously to what had been done toward the preservation of archæological objects on the public domain from destruction by vandals and relic hunters, and toward making these antiquities accessible under proper rules and regulations. Under the terms of an Act of Congress approved June 8, 1906, uniform regulations for its administration were prepared by the Secretaries of the Interior, War, and Agriculture, with the cooperation of the Smithsonian Institution, and were promulgated on December 28, 1906, in the form printed in the last report. Under Rule 8, applications for permits are referred to the Smithsonian Institution for recommendation. During the past year several such applications have been acted upon. The conservation of the nation's archæological possessions was regulated by law none too soon to prevent further mutilation or useless destruction of interesting antiquities in many places.

The President of the United States, by executive proclamation during the year, made several additions to the list of national monuments, including three of archæological interest:—(1) the Tonto National Monument in Arizona, where there are two cliff-dwellings not yet reported on; (2) the Gila Cliff-dwellings National Monument in the Gila National Forest in New Mexico, comprising a group of cliff-dwellings; and (3) the Grand Canyon National Monument, which includes a large number of cliff-dwellings, pueblos, dwelling sites, and burial places in the Grand Canyon of the Colorado.

Casa Grande Ruin in Arizona.

In 1906 Congress granted an appropriation of 3000 dollars to be expended under the supervision of the secretary of the Smithsonian Institution for the preservation of the Casa Grande ruin in Pinal County, near Florence, Ariz., and for the excavation of the reservation. An account of the work accomplished by Dr. Fewkes up to June 30, 1907, was published in the Smithsonian Miscellaneous Collections under date of October 25, 1907. The work done during the past fiscal year, under a second appropriation, is noted in an appendix of the present report. The largest structure excavated at Casa Grande is a building 200 feet long with eleven rooms, the massive walls enclosing a plaza. In the central room there is a seat called by the Pima Indians "the seat of Montezuma." The ruins at Casa Grande are found to be very much more extensive than was anticipated, and their permanent preservation is of great archæological importance.

In addition to the work of excavation, preservation, and repair of the cliff-dwellings and other prehistoric ruins in the Mesa Verde National Park in Colorado, studies have been made of the prehistoric culture of the Gila Valley, outside the Casa Grande Reservation. Dr. J. Walter Fewkes, who directed the Mesa Verde explorations, has prosecuted this later research also, and will submit an account in detail of what he has done for publication by the institution.

Bureau of American Ethnology.

The Bureau of American Ethnology has continued its investigations among the Indian tribes of the country begun more than a quarter of a century ago. Since it has not been possible to study all of the tribes in detail, a sufficient number have been taken as types to stand for all. The work accomplished in securing knowledge of these tribes has been recorded in the annual reports of the bureau, and the results obtained have been published, so far as circumstances will permit, in bulletins of the bureau. Many manuscripts are preserved in the archives of the bureau. To the present time there have been collected data relating to some sixty families of linguistic stocks and upward of 300 tribes. During the past year this fund of knowledge was added to through researches carried on in Arizona, New Mexico, Colorado, Texas, Minnesota, Pennsylvania, and Ontario.

For the first time the study of native Indian music was seriously taken up by the bureau in connection with certain investigations relating to the grand medicine ceremony of the Chippewa on the White Earth Reservation, Minn. The phonograph was employed in recording the songs. Records of songs were also secured from members of various Indian delegations visiting the capital.

This study and recording of the Indian tribes is not only of national importance, but urgent. The native American race, one of the four races of men, is fast disappearing, and the processes of obliteration are sure. If authoritative investigations are not made now, they never can be made with any like degree of accuracy or of thoroughness. It is a work the nation owes to science, to the Indian race, and to itself. It is a work worthy of a great nation, and one which can be carried on systematically only by a nation. Through the researches of the bureau the world is not only securing, while possible, a permanent record of one of the great races of men now dying out, but is gaining a knowledge of the Indian for practical purposes of administration and in the interest of humanity.

Astrophysical Observatory.

At Washington the observation of the relative brightness of different parts of the sun's disc has gone forward as there was opportunity. Improved methods of observing and reducing these observations have been adopted. Preparations for observing the absorption of water vapour in long columns of air, for the region of the spectrum where rays are chiefly emitted by the earth, have been carried to such a state that preliminary measurements have been made. The investigation is being carried on with a column of moist air about 400 feet in length.

A bolometric study of the solar corona was made on Flint Island, in the Southern Pacific, during the eclipse of January 3, 1908. The intensity and quality of sunlight was determined within twenty-five minutes of totality, both before and after, and during totality measurements were made at five different regions of the corona and on the dark moon. A general summary of the results of these and other observations follows:—

Intensity of Rays (observed through Glass).

	Intensity for unit angular area
Sun near zenith, Flint Island	10,000,000
Sky 20° from sun, Flint Island ...	140
Sky far from sun, Flint Island... ...	31
Sky average, Flint Island	62
Sky average, Mount Wilson, Cal. ...	15
Moon at night, Flint Island	12 (?)
Moon during eclipse, Flint Island ...	0
Corona $\frac{1}{10}$ radius from sun	13
Corona $\frac{1}{4}$ radius from sun	4
Corona $\frac{3}{4}$ radius from sun	0

When we recall the extreme brightness of the sky within a single degree of the sun, as compared with that 20° away, and consider also the figures just given, it seems very unlikely that the corona will ever be observed without an eclipse.

The nature of the radiation of the inner corona has been supposed by some to be principally reflected solar radiation, by others to be principally due to the incandescence of particles heated by reason of their proximity to the sun, by others to be principally luminescence perhaps similar to the aurora, and by some as a combination of all these kinds of radiation.

The spectrum of the corona is mainly continuous, but has some inconspicuous bright lines, and in its outer part has dark solar lines. Undoubtedly there is sunlight reflected by the matter of the corona, and no less surely the corona must be hot. As for the idea of luminescence by electrical discharge, though the streamers of the corona are a reminder of the aurora, one hesitates to recommend an explanation involving a thing so little understood, so that we will here speak only of the incandescence and reflection of the corona as sources of its brightness. The bolometric results indicate that the coronal radiation differs but little in quality from that of the sun, and is, in fact, far richer than the reflected rays of the moon in visible light, although less rich than sky light.

Great advantage having been found in 1905 and 1906 in making solar-constant investigations on Mount Wilson as well as in Washington, and strong evidence having been secured there of the considerable variability of the sun, it was concluded to continue in 1908 the expedition to Mount Wilson in order to secure as many observations of the solar constant as possible for the study of solar changes.

The frequent observation of the solar constant during a period of years at least equal to the sun-spot cycle was regarded by the late director, Dr. Langley, as a research of great importance. Having proved by the expeditions of 1905 and 1906 that the variation of solar radiation is highly probable, and also that numerous days suitable for solar-constant observations were found in the months from May to November on Mount Wilson, it is now proposed to erect on a small, well-isolated plot of ground leased from the Carnegie Institution a fireproof observing shelter to be occupied by Smithsonian observers each year during the months mentioned.

The annual report of the board of regents of the Smithsonian Institution, showing the operations, expenditures, and condition of the institution for the year ending June 30, 1907, has also been received. As is customary with these handsome volumes, the greater part of the available space, which here runs to 726 pages, is devoted to the general appendix, composed of important papers by men of science of different nationalities. Among papers included in this appendix may be mentioned two Royal Institution lectures, that of the Hon. Charles A. Parsons, F.R.S., on the steam turbine on land and at sea, and that of Prof. J. A. Fleming, F.R.S., on recent contributions to electric-wave telegraphy. Other papers by British men of science include that of Prof. J. W. Gregory, F.R.S., on the geology of the inner earth—igneous ores, being his address as president of the geological section of the British Association at the Leicester meeting in 1907; Mr. G. G. Chisholm's paper to the Royal Geographical Society, on inland waterways; that of Dr. D. H. Scott, F.R.S., on the present position of Palæozoic botany; and Mr. Henry Balfour's, on the fire piston. As is customary with these volumes, the illustrations are numerous and excellent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The chair of chemistry in the United College of the University of St. Andrews will be vacant at the end of the summer session on account of the resignation of Prof. T. Purdie owing to ill-health.

The Senate of the University of Glasgow has decided to confer the honorary degree of LL.D. upon Dr. C. S. Sherrington, F.R.S., professor of physiology, Liverpool University, and Mr. W. H. Maw, editor of *Engineering*, and past-president of the Royal Astronomical Society.

Industrial education, says the *Pioneer Mail*, is receiving a considerable amount of attention in the Central Provinces. During the last school year three students were granted State scholarships and sent to England, and one was given a scholarship to study under the director-general of the Geological Survey. As it is difficult to secure qualified candidates for State technical scholarships, tenable in England, scholarships have been instituted to enable students to take the preliminary course in textile industries at the Victoria Institute in Bombay, but the question of establishing similar scholarships at Sibpur Engineering College has been deferred pending the settlement of the scheme for starting a technical college or school at Nagpur for engineering and mining.

American universities and colleges continue to benefit from the munificence of wealthy citizens in the United States. A recent issue of *Science* announces that Yale University has received a gift of 10,000*l*. from an unknown donor for the purpose of establishing a memorial to the late Prof. Ely. Hamilton College is to receive a bequest of 10,000*l*. from Mrs. Annie P. Burgess, of New York City, who died about three years ago, leaving for educational and charitable purposes upward of 40,000*l*. This included 2000*l*. to Columbia University and to Barnard College for scholarships. After making some other specific bequests, she left the remainder of her estate to Hamilton College, Columbia University, and Barnard College. Among the bequests left by the late Mrs. Emma Cummings, of East Hampton, L.I., are 5000*l*. to Dartmouth College and 5000*l*. to Bowdoin College. The late Dr. Charles H. Roberts, of Highland, N.J., in his will provided for the founding of five scholarships of 48*l*. annually at Cornell University. Finally, Harvard University has received a gift of 30,000*l*. for the endowment of the University chapel.

The report of the Board of Education for the year 1907–8 has now been published (Cd. 4566). Referring to the further education required by those who have already taken as full advantage of the facilities afforded in elementary or secondary schools as their circumstances permit, the report states that the position is one of promise; the record of performance in all sections of the work is improving steadily, there is a fairly widespread recognition of existing shortcomings, and much serious effort is being made to overcome the difficulties inherent in the case. The machinery for the education of those who can give their whole time to study, including technical study, until they reach manhood, is already in existence. In particular centres and in relation to particular occupations there is a sufficient supply of adequately prepared students to enable the teaching institutions to develop their power to the full. Others still suffer from the inadequacy of this supply and from the difficulty of retaining their students long enough to complete the allotted courses. In each type of school improvement is observable in several directions; students are coming up better prepared and with several years in hand for study, technical colleges are adjusting their teaching more directly to the requirements of the related occupations, and employers are finding it of advantage to secure the services of young men who have had the technical training the colleges afford. There is, the report maintains, sufficient evidence that the teaching institutions are capable of raising the standard of their work when they have the opportunity. Attention is directed also to some aspects of evening-school organisation. It is a plain duty at the present time, says the report, to increase the number of trained teachers available for work in evening schools who are capable of bringing their teaching to bear directly upon some of the courses of instruction required in these schools in their areas.

Abundant evidence of the growing desire on the part of our educational authorities to adapt the instruction provided in elementary schools to the future needs of the children is given in the latest report (Cd. 4566) of the Board of Education. For instance, the report shows that the tendency to organise rural education so that it may be a real preparation for rural life is a growing one. In one of the eastern counties (Lindsey) a rural education subcommittee has been appointed to report to the Education Committee on the subject. In this district the demand for small holdings under the recent Act has been active, and it is satisfactory that the authority should have recognised in this way the important place that must be given to education preparatory to rural life if small holdings are to be successful. It is clear, as the report points out, that if rural education is to be efficient, the teachers must be trained properly for the work. To meet this need for suitable training, candidates for the preliminary examination of the Board of Education for the certificate can now take a course of nature-study alternatively to the course of elementary science in which botany is optional, and this should provide more inducement to secondary schools to include these subjects in their curricula. Moreover, for the certificate examination, candidates can now either continue their course of botany or follow their nature-study by a course of rural science and gardening. The importance of this is that the summer courses and Saturday classes for teachers held at the agricultural colleges can afford a direct preparation for the certificate examination. The course of rural science, introduced as an optional subject for training colleges, has so far only been adopted by one college, and it is doubtful whether, in view of the already crowded curriculum, many of the colleges will be able to adopt a comprehensive rural course. To provide an alternative method of preparing teachers for work in rural schools, the Board has expressed willingness to approve an agricultural or horticultural college as an institution affording a third year's course of training for students who have completed already the ordinary course. Up to the present little advantage has been taken of this facility, but now that certain education authorities are considering the establishment of special rural schools, and are beginning to recognise that for rural (evening) school work special qualifications are necessary, it seems likely that advantage will be taken of it.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 18.—Sir Archibald Geikie, K.C.B., president, in the chair.—An attempt to detect some electro-optical effects: Prof. H. A. **Wilson.** The paper contains a description of some experiments made with the object of detecting possible effects due to electric and magnetic fields and moving matter on the velocity of propagation of light in glass. The results obtained were negative, but it seems worth while to publish a short account of the experiments. The optical part of the apparatus is a simple form of interferometer, which proved very easy and convenient to work with. It consists of a square glass frame made up of glass bars of square cross-section, cemented together with Canada balsam.—The influence of their state in solution on the absorption spectra of dissolved dyes: Dr. S. E. **Sheppard.** In the aqueous solutions of certain dye-stuffs—isocyanines, pinacyanols, cyanine—the dye is present partially or wholly in colloid solution, and the absorption spectrum is quite different from that of the true solution. The influence of various agencies, as heat, acid and alkali, electrolytes on the absorption was examined quantitatively. In other dye solutions the change from true solution to the colloid state is accompanied by broadening and diffusion of the absorption curve, consequent on the increase in number and size of the colloid particles. Deviations from Beer's law result. The state of dyes in solid media is comparable with that in liquid, and the absorption spectrum is similarly affected. The absorption of a number of dyes by membranes was studied. The solution of dyes appears to be a combined process of disaggregation of the solute, accompanied by a progressive combination with the solvent. If the same stage of solution is attained in *different* solvents, the absorption maxima are displaced according to Kundt's law.—The ferments and latent life of resting seeds: Jean **White.** The resting seeds of cereals such as wheat, maize, barley, oats, and rye all contain diastatic, fibrin-digesting, and ereptic ferments in appreciable amount. These ferments retain their activity without appreciable change in stored dry seeds for twenty or more years, that is, long after the power of germination has been lost, which takes place in wheat after eleven to sixteen years, barley eight to ten years, oats five to nine years, maize and rye more than five years. No relation was noted between the vitality of seeds and the persistence of enzymes in them, but since the enzymes persisted longer than the power of germination, the question as to whether germination could take place in the absence of any pre-existent enzymes remains to be answered. In any case no otherwise non-germinable seeds could be excited to germination by the addition of any kind of enzyme, and where the germination was feeble the addition of enzymes usually lowered the percentage germination and often delayed germination also to some extent. The erepsin appears to be more abundant than the pepsin, but otherwise in the cases of all three ferments greater differences are shown between different samples of the same age than between different seeds, or between the same seeds of varying ages. Pepsin appears, however, to be more abundant in rye than in any other cereal, and is almost absent from maize. Dry oats, barley, and wheat can in part resist a temperature of 99° C. to 100° C. for 1–4½ hours; after six hours' exposure all are killed, but the ferments are apparently unaffected. All the ferments are destroyed after an hour's dry heat at 130° C. to 131° C. The pepsin appeared to be least (one hour at 124° C.), the erepsin more (one hour at 124° C. to 128° C.), and the diastase, especially of barley, most resistant to dry heat (one hour at 124° C. to 131° C.). Two days' exposure to liquid air, although it delays the subsequent germination, and may also decrease the percentage, did not absolutely destroy any of the seeds tested, and did not appreciably affect the ferments in any of the cereals. The dry diastase of barley is therefore able to withstand a range of temperature of 200° C. to −130° C.; it is therefore thermally a highly stable chemical compound. Many seeds, including all cereals, give off appreciable quantities of carbon dioxide when stored in the air-dried condition, but others show no signs of respiration whatever. The respiration of air-dried wheat is especially pronounced, but in practically all cases every sign of respiration ceases when the seeds are moderately desiccated, although in the case of large seeds like maize minute traces of carbon dioxide may continue to escape for a time.

Geological Society, February 19.—Annual general meeting.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Anniversary address: Prof. W. J. **Sollas.** The president dealt with the question of time, considered in relation to geological events and to the development of the organic world, referring, first of all, to recent evidence in proof of the extreme rigidity of the interior of the earth. He remarked that Mr. Strutt's method of estimating the age of sediments by reference to their radio-active constituents was of great promise, but a long series of concordant observations would be required to inspire absolute confidence in its results. Prof. Joly's method of determining the age of the ocean, based on the ratio of the amount of sodium which it contained to that annually contributed to it by rivers, was subjected to a detailed analysis, in the course of which it was pointed out that the sodium contained in river-water existed chiefly as sulphate or chloride, though theoretically it should be in the state of carbonate. The origin of the chlorine was manifold; some was traced to salts borne by the winds from the ocean, some to supplies from ancient desert-lakes and some to juvenile waters escaping as hot springs or impregnating the vadose waters underground. The probable limits for the age of the ocean were 80 to 170 millions of years. An examination of the sedimentary series, where developed to their maximum thickness, gave a period of 35 millions of years, on the assumption that deposition had proceeded at a rate of 1 foot in a century. Explanations of the discrepancy were suggested, and it was proposed to divide stratigraphical time into two moieties, each of 40 millions of years' duration. The earlier or pre-Cambrian moiety was termed the Protæon, the latter, or post-Cambrian, the Neatæon. Using the scale of 1 foot in 100 years as a rough chronological measure, it was applied to illustrate the rate of evolution in the case of the Equidæ and the chief varieties or species of man. Though relatively rapid, when considered in connection with some other groups of organisms, this was shown to be so slow, when measured in terms of years, that perceptible differences in a linear ancestral series would have required tens of thousands of years for their production.

February 24.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Palæolithic implements, &c., from Hackpen Hill, Winterbourne Bassett, and Knowle Farm Pit (Wiltshire): Rev. H. G. O. **Kendall.** Implements are described from the localities mentioned in the title. Trimmed stones of eolithic nature were obtained from fields ploughed in Drift-gravels, together with abraded Upper Greensand chert, quartzite-pebbles, and small flints. Most of the flaked stones were found in shallow pits excavated in Drift-clay, exposed at the edges of the larger hollows. The implements are unabraded, abraded, and striated; evidently some are *in situ*, others were brought with the Drift. The implements are referred to the Chelléen period. While implements and flakes are numerous on the top of Hackpen Hill as compared with trimmed pieces, yet at Winterbourne Bassett plain implements and flakes are scarce, while trimmed pieces are numerous. Many of the latter have been re-chipped, and are of later date. Implements of at least three Palæolithic periods are found at Knowle.—The Karroo system in northern Rhodesia, and its relation to the general geology: A. J. C. **Molyneux.** In 1903 the author described deposits, that have since been recognised as of Karroo age, in southern Rhodesia. Here he traces their extension across the Zambesi, where their boundary follows the foot of the line of escarpments that divide the plateau from the low-lying regions of the Zambesi Valley. Karroo deposits also form the floor of the trench-like valleys of the Luangwa, Lukasashi, and Lusenfwa (or Luano), the walls of which are of rock-gneiss, schist, and granite. The Luano Valley is described, and the Lusenfwa and Molongushi rivers are followed in their courses across the plateau-plains. The Karroo deposits are grouped into basal conglomerates, Coal-measures, Upper Matobola beds, and escarpment series. In the Luano Valley, the conglomerates are made up of resisting quartz-quartzite boulders and pebbles. Though they form the base of the Karroo system, there is no certain evidence of glaciation. In the Lukasashi and the Luano there is a dip of the strata north-westwards. Nowhere on the plateau in the vicinity of the valley-walls have Karroo beds been found. It is certain that the valleys were at one time filled almost to plateau-level, as the rivers pass through Archæan inliers by deep clefts. The late times in which the Machinga escarpment was laid bare, and the rejuvenation of the Lusenfwa River, suggest a filling of the valleys. It is possible that the Karroo beds extended over a part of the plateau, and were included in folding and faulting movements. Subsequently the surface was planed off to a plateau of remarkable monotony, and on a change of conditions taking place, erosion of the softer Karroo strata set in by which the present valleys are again reaching a plane of denudation. The trough-valleys of clastic rocks probably merely follow the axis of pre-Karroo and post-Karroo movements, trending in three directions. A distance of 800 miles displays movements that commenced in pre-Karroo periods, and have repeated themselves since the Karroo time. Fossils from the areas support the allocation of the deposits to the Permo-Carboniferous and to the Karroo system of South Africa. Palæolithic stone implements were found at separate localities on the surface, about the latitude of 14° 50′ S.—Plant-containing nodules from Japan, considered structurally in their relation to the "coal-balls" and "roof-nodules" of the European Carboniferous: Marie C. **Stopes.** The plant petrifactions are of a type unknown from the Mesozoic. The nodules are of Cretaceous age. They enclose well-petrified marine shells and plant-remains. Unlike the "coal-balls" and "roof-nodules," they are not contained in coal-seams or in the roof thereof, but occur in a thick series of shales below the coals, which appear to be of Tertiary age. Chemically they consist of about 60 per cent. of carbonates, both lime and magnesia being present, with 30 per cent. of silicates; the large proportion of silicates is a point of difference from the Carboniferous nodules. In having plant fragments in a single nodule, and in the type of petrifaction, the nodules are like coal-balls; in having marine shells included in the matrix they are more like roof-nodules. They probably represent fragments of tangled débris.

Royal Anthropological Institute, March 9.—Mr. Henry Balfour, past-president, and afterwards Sir Henry Howorth, in the chair.—The Veddas: Dr. C. G. **Seligmann.** A description was given of the manners and customs of these people. An interesting feature of these customs is the cult of the dead, which has given rise to a series of dances, often pantomimic in character, and so perhaps in the nature of imitative magic, and accompanied by offerings of food to the spirits of the departed. These dances are performed especially by men who have been trained to invoke the spirits of the dead. The use of a ceremonial arrow, with a blade more than a foot long and with a short handle, is an indispensable feature of some of these ceremonies, in all of which the chief actor becomes possessed by one or more of the spirits he invokes.

Royal Meteorological Society, March 17.—Mr. H. Mellish, president, in the chair.—Wind-waves in water, sand, and snow: Dr. Vaughan **Cornish.** Dealing first with waves of the sea, the lecturer described the gradual evolution of large sea-waves during the passage of a cyclone or other depression across the Atlantic. The great sea-waves are produced at that portion of the cyclone where the direction of the wind coincides with the direction of advance of the depression. Along this line of advance the waves in their gravitational progress are accompanied by a strong wind blowing across their ridges so long as the atmospheric depression maintains itself. Thus the waves are developed until they attain a considerable steepness. The average height attained by these waves (in feet) is about half the velocity of the wind (in miles per hour). Thus a wind of fifty-two miles per hour gives waves of an average height of about 26 feet, although individuals will then attain a height of 40 feet. In the circumpolar southern ocean the height of North Atlantic waves is somewhat exceeded, but the outstanding feature of the waves of high southern latitudes is their greater length from crest to crest. South of the Cape of Good Hope and of Cape Horn there is neither windward nor leeward shore, and the prevailing wind in all longitudes is westerly. Thus, wherever a westerly wind springs up it finds a long westerly swell, the effect of a previous wind, still running, and the principal effect of the newly-born wind is to increase the steepness of the already running long swell so as to form majestic storm-waves, which sometimes attain a length of 1200 feet from crest to crest. The longest swells due to wind are almost invisible during storms, for they are masked by the shorter and steeper waves. They emerge into view, however, after, or beyond, the storm, and Dr. Cornish has found their speed to be approximately equal to that of the wind by which they are created, sometimes attaining, even in the North Atlantic, a velocity of more than sixty miles per hour. Sand-waves are unable to travel by gravitation, as do the waves of the sea; their movements are entirely directed and controlled by the wind, and are therefore much simpler and more regular in form and movement than ocean-waves. When they grow to great size, as in the desert sand-dunes, which attain a height of several hundred feet, the forms become more complicated owing to the partial consolidation of the lower layers of sand by pressure. Nevertheless, the characteristic wave-form can still be distinguished. Mackerel-sky is produced by the formation of an undulating surface where a lighter layer of air flows over a heavier one. The positive and negative of a rippled-cloud photograph were shown, and it was explained that the negative (showing the pattern, not of the clouds themselves, but of the unclouded sky between) was the true aërial "ripplemark," corresponding to sand-waves. Freshly fallen dry snow is drifted by wind in a procession of regular waves, similar to desert sand-waves, but less than half as steep, the wave-length being fifty times as great as the height. The flatness of the wind-formed snow-waves affords a valuable indication of the great distance to which hills give effective shelter from wind, and helps to explain the climatic advantages of certain localities.

Zoological Society, March 16.—Mr. F. Gillett, vice-president, in the chair.—Reports of the Grouse Disease Committee:—(*a*) the ectoparasites of the grouse; (*b*) the thread-worms (Nematoda) of the red grouse (*Tetrao scoticus*); (*c*) the tape-worms (Cestoda) of the grouse. Appendix, parasites of birds allied to the grouse: Dr. A. E. **Shipley.** The author gave a general description of the work of the committee, and explained the results of the examination of the parasites of the grouse, exhibiting drawings and specimens to illustrate his remarks.—Fossilised remains of a small passerine bird, from the Lower Pliocene of Gabbro, near Leghorn: W. P. **Pycraft.** The remains most nearly resembled those of the living species known as Berthelot's pipit (*Anthus berthelotі*).—A collection of mammals from western Java, presented to the National Museum by Mr. W. E. Balston: Oldfield **Thomas** and R. C. **Wroughton.** The island of Java had been almost entirely neglected during the last sixty years, while it had been one of the most prolific sources of early described species, and in consequence workers had been much embarrassed for want of modern specimens representing these early species for comparison with their allies elsewhere. Now, thanks to the generosity of Mr. Balston, a very fine collection had been made in the island by Mr. G. C. Shortridge, and presented to the National Museum. It consisted in all of more than 1500 specimens, belonging to seventy-four species, of which six were new.

MANCHESTER.

Literary and Philosophical Society. February 9.—Prof. H. B. Dixon, F.R.S., president, in the chair.—Experiments on the ignition point of gases by the method of adiabatic compression suggested by Prof. Nernst: Prof. H. B. **Dixon.** In the first experiments tried the compression was effected in a strong glass tube, and photographs of the explosion were taken on a rapidly moving film. The photographs showed that the ignition was not set up instantaneously throughout the whole mass of compressed gas, but began at one point, which might be varied according to the velocity of the piston. In a mixture of hydrogen and oxygen "detonation" is very rapidly set up, but not instantaneously. The later experiments were made in a steel tube, a window being inserted near the lower end of the tube so as to observe the flame produced.

February 23.—Prof. H. B. Dixon, F.R.S., president, in the chair.—A simple method of silvering transparent grating replicas, whether plane or mounted on curved surfaces: T. **Thorp.** The process is a modification of the quicksilver and tinfoil method used for ordinary mirrors before the wet silvering process had been discovered.—A preliminary account of the submerged vegetation of Lake Windermere as affecting the feeding grounds of the fish: Prof. F. E. **Weiss.** Some of the shallow feeding grounds of the trout and char have become overgrown by dense masses of weeds, with the consequence that the young fish cannot feed and are driven into deeper water, where they are devoured by pike and other enemies. An examination of the vegetation, undertaken at the suggestion of Mr. F. Nicholson, showed that it consisted chiefly of one of the brittleworts, *Nitella opaca*, the Canadian pondweed, *Elodea canadensis*, the water milfoil, Myriophyllum, and a large weed, *Potomogeton praelongus*. The first two were the most deleterious. Experiments made indicate that the best method of removal of the accumulated weed is by dragging the bay with fishing nets, such as are used for netting char. Other methods break up the plant, but as some of these weeds have very great powers of rooting from small broken fragments, such methods are not to be recommended.—The use of wind by migrating birds: F. **Stubbs.** The author criticised and combated the opinion very largely held that birds, when migrating, either fly against a head wind or with a side or beam wind. On the assumption of the head-wind theory it is evident that no bird can make headway against a wind that has greater velocity than its own speed of flight. A bird in air, like a swimmer in a strongly flowing river, is wholly in a moving supporting medium, and there is little doubt that, if a bird cannot find shelter, it will be more comfortable on the wing than on the ground during the progress of a storm, the reason being that, in the fiercest gales, the air, as a mass, is at rest. The bird then can fly about in any direction in this wind, but the direction of the wind may or may not coincide with that of the bird's flight. The author believes that birds habitually make use of cyclones as a means of travelling from one part of their range to another under the most favourable conditions for the exercise of flight.

DIARY OF SOCIETIES.

THURSDAY, MARCH 25.

ROYAL SOCIETY, at 4.30.—Liberation of Helium fr.m Radio-active Minerals by Grinding: J. A. Gray.—The Expulsion of Radio-active Matter in the Radium Transformations: S. Russ and W. Makower.—*Sphaerostoma ovale*, n.gen., and *Crossotheca Grievii*, n.spec.: an Account of the Structure and Relations of the Reproductive Organs of *Heterangium Grievii*: Miss M. Benson.

ROYAL INSTITUTION, at 3.—On Aërial Flight in Theory and Practice: Prof. G. H. Bryan, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electrical System of the London County Council Tramways: J. H. Rider.

ROYAL SOCIETY OF ARTS, at 4.30.—Native Man in Southern India: Edgar Thurston.

FRIDAY, MARCH 26.

ROYAL INSTITUTION, at 9.—Recent Results of Astronomical Research: A. S. Eddington.

PHYSICAL SOCIETY, at 5.—Note on the Production of Steady Electric Oscillations in Closed Circuits and a Method of Testing Radio telegraphic Receivers: Prof. J. A. Fleming, F.R.S., and G. B. Dyke.—The Effect of an Air Blast upon the Spark Discharge of a Condenser Charged by an Induction Coil or Transformer: Prof. J. A. Fleming and H. W. Richardson.—On the Action between Metals and Acids and the Conditions under which Mercury causes Evolution of Hydrogen: Dr. S. W. J. Smith.

SATURDAY, MARCH 27.

ROYAL INSTITUTION, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 29.

ROYAL SOCIETY OF ARTS, at 8.—Steam Turbines: G. G. Stoney.

INSTITUTE OF ACTUARIES, at 5.—On the Annuity Business of British Offices and the Valuation Thereof: H. J. P. Oakley.

TUESDAY, MARCH 30.

ROYAL INSTITUTION, at 3.—The Evolution of the Brain as an Organ of Mind: Prof. F. W. Mott, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Construction and Wear of Roads: A. Mallock, F.R.S.

FARADAY SOCIETY, at 8.—The Electro-analysis of Mercury Compounds with a Gold Kathode: Dr. F. Mollwo Perkin.—The Relation between Composition and Conductivity in Solutions of *meta*- and *ortho*-Phosphoric Acids: Dr. E. B. R. Prideaux.—A New Electrical Hardening Furnace: E. Sabersky and E. Adler.—Experiments on the Current- and Energy-Efficiencies of the Finlay Alkali Chlorine Cell: Dr. F. G. Donnan.

WEDNESDAY, MARCH 31.

ROYAL SOCIETY OF ARTS, at 8.—The Island of St. Helena: J. C. Mellis.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—Lord Kelvin on the Extent of the Universe: Gavin J. Burns.

THURSDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Aërial Flight in Theory and Practice: Prof. G. H. Bryan, F.R.S.

LINNEAN SOCIETY, at 8.—The Amphipoda Hyperiidea of the *Sealark* Expedition to the Indian Ocean: A. O. Walker.—The Marine Mollusca from the same Expedition: J. Cosmo Melvill.—The Land and Freshwater Mollusca of the Seychelles Archipelago: E. R. Sykes.—On a Blind Prawn from the Sea of Galilee, *Typhlocaris galilea*, g. et sp. n.: Dr. W. T. Calman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electrical System of the L.C.C. Tramways: J. H. Rider. (*Adjourned discussion.*)—The Theory and Application of Motor Converters: H. S. Hallo.

RÖNTGEN SOCIETY, at 8.15.—The Origin, History and Development of the X-Ray Tube: J. H. Gardiner.

FRIDAY, APRIL 2.

ROYAL INSTITUTION, at 9.—Electrical Striations: Sir J. J. Thomson, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Storms, and their Effect Upon the Sea Coast: Dr. J. S. Owens.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Reinforced Concrete on Railways: W. E. R. Gurney.

SATURDAY, APRIL 3.

ROYAL INSTITUTION, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.—The Head as an Index of Race: J. Gray.

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THURSDAY, APRIL 1, 1909.

ALASKA.

Alaska, ein Beitrag zur Geschichte nordischer Kolonisation. By Prof. H. Erdmann. Pp. xv +223; with 68 figures and a map. (Berlin: Dietrich Reimer [Ernst Vohsen], 1909.) Price 8 marks.

IN this book Prof. Erdmann has prepared for the German public a concise account of the opening up of Alaska and its present condition. It is a story rich in interest to the student either of earth-lore or of sociology, and the theme arouses manifold reflections. What would happen, one wonders, if gold, or any other such commodity precious in the market, should be discovered in quantity in some still more inaccessible corner of the world—say, in north-east Greenland, or among the islands of the Parry archipelago, or on the Antarctic continent? Certain it is that no region where wealth may be easily gained has yet proved inaccessible to the adventurous throng. Such exploration has a purpose that is understood of every man, and has every man's support.

While the story of Alaska has the same old treasure-seeking plot that has served us for generations, we have never before had it in an Arctic setting. When Time has rounded off the saga, we shall find it to the full as romantic as any. Moreover, the circumstances of rush to the Yukon basin in 1896–7 are fraught with encouragement to those who have faith in the qualities of modern man. That tens of thousands of persons, without organisation and each on his own initiative, should, on the rumour of gold, have flung themselves into a distant and well-nigh resourceless wilderness of which the best informed among them had but little knowledge and the majority none at all; that they should have managed, somehow, either to establish and maintain themselves in the land or to make good their retreat without collective disaster; and that, from the self-interest of the units alone, there should have been evolved a system of transport and commissariat to meet their needs under conditions that had never before been faced—these things, surely, betoken the advance of individual and social powers in the race to a stage unattained in previous time.

It is not, however, from any contemplative aspect of this kind that Prof. Erdmann views his subject. His purpose throughout is practical and business-like, occasionally even political. One of his main objects is to demonstrate to his countrymen how valuable the resources of a northern land may be; how preferable to a tropical colony; and how profitable to the United States the purchase of Alaska from the Russians in 1867 has proved:—matters to be remembered should Germany have the opportunity to acquire a northern territory—Greenland, for example (p. 165). His journey through Alaska, made in 1906, was with the support of the Prussian "Kultusminister"; therefore it is perhaps essential that he should thus show its national utility.

With the advantage of his previous knowledge of the goldfields of Siberia and the Urals, the author was well qualified for the study of Alaskan mining conditions, and his book contains a clear description of the different modes of occurrence and different methods of winning the precious metal. The scientific explorations of the Canadian and U.S. Geological Surveys have made us acquainted with the main outlines of the geology and geography of the country, and are the basis of a voluminous literature which has recently been well summarised and catalogued in official publications of the last-mentioned survey. To this literature Prof. Erdmann acknowledges his indebtedness; and it is in the spirit of an observer of the known, not as an explorer of the unknown, that his book is written. While containing little that is scientifically new, it appeals to us as the well-written record of the impressions and experiences of a scientific traveller with an especially keen interest in the social and economic conditions of the new land. His outward journey followed the usual coast route from Seattle to Skagway; thence across the mountains by railway to the Upper Yukon and down the river to Dawson City. Resuming his river trip, he disembarked again at Circle City, in U.S. territory, and crossed the country westward by trail to Fairbanks, the centre of the new goldfield on the Tanana river. From Fairbanks he availed himself of the steamboat service, which brought him down the Tanana to the Yukon and thence to the coast, with only such minor adventures and discomforts by the way as are common incidents on new lines of traffic. On the coast at Nome he had opportunity to study the extensive gold workings in the beach deposits, after which he took ship and returned by the outer or ocean route to Seattle.

Like many another observer, he was shocked with the selfish and wilful destructiveness of the average gold-seeker, who, for the very smallest temporary advantage, has no scruple in burning down the thin but invaluable timber, thus perhaps permanently laying waste the land. How few men indeed are there as yet who have sufficient social conscience to be turned loose in the world untrammelled by enforceable laws! Symbolic of much was the fate of the head of a mammoth, regretfully mentioned by Prof. Erdmann (p. 129), that dared to interpose itself between an American citizen and pay-dirt.

On the other hand, the author is duly impressed with the vigour and adaptability of the colonists in all circumstances, and by their hardy spirit in the face of disaster, as exemplified in the rapid rebuilding of Fairbanks after its destruction by fire (p. 119). The conditions of labour are frequently discussed in the course of the book, with notes on the rate of pay, cost and mode of living, and methods of trade. The industries other than mining are touched upon, including the seal-hunting, salmon fisheries, attempts at agriculture, &c.; and the varied modes of transport in summer and winter are described. The author has a good eye for country, and depicts vividly and tersely its aspect along the routes traversed. He also gives some account of the aborigines—Indian and Eskimos—and of the influence of the colonists upon them. Quite shrewd was the guess of the intelligent Eskimo here mentioned (p. 201), who from his respect for the prospectors' provision-cans opined that the mysterious phonograph might be "tinned white man."

The book is enlivened by personal incidents and anecdotes, and is abundantly illustrated by well-chosen photographs excellently reproduced. But the cover is ugly both in design and colouring.

G. W. L.

A TEXT-BOOK OF PHYSICS.

General Physics: an Elementary Text-book for Colleges. By Dr. Henry Crew. Pp. xi+522; figures. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 12s. net.

"IN these days of numerous text-books the author, who dares still further to increase the number, owes to the public, at least an explanation in which he shall set forth his purpose, however far short of accomplishment he may have fallen."

In these words our author introduces himself to us in his preface; and of the reasons adduced for the present volume the most important is that he has sought "not merely, or even mainly, to impart information, but to set before the student a large and compact body of truth obtained by a method which shall remain for him, throughout life, a pattern and norm of clear and correct thinking."

Prof. Crew has certainly succeeded in presenting a lively account of modern physics, in so far at least as it can be presented in a series of class lectures in which all experiments are of a qualitative nature only. We regret that he has not done more than this. It is quite possible in very many cases in class lectures to perform quantitative experiments also, and students are never so interested as when such experiments are being performed. There is no suggestion of this in the book before us. This is to be regretted, because, even if in the lectures which the student is privileged to hear qualitative methods are alone presented, yet his text-book should provide him with a detailed account of some of the historical experimental methods by which the present state of science has been attained. We do not quarrel in general with what we find here, but with what is omitted. Open where we may, and it is rare that we find what we hoped. Thus, in connection with Charles's law for gases:—

"The actual measurement of these quantities is a somewhat difficult matter, requiring many precautions, and may well be reserved for the student's second or third year in physics."

We are astonished that this should be thought to be advisable.

Conspicuous gaps also exist in the exposition. After emphasising the fact that speed is the *limiting value* of a ratio of distance over time, and the importance of a knowledge of limiting values even in elementary physics, Prof. Crew does not make the slightest effort to impart this knowledge. How easy and instructive it is to take one or two cases as illustrations, such as $y=\kappa t$ or $y=\kappa t^2$, and calculate the speeds from them. The student thereby learns something, whereas, at present, the matter is left with an air of mystery hanging over it.

We are not enthusiastic admirers of D'Alembert's principle; it is correct but confusing, introducing a fictitious equilibrium where equilibrium does not exist. But, at the early stage of instruction covered by the book, to speak of the reversed effective forces as the reaction of the masses against their acceleration immediately after having given Newton's law of action and reaction (the reaction acting on a second body) is only to make confusion worse confounded.

Prof. Crew follows everyone else in defining energy as power of doing work. In view of the fact which everybody recognises, that a body may have enormous stores of energy and yet have no power of doing work, is it not time that the customary definition should be revised? The present writer is accustomed to define it as "that which diminishes when work is done, by an amount equal to the work so done."

The formula for a simple pendulum is written $T=2\pi\sqrt{l\theta/(g\sin\theta)}$, as though this was the exact form, the usual approximation following it; of course, this is not the case.

Pascal's theorem for fluid pressure is given as "At any point in a liquid at rest the stress (pressure) is the same in all directions." This is not the principle which usually goes under the name of Pascal's theorem.

The subject of magnetism is started with the definition, Any body which attracts iron filings is said to be magnetised and is called a magnet. Surely something more satisfactory than this can be found in the way of a definition. Those of us who have had considerable experience in examining are very familiar with the candidate who presses the passion for the unification of knowledge so far as to consider identical all forces of attraction. The present writer has been told by many dozens that we know the earth to be a magnet because if it were not so and we were to jump out of a window we should not fall down.

Looking back over this review, the writer feels that adverse criticism preponderates in it. He does not wish to convey the idea that the book must be condemned, but to show where it might be improved. He has read it from cover to cover (except the index); there is a certain breezy informality about it which is somewhat pleasing, although, to an English ear, a few of the expressions suggest slang.

Prof. Crew has evidently considerable interest in the historical side of the subject. Every leading principle is attributed to its source and is dated. He takes special pains to introduce each section by allusion to facts of familiar experience, and then endeavours out of this "chaos" to produce scientific order. This method serves to stimulate interest, and deserves commendation.

The book includes the whole range of physics; the part on mechanics (205 pages) bears, perhaps, an excessive ratio to the rest.

SPHERICAL ASTRONOMY.

A Treatise on Spherical Astronomy. By Sir Robert Ball, F.R.S. Pp. xii+506. (Cambridge: University Press, 1908.) Price 12*s.* net.

IT is difficult to decide what limits an author should set himself in writing a text-book on this subject. Gravitational astronomy on the one hand and descriptive and general astronomy on the other should be, for the most part, omitted. A more difficult question arises as to what details of practical astronomy should be included. It seems to us that the aim of such a book should be to show how the geometrical positions of stars and other heavenly bodies are defined and accurately determined, and how these positions vary with the place and time of observation, and from such causes as refraction and aberration. Some description of the more important instruments, *e.g.* the transit circle, the equatorial, theodolite, and sextant, should be included, and preferably in connection with the class of astronomical problem to which they are applied, and the geometrical problems to which they give rise or which arise in connection with them. The excellent little book, written by Sir Robert Ball in 1877, fulfils this condition. Godfray's "Astronomy" is incomplete and antiquated, but in this way is an admirable manual for students.

In the work under review the instruments are considered as particular cases of the "generalised instrument." This mode of treatment is of considerable geometrical interest, but it does not give the student an adequate idea of the use of astronomical instruments or the parts they play in astronomical investigations. As the author explains in the preface that he proposes to avoid the multitudinous details of practical astronomy, this criticism is perhaps beside the mark, but the student will, we think, need to read concurrently with this work one on the outlines of practical astronomy. The most striking illustration of the difficulties which arise from the separation of the geometrical problems from the instruments which furnish their data is found in the scanty treatment of the determination of latitude and longitude. With the exception of Sumner's method, only incidental references are made to a subject which requires at least one chapter for an account of the various methods applicable under different conditions.

Within the limits the author has imposed on himself, the book will be found very useful by students whose mathematical attainments are sufficient to obtain a first class in the mathematical tripos at Cambridge. The author usually treats questions generally and analytically, and then proceeds to transform, simplify, and approximate. This method is naturally and necessarily employed in treatises, such as Chauvenet's, intended for the actual requirements of astronomers, and is the simplest for students to whom the mathematics does not present difficulty. For other students more elementary methods applied to the simplest cases will be found necessary.

A valuable feature of the work is the constant introduction of the numerical values of the astronomical constants, and the frequent solution of numerical examples. The short exposition of the art of interpolation properly finds a place in the book.

In the chapter dealing with the use of spherical coordinates, it is pointed out that the direction of graduation of a circle enables the two poles to be distinguished, and the use of the word *nole* is suggested for the one generally called the North Pole. Such a term is a useful one, as the words North Pole can then be restricted to the actual North Pole of the heavens.

We are glad to see that a short account is given of the theory of map-making. It is very desirable that a knowledge of the principles on which maps are constructed should be more widely known, and not confined to students of pure mathematics.

Attention may be directed to the chapter on refraction. This subject presents difficulties both to the astronomer and the teacher. The theories of Bessel, Gylden, and Radau are too complicated for a text-book, and yet the importance of the subject demands more than is usually given when these are omitted. The author, who gives a simple approximate integration of the differential equation of refraction (for which he expresses his indebtedness to Prof. E. T. Whittaker), has presented the whole question in a satisfactory and adequate manner.

The geometry of such questions as aberration, parallax, and occultations is well presented. Generally speaking, the book will be found very useful both by teachers and students in all applications of spherical trigonometry to astronomy. The collection of exercises is well chosen, and the numerical applications, both in the text and among the exercises, serve to give a real connection between the mathematical formulæ and astronomical phenomena. F. W. D.

THE CELL AND ITS WORK.

The Cell as the Unit of Life, and other Lectures delivered at the Royal Institution, London, 1899–1902. *An Introduction to Biology.* By the late Allan Macfadyen. Edited by Prof. R. Tanner Hewlett. Pp. xvi+381. (London: J. and A. Churchill, 1908.) Price 7*s.* 6*d.* net.

THE volume before us is the outcome of courses of lectures delivered some years ago by the late Dr. Allan Macfadyen in his capacity of Fullerian professor of physiology in the Royal Institution. Naturally, owing to the time that has elapsed since they were delivered, some modification must have been rendered necessary, and Prof. Hewlett, who has undertaken the task of editing the book, is to be congratulated on the way in which he has performed his part.

The lectures themselves deal principally with the cell as the morphological and physiological unit of organic life. The author strongly emphasises this point of view. It is one which, in our judgment also, still affords the most comprehensive as well as the most effective grasp of the problems presented by living beings, notwithstanding the attacks that have been from time to time directed against it. The manifold and complex phenomena of life must, in the last analysis to which we can for the present hope to submit them, be considered as attributes of cellular activity.

"There is a solidarity in the essential phenomena of life which is shared not only by the simple Amœba, but by the most specialised cell in a tissue of the human body."

As might be anticipated by those who will now become acquainted with the lectures for the first time, the consideration of the ferments, toxins, and other properties of the cell occupies an important part of the whole work. Prof. Macfadyen is best known by his investigations in this department of biology, and even if the point of view has somewhat changed during the last few years, it is hardly possible to read the book without profit. The method of treatment, as befits a course of lectures of this kind, is necessarily somewhat elementary, but it is not by any means superficial, and the thread of the argument can easily be followed by anyone, even though he have no special previous knowledge of the subject.

Great insistence is placed on the distinction between the reactions of living protoplasm and the molecular groups that arise out of it when the attribute of life has been lost. This is not always remembered sufficiently by some who would reduce all the phenomena of life to proximate questions of contemporary chemistry and physics, without reflecting on the limited area of these sciences that has been explored up to the present time.

"A great part of physiological inquiry has consisted in the examination and explanation, *not* of life but of the mechanism of life, and so far as this mechanism is concerned, adequate and satisfactory explanations have been found in the ordinary laws of physics. It is when we come to cellular activity that our real difficulties begin as regards the essentially vital problems."

Of course, this does not affect the truth of the statement that the greatest real advances have been actually made along the paths indicated by chemistry and physics, but rather that these two sciences occupy themselves as yet with relatively simple problems, whilst those that confront the physiologist are so complex that means have not as yet been discovered, at least in most instances, to split them up into those simpler and more manageable components into which analysis will one day assuredly cleave them. It may be that the requisite tool will be fashioned as the result of the investigations on ferments that are now being so energetically studied. At any rate, researches on these bodies are yielding, at the present time, results of far-reaching importance, and we have come to realise that it is by their agency within the living cell that many of the reactions that used to be associated essentially with "living" substance are demonstrably brought about.

The lectures deal with these and other topics. The style is always interesting, and the book may well claim to form an introduction to a study of some of the fundamental problems of biology, if not to biology itself.

INTERNAL COMBUSTION ENGINES.

(1) *The Internal Combustion Engine.* By H. E. Wimperis. Pp. xiii+326. (London: Constable and Co., Ltd., 1908.) Price 6*s.* net.

(2) *Internal Combustion Engines, their Theory, Construction, and Operation.* By R. C. Carpenter and H. Diederichs. Pp. xiv+597. (London: Crosby Lockwood and Son; New York: D. van Nostrand Co., 1908.) Price 21*s.* net.

(1) THE developments of the theory and practice of engineering in relation to the internal-combustion engine have been so rapid in the last few years that old text-books are practically obsolete, and the serious student of this fascinating subject can only obtain trustworthy information by consulting a mass of original papers. The present text-books are of the class which will appeal to advanced students of engineering, and will also be welcomed by engineers who, without having a specialist knowledge of the subject, wish to keep abreast of modern developments.

Mr. Wimperis has dealt very successfully with a considerable range of theory and practice, and, in a moderate compass, has given a clear account of the theory of the internal-combustion engine. The distinctive feature of the early part of his work is the development of the thermodynamic equations on the assumption that the specific heat of the charge varies linearly with the temperature.

Modern research on the specific heats of gases at very high temperatures shows that a theory based on an invariable specific heat is so incorrect as to make the standard of reference of little value.

The exact way in which the specific heat of the charge varies has not been settled in a satisfactory manner, and it appears that the law of change is not a linear function of the temperature; but in the present state of our knowledge the extra complication produced by a parabolic formula is not warranted. The second section of the book is devoted to the construction and operation of gas engines and producers, and covers a fair range of practice. Some of the sections, such as that on the balancing of engines, merely touch the fringe of the subject, but balancing could not be adequately treated without materially adding to the size of the book.

We think that the author might have devoted more space to the consideration of indicators, especially to those which have developed from the diaphragm indicator invented by Prof. Perry, and which in their modern forms have become so important in tests of high-speed engines of all kinds.

Oil and petrol motors are dealt with in the final section of the book, and considerable space is devoted to carburettors, ignition, rating of petrol motors, and their efficiency. The book is clearly printed, the illustrations are well chosen, and it is one of the most interesting and readable works which has appeared for a very long time.

(2) The work by Profs. Carpenter and Diederichs, of Cornell University, is on a more extensive scale, and is based on a course of lectures to engineering students at Sibley College. It is therefore written

more from the point of view of a teacher, and, in its early chapters, the theory of the internal-combustion engine is developed on the assumption of a constant specific heat. Later the variation of the specific heat with temperature is discussed in general terms, and the results of Clerk, Mallard, and Le Chatelier are given.

The principal feature of the work, however, is the very full account of the growth and development of the internal-combustion engine in America.

All the well-known types are described and generally very fully illustrated. In this respect the work is somewhat encyclopædic in character, and ought rather to be regarded as a reference book than a text-book. The same remark applies to other sections devoted to fuels, testing of engines, methods of regulation, gas-engine auxiliaries, and the like. In all these we find a mass of information, with copious references to the original sources.

Anyone wishing to obtain a good general idea of present-day practice in America will find this book a valuable work.

E. G. Coker.

OUR BOOK SHELF.

Abhandlungen zur Physiologie der Gesichtsempfindungen aus dem physiologischen Institut zu Freiburg-i-B. Herausgegeben von J. von Kries. Drittes Heft. Pp. 192. (Leipzig: Verlag von J. A. Barth, 1908.) Price 6 marks.

This volume comprises the third series of collected papers from the laboratory of Prof. von Kries at Freiburg. The communications have all been previously published in the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, the earliest having appeared in 1903. It is doubtful whether their republication in this form will lead to recognition by a larger audience, not because of any lack of inherent excellence, but rather because of their highly specialised nature.

The first paper is an interesting note on the perception of flicker in normal and totally colour-blind persons. The researches of Schaternikoff tend to show that the retinal rods possess a lower sensitivity for rapid periodic variation in the intensity of the incident light than the cones; hence more rapid rotation of the disc in the usual method of eliciting the flicker phenomenon is necessary to produce complete fusion with the eye adapted for light than with the dark adapted eye. It became of interest, therefore, to investigate the behaviour of the totally colour-blind eye in these circumstances. At the suggestion of Prof. von Kries, who had not a suitable case under his observation, Prof. Uhthoff carried out some investigations. He found that much more rapid rotation—about three times—was necessary with the normal eye to eliminate flicker than with the totally colour-blind eye.

Porter has investigated the relationship between the intensity of illumination and the frequency of change necessary to eliminate flicker. He found that the curves representing this relationship show two parts, each nearly straight, but having two different constants. These curves are analogous to those obtained by König for the relationship between visual acuity and intensity of illumination. In the one case the fusion frequency, in the other the visual acuity, is proportional to the logarithm of the illumination. Both, therefore, behave in identical fashion: with the smallest intensities of light both increase slowly; at approximately the same intensity a much more rapid increase suddenly becomes apparent. The simplest explanation of these phenomena is that there are two mechanisms at work, one of which is influenced by light of low, the other by light of higher, intensity.

In succeeding papers Dr. Wilhelm Trendelenburg records quantitative estimates of the bleaching of visual purple by monochromatic light and (with Dr. Roswell P. Angier) of mixtures of complementary colours to form white. Siebeck has investigated the intensity of monochromatic light in extremely small fields, so small, in fact, as to eliminate the colour element (Minimalfeldhelligkeit). Prof. von Kries, in a paper founded on observations by Dr. Eyster, calculates in absolute terms the energy necessary for stimulation of the retina, and Dr. F. P. Boswell applies the same principles to the fovea. They thus attempt what has already been done for the ear by Lord Rayleigh and others. Other papers on colour mixtures and colour memory will repay perusal, and Prof. von Kries describes a simple apparatus for the mixture of monochromatic lights which may be commended to the notice of teachers of physiological psychology.

Fresh-water Algae from Burma, including a few from Bengal and Madras. By W. West and G. S. West. Pp. 175–260; 7 plates. (Annals of the Royal Botanic Garden, Calcutta, vol. vi., part ii.) Price Rs. 10, or 15*s*.

The material was collected in certain districts of Burma, and a few species in the Burdwan district of Bengal and Vizagapatam district of Madras by Mr. I. H. Burkill, and was forwarded for determination by Lieut.-Col. Prain, at that time director of the Botanical Survey of India. The work is almost entirely systematic, as would be expected in dealing with material from districts where the algal flora was previously almost unknown, and has added very materially to our knowledge of the distribution of fresh-water algæ in the Indian region. Two new genera are described—Euastridium, a large and handsome Desmid. possessing peculiar morphological features, and Burkillia, belonging to the Protococcaceæ, occurring as free-floating colonies furnished with stout horns. Among the many new species described, *Mougeotia producta* is of special importance because of the presence of aplanospores in no way different from those which are found in the genus Gonatonema. In the last-named genus aplanospores only are formed, whereas in Mougeotia, aplanospores and spores, as a result of conjugation, are both present, hence it may be necessary to place Gonatonema merely as a section of the genus Mougeotia, in which spores resulting from conjugation have ceased to exist. *Urococcus tropicus* is remarkable in being green, whereas the cells of other species of the genus usually contain an abundance of a red-brown pigment.

The collection contained a number of interesting Desmids which, with previous records, are said to furnish material for a very interesting discussion on their distribution in the East Indies generally. Even from the knowledge forthcoming, certain Desmids appear to be confined to an area extending from India and Ceylon, across Burma and the Malay Peninsula to Sumatra and Java, and thence to Queensland.

As evidence of the wide geographical range of some species of algæ, *Nostoc humifusum*, first recorded from Scotland, and *Plectonema wollei*, from the United States, were included in the collection.

The number of varieties and forms hovering around many of the species suggests that, from the standpoint of de Vries, many incipient species are being produced.

The work is a perfect model of descriptive or systematic botany, combining a true sense of proportion, the authors' well-known grasp of their subject enabling them to deal primarily with the material under investigation, and, secondly, with the book phase of the subject known as synonymy.

Seven beautifully executed plates elucidate the text.

Trees: a Handbook of Forest-Botany for the Woodlands and the Laboratory. Vol. iv. Fruits. By the late Prof. H. Marshall Ward. Pp. iv+161. (Cambridge: University Press, 1908.) Price 4s. 6*d*. net.

It was the intention of the author to complete this work in six volumes, but unhappily he was not spared to see the scheme accomplished. However, three excellent volumes, full of useful and interesting information, dealing respectively with buds, leaves, and flowers, had been published, and the author left behind sufficient manuscript for two other volumes. Prof. Groom undertook the task to see these two volumes through the press. A perusal of the present volume shows that the manuscript could not have fallen into better hands. The skill with which he has edited this part leaves nothing to be desired. Like its predecessors, vol. iv. is divided into two sections—a general and a special. The first section contains seven chapters. The first chapter gives an idea of what fruit is, its function and parts. In the second chapter is given a classification of fruits, and the remaining chapters of this section deal with the fruits of woody plants, each under its own natural order. In section ii. we have a tabular classification of trees and shrubs according to their fruits and seeds.

The many excellent illustrations given throughout the volume serve to enhance its value as a book for students and others who may wish to study fruits, and it will also be found of service for the purpose of reference.

The next and final volume is already in the press, and when issued will complete a monumental work on trees written by an enthusiast as only one who is imbued with the love of his subject can write.

"Trees," by Prof. Marshall Ward, will be found of use to the expert and student alike, while the beginner who has once started to read will soon find himself becoming enthusiastic under the inspiring influence of the writer.

A complete index has been compiled for this as well as for the other volumes by Mrs. Marshall Ward.

The Story of Iron and Steel. By J. Russell Smith. Pp. xi+193. (London: Appleton and Co., 1908.) Price 2*s*. 6*d*. net.

To all who are interested in the gradual development of our great iron industries, and especially the more recent development in America, this little volume may be of some interest. It, however, can hardly be said that the author has succeeded in carrying out the object he had in view, as stated in his preface, of presenting to intelligent persons a clear and concise description of the complex technical phenomena of iron- and steel-making. The author's apparent lack of detail technical knowledge has prevented his emphasising in his descriptions the fundamental principles involved in the various processes to which he refers. Thus, in dealing with the reduction of iron as it was practised during the various stages of development in passing from the catalan forge to the modern blast furnace, there is not the slightest suggestion made that there is any chemical reaction between the iron ores and the fuel employed, and the lay reader would go away with the impression that the only function of the carbon, in whatever form it was used, was to act as a heating agent.

On p. 99, in dealing with the quality of iron produced, he makes the statement that if the iron is *melted* at 800° centigrade, it will contain 1 per cent. of silicon, which is, of course, an absurdity, as this temperature is below the melting point of iron. A page or two further on he speaks of the hot blast being injected into the furnace at 800° or 1100° centigrade.

His description of the puddling furnace is of the crudest when he speaks of the carbon in the pig-iron being combustible and gradually burnt out by the flame, while no suggestion is made that the real oxidising agent is the oxide of iron added. In chapter xi., "On the New Steels and their Significance," in which he refers to various alloy-steels, he seems to be under the impression that the self-hardening properties of high-grade steel tools are a function of their melting points, and his statement as to certain influences of manganese on steel certainly has the single advantage of being distinctly novel.

It is to be regretted that the technical descriptions in this little volume are so inaccurate, as in other respects it is a very interesting synopsis of the progress of the iron and steel industry. Perhaps the most interesting portions of the book are those chapters dealing with the various causes which have influenced the great developments in recent years in America, and also induced the rise and growth of the great financial trusts that now so largely control steel manufacture in the States.

Physiological and Medical Observations among the Indians of South-western United States and Northern Mexico. By Aleš Hrdlička. Pp. ix+460. (Washington: Government Printing Office, 1908.)

This publication is a bulletin of the Bureau of American Ethnology (Smithsonian Institution), and comprises the result of observations among a large number of Indian tribes. It will prove a mine of useful information to those interested in anthropology, but, like the publications of most Government institutions, is hardly written in a manner to make it interesting to the general reader. It contains, for instance, nearly 200 pages of statistical tables. Its title—physiological and medical observations—is justified because the data collected include what is so often missing in books on ethnology, details not only of size, stature, date of puberty, rate of pulse, muscular development, and so forth, but also statistics relating to prevalent diseases and native methods of treatment. Not the least attractive feature of the work is a series of twenty-eight beautiful plates, which illustrate the physiognomy and dwellings of the native races, as well as other points interesting to those who study folk-lore.

The author appears to have spared no pains in carrying out his investigations.

Ernst Haeckel. Versuch einer Chronik seines Lebens und Wirkens. By Prof. Walther May. Pp. vii+301. (Leipzig: J. A. Barth, 1909.) Price 5·60 marks; bound, 6·60 marks.

There are already two biographies of Haeckel, but Prof. May's book is complementary to these, and written in a different mood. It aims at showing what the great naturalist has accomplished, from his first research in 1855 to the institution of the Phyletic Museum in 1907. The author gives a careful account of the chief results of Haeckel's books, including the "Generelle Morphologie," and shows us—rather by a statement of facts than by any formal estimate—the influence Haeckel has had on modern biology and on the intellectual outlook generally. He does not hesitate to quote the hardest things that have been said of Haeckel's physics and metaphysics, and even of his biology, but he gives us something of the defence as well. The quotations from irresponsible authors might have been left out, as well as all the verses from "Jugend," "Kladderadatsch," and the like, which seem out of keeping with the serious character of the book. It is a restrained and careful piece of work, tending, perhaps, to exaggerate the importance of Haeckel's later writings, but marked by unusual objectivity and impartiality of statement. There is an excellent bibliography.

Ventilation for Dwellings, Rural Schools and Stables. By F. H. King. Pp. iv+128. (Madison, Wis.: Published by the Author, 1908.) Price 75 cents.

PROF. KING knows the value of experimental demonstration in explaining scientific principles, and makes excellent use of it in his little book. The interesting treatment of the facts upon which successful ventilation depends, and the application of theoretical conclusions to practical problems, should make the book useful to a wide circle of readers. The supply of pure air is of vital importance in all the circumstances with which the book is concerned, and the volume may be commended specially to parents, teachers, and stock owners.

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 intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Temperature of the Upper Atmosphere.

SINCE my letters which appeared in NATURE on March 12 and July 30, 1908, you have published various communications on this subject. In your issue of March 18, p. 68, Mr. E. Gold contributes a mathematical calculation of the possible size of the difference between the temperature of the surrounding air and that of the balloon or the thermometer. His conclusion, if I rightly understand him, is that under the conditions which he postulates it is impossible for a thermometer of the Hergesell pattern to differ from the temperature of the surrounding air by sensibly more than 2° C.

In my last letter I specified actual cases in which *differences* larger than 2° C. had been observed between two thermometers of different types sent up with the same balloon, on occasions when a comparison of falling and rising readings seemed to show the impossibility of explaining this by mere errors of graduation. The causes which Mr. Gold investigates would naturally affect the two thermometers in the *same* direction, so that the difference between them is presumably an underestimate—possibly a large underestimate—of the disturbing influences exerted on the thermometer most affected. This does not, of course, necessarily invalidate the accuracy of Mr. Gold's work, because the conditions which he postulates may have been violated during the ascents in question; but I have no reason to suppose that I hit upon ascents which could reasonably be regarded as of a wholly exceptional character at the stations concerned. Out of the considerable number of records which I examined, there were only a few which gave data from two thermometers, and there seems no reason to suppose that the physical conditions on these occasions were exceptional. Considering the many uncertainties in the physical data available at present, I am afraid that any mathematical calculation must be received with considerable reserve so far as practical applications are concerned.

I am glad to see, both from his letter and from a recent paper in the Proceedings of the Royal Society, that Mr. Gold prefers to speak of an isothermal *region* rather than of an isothermal *layer*; but I would invite him and other active meteorologists to take yet a second step, and discard the term *isothermal*. What the *instruments* usually suggest—rightly or wrongly—is, as I pointed out before, not uniformity in temperature, but an inversion of temperature. It is surely ridiculous to apply the term *isothermal* to the phenomena observed at Uccle on July 25, 1907, during the highest ascent yet effected (*Meteorologische Zeitschrift*, February, p. 88). During the ascent temperature fell from $+13°{\cdot}5$ C. at 360 metres to $-56°{\cdot}8$ at 12,112 metres. Then came, according to the records, an inversion, temperature rising until at 26,557 metres, the greatest height attained, it was $-42°{\cdot}3$, or $14\frac{1}{2}°$ C. above the minimum. The temperatures recorded during the fall agreed remarkably with those recorded at the same heights during the ascent, thus affording—as is pointed out in the *Meteorologische Zeitschrift*—strong support to the view that the ventilation was throughout sufficient. It is surely a misuse of words to apply the term *isothermal* to a region of which different portions—according to the only evidence available—differ in temperature by at least $14\frac{1}{2}°$ C. The records from some ascents even raise doubts as to whether, above the height of inversion, the temperature gradient is always and everywhere very small. The Uccle record above referred to showed a rise of 6° C. during the ascent from 12,112 metres to 13,000 metres, and a fall of $5°{\cdot}6$ C. during the descent from 13,000 metres to 12,000 metres. C. CHREE.

March 20.

The Encouragement of Research.

I TRUST that you will permit an appeal to be made to those of your readers who believe that the encouragement of scientific research is a matter of national as well as of local importance.

The new buildings erected by the council of this college in the Cathays Park, Cardiff, are now approaching completion, and a special feature of those buildings is a laboratory dedicated wholly to the purposes of scientific research.

The erection of the whole of the new college buildings, according to the designs of Mr. Caroe, would involve an outlay of close upon 250,000*l*. The council has not considered it possible, at the present time, to undertake such an expenditure, but has sanctioned the completion of the buildings assigned to the arts, the administrative and the educational departments, the library, and the research laboratory. The erection and equipment of this portion of the buildings involves an expenditure of nearly 140,000*l*., of which about 100,000*l*. has been secured. A special and strenuous effort is now being made to raise from local sources the 40,000*l*. immediately required.

In such circumstances it is felt that any attempt to secure in this district, at the present time, the amount necessary for the equipment and modest endowment of the research laboratory might react injuriously upon the prospects of the special effort to which reference has already been made.

I venture, therefore, to appeal to those of your readers who, although not directly interested in educational matters in this district, feel that the encouragement of research is a national duty, to assist the movement for obtaining the necessary equipment for the suitable and handsome edifice which is being provided by local generosity and dedicated by the council of the college to the purposes of scientific investigation.

A collection of physical apparatus has already been presented to the laboratory, but as it is of a somewhat specialised nature it can only be regarded as a nucleus.

All donations received in answer to this appeal will be devoted solely to the equipment and upkeep of the research laboratory. They may be paid to the treasurer of the college or to the undersigned.

E. H. Griffiths.

University College of South Wales and Monmouthshire, Cardiff.

Research and the Colleges.

It is evident that the question of subject-matter for research is still a difficult one, and that our colleges are still unable to meet it. In the meantime, it is essential that the students should be instructed in such procedure, unless the matter is to be shelved until some outside source of supply can be obtained.

I would suggest that class research be instituted on the following basis. The senior students, divided into groups of, say, four, would engage in some well-recognised research of a classic nature, which would be selected from the published work in this direction. It must follow, I think, that the difficulties met with by the original investigator would come to the surface, and be followed by the students step by step.

The different groups in class would at intervals examine each section's work, and be instructed generally in the same by the staff. By a careful selection, and in this way, the work coming before the students might cover research in pure chemistry, and technical or industrial research as well.

From the industrial side of the question, it seems that Prof. Kipping's recent criticisms on the Institute of Chemistry for not insisting that the subject of original research shall be compulsory are a little premature, while the colleges themselves do not do more in this direction. From this point of view the institute might insist that all senior students shall be instructed in the methods of research in a practical and thorough way, and might refuse to "recognise" any college not conforming to this regulation. With the above method of class research this training is available. The fact is often lost sight of that the more important the nature of industrial research the less possible is it to publish it, even to the examiners themselves. Thus the opposite conditions obtain from those in the colleges, but the mass of this hidden research is of far greater value and importance than that which is published from these institutions, at any rate to the present generation.

W. P. Dreaper.

Fall of an Aërolite in Mokoia, New Zealand, on November 26, 1908.

By the kindness of Mr. J. T. Ward, honorary director of the Wanganui Observatory, and Mr. G. R. Marriner, curator of the museum at the same place, I have received particulars of the aërolitic fall of November 26 last, together with several fragments of the object. Perhaps it will be best to quote from their accounts:—

The flash of the meteor was seen at 12.30 p.m. to 12.35 p.m. (civil time, 11.30 fast on Greenwich), and the loud detonations were heard by many persons distributed over more than 100 miles of coast-line and for a considerable distance inland. The object left a streak like a line of smoke or steam, which broke into three portions and drifted apart before it disappeared in about five minutes. The sound appeared to follow the flash after a minute or more, and formed a combination of booming with sharp cracking sounds, similar to that produced by thunder and discharges of musketry. The observed flash, or meteor-flight, occupied the following position as ascertained by Mr. Ward from various observers:—$250°-30°$ to $220°-5°$.

At Stratford, twenty-five miles from the place of the meteor's descent, the noise was very loud, and startled the horses and cattle, as well as many persons who were in the open and amid quiet surroundings. Mr. Marriner visited Mokoia and recovered two fragments of the body, but a third, which was seen to fall in a plantation, could not be found owing to the thickness of the bush. The pieces secured were $4\frac{1}{2}$ lb. and 3 lb. in weight, and the former fell at the foot of a tree, splintering a part of it and making a hole in the ground about 15 inches deep. Mr. Marriner estimates the whole weight of the meteorite which fell on Mr. Hawkins's estate as 12 lb., but as disintegration occurred before its descent, the original body was much larger, and it is to be hoped that other fragments will be found after more careful examination of the district.

The portions received by me are composed of a very dark grey stone or admixture of stone and iron, which has evidently undergone intense heat, and seems of a crumbly nature. The analysis of the meteorite is being made at Wanganui, and will be published shortly. After circulating in space for probably countless ages, it had apparently ceased its rovings when it struck the root of the tree in Mokoia and penetrated about 15 inches below the soil; but it was destined for a further flight from one side of our globe to the other, for it has just completed its transit of about 13,000 miles to Bristol!

It is interesting, after a person has habitually watched the luminous careers of these bodies during many years, to hold a similar object in one's hand and contemplate it from a much nearer point of view!

Bristol, March 19. W. F. Denning.

Early References to Fluorescence and Light transmitted by Thin Gold Films.

Petro van Musschenbroek, in his "Elementa Physicæ," after a discussion of the colours of thin films, proceeds:—"id quoque conspicuum est in infuso Ligni Nephritici, quod pro diverso tam oculi, quam lucis situ, alio colore apparet" (p. 393, second edition, Leyden, 1741).

This clearly could not have been an instance of ordinary interference colours, and it occurred to me that we might have here an early observation of fluorescence.

Inquiries kindly made for me by Mr. Harold Evans have elicited, in a letter to the *Gardeners' Chronicle*, the facts that the wood *Lignum Nephriticum* was shown in the Paris Exhibition of 1855, that its source is some Mexican tree, but that this tree was not identified, at any rate in 1871. In the Admiralty Manual of Scientific Inquiry for that year information as to its origin is asked for, and it is stated that "its infusion is remarkable for having the blue tint seen in a solution of quinine."

This seems to confirm definitely my conjecture that van Musschenbroek had observed fluorescence at least ninety-two years before it was recorded in alcoholic chlorophyll solutions by Brewster, and more than one hundred years before Herschel described it in solutions of quinine sulphate.

Can any of your readers throw any further light upon the nature of *Lignum Nephriticum*?

In the next sentence after the one quoted above van Musschenbroek alludes to the blue colour of the light transmitted by very thin films of gold:—"tum Auri lamellae tenuissimae ante Microscopium positae; per quarum poros Lux caerulea tantum transit."

John H. Shaxby.

University College of South Wales and Monmouthshire, Cardiff, March 22.

Another Fossil Tsetse Fly.

In Nature, August 22, 1907, I reported the discovery of a tsetse-fly (Glossina) in the Miocene shales of Florissant, Colorado. In going over the materials collected in the same locality in 1908, I find a second species of the same genus. It is preserved showing the lateral aspect, the abdomen arched dorsally, and the proboscis evident, though imperfect. It is about $10\frac{1}{2}$ mm. long, the wing 7 mm., thus much smaller than *G. oligocena*. The venation is perfectly typical for Glossina, but the first basal cell bulges less subapically than in *G. oligocena*, its maximum breadth or depth being only 323 micromillimetres. The vein bounding the outer side of the discal cell has a double curve, as in the Œstridæ.

For the new species I propose the name *Glossina osborni*, after Prof. H. F. Osborn, the distinguished palæontologist.

T. D. A. Cockerell.

University of Colorado, Boulder, Colorado, March 15.

HINTS FOR NATURE-STUDY.[1]

(1) Mrs. Brightwen was one of the pioneers in the art of making young people acquainted in a pleasant way with the plants and animals round about them, and we wish to express our opinion that the mood and method of much of the "Nature-Study" which has been hurriedly set a-going in schools to-day is right or wrong just as it agrees or differs from what we find in the simple and homely studies by the author of "Wild Nature Won by Kindness." We say this very deliberately, although, to tell the truth, there is not much in the particular book before us, which must be treated tenderly, as its title suggests, and for the sake of what has gone before. But even here we find some of the qualities which distinguish sound nature-study—fidelity to observed fact, appreciation of the wonder and beauty of common things, and insistence on interpretation rather than information. The book shows how problems of a simple sort may be solved in simple ways, given patience and a window-sill.

(2) We have also before us a beautiful popular edition of Mr. R. Kearton's "Adventures of Cock Robin and his Mate"—a book for boys and girls, which first appeared in 1904, and has been deservedly popular. The photographic illustrations have never been excelled, and there is plenty of sound natural history in the often rather quaint colloquy between the cock robin and his precocious chicks, who persist in asking about migration and that sort of thing. We wish to record—for what it is worth—the opinion of some young readers that they like to listen to Mr. Kearton and to the robin, but not to the two at once.

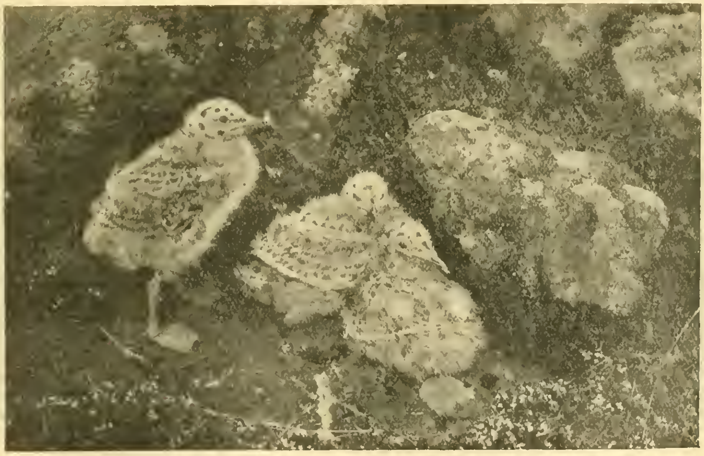


Fig. 1.—Young Great Black-backed Gulls. From "The Adventures of Cock Robin and his Mate."

(3) Mr. Snell apologises for his study of the common objects of the country, but there is no need for apology. His unpretentious descriptions are direct and appreciative, his photographic illustrations are beautiful and with ideas behind them, and the whole book has an open-air feeling about it. In connection with "Nature-Study" in schools, this book will be of service in showing the beauty and interest of common things. Mr. Snell begins with a study of the so-called sleep of plants, and shows us anemones and wood-sorrel and goatsbeard open and closed, and the sweet-scented evening campion conspicuous in the dim light. Another study deals with protective coloration, and is illustrated, for instance, by admirable photographs of the eggs of the ringed plover among the stones on the beach, and of the lappet-moth, so like a crumpled, withered leaf. The author has an interesting note on the way animals squat in conspicuous places when they are away from their usual surroundings, and he doubts if birds often catch butterflies in flight; but this useful scepticism might have been extended with advantage to some of the author's own sentences, *e.g.* that which points out the boulder-like appearance of the "half-wild mountain sheep" of Wales and Scotland. Are these the *moutons sauvages* which the French visitor slew in default of deer? There are admirable studies of the sundew, of the life-history of the frog, of the beautiful forms of fungi, and of clouds, all with fine illustrations. Very interesting is the series of photographs taken in the woods at night—of moths feeding, of woodlice on the tree trunk, of slug and frog, and so on. The value of the book is increased by the practical directions given in connection with some of the more difficult photographs, for no one can look at them without wishing to be able to attain to similar success in recording observations.

(4) Cassell's "Nature-Book" is probably the most beautiful of the many volumes already called into existence by the increased interest which is being taken in open-air natural history. It is lavishly illustrated with charming photographs and coloured pictures, and even to turn over its pages is a great pleasure. Yet, in the strict sense, it is not a book, having neither unity nor continuity. It is made up of such delightful parts, by many different authors, that we cannot but regret that they do not form a

[1] (1) "Last Hours with Nature." By Eliza Brightwen. Edited by W. H. Chesson. Pp. 223; illustrated. (London: T. Fisher Unwin, 1908.) Price 2*s*. 6*d*. net.
(2) "The Adventures of Cock Robin and his Mate." By R. Kearton. With upwards of 120 illustrations from photographs taken direct from nature by Cherry and Richard Kearton. Pp. xvi+240. (London: Cassell and Co., Ltd., 1908.) Price 3*s*. 6*d*.
(3) "Nature Studies by Night and Day." By F. C. Snell. Pp. 319; illustrated. (London: T. Fisher Unwin, 1908.) Price 5*s*.
(4) "The Nature-Book. I. A Popular Description by Pen and Camera of the Delights and Beauties of the Open Air." Pp. iv+372; 13 plates, 12 coloured, and numerous illustrations. (London: Cassell and Co., Ltd., 1908.) Price 12*s*. net.
(5) "The Story of the Sea and Seashore." By W. Percival Westell. Pp. 343; illustrations from photographs and drawings (the latter mostly by C. F. Newall) and 8 coloured plates (7 by W. S. Berridge and 1 by C. F. Newall). (London: Robert Culley, n.d.) Price 5*s*. net.
(6) "The House in the Water; a Book of Animal Life." By Charles G. D. Roberts. Pp. 323; with 18 full-page plates. (London: Ward, Lock and Co. Ltd., 1908.) Price 6*s*.
(7) "Close to Nature's Heart." By William M'Conachie. Pp. x+276. (Edinburgh and London: William Blackwood and Sons, 1908.)

whole. The book gives useful samples of profitable nature-studies, *e.g.* of a river or of a wasp nest, but more should have been made of the remarkably fine collection of illustrations. We may also point out that there is an unpleasant smack in some of the much too ambitious titles—"How to know the Insects," and so on.

(5) Mr. Westell's guide to the natural history of the sea and seashore contains much interesting information, somewhat carelessly stated, and many of the illustrations are very fine. In many cases the coloured plates do not show the natural colours, and the text contains many errors. It is a pity to speak of the "bones of starfish," of the Bass Rock as a "remarkable headland," of Luidia as "one of the largest British brittle-stars," of Polycystina as "shell-fish." Mr. Westell refers frequently and gratefully to Miss Newbigin's admirable "Life by the Seashore," but the fact that he never spells her name correctly is a trivial illustration of the carelessness which disfigures his book.

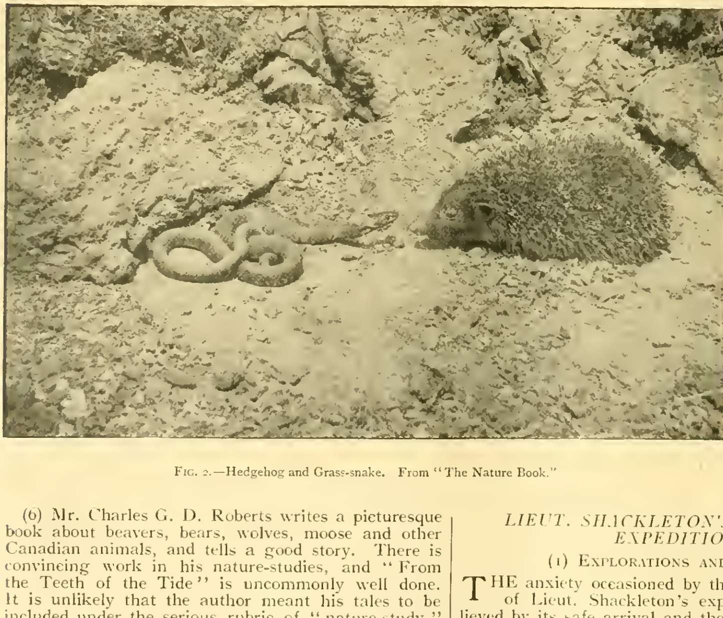


FIG. 2.—Hedgehog and Grass-snake. From "The Nature Book."

(6) Mr. Charles G. D. Roberts writes a picturesque book about beavers, bears, wolves, moose and other Canadian animals, and tells a good story. There is convincing work in his nature-studies, and "From the Teeth of the Tide" is uncommonly well done. It is unlikely that the author meant his tales to be included under the serious rubric of "nature-study," but they may help some to get away from the fallacious automatic-machine theory of the creature.

(7) What are the ends of nature-study, for they are many? We are told that this discipline—which is now part of the day's work of the elementary school—"implies an appreciative outlook upon the whole environment, and that not from a scientific view-point only, but from the æsthetic and practical as well." Thus among the aids to nature-study which have sprung up on demand with almost magical quickness, some emphasise precise observation and others graphic registering; some the cultivation of the school garden, and others the culture of the scientific mood; and all this is well if it be well done. But that there is something more than all this a book like Mr. M'Conachie's reminds us, for it expresses an end of nature-study which, if attained, covers a multitude of sins, but without which the naturalist with his lynx eye is a fingering slave, and the school garden only an open-air laboratory. That end is the love of the country, which is to be felt, not spoken about. Mr. M'Conachie does not speak of it, except, perhaps, in the repellent title of his book, which is congruent, however, with his vocation, but his pictures, which are worthy of a place beside those of Jefferies and Burroughs, reveal it eloquently. He knows his birds and his flowers not as species so much as familiar friends; he takes us, not on botanical excursions, but for a walk in the country, and we return wondering whether it was poet or naturalist who led us. *Nur was du fuhlst das ist dein Eigenthum,* and no one can read these sketches—such as the coming ot spring, the promise of summer, the turn of the year, and December days—without feeling that the author has made the natural history of the year his own in the truest sense. Many of the sketches are local; but though we have never been very near the Scotch parish which contains the quarry pool, the brook path, the mill stream, the haunt of the pike, and the old forest that we now know, there is so much of the universal in the pictures that we seem to have known and loved them for many years. To all who would know the true inwardness of nature-study we commend this book. J. A. T.

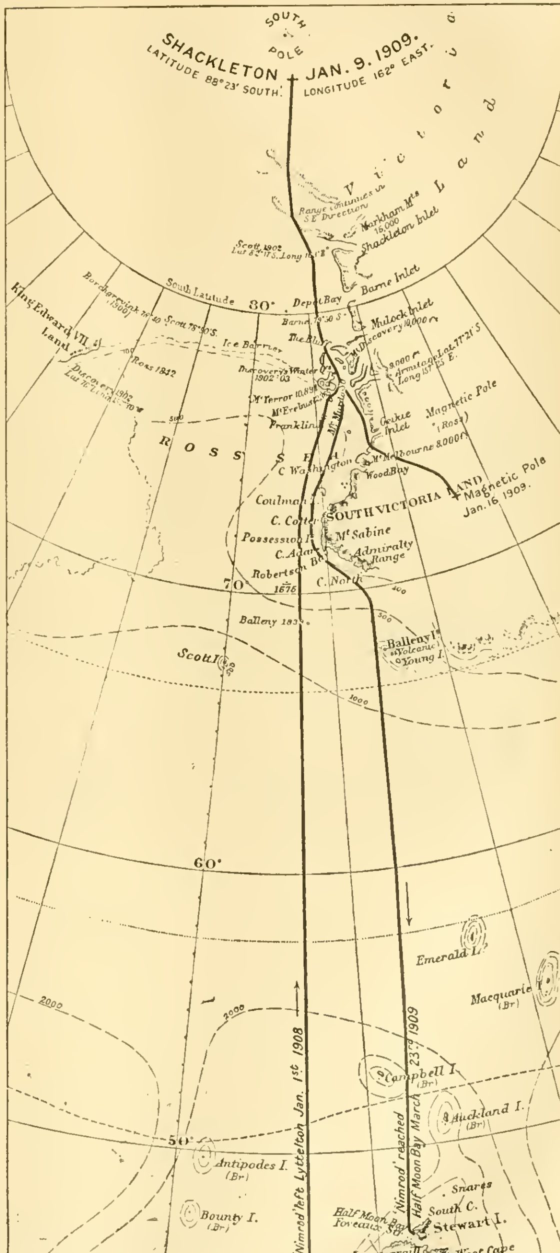
LIEUT. SHACKLETON'S ANTARCTIC EXPEDITION.

(1) EXPLORATIONS AND RESULTS.

THE anxiety occasioned by the delay in the return of Lieut. Shackleton's expedition has been relieved by its safe arrival and the news of its supreme success. A cable published in the *Daily Mail* of March 24 records the magnificent exploits of the expedition, and though there are occasional obvious verbal inaccuracies in regard to some technical points, the report makes clear the main outlines of its great achievements. They unquestionably place it in the front rank of Polar expeditions. Its two most striking achievements were the sledge journeys by which Lieut. Shackleton reached within one hundred geographical miles of the South Pole, and discovered the nature of the very centre of the South Polar region, and by which Prof. David gained the magnetic south pole, and rendered almost certain the continuity of South Victoria Land and Wilkes Land.

The expedition was landed early in 1908 near the former winter quarters of the *Discovery* on MacMurdo Sound, and there established its main base. It gained its first success by the ascent of Mount Erebus (13,120 feet high), and the discovery of its old crater at the height of 11,000 feet. During the winter depôts were established in readiness for the summer journeys, and in this work the motor-car proved of great service over the sea ice, though it could not be used on the land ice or on the Barrier.

The southern sledging party—Lieut. Shackleton, Lieut. Adams, Mr. Marshall, the surgeon, and Mr. Frank Wild—left Hut Point on November 3, 1908. On November 5 the explorers were stopped by a blizzard, which delayed them for four days; thanks to their pony sledges progress southward was rapid, and on November 13 they reached a depôt previously formed at latitude 79° 36′. The route selected was along the meridian of 168° E., to the east of that followed by Capt. Scott's party. The Ice Barrier proved to have an undulating surface, and from the brief reports much of the upper part of it appears to be composed of snow. The previous southern record was passed on November 26, and about eighty miles further south the Great Ice Barrier appeared to end as "the ridges of snow and ice turned into land." At this point, 83° 33′ S. and 172° E., Lieut. Shackleton began the ascent of a great glacier, which was so crevassed that on December 6 the party only advanced 600 yards in the one day. It may therefore be inferred that progress to the south was blocked by the mountains on the eastern margin of South Victoria Land bending round to the east, and, judging from the crevassed nature of the ice, the face of the plateau is very steep. On December 8 the air was clear, and some new mountains were discovered trending southward and south-westward. The glacier by which the route on to the ice plateau was achieved appears to have been badly crevassed throughout, and it took twelve days to reach an altitude of 6800 feet. Everything that could be spared was left behind in a depôt at 85° 10′ S., and on reduced rations the party struck southward toward the Pole, forcing their way against southern blizzards. Eight days' march over undulating, and apparently in places very broken, ice led to the summit of the plateau at the height of 10,500 feet. The mountains had disappeared in the distance by December 27, so probably they were a mountain range striking westward from those along



the margin of the plateau. Once again equipment was lightened as the available time was nearly spent. Nearly the whole of three precious days, January 7 to 9, were lost by a blizzard, with a wind estimated at seventy miles an hour, and a temperature of 40° below zero. The conditions improved on January 9, and upon that day the expedition attained its most southern point, 88° 23′ S. in 162° E. From that position no mountains were visible, and so far as could be seen the country to the south consisted of an ice plateau.

The return journey necessarily followed the same route, and the party were harassed by the bad condition of the snow, and illness due to their privations and over-exertion. They were fortunately helped most of the way by the strong southern wind. Two of the party collapsed, but Shackleton and Wild obtained help from the ship, and the party were all safe at Hut Point on March 4, after a brilliant journey of 1708 miles in 126 days.

Meanwhile a party consisting of Sir Philip Brocklehurst, Mr. Priestley, of Bristol, a geologist, and Mr. Armytage, were at work in the neighbourhood of the Ferrar Glacier; while Prof. David, of Sydney, Mr. Mawson, of Adelaide, and Mr. Mackay, as surgeon, were engaged on a brilliantly successful sledging expedition into northern Victoria Land. The party crossed from Hut Point to the mainland at Butter Point (77° 40′ S.); thence it sledged northward on sea ice to the latitude of about 75°, and then endeavoured to climb on to the plateau through the gap between Mounts Nansen and Larsen. That route was abandoned, but the report does not state by what line the inland ice sheet was eventually gained. The party experienced strong southerly winds and temperatures of 18° below zero, and on January 16 reached its goal, the Magnetic South Pole, at 72° 25′ S., 154° E. The report describes this journey as extending for 260 statute miles north-west of their depôt on the coast; and this distance would have taken them half-way across the country to the shore of Wilkes Land. On their arrival at the shore their retreat was found to be cut off by the dispersal of the ice, and Prof. David and his comrades were finally rescued by the *Nimrod* on February 4. This magnificent journey not only gained the Magnetic Pole, but renders almost certain the continuity of the ice plateau from South Victoria Land to Wilkes Land.

The scientific and geographical results of the expedition are obviously both of the highest importance. The main object of the expedition was to get as near as possible to the South Pole; but that sentimental interest led the expedition along the line of greatest scientific interest. All preliminary investigations on central Antarctica depend on its topography, and the South Pole lies in the very centre of the unknown region. The route to it was the most illuminating that could have been followed. Further details as to the nature of the southern mountain ranges discovered by the expedition in latitude 86° and 87° will be awaited with the keenest interest, in the hope that they may throw light on the connection between South Victoria Land and Graham Land.

The result of the expedition appears to confirm the prediction as to the probable nature of the South Polar area suggested in an article on Antarctic research by Prof. J. W. Gregory in NATURE in 1901. It was there suggested that the chief mountain chain in Antarctica would be found to lie along a line connecting Graham's Land and the coast of Victoria Land, and that "to the south of the main mountain range there may be an undulating, ice-covered region descending slowly across the Pole to the shore of the Weddell Sea. The main ice-drainages would then be not from the Pole radially in all directions; the iceshed would run along the Pacific shore with a short, steep northern face and a long, gradual slope southward to the Pole and across it northward to the Atlantic" (NATURE, vol. lxiii., 1901, p. 612).

This view is now apparently fully confirmed by Lieut. Shackleton's report that the geographical South Pole "is doubtless situated on a plateau ten to eleven thousand feet above sea-level." The mountains that he discovered range from three thousand to twelve thousand feet in height, so though lower than some of the peaks in northern Victoria Land, the great altitude of the plateau is maintained.

This conclusion as to the structure of the South Polar district had been regarded as so probable from the work of the National Antarctic Expedition that the north-western sledging expedition under Prof. David throws perhaps equally important light on the structure of Antarctica. For the journey 260 miles north-west from their depôt on the shore of the Ross Sea carried them almost into Wilkes Land. The altitude of the southern magnetic pole is not stated, but judging by the distances marched, most of the route probably lay over an undulating ice plateau, which probably extends northward to the coast of Wilkes Land.

Of the meteorological results the most striking that can be learnt from the cable is the wide distribution of prevalent southerly winds, blowing with the force of blizzards even to the farthest south. So that elusive South Polar anticyclone has not yet been found, and if it exists at all must be situated on the Atlantic side of the South Pole. If so, the ice-covered plateau around the South Pole may keep at a high altitude for a great distance from the Pole towards the Weddell Sea.

The zoological results are said to be valuable, and the announcement of the collection of many rotifers, infusorians, and other organisms in the freshwater lakes, by Mr. James Murray, is of particular interest.

The geological results may be expected to throw light on many important problems. Lieut. Shackleton reports the discovery of "Coal-measures in limestone" apparently among his southern mountains. This statement probably means that the rocks containing the carbonaceous material found by Mr. Ferrar near the *Discovery* winter quarters extend into the southern mountains, and are there associated with limestones. The only definite fossils referred to are some radiolaria discovered by Prof. David in boulders. They may be of any age, but, considering the resemblance of the slates of Cape Adare to those of the Lower Palæozoic rocks of southern Australia, it will not be surprising if these radiolaria prove to belong to that series. As no other fossils are referred to, their absence, or at least their rarity, suggests that the area was under severe climatic conditions during the deposition of all the sedimentary rocks discovered.

Prof. David reports that the chief Antarctic bergs are snow-bergs, and this announcement and Lieut. Shackleton's description of the nature of the ice barrier both confirm the conclusion as to its origin advocated in the review of Captain Scott's book in NATURE (vol. lxxvii., p. 298), viz. that this ice had not been formed from the glaciers but from sea ice "by the accumulation of layers of snow upon the surface more quickly than the ice was dissolved by the sea beneath." A photograph of the face of the barrier was reproduced to show that its material resembles ice formed from cemented stratified snow rather than glacier ice. The method of its probable formation was also illustrated in NATURE (vol. lxxvii., p. 561) by a photograph from the report on the geology of South Victoria Land.

The tectonic geography of Victoria Land, we may now expect, will be conclusively settled, as the expedition fortunately had with it Prof. Edgeworth David, of Sydney, who determined the monoclinal structure of eastern New South Wales. The first geological information regarding South Victoria Land announced by the *Discovery* suggested that the country was a typical representative of the Pacific coast type; but this conclusion has been regarded as improbable by Dr. Prior and Herr Emil Philippi on petrographic grounds. But that evidence will not give the final test, and the data collected by the National Antarctic Expedition render it probable that the coast of South Victoria Land is of the sub-Pacific type, agreeing essentially with that of the eastern coast of Australia. As the greatest authority on the geology of that coast was a member of the expedition, he may be trusted to give this question its final solution.

The expedition is a great triumph for Lieut. Shackleton. The greatness of his results is not merely due to the distance by which he surpassed previous southern records, but to his having, in the far south, left the low-level ice and climbed on to the plateau and discovered its nature in close proximity to the Pole. He would probably have added little further of scientific value by going another one hundred miles southward, for he no doubt saw enough to justify his belief that the ice plateau continued across and beyond the Pole. The results of his journey show him to be a great leader as well as a bold pioneer. He inspired his colleagues with implicit confidence, and the rich harvest secured in one short season's work is due not only to his energy and personal courage, but to his full use of the capacities of every member of his staff. He had the nerve as a commander to run great risks by scattering his forces, and the judgment that enabled him to avoid disaster. The messages of congratulation which have been sent to him by the King and Queen, the Royal Society, and the Royal Geographical Society, represent the warm feeling of national pride and satisfaction at the remarkable achievements of the expedition.

(2) THE SOUTH MAGNETIC POLE.

The position obtained by the Shackleton expedition for the south magnetic pole is lat. 72° 25′ S., long. 154° E. It may be of interest to compare the position thus indicated with earlier results. The first observational data enabling an approximate position to be assigned were those obtained by Sir J. Ross about sixty-five years ago. General Sabine's Antarctic declination chart based on these observations places the pole at about $73\frac{1}{2}$° S., $147\frac{1}{2}$° E. In chart vi. attached to vol. ii. of Prof. J. C. Adams's "Collected Papers," the position deduced from Ross's data is about 73° 40′ S., 147° 7′ E. The next observational data are those of the *Southern Cross* expedition of 1898–1900, consisting of dip observations made by the magnetic observer, Mr. L. C. Bernacchi. In the discussion of these by Mr. Bernacchi and the present writer the approximate position deduced for the Pole at the epoch 1900 was 72° 40′ S., 152° 30′ E. The National Antarctic Expedition of 1901–4 provided a much more copious series of observations. The dip and the declination observations, treated independently by Commanders L. W. P. Chetwynd, R.N., and F. Creagh-Osborne, R.N., gave almost identical positions, the mean finally accepted [1] being 72° 51′ S., 156° 25′ E. The position of the pole undergoes presumably slow secular change, and unless the regular diurnal and the irregular changes of terrestrial magnetism in its immediate neighbourhood are totally different in character and size from those a few hundred miles away—an unlikely contingency—there is probably a more or less regular diurnal change of position, in which the pole (if defined as the spot where the dipping needle is vertical) describes an oval curve several miles in diameter. Superposed on this are doubtless irregular excursions, which may occasionally be of much larger amplitude. Owing to the low directive force on the compass needle, and the extent to which it is affected near a magnetic pole by irregular disturbances, the members of the expedition were probably well advised in using a dip circle, especially if they observed in two perpendicular planes, so as to get rid of the uncertainty in the position of the magnetic meridian. Magneticians will await with interest a detailed account of the method of observation adopted, and the exact nature of the results obtained.

C. CHREE.

[1] National Antarctic Expedition, 1901–4. Physical Observations, p. 156.

(3) METEOROLOGICAL OBSERVATIONS.

The information available in the summary of the results of Lieut. Shackleton's expedition does not enable us to go much further into the interesting question of the Antarctic anticyclone, but it is noteworthy that Lieut. Shackleton, like Capt. Scott in his journey to the south, experienced strong and persistent southerly winds. From the time he reached the plateau at an altitude of about 10,000 feet on December 26 until the return to the ship we find constant mention of a "southerly blizzard," the wind behind the party greatly facilitating the return journey. From the observations of temperature, which must, of course, be scanty until sufficient time has elapsed for mails to be received, it would appear as though the surface temperature on the barrier ice and that on the high plateau were not very different, notwithstanding the difference of 10,000 feet in the altitude. In ordinary climates this difference means a fall of 33° F. in the temperature. On reaching the summit the temperature ranged from −5° to −38°. The blizzard which detained the party during January 7, 8, and 9 had a temperature of −40° (rather a different kind of thing, probably, from the so-called English blizzards of which we have heard so much of late). On the barrier-ice temperatures of −18° and −35° F. are given, so that the conditions do not seem to have been more severe at the greater altitude. In the Alps, and the rule is probably general, a small vertical temperature gradient is associated with anticyclonic conditions; if full information, when it is received, bears out this inference of the slight or non-existent fall of temperature with height, it will go far to establish the belief in an Antarctic anticyclone.

But the persistent southerly winds are hard to explain, though we can hardly now doubt their existence on the western part of the great ice barrier. On the slope to the southward they may be due to the same causes that make a wind blow down a valley at night, and on the barrier ice, as Mr. R. H. Curtis has stated, an east or south-east wind may be deflected into a south wind by the range of mountains to the westward. On the plateau neither explanation will serve. It is just possible that the south is not the prevailing wind there, since a month is not long enough to show the prevailing direction.

Probably the blizzards of these regions are extremely shallow, for it was noted during the expedition of Capt. Scott that the motion of the barometer was of very little use in foretelling the weather, and the winds, therefore, cannot be of the same character as those to which we are accustomed.

Lieut. Shackleton and his companions are certainly to be congratulated on the excellent results they have achieved, and on their safe return. Many Arctic and Antarctic expeditions have shown that, apart from scurvy, which can now be avoided, extreme cold is not unfavourable to health, but the magnitude of the results and the absence of serious accidents in the face of such difficulties are beyond all praise.

W. H. DINES.

(4) BIOLOGICAL RESULTS.

As regards the biological results of Lieut. Shackleton's achievement, little can be inferred from the tantalisingly brief statements made in the telegrams. That there will be news of great interest is certain, for Mr. James Murray, whose skill and perseverance as an investigator were proved in the course of the Scottish Lake Survey, is not one to have failed in making the most of his unique opportunity. There is biological as well as geological interest in the report—rich deposits of foraminiferal mud (with abundant Biloculina) 40 feet above sea-level, of radiolarian remains in the erratic chert boulders at Cape Royds, and of Coal measures in latitude 85°, with seams of coal 1 foot to 7 feet thick. The frozen fresh-water lakes near Cape Royds contained large sheets of a "fungus-like plant" and abundant diatoms. Many lichens were found and a few mosses. Mr. Murray found abundant infusorians, rotifers, and water-bears (Tardigrada) in the fresh-water lakes, and demonstrated afresh the strong resistance which rotifers have to extremes of temperature. It is well known that many rotifers may survive very thorough desiccation, and that some are able to resist deprivation of air in an ordinary air-pump vacuum. Zelinka showed that Callidina can revive after exposure to $-20°$ C. and immersion in hot water at 70° C.; it will be interesting to hear what fresh instances of plasticity are afforded by Mr. Murray's researches on the microscopic fauna of these polar lakes. One of the despatches says that numbers of rotifers which had been frozen into ice for three years revived after a few minutes' thawing, and began eagerly devouring the fungus that abounds in the lakes. What is probably an unauthorised addendum to the original telegraph credits Mr. Murray with discovering that the southern rotifers are peculiar in being viviparous, but viviparous species of rotifers have been known for a long time. Another crumb of biological information is the report of the ringed penguin at Cape Royds, which extends the record of the southerly range of this bird. The only other crumb requires a grain of salt, for it tells us that the marine fauna near Cape Royds resembles the Carboniferous fauna of Australia.

THE SOLAR RESEARCH UNION.[1]

THE first volume of Transactions, at the first and second conferences, of this International Union has already been noticed in NATURE (vol. lxxv., p. 458).

The present publication concerns itself with the proceedings of the third conference, held at Meudon on May 20–23, 1907, together with reports of various committees of the union, and some original papers which have not appeared previously in an accessible form. As in the case of the first volume, the general editorship has been in the capable hands of Prof. Schuster, chairman of the executive committee.

Of the six parts into which the book is divided the first two consist simply of lists of the scientific bodies constituting the union, delegates present, and men of science invited to take part. The third section, thanks to the excellent record kept by the three secretaries, gives full minutes of the six meetings held during the conference.

The first action of the delegates was to elect as president, by acclamation, M. Janssen, the venerable and illustrious director of the Observatory of Meudon, whose subsequent death has been universally mourned. His short speech, accepting office and returning thanks, was concluded by the following words:—"C'est à vous, Messieurs, que je confie l'avenir de cette science du soleil que j'ai cultivée avec passion pendant plus de quarante années, de cette science des mondes dont j'entrevois l'avenir fructueux. Laissez-moi vous remercier, au moment où je termine ma carrière, de la joie que vous me donnez aujourd'hui."

Mutual helpfulness and coordination, with due regard to the disparity among the equipments involved, might be regarded as the watchwords of the conference. The necessity for these in the spectroscopic determination of the solar rotation periods and in the observation and classification of solar prominences was urged by various members.

M. Perot presented a new measure of the red cadmium line for use as a primary standard, made by MM. Benoit, Fabry, and himself, while the committee on standards of wave-length was given, by resolution, the further duty of preparing a list of secondary standards, to be submitted to the constituent societies, and, if approved by them, adopted by the Union. Both the paper on the red line of cadmium and a further paper by MM. Fabry and Buisson, on the measurement of wave-lengths for the establishment of a system of standard lines, are printed in full.

A complete account of the scheme of sun-spot spectrum observations, suggested by the committee on sun-spot spectra and drawn up by Prof. Fowler, was adopted by the Union, and is incorporated in the Transactions. This scheme allots to each observer a section of the spectrum of about 250 tenth-metres, together with certain other observations outside the special region, but is far from discouraging the initiative of the individual in undertaking further work when opportunity presents itself. The whole of the visible spectrum, in overlapping sections, is already portioned out among the observers available. Though almost without doubt the future of this subject lies with the photographic method, it is a wise policy to make use of the equipments already existing and of the observers already trained in visual observations of spot spectra for a more complete and co-ordinated study than has yet been undertaken. The further knowledge gained will be a welcome endowment for the large sun-spot spectrographs when they are more plentiful than at present.

With regard to the solar constant, resolutions were adopted stating the need for central stations where instruments for this work might be tested and standardised, and indicating the laboratory of M. Ångström at the University of Upsala as the principal central station. A report of the work carried out in the Smithsonian Astrophysical Observatory, relative to the solar constant, is also printed.

The report of the committee on work with the spectroheliograph gives the general programme of observations suggested to the individuals and institutions cooperating in this important work. The need for mutual help, in the interest of progress, is particularly great in work of this character. For intimate study of the rapidly changing solar activities a series of photographs taken as closely together in time as possible is desirable. With a ring of stations round the globe the records at the more westerly would be in sequence after the more easterly, and thus in any one day a series of photographs would

[1] "Transactions of the International Union for Cooperation in Solar Research." Vol. ii. (Third Conference.) Pp. viii+244. (Manchester: University Press, 1908.) Price 7s. 6d. net.

be available on which to trace changes. The present distribution of contributing stations, India, western Europe, and America, fulfils in some sort this need, though a distinct lacuna exists in the longitude of Australia.

A paper, by Prof. Hale, on the measurement of spectroheliograms gave rise to an interesting discussion concerning the methods of reducing the photographs already obtained. In his case, after some experiments, a photometric method of determining the areas of selected flocculi had given satisfactory accord, while Sir Norman Lockyer was able to report that, in the direct measurement of the series of spectroheliograms being formed at South Kensington, and in spite of the difficulties, good agreement was obtained by the two observers engaged in the work. In the study of the relation between solar activities and terrestrial changes, measurements of the numbers and areas of flocculi are likely to be of great importance. At all times the areas affected are greatly in excess of the spotted areas, while during the almost spotless periods of sun-spot minima, flocculi persist (in lessened degree), and bridge what would be otherwise practically a gap in the records.

The computing bureau of the union, established at Oxford under Prof. Turner, will make special studies of such spectroheliograph negatives as are entrusted to it by members: this, however, without prejudice to the right of reducing and studying photographs by those responsible for their taking. A start has already been made at Oxford on some plates lent by Prof. Hale.

The difficulties in the selection of the flocculi, recorded on the plates, for measurement, together with differences in size and quality of the photographs, make satisfactory and comparable measures far from easy. Great credit is due to the institutions and workers on this subject for the progress already made.

A proposition by Sir Norman Lockyer supporting the project for the establishment of a solar physics observatory in Australia was carried unanimously. This project, if carried into effect, would add another link to the chain of spectroheliographs girdling the earth.

An account, by M. Deslandres, of the spectroheliograph equipment and work accomplished with it at Meudon, together with an excellent picture of the sun in K_2 light, and a series of spectra in the neighbourhood of K used for the determination of the radial velocities involved in the solar activities, concludes the volume.

The delegates were invited by Prof. Hale to come to California for the next meeting, so that the date 1910 and the place Mount Wilson were provisionally decided upon, Prof. Hale being thanked for his kind invitation.

The publishers are to be congratulated on the get-up of the book, the paper and printing being good and the binding neat and effective.

T. F. C.

THE MANUFACTURE OF BASIC STEEL.

Of the many varieties of cast- or pig-iron, the three following percentage compositions may be taken as representing three most important types:—

	(a)	(b)	(c)
Carbon ...	3·5	3·5	3·5
Silicon ...	2·5	1·0	2·5
Manganese	0·5	2·0	0·6
Sulphur ...	0·05	0·06	0·04
Phosphorus	0·05	2·0	1·6

An average chemical specification with regard to sulphur and phosphorus in steel is "not to exceed 0·06 per cent. of each." For certain Government work the standard is 0·04, and easier specifications allow of 0·08, but 0·06 is a fair average.

The first pig (*a*) is suitable for conversion into steel by the acid process, in which the oxidising agent, whether oxygen of the air or oxygen from oxide of iron, acts upon the metal while it is contained in a vessel or a hearth composed mainly of the acid material silica. In this process the slag is necessarily of an acid nature, and sulphur and phosphorus therefore are not eliminated. Enormous quantities of iron ore are available, which contain very much higher proportions of phosphate than the hæmatite from which the cast iron of the (*a*) variety is produced, and as in the blast furnace practically all the phosphorus in the charge of ore, fuel, and flux enters into the metal, pig-irons are made that are much too high in phosphorus for conversion into steel by the acid process. By using a vessel or a hearth lined with basic material, such as burnt dolomite or magnesia, the steel can be finished in contact with a slag sufficiently basic to effect the removal of the phosphorus. The basic process as commonly worked some years ago, and sometimes even to-day, consisted in charging a mixture of about equal parts of pig-iron and scrap on a basic hearth, and then, by additions of iron ore and lime, eliminating the silicon and manganese, as well as the carbon and the phosphorus, to the extent necessary in the manufacture of mild steel. By this ordinary method of working, as the phosphorus is only sufficiently eliminated when the carbon is low, the process was generally used for the manufacture of mild steels, as unless the highly phosphoric slag is removed from the surface of the metal at the end, during re-carburisation phosphorus is reduced from the slag, resulting in an increased percentage of phosphorus in the bath. Sulphur is not to any great extent removed during the process as ordinarily conducted, and although the amount of sulphur in the bath can be reduced by additions of fluor-spar during the conduct of the process, these additions, if in excess, not only prove destructive to the banks of the basin-shaped receptacle, but render the phosphate in the slag insoluble, and thus decrease its value for agricultural purposes.

The pig-iron for the basic process must therefore be comparatively low in sulphur for successful regular working, and if by any means it should be high in sulphur must be subjected to a desulphurising process, such as the Massenez manganese process or the Saniter oxychloride or fluoride process.

The ordinary conditions for the manufacture in the blast furnace of pig-iron high in silicon content are those favourable to the production of a pig-iron low in sulphur, but a high-silicon pig-iron used in the ordinary basic process is again destructive to the banks of the furnace. The manufacture of a low-silicon low-sulphur pig, such as (*b*), can be effected by the use of manganiferous ores added to the blast-furnace charge. These ores are expensive, and the manganese in the pig-iron is lost during the conversion of the pig into steel. These statements give shortly the conditions connected with the manufacture of basic steel.

Many attempts have been made to improve the ordinary method of working, either from the point of view of being able to accept pig-iron high in sulphur, or, on the other hand, of being able to use a pig-iron high in silicon, because of the difficulty and expense connected with making the pig low in silicon and sulphur.

In 1894 a patent was granted to Messrs. Bertrand and Thiel for removing the silicon, the bulk of the phosphorus, and part of the carbon and manganese in one basic furnace and then transferring the metal, but not the slag, to a second furnace, completing the purification and finishing the steel in the second furnace. The slag of the primary furnace is valuable, and the removal of the phosphorus before the carbon is a great advantage. This process has met with considerable success. In 1898 Talbot introduced his continuous process, which is so well known that it need hardly be described.

In 1900 Monell patented a process which has come into considerable public prominence owing to a recently decided law case with regard to its alleged infringement. In certain circumstances the amount of scrap required for the ordinary working of the basic open-hearth process is not easily obtained, and although by the ordinary process an all-pig charge may be successfully worked, the time occupied in getting rid of the large quantity of impurities increases the length of time necessary for purification, and hence decreases the output of a furnace of a given size. Monell charges on to the bottom of the open-hearth the usual quantity of limestone which was employed in a furnace of like capacity with charges of half pig and half scrap. But along with this limestone he charges an amount of oxide of iron, generally in the form of iron ore, equal to about 20 per cent. of the weight of the pig-iron it is proposed to treat. These materials are heated to a red heat, and whilst still unfused the charge of pig-iron in the molten condition, either direct from the blast furnace or from a metal mixer, is poured into the furnace as rapidly as possible. This causes an active reaction, and the materials being at a comparatively low temperature the ore oxidises the phosphorus, silicon, and manganese in the pig-iron with extreme rapidity, and at the same time oxidises a portion of the carbon.

If the phosphorus in the original pig be not more than 0·80 per cent., in about one hour it will be reduced to less than 0·1 per cent., the carbon remaining being about 2 per cent. Eighty per cent. of the slag is now removed, leaving the metal only very thinly covered, and then oxide of iron is added to the bath and the carbon gradually reduced to the percentage required; so that by this means, in the basic furnace, a steel sufficiently low in sulphur and phosphorus is produced, and of any carbon desired, without the necessity of going down to a very low percentage of carbon, as in the ordinary process, and either being content to make only mild steel or to make special arrangements for carburising after removal of the slag (the Darby process). The yield by the Monell process is more than 100 per cent. of the metallic charge, owing to reduction of iron from the ore, the mean of about eighty consecutive trial heats being 108 per cent., but this is a feature not peculiar to this modification only. Unfortunately for the usefulness of the Monell process in this country, when the pig-iron contains from 1·5 per cent. to 2·0 per cent. phosphorus, as only about 80 to 90 per cent. of the total phosphorus is removed, too much remains in the metal at the end of the reaction to make the process valuable, and after the removal of the first slag, additions of lime and ore must be made as in ordinary working.

Improvements made in the basic process even since 1900 have rendered the application of the Monell process unnecessary in this country. Metal mixers, large vessels in which molten iron from the blast furnace is stored, were originally used mainly to obtain a more regular composition of iron for either the converter or the open-hearth process. Gradually these have developed in size from a capacity of about 70 or 80 tons up to the present day, when mixers of 200 to 600 tons capacity are used, and the metal-mixer is now often gas-fired, so that the heat of the metal can be maintained for longer periods, and even cold pig-iron can be added. The metal mixer is now much used as a furnace for the preliminary purification of the molten cast-iron from the blast furnace. The modern metal mixers are lined with dolomite or magnesia, are gas heated, oxides of iron are added to the contents, and the blast-furnace metal made and cast into pigs during week-ends, and generally called week-end metal, can be melted in them. At the comparatively low temperature maintained in the mixers (about 1500° C.) silicon and phosphorus are partially eliminated, whilst the carbon is but little affected. The sulphur is decreased because of the length of time the metal is lying in a molten condition in the mixer, during which the manganese sulphide gradually floats to the top and is removed with the slag. The resulting metal is in good condition, and of suitable composition to be transferred to the ordinary basic open-hearth furnace and finished with a comparatively clean slag—that is, a slag not rich in phosphate.

From the results given by Mr. A. Windsor Richards in a paper to the Iron and Steel Institute recently, it would seem as if the basic Bessemer process had received, through the modification in its working designed by Dr. Massenez, an efficient tonic in its desperate struggle with the open-hearth process. By this modification the ordinary high-silicon low-sulphur Cleveland pig (*c*), made from native ores, is poured in a molten condition into a basic lined converter, into which has been previously placed iron ore, with a small quantity of lime. The blow is continued until the carbon flame appears and all the silicon is oxidised, when the converter is turned down and the slag is carefully removed, this slag containing 35 to 45 per cent. silica and practically no phosphate. The linings are not affected because of the short time during which this slag is acting, and also because of the comparatively low temperature. The charge is then finally blown in the ordinary way, giving a slag containing 14 to 20 per cent. of phosphoric anhydride, 95 per cent. of which is in the soluble condition. The addition of oxide distinctly improves the yield, and the process is said to be working thoroughly successfully. Week-end metal is cast into pig beds and put on the market for foundry purposes, which cannot be done with basic pig (*b*), as it is only suitable for conversion into steel by the basic process.

A. McW.

NOTES.

Prof. T. G. Bonney, F.R.S., will be the president of the British Association at the meeting to be held at Sheffield next year.

We have to announce, with deep regret, that Dr. Arthur Gamgee, F.R.S., emeritus professor of physiology, University of Manchester, and late Fullerian professor of physiology in the Royal Institution, died in Paris on Monday, March 29, at sixty-seven years of age.

The Anthropological Society of Paris will celebrate the jubilee of its foundation on July 7–9 next. The society was founded in 1859 by Broca.

The annual meeting of the German Bunsen Society of Applied Physical Chemistry is to be held at Aachen on May 23–26, immediately before the International Congress of Applied Chemistry in London. Among the subjects to be discussed is the application of physical chemistry to metallurgy.

The Oliver-Sharpey lectures of the Royal College of Physicians will be given for this year by Prof. C. S. Sherrington, F.R.S., to-day, April 1, and to-morrow, at 5 p.m., at the Royal College. The subject of the lectures is "The *Rôle* of Reflex Inhibition in the Coordination of Muscular Action."

The *Rendiconti del R. Istituto Lombardo* announces, under the prize awards of the society, a grant of 1000 lire to Dr. Umberto Savoia, for his studies in metallography, and a grant of 1500 lire to Prof. Ernesto Bertarelli, of Parma, for his work on syphilis. Among the subjects offered for the present and next year we notice Lie's theory of transformation groups, relations between the variations in wages and price of production, the colloidal state of matter, and the anatomy of the nervous system.

In 1910 an exhibition, on an extensive scale, of the arts, sciences, manufactures, industries, and products of Great Britain and of Japan is to be held at Shepherd's Bush. The scheme is being supported by the Japanese Government, and the British Government is believed to be in sympathy with the project. Satisfactory arrangements have been concluded between the British organisers and representatives of the Japanese Department of Agriculture and Commerce.

In Nature of March 11 last (vol. lxxx., p. 47) attention was directed to the movement which is being organised by the British Empire League to provide London with a monument to Captain Cook. It was then pointed out that a general committee of distinguished persons had been formed, and that steps would be taken later to appoint an executive to collect the necessary funds, to determine the character of the memorial, and to select the best available site. A meeting of the general committee was held at the Mansion House on March 30 and elected an executive, on whom will devolve, in due course, the duty of issuing an appeal for funds and of taking the necessary steps for the erection of a memorial. The Prince of Wales has consented to become honorary chairman of the general committee, and Lord Brassey to undertake the duties of treasurer.

The following are among the lecture arrangements at the Royal Institution after Easter:—Prof. F. W. Mott, two lectures on the brain in relation to right-handedness and speech; Prof. Svante Arrhenius, two lectures on cosmogonical questions (the Tyndall lectures); Prof. J. Garstang, two lectures on the Hittites, (1) monuments of Egypt and Asia Minor, (2) recent discoveries in Asia Minor and northern Syria; Dr. F. Gowland Hopkins, two lectures on biological chemistry; Mr. J. G. Millais, three lectures on Newfoundland; Prof. W. E. Dalby, two lectures on a modern railway problem, Steam *v.* Electricity; Mr. R. T. Günther, two lectures on the earth movements of the Italian coast and their effects; Dr. W. H. R. Rivers, two lectures on the secret societies of Banks' Islands; and Dr. F. F. Blackman, two lectures on the vitality of seeds and plants, (1) a vindication of the vitality of plants, (2) the life and death of seeds. The Friday evening meetings will be resumed on April 23, when Mr. Alexander Siemens will deliver a discourse on tantalum and its industrial applications. Succeeding discourses will probably be given by Major Ronald Ross, Prof. G. E. Hale, Dr. J. Emerson Reynolds, Prof. J. A. Fleming, and Sir James Dewar.

The Royal Academy of Sciences and Letters of Denmark has issued a descriptive circular showing prize subjects proposed by it this year. In philosophy the subject is a critical consideration of Socrates and his philosophic influence since the time of Aristotle. The problem in astronomy is to examine the conditions in which it is possible to determine the mass of a comet, and to investigate whether these conditions are satisfied by comets which do not traverse exactly the orbits calculated for them by the usual methods. It is required that for at least one comet of this class the orbit should be calculated using the whole of the seven constants of the formulæ relating to the movement of two bodies, and that the results obtained should be compared with those of observation. The prize in physics is for a study of the influence produced by pressure, temperature, and wave-length upon the index of refraction of substances in the liquid and gaseous states. A prize is offered also for a study of the changes undergone by calcium cyanamide in the course of its manufacture for purposes of agriculture and during its use as a fertiliser. In each case the prize is the gold medal of the academy, having a value of about 18*l*. The papers may be written in Danish, Swedish, Norwegian, English, French, or Latin, and must be sent in before October 31, 1910, in each case except that of physics, the closing day of which is one year later. Further particulars may be obtained from the secretary of the academy, Prof. H. G. Zeuthen, The University, Copenhagen.

The most important article in the January issue of the Annals of the Transvaal Museum is one by Dr. L. H. Gough on the South African lizards of the genus Agama, in which the various species are re-described and illustrated from spirit-specimens.

Prehistoric Scandinavian implements, with special reference to the use of deer-antlers, form the subject of an illustrated article, by Mr. J. A. Grieg, in the March number of *Naturen*. Another paper on the same subject, by Prof. A. W. Brøgger, but devoted chiefly to stone implements, although also containing illustrations of incised figures of certain animals, appears in the third part of the *Bergens Museum Aarbog* for 1908. Attention is likewise directed to some of the more remarkable types of these implements by Dr. H. Schetelig, the director of the historical and antiquarian section, in the *Aarsberetning* of the same institution for 1908. According to the last-named publication, the Bergen Museum continues to make satisfactory progress in all departments, special attention being directed to the mounting of groups of animals in imitation of their natural surroundings in the zoological section.

We have to acknowledge the receipt of vol. x. of the third series of the *Annales del Museo Nacional de Buenos Aires*, a volume bearing the date 1909, although the whole of the numerous articles, with the exception of the two last, were separately issued during 1908. Of these, two by Dr. Ameghino, one dealing with the edentate shoulder-girdle and the other with the supposed fossil armadillos of France and Germany, have been already noticed in our columns. We may here refer to a paper by Mr. J. Brethes on the nests of the Argentine spider known as *Mastophora extraordinaria*. These minute spiders construct nests in the form of some half-dozen circular chambers of the size of large peas, each attached to the surface, from which they hang by a slender pedicel. They are made of a substance resembling *papier-maché*, and in colour are white with numerous irregular black blotches. In the interior of each is deposited a cluster of eggs. The receptacles have a perfectly uniform structure, and show no signs of a closed-up entrance hole. The marvel is how the spider contrives to introduce her eggs into these closed chambers.

The report of a committee appointed by the Royal Society of Medicine to consider the request of the chief surgeon of the Metropolitan Police on the best method of artificial respiration in the case of the apparently drowned was adopted by the council of that society in July last, and a copy of the report has just reached us. The committee was fully representative, and included surgeons, physicians, and physiologists; Sir William Church acted as chairman. The report is unanimous, and recommends the simple and safe method introduced by Prof. Schäfer in preference to the older and more risky methods of Sylvester and Marshall Hall. We learn with satisfaction that the report has been officially accepted for adoption throughout the metropolitan area. We can only hope this example will be followed in other quarters. For the sake of our readers who may not be acquainted with the Schäfer method, and one never knows when the occasion may arise for its employment, we may add a brief description of the process. The individual is laid on the ground in the prone position with a thick folded garment under his chest. The operator kneels athwart him, facing his head, and places his hands on each side over the lower ribs. He then slowly throws the weight of his body forwards, and thus presses upon the thorax of the subject and forces air out of the lungs; he then gradually relaxes the pressure by bringing his body up again, but without removing his hands. This is repeated regularly at the rate of twelve to fifteen times a minute until normal respiration begins or until all hope of restoration is given up; but it is best to persevere for at least an hour.

An insect has appeared in Antigua that causes the dropping of the flower buds of cotton, and an investigation on the spot has been made by Mr. Ballou, whose preliminary report is published in a recent issue of the *Agricultural News*. The insect was found living on the wild cotton, and apparently on privet, and is now being further examined.

We have received the current number of *Tropical Life*, a monthly journal devoted to those interested in tropical or subtropical countries. It contains several useful articles on important tropical crops, such as cacao, pea-nut, and sisal, as well as notes on appliances likely to prove useful on tropical estates. Market reports are also given, and general articles calculated to interest those whom the journal is designed to serve.

Now that the interest in breeding problems has become so widespread, it is very necessary to have some system of records by which the parentage of any particular individual breed during the experiment may be at once ascertained. The method adopted at the Rhode Island Agricultural Experiment Station for keeping pedigree records is described by Dr. L. J. Cole in the annual report of the station. It is a modification of Galton's method (Nature, 1903, vol. lxix., p. 586), and is worked on the card-index system, giving each individual a separate card; the advantage claimed for it is that it enables the ancestors and the descendants of any individual to be traced with very little difficulty.

Three bulletins from the United States Department of Agriculture Bureau of Entomology are to hand. Dr. Ball discusses (No. 66) the leaf-hoppers of the sugar-beet and their relation to the "curly leaf" condition. *Eutettix tenella* is described at length; illustrations and descriptions are also given of other species of Eutettix, of Agallia, and of a small green Empoasca. It is concluded that *Eutettix tenella* is responsible for one common kind of "curly leaf." In No. 104 Dr. Chittenden deals with the red spider (*Tetranychus bimaculatus*), which is particularly injurious to violets, roses, melons, cucumbers, tomatoes, &c. This spider resists fumigation with tobacco or hydrocyanic acid more than many other insects, but it is destroyed by sulphur or soap solution. In Bulletin No. 344 Mr. W. D. Hunter deals, from the farmer's standpoint, with the cotton-boll weevil, which does a great amount of damage each year; the loss caused by the weevil since it invaded the States is estimated at 125,000,000 dollars.

The influence of breed on egg-production in poultry is well seen in a report recently issued by Messrs. E. and W. Brown from University College, Reading. Danish, American, and English Leghorns were kept under comparable conditions for twelve months, and careful record was kept of the number of eggs laid. The Danish birds had been bred to yield a large number of eggs of moderate size; the English birds, on the other hand, had been largely bred for exhibition purposes, for which egg-producing capacity is not needed. The consequence is seen in the following table:—

	Danish brown Leghorns	American white Leghorns	English white Leghorns
Average number of eggs per bird...	153·7	142	76
Average weight of each egg...	2·12 oz.	2·34 oz.	2·05 oz.
Percentage of eggs weighing less than 2 oz.	1·8	0·5	32·9

The profit on the English birds is shown to be much less than that on the Danish or American birds.

The tenth report of the Woburn Experimental Fruit Farm follows closely on the ninth, and deals with the treatment of trees for insect pests. It was found that nursery stock could be freed entirely from woolly aphis by immersion for ten minutes in water heated to 115° F., at which temperature the plants did not suffer. Treatment with petrol was equally effective so far as the destruction of aphis was concerned, but might be likely to cause more damage to the plants. On the other hand, fumigation with hydrocyanic acid was both risky and uncertain, and is not recommended by the authors. Trees infested with aphis could be cleansed by spraying with light paraffins like petrol in the undiluted state, but their leaves suffer so much that the method should only be adopted in extreme cases. It is shown that injection of paraffin into the soil produces but little direct injury to the tree, and there seems the possibility that it might prove a useful method for killing the insects that harbour round the roots, and that do a good deal of harm by their migrations to the branches. Experiments were also made with nicotine, which was found to destroy Psylla, but not caterpillars. Paraffin emulsion, however, proved quite fatal to the caterpillars of the winter moth, the gooseberry saw-fly, and the currant saw-fly, and had the further advantage of not interfering with the sale of any fruit which might happen to be on the bushes at the time.

A short practical pamphlet on lawns, prepared by Mr. W. J. Stevens, has been published in the series of "One and All" garden books. It contains the necessary information on the making of lawns with turf or with seed, renovation and manuring, also a list of suitable varieties of grass seed. It concludes with a few hints by Tom Hearne on cricket and tennis grounds.

It is now generally recognised that bakers prefer strong wheats, because the flour gives a more shapely loaf. Soft wheats have been recommended for Indian cultivation in the past, but a trial of samples, recorded by Mr. A. Howard in Bulletin No. 41 of the Agricultural Research Institute, Pusa, reverses the verdict. Of ten samples, three hard wheats from the Punjab furnished good results, but they were excelled by a new hard wheat selected for cultivation at Pusa. All four varieties yield good straw, and are considerably rust resistant. It is noteworthy that the order of all ten samples, based on baking tests, corresponded exactly with their nitrogen content.

THE economic value of certain Australian pasture grasses forms the subject of an article by Mr. F. Turner, published in the *Kew Bulletin* (No. 1). *Trigonella suavissima*, a clover-like plant, makes good forage, or may be served as a vegetable; similarly, *Tetragonia expansa*, receiving the name of Warrigal cabbage, may be used in both ways. *Boerhaavia diffusa*, known as hog weed, and *Geranium dissectum* are forage plants bearing fleshy roots that formerly provided food for the aborigines. *Erodium cygnorum* is another herb that in the young succulent stage is much relished by stock. *Calandrinia balonensis* contains moisture as well as nutrition in its succulent leaves, and *Portulaca oleracea* is similar. A plantain, *Plantago varia*, affords good pasture, and *Psoralea tenax* receives the name of native lucerne, while the plant known as nardoo is the hydrophytic fern *Marsilea quadrifolia*.

THE section Gamopetalæ is completed in the twenty-first part of "Materials for a Flora of the Malayan Peninsula," that is reprinted from the Journal of the Asiatic Society of Bengal (vol. lxxiv., extra number, 1908). This part contains the family Gesneraceæ, for which Mr. H. N. Ridley is responsible, and the family Verbenaceæ, collated by Mr. J. S. Gamble. A large number of new species were described by Mr. Ridley in 1905, to which are now added two new species of Æschynanthus, and *Lepadanthus flexurus*, the type of a new genus. Didymocarpus is the most important genus as regards the number of species. Several of the genera are confined to the Malayan or Indo-Malayan regions. The diagnoses of several new species in the Verbenaceæ were published in the *Kew Bulletin* for 1908. Premna, Vitex, and Clerodendron are large genera; *Vitex peralata* is noted as an ornamental tree worthy of cultivation.

IT may be hoped that the appointment of Mr. N. W. Thomas on the anthropological survey of the Niger delta will not lead to the discontinuance of his "Bibliography of Anthropology and Folk-lore," of which the second annual issue for 1907 has recently appeared, at the modest price of two shillings, under the auspices of the Royal Anthropological Institute and the Folk-lore Society. It deals only with books and periodicals published within the British Empire, with a few references to English publications on countries like China; there is no attempt to include more than prehistoric archæology, and only unwritten languages are noticed. The range of the compilation is thus limited, but it is useful so far as it goes, and its publication emphasises the urgent need of concerted action. The work is of a kind which should not depend upon the labours of any single worker, however energetic. Surely the societies which deal with the phases of man's life, past and present, might combine to do what the Royal Geographical Society so admirably accomplishes in the bibliography contained in its monthly journal.

MR. A. LANG, in a paper published in vol. iii. of the Proceedings of the British Academy, discusses the origin of the terms of human relationship. He suggests that "own" relations, maternal or paternal at least, were recognised before the evolution of the family groups into the tribe introduced "tribal" mothers, brothers, and sisters. Then, as tribal law developed, regulating all things by grade of age, the old names for the nearest relationships were simply extended (sometimes with qualifications, such as "elder," "younger," "little") to all persons of the same age-grade, in the same phratry, with the same duties, privileges, and restrictions. He sums up the discussion in the provisional conclusion that the classificatory, widely inclusive terms of relationship prove nothing, neither for nor against a theory of primal promiscuity. The material for these inductions is largely drawn from the Arunta and other Australian tribes, about whom our information is still very incomplete. It is difficult, for instance, to reconcile the accounts of the Arunta given by Messrs. Spencer and Gillen with those of later observers, and Mr. Lang, in his analysis of Australian terms of relationship, depends largely on analogies drawn from Aryan languages. The value of such material interpreted by such methods is obviously small, and our anthropologists would be well advised to defer speculation on the sociology of primitive man in general until the customs and languages of the native Australians, which supply evidence essential to such an inquiry, have been ascertained with much greater certainty.

THE stone implements of the French older Palæolithic age have been recently critically studied by Dr. Hugo Obermaier, with special reference to their stratigraphy and evolution (*Mitteilungen der prähistorischen Kommission der Kais. Acad. der Wiss. Wien*, Band ii., No. 1, 1908, pp. 41–125, 134 figures in text). The relative chronology of forms of implements suggested by G. de Mortillet is confirmed and amplified. Dr. Obermaier's results may be very briefly summarised as follows. An Early Chellian period, devoid of hand-wedge (Faustkeil) implements, was followed by the High Chellian, characterised by its primitive hand-wedge (Urfaustkeil) implement. The Acheulean evolving therefrom must be divided into an older and newer period, as exemplified in the forms of the hand-wedge. The groups of "La Micoque" and "Levallois" are subdivisions of the latter. The hand-wedge is either absent or completely decadent in the Mousterian age. In *Le Préhistorique* (1900) G. and A. de Mortillet state repeatedly that the hand-wedge (*coup de poing*) was the sole implement of the Chellian age, and that the chips of this age are of no significance; but in this they are mistaken, since numerous smaller implements have been recognised; for example, the scraper and blade appear in the Early Chellian, borers and punchers also occur in Chellian deposits, as do a cutting implement with a dressed arched back, and some other tools. The numerous illustrations render this paper indispensable to those who desire to trace the evolution of the various types of flint implements during the earlier phases of the Palæolithic age.

FROM the offices of the Egyptian Survey Department, Ministry of Finance, we have received a copy of a very useful almanac for 1909, which contains much information concerning the various Government and public offices and institutions of Egypt. Under the title of "General Information" we find numerous tables concerning meteorological data, the height of the Nile, the planting and reaping of various crops, and the conversion of weights, measures, and money. The almanac has been compiled by the Survey Department, and is sold for 25 *milliemes* ($6\frac{1}{4}$*d.*).

MM. FLAMMARION and Loisel give their usual summary of the climatology of the past year (1908) in the February and March numbers of the *Bulletin de la Société astronomique de France*. The results are founded on the observations made at the Juvisy Observatory, and deal with temperature, pressure, rainfall, insolation, cloudiness, &c. Numerous curves show the daily or monthly march of each element, whilst other curves and tables compare the results with those of previous years since 1886. Comparisons are also made of the seasons, and those having similar meteorological records in different years are grouped together in a very handy form for reference. In a general remark, the observers state that for several years now late summers have been the rule.

The director of the meteorological observatory, Chemulpo, has sent us the results of the observations made at six Japanese meteorological stations in Korea for each of the months January–December, 1907. The observations are made thrice daily, with monthly summaries, and are a valuable contribution to the meteorology of the Far East. An annual summary would be a very useful addition to the tables, which have been very carefully prepared by Mr. Y. Wada. The instruments and method of observation are the same as those at the meteorological stations in Japan; this is a sufficient guarantee of their accuracy.

The fifteenth annual report of meteorology in Mysore, for 1907, has been received, containing daily and monthly means for the second-class stations of Bangalore and Mysore, and 8h. a.m. observations and means for the third-class stations of Hassan and Chitaldrug. The altitude of these important stations varies from approximately 2400 feet at Chitaldrug to 3100 feet at Hassan, and they lie at the corners of a quadrilateral of which the diagonal, ninety-seven miles in length, is almost due west, Bangalore, the easternmost station, being 190 miles west of Madras. The observations have been very carefully discussed by Mr. N. V. Iyengar, chief observer in charge, and include mean values for the years 1893–1907. The absolute maxima of shade temperature during that period exceeded 100° at all stations, and reached 103° at Chitaldrug; the lowest reading was 42°·7, at Hassan. On extreme occasions relative humidity fell to between 4 per cent. and 6 per cent. at the different stations. The mean yearly rainfall varied from 25·6 inches at Chitaldrug to 35 inches at Bangalore.

A correspondent, Mr. A. E. H. Bott, of Fishburn, Alberta, asks for information on a matter which is of common interest to many where severe cold is experienced. An ordinary horizontal minimum thermometer filled with coloured alcohol was placed about 6 feet above the ground on the north wall of a house. The instrument registered from −60° F. to +114°. In the early part of January the thermometer registered from −35° to −53° for about six or seven nights in succession. The thermometer was tilted every day in order to replace the index at the end of the thread of alcohol. The thermometer was afterwards left untouched for some days, while the observer was away from home, and it was then found that the colouring matter, apparently the red of cochineal, had entirely left the upper part of the thread, which was now difficult to see. When writing, the top of the column stood at +14°, but the deep-red colour began to pale at about −50°, and faded gradually until it disappeared completely at about −14°. It seems probable that the cochineal was frozen out of the solution, and that the mixture was rather mechanical than chemical. In all probability heating or warming the mixture would restore the instrument to the same condition as when purchased, but a recurrence of the separation of the colouring matter with extreme cold seems probable.

In the Bulletin of the American Mathematical Society for March, Miss Eva M. Smith discusses some surfaces having a family of helices as one set of lines of curvature. From the investigation it appears that surfaces can exist one set of the lines of curvature of which are general helices defined by constant ratio of curvature and torsion, but no surfaces have regular helices (*i.e.* helices on right circular cylinders) for their lines of curvature.

The February issue of the Journal of the Institution of Electrical Engineers contains Mr. W. R. Cooper's paper on the tariffs now in force for the supply of electricity for domestic purposes. He considers that their present tendency is to discourage the demand for electricity, and advocates with much force the substitution for them of the payment of a fixed sum per annum based on the number and power of the lamps installed, *plus* a small charge, not exceeding one penny per unit, for the electricity used. In the discussions of Mr. Cooper's paper, which took place in London, Glasgow, and Dublin, widely divergent opinions were expressed by lighting engineers as to the relative merits of the old and the proposed systems, but almost all were agreed that some reform is necessary if the more extensive use of electricity for domestic purposes is to be encouraged.

Metallurgists who have not made a special study of the accurate measurement of high temperatures, and who are therefore not in a position to judge of the relative merits of the various determinations of the melting point of iron, will be very grateful to Prof. Carpenter, of Manchester, for a critical summary of our knowledge on the subject, which appears in part iii. of the Journal of the Iron and Steel Institute for 1908. After a brief statement of the relations of the gas, the thermo-electric and the optical temperature scales to each other, Prof. Carpenter gives the results obtained during the last five years by observers at the national physical laboratories of Germany, France, America, and England, and concludes that the freezing point of iron is 1505° C. on the thermo-electric temperature scale, which corresponds to 1519° C. on the optical scale as at present used.

We have received eight pamphlets forming appendices to the annual reports of the Coast and Geodetic Survey from 1899 to 1906, which deal with the observational magnetic work carried out in the United States under the supervision of Dr. L. A. Bauer, chief of the division of terrestrial magnetism. These appendices consist largely of observational data, accompanied by descriptions of the stations where the observations were made. Particular care is taken in indicating the exact sites, which are marked with wooden pegs or stone blocks. In addition to observational details there are descriptions of the magnetic observatories of the Survey and their instrumental outfit, as well as of the field instruments. The instruments at the fixed observatories seem mainly of German origin. Of the field instruments, the magnetometers are of a special pattern—a combined magnetometer and theodolite—made in the Survey's workshops. The dip circles—including the ordinary land pattern and the Lloyd-Creak for use at sea—are mostly of English make. Fitted with Lloyd's total-force needles and an auxiliary compass, the dip-circle seems to have proved a very useful universal instrument. The latest of the publications contains an isogonic chart for the United States for the epoch 1905, based on results from some 3500 stations, and it also gives tables of secular change—a good many extending back to 1750—for some eighty stations. Lists of observers in several years include more than thirty names, and it is abundantly clear that magnetic work has an importance attached to it in the United States to which there is hardly a parallel elsewhere.

A PAPER on the construction and wear of roads, by Mr. H. A. R. Mallock, F.R.S., was read before the Institution of Civil Engineers on March 23. The subject was considered from a theoretical point of view with regard to the foundation of the road, its surface, and the character of the traffic. It was suggested that roads with a hollow cross-section, drained by a central gutter covered by a continuous grating, would be worthy of trial, as tending to prevent the accumulation of mud and water close to the footways, and as giving the greatest facilities for keeping the whole of the roadway clean. The origin of dust and mud on roads is imputed almost entirely to the grinding and crushing action of iron tyres and iron horseshoes. The conclusion drawn from the whole of the evidence is that the chief enemies of good roads are iron tyres and iron-shod horses, or, indeed, any forms of traction which cause very intense local pressure on the road surface. The view was expressed that with soft tyres the wear on any good road is extremely small, and with pneumatic tyres still less, but that so long as iron tyres and iron-shod horses are used for traction, the best means of preserving a clean and unbroken road surface is to be found either in the applications of tar (many of which have already been made with considerable success), or in some other method which will give the same large limits of elasticity and rupture to the upper layer of road material. For roads used exclusively by soft tyres there is a far wider choice of suitable road material than where the surface is exposed to very intense pressure.

A SECOND edition of Dr. M. Abraham's "Elektromagnetische Theorie der Strahlung" has been published by the firm of B. G. Teubner, of Leipzig and Berlin. This work is the second volume of the "Theorie der Elektrizität," reviewed in our issue for August 15, 1907 (vol. lxxvi., p. 377). The price of the present part is 10 marks.

WE note with interest and satisfaction the publication of German editions of two well-known works of science originally published in English. The first is "Habit and Instinct," by Prof. Lloyd Morgan, F.R.S., which has been translated by Maria Semon, and issued by the firm of B. G. Teubner, of Leipzig and Berlin, at the price of 5 marks. The second is Prof. Alexander Smith's "Introduction to General Inorganic Chemistry," translated by Dr. Ernst Stern, and published by the firm of G. Braun, of Karlsruhe.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL:—

April 1. 22h. Jupiter in conjunction with the Moon (Jupiter 3° 45′ S.).
2. 22h. Saturn in conjunction with the Sun.
3. 9h. 55m. to 11h. 5m. Moon occults ν Virginis (mag. 4·2).
10. 9h. 8m. to 12h. 34m. Transit of Jupiter's Satellite III. (Ganymede).
,, 15h. 52m. to 16h. 32m. Moon occults b Ophiuchi (mag. 4·3).
13. 19h. Mars in conjunction with the Moon (Mars 2° 29′ N.).
15. 10h. 30m. to 14h. 46m. Transit of Jupiter's Satellite IV. (Callisto).
19. 9h. 43m. Minimum of Algol (β Persei).
19-22. Epoch of Lyrid meteors. (Radiant 271° + 33°.)
21. Venus. Apparent diameter 9″·8.

THE ROTATION OF THE SUN.—In a paper appearing in the March number of the *Astrophysical Journal* (vol. xxix., No. 2, p. 110) Prof. W. S. Adams gives and discusses the results obtained during 1908 in the spectroscopical investigation of the sun's rotational velocities. In general, these results agree closely with those obtained during the 1906–7 investigation, although for latitudes greater than 50° larger values are now obtained for the velocity; there is no evidence, however, of the existence of a variation of the rate of rotation. Lines of lanthanum and of cyanogen are again found to give low values, as are also two "enhanced" lines investigated. On the other hand, certain lines of manganese and iron indicate high velocities. In general, such abnormal behaviour becomes more marked in the higher latitudes.

The present results were derived from spectrograms taken with the tower telescope and the 30-feet spectroscope, and show a marked increase of probable accuracy over those obtained with the smaller equipment in 1906–7. They also show that Faye's equation for the rotation holds quite good up to within 10° of the poles. Special plates taken with solar vortices in the field show that the vortices may introduce variations of such magnitude as to invalidate any conclusion normally derived from the measures.

Special studies were also made of the behaviour of the calcium line at λ 4227 and of the Hα line, and it was found that both give high rotational velocities; such abnormalities are explained by the greater height reached by the matter producing these lines. The former line was found to be indubitably double, although the separation of the components is extremely small. The study of Hα gave some very interesting results, among which we may mention that at different distances from the limb this line indicates very different velocities; it also shows only a slight equatorial acceleration.

COMMON MOTIONS OF THE PRINCIPAL URSÆ MAJORIS STARS.—A number of investigators have discovered evidence of a probable physical connection between the seven principal stars of the constellation Ursa Major, and in Nos. 4313–4 of the *Astronomische Nachrichten* Dr. Ludendorff again discusses the question on the basis of radial velocities determined at Potsdam.

The radial velocities of β, ϵ, and ζ Ursæ Majoris were investigated. In the case of β, the measures indicate a variable velocity with a period of about 27·16 days. The absolute values found for ϵ can only be looked upon as approximate, but they indicate a variability of restricted range and long period, the variation being between −8 km. and −18 km., with a period of about 2·1 years. The centre of gravity of the system of ζ Ursæ Majoris is shown to have a large range (269 km.) of velocity, with a period of 20·536 days.

Considering together the proper motions and parallaxes of the seven stars, it is found that there are probably two connected systems, system i. including β, γ δ, ϵ, and ζ, and system ii. including α and η, both of which have approximately the same parallax and the same velocity relative to the sun, but the angle between the directions of the two systems is about 101°.

THE SURFACE OF ROTATING MERCURY AS A REFLECTING TELESCOPE.—Having made a striking series of experiments on the possibilities of the paraboloidal surface of rotating mercury as a reflecting telescope, Prof. R. W. Wood describes and illustrates his results in No. 2, vol. xxix., of the *Astrophysical Journal* (p. 164, March).

Prof. Wood succeeded, by very finely adjusting the motion of his rotating tank, in producing mercury surfaces on which the disturbances were negligible, and for which a constancy of focus could be maintained for some time. Although the experiments appear, at first glance, to be merely of theoretical interest, Prof. Wood is so gratified with the results that he suggests methods whereby results of practical interest might be obtained. One of these is the possibility of taking casts, in some easily fusible material, of sufficient rigidity when solidified to bear electrotypes being made from it. These electrotypes, suitably mounted and silvered, might then be used in reflecting telescopes.

PHOTOGRAPHS OF THE EARTHSHINE ON THE MOON.—Two excellent photographs, showing the greater part of the lunar surface illuminated by the light reflected from the earth, are reproduced in the March number of the *Bulletin de la Société astronomique de France*.

Whilst most people are familiar with the appearance of the moon thus partially illuminated, it is not an easy matter to photograph the phenomenon successfully, but on these photographs many lunar details are shown quite well, except in the sunlit crescent, which is, of course, much over-exposed.

The photographs were taken by M. Quénisset at the Juvisy Observatory, using the Viennet objective of 16 cm. aperture and 2·90 m. focal length, with ten minutes' exposure on a fast plate at the focus.

COSMICAL MATTER IN SPACE.—In his address as retiring president of the Royal Astronomical Society, Prof. Newall directed attention to, and briefly discussed, the possibility that the chief characteristic spectroscopic phenomena of the sun and the stars are mainly produced by matter streaming into these bodies from without rather than by matter brought from their interior layers to their radiating surfaces.

Appealing to various solar, cometary, and physical phenomena, Mr. Newall educed evidence that this view of astrophysics is not an obviously impossible one, and would, if found acceptable, account for several outstanding anomalies (Monthly Notices, R.A.S., vol. lxix., No. 4, February).

OBSERVATIONS OF VARIABLE STARS.—During 1908 Prof. Nijland observed, at the Utrecht Observatory, twenty-one Algol variables, six short-period variables, three variables of the U Geminorum type, SS Cygni, and forty-five long-period variable stars. The results of these observations now appear in No. 4309 of the *Astronomische Nachrichten*, together with a series of notes dealing with any special features observed.

THE CARNEGIE INSTITUTION OF WASHINGTON.

THE seventh year-book of the Carnegie Institution of Washington, for 1908, has just been received, and consists of reports of the president and the executive committee, and of directors of departments and other grantees who, with the assistance of the institution, have been carrying on investigations during the year.

The president's report gives the following facts and figures indicating the growth and extent of the work so far undertaken and accomplished by the institution. Since its organisation, in 1902, about 1000 individuals have been engaged in investigations under the auspices of the institution, and there are at present nearly 500 so engaged. Ten independent departments, each with its staff of investigators and assistants, have been established. In addition to these larger departments of work, organised by the institution itself, numerous special researches carried on by individuals have been subsidised. Six laboratories, for as many different fields of investigation and in widely separated localities, have been constructed and equipped. Work in almost every field of research, from archæology and astronomy to thermodynamics and zoology, has been undertaken, and the geographical range of this work has extended to more than thirty different countries.

At the end of the fiscal year, October 31, 1908, 120 volumes of researches in nineteen different fields of research, with a total of more than 30,000 pages, had been published, and twenty-seven volumes of researches were in the press. In addition to these publications issued by the institution, about 1000 shorter papers have been published in the current journals of the world by departmental investigators, by associates, and by assistants. The total amount of funds allocated for expenditure to November 1, 1908, was 737,000*l*., which included 59,000*l*. reverted and afterwards re-appropriated. The total amount expended was 672,000*l*.

During the past year the Nutrition Laboratory in Boston has been equipped, and systematic investigations are already in progress.

The construction of a building in Washington, D.C., at the south-east corner of Sixteenth and P Streets, N.W., was begun a year ago. This building is for administrative offices and the storage of records and publications, and when completed will cost about 44,000*l*.

The plans and specifications for the construction of a specially designed ship for ocean magnetic work have recently been completed. These plans require a non-magnetic sailing vessel with auxiliary propulsion. She will be classified as a yacht, will be called the *Carnegie*, and will, upon completion, proceed upon a magnetic survey of the Atlantic Ocean under the direction of the department of terrestrial magnetism of the institution. The grant for the construction of this vessel is 8000*l*.

A temporary observatory for supplementary measures of the positions of the fixed stars of the southern hemisphere is now being built at San Luis, Argentina, under the direction of Prof. Lewis Boss, head of the department of meridian astronomy of the institution. Prof. R. H. Tucker will be resident astronomer in charge of the work of observing and computing in South America, which will require three to five years for completion. The meridian instrument of the Dudley Observatory, the constants of which have been thoroughly investigated, will be transferred to San Luis and used in securing the desired measurements of the positions of stars in both hemispheres.

Work in the other departments of the institution has progressed rapidly and successfully. The investigations of Dr. G. E. Hale, director of the Solar Observatory on Mount Wilson, California, are of great interest. During the year, with the aid of his exceptional equipment, the discoveries which have been made with regard to sun-spots will probably prove of as great importance to terrestrial and molecular physics as to solar physics. The progress inaugurated may be confidently expected to lead rapidly to definite and important results. The expenditure on account of the site, buildings, instruments, and other appliances of the observatory was, up to September 30, 1908, 71,631*l*.

Under the direction of the department of historical research, work upon manuscript materials for American history has been pursued in France, Italy, and England, and next year will be extended to Germany. Many remarkable experiments and investigations are in progress under the department of botanical research at the Desert Laboratory at Tucson, Arizona.

In addition to the work carried on in the departments of the institution during the year, thirty-one grants were made to individuals and organisations in aid of researches conducted by them, and many other researches begun in former years have been carried forward. The publication of twenty volumes was authorised, and twenty-seven volumes and an atlas have been published. The latter include the report upon the California earthquake of April 18, 1906, a handbook of learned societies and institutions of North and South America, and a reproduction of the "Old Yellow Book," the source of Browning's "The Ring and the Book." These volumes and others issued by the institution are offered for sale at the cost of printing and transportation to purchasers.

At the annual meeting of the board of trustees on December 8, 1908, the sum of 127,260*l*. was allocated to carry on work of investigation, publication, and administration during the year 1909.

RECENT PAPERS ON DARWINISM.

THE *Fortnightly Review* for March contains an admirable article, by Dr. A. Russel Wallace, on "The World of Life, as Visualised and Interpreted by Darwinism." The veteran author argues with all his old vigour and eloquence in favour of the theory of the origin of species by natural selection, bringing out the facts of extensive and independent variation under natural conditions, emphasising the reality of the struggle for life, and insisting on the facts of adaptation as inexplicable under any other hypothesis than that of Darwin. He shows how the commonest of the popular objections to the theory "rests upon the strange belief that variation is a rare phenomenon, that favourable variations occur singly and at long intervals, and, therefore, can have no effect in producing any important change"—an idea which is entirely at variance with the actual facts of nature. But while strenuously upholding the sufficiency of the Darwinian explanation of the phenomena of life within its own sphere, he still allows that "neither Darwinism nor any other theory in science or philosophy can give more than a secondary explanation of phenomena."

A paper by Mr. E. S. Russell in the Bologna *Rivista di Scienza*, entitled "The Evidence for Natural Selection," affords a good illustration of the tone, alternately patronising and depreciatory, which certain writers think fit to adopt in speaking of the epoch-making work of Darwin. After noticing several of the well-known cases in which the operation of natural selection has been actually demonstrated, and after so far giving his approval as to say that "the theory of natural selectinn . . . is a very suggestive and valuable one," the author thinks it sufficient to add that "it is highly probable that natural selection has played a part in evolution," and that it is "the formula of what seems to be a general process in nature, but it is a formula without much content." This is indeed to damn with faint praise. The paper concludes with the cryptic utterance that the theory "must become largely superseded by the very deepening of our knowledge of it."

Another paper in the *Rivista* by the same writer, on the "Transmission of Acquired Characters," contrives to introduce confusion into what is essentially a very simple issue. It is of great importance to know whether a modification induced upon the soma can be transmitted by inheritance; it is of comparatively little importance to know whether soma and germ can be affected in common by the same external agent, as, for example, by temperature in the case of cold-blooded animals like insects. The two ideas are essentially distinct, and nothing is to be gained by attempting to identify them.

Darwinism and Darwin loom large in other recent publications. The *American Naturalist*, for instance, contains five articles on these subjects, communicated, in the first instance, to a special Darwin memorial session held at Baltimore by the Botanical Society of America. In these Prof. W. Trelease discusses Darwin as a naturalist, and his work on cross-pollination in plants; Prof. F. E. Clements follows with an inquiry into the influence of Darwin in relation to the geography and ecology of plants; while Prof. H. M. Richards winds up with a review of Darwin's on plant-movements. In an independent article, which did not form part of the Baltimore meeting, Prof. E. Linton examines and criticises the "Origin of Species" in the light of recent observations and experiments.

To the March issue of *Himmel und Erde* Prof. Plate communicates a centenary eulogy on Darwin, originally delivered as a lecture at a festival meeting on Darwinism and evolution, held at the Royal Agricultary High School, Berlin. The *Zoologist* for March also has an article, by Prof. W. C. McIntosh, of St. Andrews, on the Darwinian theory in 1867 and now. This is a reprint, with interpolations, of a lecture given by the author in March of the year referred to before the Literary and Antiquarian Society of Perth. One passage in the original lecture, relating to "the appearance of the various species of Ichthyosaurus in the marine strata of the Chalk period, and the utter blank in reference to any form calculated to throw light on their origin," was incorrect when originally written, and now stands in urgent need of an explanatory paragraph in view of modern discoveries.

To the March number of *Rassegna Contemporanea* (published in Rome) Mr. Ugo Giovannozzi contributes an article on Darwin's life and works. The article is divided into sections, each dealing with separate periods of the career of the great evolutionist, special attention being directed to the influence of the voyage in the *Beagle* on his opinions, and to the appearance of the "Origin of Species." In the concluding paragraphs reference is made to Darwin's views on religion.

"Der gegenwartige Stand der Abstammungslehre" is the title of a pamphlet, by Prof. L. Plate, published in Berlin, which purports to be a popular explanation of the doctrine of evolution. After stating that evolution is supported by an overwhelming amount of evidence, and that no other theory is in existence capable of taking its place, and with a reference to its importance to mankind in general and to its bearing on religious belief, the author proceeds to state that, in his opinion, Darwin's selection-theory affords at present the only satisfactory explanation of the mode in which evolution has acted. The mutation-theory of de Vries, he adds, is not new in principle, but merely a restricted form of the selection-theory. Mutations are nothing more than pronounced variations, which Darwin called fluctuations or individualities.

THE ELECTRICAL PROPERTIES OF FLAME.[1]

When a flame is brought near to an insulated conductor charged with electricity, the charge disappears. This is explained by supposing that the gases in the flame are partially dissociated into ions. A neutral molecule splits up into two ions, one having a negative charge and the other a positive charge. The conductor, if positively charged, attracts the negative ions out of the flame, and their charges when they reach it neutralise its charge.

When a plate of an insulator, such as ebonite, is placed between the flame and the charged conductor, the ions are still attracted through the plate, but when they reach it they cannot get through, and so remain on its surface. The side of the plate turned towards the flame thus gets a charge of opposite sign to that on the conductor. This shows that the disappearance of the charge in the first case was due to an opposite charge attracted out of the flame, and not to the charge on the conductor escaping into the flame.

We have a stream of gas rising from the flame, and the ions go up in the stream. The ions of opposite sign attract one another, and when two come together their charges are neutralised, and the two ions are said to have disappeared by re-combination. Thus as we go up in the stream of gas from the flame the number of ions diminishes. If the stream of gas is allowed to pass up a long tube containing along its axis a series of charged electrodes, then the bottom electrode will be discharged first, and then the next one, and so on. The ions are used up in discharging the electrodes, so that the electrodes are discharged in order, beginning with the lowest one. When the lower electrodes have been discharged, the upper ones begin to be discharged, but more slowly, because many of the ions disappear by re-combination before they get far up the tube. Another effect also comes in; as the gases cool down the ions do not move so freely through them, and are not so easily attracted by the electrodes. This makes the rate of discharge of the upper electrodes still slower.

Thus, as we go down towards the flame the number of ions and their mobility rapidly increases, and right inside the flame the number is so large that the flame behaves like a good conductor of electricity.

When the terminals of an induction coil are connected to two Bunsen burners, sparks can be passed from the tip of one flame to the tip of the other. The temperature of the flame is about 2000° C., so that the density of the gases in it is about one-seventh of their density at the ordinary temperature. The potential difference required to send a spark through the flame is about the same as that required to send a spark through an equal length of air at one-seventh of ordinary atmospheric pressure. It appears, therefore, that the ions do not make it easier for a spark to pass. This is due to the fact that the current in the spark is greater than the ions can carry, so that the potential difference has to be enough to produce more ions, and so is the same in the flame as in un-ionised air at the same density.

[1] Discourse delivered at the Royal Institution on Friday, February by Prof. H. A. Wilson, F.R.S.

To study the conductivity of flame, it is convenient to use a row of small Bunsen flames placed so that they touch each other. I use a row of fifty flames burning from quartz tubes 1 cm. apart. This gives a flame 50 cm. long and about 10 cm. high. The quartz tubes insulate very well, so that a current can be passed along the flame horizontally from one end to the other.

When two parallel platinum electrodes immersed in the flame are connected to a galvanometer and battery, it is found that a measurable current is obtained. The relation between the current (i) and the difference of potential (V) between the electrodes is given by the equation

$$V = Ai^2 + Bdi,$$

where A and B are constants, and d denotes the distance between the electrodes. If d is small, say one or two millimetres, the term Bdi is negligible (except when i is very small), and we get $V = Ai^2$. In this case the current is almost independent of the distance between the electrodes.

The reason for this peculiar relation between the current and potential difference becomes apparent when the variation of the potential along the flame from one electrode to the other is examined. An electrometer is connected to two platinum wires, which are immersed in the flame, and can be moved along horizontally between the electrodes. Each wire takes up the potential of the flame at the point where the wire is situated, so the deflection of the electrometer indicates the difference of potential between the two points where the wires are put in. Suppose one wire is allowed to touch the positive electrode and the other is gradually moved along the flame from the positive to the negative electrode. It is found that in the space between the electrodes there is a small uniform potential gradient, but near each electrode there is a comparatively sudden drop in the potential. The drop near the negative electrode is much larger than the drop near the positive electrode. Thus nearly all the electromotive force of the battery is used up close to the negative electrode. This shows that nearly all the resistance offered by the flame to the passage of the current is close to the negative electrode. The positive ions in the flame move towards the negative electrode and the negative ions towards the positive electrode; in fact, the current is carried through the flame by these two streams of ions. Hence, close to the negative electrode, the current must be carried entirely by positive ions moving towards it, and at the positive electrode the current must be entirely carried by negative ions. We find that the resistance near the negative electrode is much greater than near the positive electrode, so that we conclude that the negative ions carry the current more easily than the positive ions. With a given electric force, the negative ions move very much faster than the positive ions. It has been shown experimentally that the velocity of the negative ions is about 10,000 cm. per sec. for one volt per cm., while that of the positive ions is about 100 times smaller than this.

In the flame away from the electrodes the electric force is found to be proportional to the current, so that here the flame obeys Ohm's law like a metallic conductor. Its conductivity is about 10^{11} times less than that of copper. In the equation $V = Ai^2 + Bdi$, the term Bdi is the part of the E.M.F. used up between the electrodes, so it is proportional to the current and to the distance. Sir J. J. Thomson has shown theoretically that the drop of potential near the electrodes should be proportional to the square of the current, as is found experimentally to be the case.

The conductivity of a Bunsen flame may be compared with the conductivity of liquids, such as water. In pure water some of the molecules are dissociated into ions and the water is a conductor, although only a poor one; but if a salt like sodium chloride is dissolved in the water, the salt dissociates into ions almost completely, and the conductivity is greatly increased. Suppose we hold a bead of salt on a platinum wire in a flame, then the salt volatilises and the flame is filled with its vapour, and, just as with the water, the conductivity is enormously increased.

With the long flame and an electrode at each end, we can try the effect on the current of putting salt in different parts of the flame between the electrodes. In this way it is easy to show that the current is practically unchanged, unless the salt vapour is put in close to the negative electrode, but in that case it produces a very great increase in the current. This confirms the conclusion that nearly all the resistance to the passage of the current is situated close to the negative electrode. When the salt is put in anywhere it diminishes the resistance there to a small fraction of its value, but it is only close to the negative electrode that the diminution in the total resistance is appreciable. If we measure the potential difference between two points in the flame away from the electrodes, and then put salt vapour in the flame between them, we find that the P.D. drops to a small fraction of its value, although the current is the same as before. This shows clearly that the salt vapour greatly increases the conductivity wherever it is put in.

When some salt is put on the negative electrode, the sudden drop in potential there almost disappears, and we get a nearly uniform potential gradient from one electrode to the other, so that now the resistance is nearly uniformly distributed along the flame. If now salt vapour be put in anywhere between the electrodes, the current is increased. If, for example, we fill half the length of the flame with salt vapour, we nearly double the current.

When salt is put on one electrode, the flame can be used as a rectifier for an alternating current, for when the salted electrode is negative the resistance of the flame is much smaller than when it is positive.

Measurements have been made of the conductivities of a number of alkali salt vapours in a current of air flowing along a platinum tube heated in a gas furnace. An electrode was fixed along the axis of the tube, and the current from it through the salt vapour to the surrounding tube was measured with a galvanometer. It was found that at temperatures above 1400° C., and with electromotive forces of about 1000 volts, the current was proportional to the amount of salt passing through the tube, and for different salts in equal quantities inversely proportional to the electrochemical equivalent of the salt. This shows that the quantity of electricity per molecule of salt is the same for all salts. It was also found that the quantity of electricity carried per molecule was equal to that carried per molecule when a solution of salt in water is electrolysed. It appears, therefore, that the laws of electrolysis discovered by Faraday for liquids apply also to salts in the state of vapour.

When a molecule of salt like sodium chloride dissociates into two ions in water, the sodium atom forms the positive ion and the chlorine atom the negative ion, and when a current is passed through the solution the sodium is attracted to the negative electrode and the chlorine goes to the positive electrode. We might expect the same thing to happen when a current is passed through the salt vapour in a flame. If we put two wires in the flame, and put some sodium salt on one, and then connect them to an induction coil, and pass a discharge from the salted one to the other, we find that the yellow sodium vapour appears at it when it is the negative pole, but not when it is positive. This shows that in the flame the positive ions of the salt vapour contain the metal just as they do in solutions. The negative ions, however, do not appear to be the same in flames as in solutions. In flames the very high velocity of the negative ions indicates that they are the electrons the properties of which have been investigated in vacuum tubes by Sir William Crookes and Sir Joseph Thomson. The positive ion, then, is an atom or molecule, while the negative ion is an electron the mass of which is several thousand times smaller. This is the explanation of the fact that the negative ions move 100 times more quickly than the positive ions.

HEAT-TRANSMISSION IN STEAM BOILERS.[1]

At the present time the relations between the various factors that govern the flow of heat from a gaseous fluid into a metal surface with which it is in contact remain extremely obscure.

The formulæ in general use, which express in a concrete manner the views of engineers upon the subject, are of a purely empirical character and without theoretical

[1] Abstract of paper on "Laws of Heat and Transmission deduced from Experiment," by Prof. J. T. Nicolson, read before the Junior Institution of Engineers.

foundation. They all agree in attributing to the greater or smaller temperature-differences between gas and wall which occur in practice the higher or lower rates of heat transference which are met with, and in ignoring any effect upon that rate which may be produced by a variation of the speed of gas flow.

In 1874 Prof. Osborne Reynolds brought before the Literary and Philosophical Society of Manchester a paper entitled "The Extent and Action of the Heating Surface of Steam Boilers." In this paper, starting with the laws then recently discovered of the internal diffusion of fluids, he endeavoured to deduce from theoretical considerations the laws for the transmission of heat. His formula expressing this law is

$$H=(A+B\rho u)(T-\theta),$$

where A and B are constants, ρ, u, and T are the density, speed and temperature of the fluid, and θ is the temperature of the wall. For small values of u this becomes Newton's law of cooling; for large values the A-term is less important, and the formula becomes one which is applicable to steam boilers.

No further investigation of the subject was made until 1897, when Dr. T. E. Stanton made a series of experiments to test the truth of the views advanced. He found that the amount of heat transferred when *water* forms both the heat-conveying and heat-receiving medium is nearly proportional to the speed of flow, and that Osborne Reynolds's views were abundantly confirmed.

In 1899 Prof. Perry, in his book on the "Steam Engine," wrote a chapter on "How Fluids give up Heat and Momentum"; and, in discussing the efficiency of steam boilers, he finally remarked:—"It seems to me that when a good scrubbing action is established on both sides of the metal there ought to be at least ten times, and may be more than 100 times, as rapid an evaporation per square foot of heating surface as has yet been obtained in any boiler."

There is no record that up to the present time any British or Continental engineer has paid serious attention to these pregnant words, or has realised the immense possibilities which lie behind Prof. Osborne Reynolds's statements, should their truth be experimentally demonstrated.

The author attached so much importance to the matter that, in 1898, after reading Dr. Stanton's paper, he constructed an apparatus in his laboratory at the McGill University for the purpose of further study. His removal to Manchester in 1899, and his subsequent occupation by other work, had, however, prevented his further taking up the question until 1905.

Since that time three series of experiments have been made by himself, and one series by his pupil, Mr. H. P. Jordan, on the subject.

The apparatus used was usually of a fairly simple type, consisting of two long concentric tubes through which (*a*) warm compressed air and cold water, (*b*) superheated steam and cold compressed air, (*c*) superheated steam and cold water, and (*d*) products of combustion of coal and boiling water, were passed in opposite directions through the two pipes at various rates of speed.

An analysis of all these results, together with those of Petiet and Geoffroy, and Henry and Marié upon locomotive boilers, have led to the formula:—

$$Q=\left[\frac{\phi}{200}+\sqrt{\frac{\phi}{40}}\left(1+\frac{1}{m_1}\right)\rho_1 u_1\right]\left(T-\theta\right)$$

for the heat flow Q in B.Th.U. per sq. ft. per hour when:

T = temperature of gas (°F.),
θ = ,, wall (°F.),
ρ_1 = density of gas (lbs./cu ft.),
u_1 = speed of gas flow (feet/sec.),
$\phi = \frac{1}{2}(T+\theta)$ = mean film-temperature,
m_1 = hydraulic mean depth of gas-flue (inches).

According to this formula, the rate of heat transfer *for a given temperature-difference* between gas and wall depends upon (*a*) the mass-flow of the gas, lb. per sec. per sq. ft. of flue-section; (*b*) the average temperature of gas and wall; and (*c*) the smallness of bore of the tube or width of channel conveying the gas.

The usual rate of heat transfer in steam boilers is (from 3 to 10) about 5 B.Th.U. per sq. ft. per hour per degree difference of gas and water (*i.e.* wall) temperature. In the author's experimental apparatus he succeeded in transmitting more than 300 B.Th.U. per sq. ft. per hour per degree difference, *although the air was only about* 30° F. *hotter* than the water.

In an experimental boiler he was able also to produce evaporations at the rate of from 30 lb. to 50 lb. of steam (as from and at 212° F.) per sq. ft. of *indirect* heating surface per hour when the gas temperature was at about 1500° F. and the water at 300° F. In both cases this high rate of heat transference was principally due to the very high gas velocities employed. These varied from 300 to 550 feet per second, whereas in ordinary boiler practice it never exceeds 150, and is usually from 10 to 30 feet per second.

The way in which the new experimental facts should influence practice in steam generation may be stated as follows:—

In the first place, since the amount of heat that can be transmitted for a given temperature difference is almost directly proportional to the speed of the gases, a reduction of area of the heating surface in steam boilers—to one-half, one-quarter, or even one-tenth of what is now usual—can be made without the chimney temperatures being raised or the efficiency lowered to any material extent. Or, otherwise, if the surface be kept the same, but the cross-sectional area through the flues be reduced, in order to obtain the necessary high gas speed, a very much lower chimney temperature and correspondingly higher efficiency can be secured than is now available.

Accordingly, drafts of 10 or 20 inches of water gauge, induced by fans, should always be employed for really economical working.

In the case of boilers of usual construction, in which the gases pass through flues or tubes and leave the boiler at a point where the temperature on the other side of the heating surface is that corresponding to the steam pressure, a limit will soon be reached as to the amount of draft-suction which can be employed, and this from one or other of two causes:—

(*a*) Whilst the fire need not be forced, even when these high drafts are used, to a greater extent than that now usual, the high speed of entry of the glowing gas at the furnace end of the tubes will cause leakage, and some other construction for such purposes than that now generally employed must be sought for.

(*b*) The fall in temperature of the chimney gases due to the small flue-section and accompanying high speed will, as intimated above, certainly provide an additional amount of evaporation which can be drawn upon to cover the extra power required for the fans, but the margin between present chimney temperatures and the lowest which are possible in ordinary designs of boiler under the above conditions is not very great when the steam temperatures are from 350° F. to 400° F. A limit will therefore soon be reached beyond which it will not pay to pass. The author, after a careful investigation of costs and running expenses, has good reason to believe that this limit of draft-pressure is, even for the ordinary type of boiler, much higher than that now in common use.

In the second place, since the author's experiments have shown that with a counter-current flow of gas and water it is possible to lower the gas temperature (at such high speeds as he used) to within 20° F. of that of the entering feed, we have here the evidence that chimney temperatures of 100° F. to 150° F. can be reached and maintained provided only high gas and water speeds are resorted to and the boiler is designed on the economiser principle, with strict attention to counter-current methods of flow.

Now such a low chimney temperature as this corresponds to a transmission efficiency of more than 95 per cent.! The margin of additional evaporation available for the supply of the fan-power is, accordingly, so much greater than is required that not only can higher economies be obtained on this system than have hitherto been thought possible, but they can be effected with boilers having smaller areas of heating surface, smaller total volumes, smaller floor areas, lighter weights, and lower first costs than those we ordinarily employ.

Finally, since the enhanced evaporative efficiency of the heating surface due to high speed, and its correspondingly reduced area, renders it possible economically to line that part of the surface nearest to the furnace with refractory material, and so to secure a non-water-cooled or reverberatory chamber in which the combustion processes may be perfectly completed, any special need for skilful firing is dispensed with, and, by providing plenty of air and an ample mixing space behind the bridge, excellent results, and an entire absence of smoke, may be obtained without special care.

Such brick-lined combustion chambers cannot now be afforded next the furnace in ordinary boilers, for the heating surface at this point is almost all that the boiler has of even *moderately* good evaporative power, and it cannot be sacrificed, as convective heating surface, to be lined with a protective coating for the purposes of a combustion chamber.

Nor is this all. Any lack of high furnace temperature accompanying such air excess can so easily be made up for by the additional gas speed that nearly the whole heat-value of the coal can still be passed into the water, even when the flue gases are relatively cool, without any undue extension of the heating surface being found necessary. We see also that the extra quantities of air just mentioned may be admitted to the furnace without encountering the evil results which usually follow such a course. For, as practically all the heat is extracted from the gaseous products before they reach the chimney when this high-speed counter-current method of working is adopted, it matters but little to what extent they are diluted.

Thus the proposed new method of working, using both high-speed and counter-current gas and water flow, appears to be capable of introducing several features of radical improvement into the present practice of steam-boiler construction and working.

The author believes that some such features must shortly be incorporated in boiler design if the steam engine is to retain the preeminence it has so long enjoyed in the economical production of power.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Among the courses of lectures announced by the University of Göttingen in the Bulletin of the American Mathematical Society, we notice the entry:—"By Prof. L. Prandtl: Theory of aëronautics, four hours."

Science announces that the passage of the Legislative Appropriation Bill carrying 196,400*l.* for the University of Kansas, gives the University all it asked, except an appropriation for a dormitory. From the same source we learn that by the will of Ellen A. Kendall, her residuary estate is given to Wellesley College to found a professorship bearing her name. It is provided that if the fund exceeds 12,000*l.* the income of the excess shall be used to aid worthy students.

The *Lancet* states that one friend of McGill University has recently promised to give 20,000*l.* to the University as soon as 100,000*l.* has been raised elsewhere, and another has presented the governors of the institution with an unconditional gift of 5000*l.* The above announcements were made at a recent meeting of the corporation of the University, and as the authorities have now in hand about 20,000*l.*, it was decided for the present to leave in abeyance the plans for obtaining the 400,000*l.* which the institution needs, and to concentrate all possible efforts towards securing the other 80,000*l.* necessary before the new 20,000*l.* donation can be accepted.

We have received a copy of the March issue of *The Record*, the magazine of the South-Western Polytechnic Institute, Chelsea. In addition to the interesting chronicle of the doings of the various societies in connection with the institute, the magazine contains several articles by old students and others on aspects of the engineering profession. An illustrated account is given of a recently acquired 50-ton testing machine in the mechanical engineering laboratory, and a compound steam engine provided by the London County Council is included. These additions are good instances of the satisfactory equipment with which technical institutions of London are now able to instruct their students in the practical requirements of industrial enterprise.

The annual meeting of the Swanley Horticultural College (for Women) was held on March 24. The chairman, Sir John Cockburn, in moving the adoption of the report and balance-sheet, laid stress on the admirable work done by the college in meeting the two great requirements of the day, viz. rural education and the higher education of women. Mr. C. Bathurst, in seconding the resolution, directed attention to the growing demand on the part of local educational authorities for teachers qualified to give instruction in nature-study and school gardening in both elementary and secondary schools, and the increasing usefulness of Swanley in meeting this demand. Short courses of instruction upon gardening and other country occupations will be given at the college from May 6 to June 15 and from June 18 to July 27. There will also be a nature-study course from July 31 to August 14.

As technical education in India is about to receive serious consideration, attention is directed in an article in *Indian Engineering* for February 20 to certain causes of failure in the past. The original scheme of education in India seems to have been instituted for the principal purpose of providing a supply of Indian clerks having a knowledge of English. As the result of fifty years of this policy it is now found that higher education is pursued with too exclusive a view to entering Government service, and its scope is thus unduly limited. Again, difficult work requires expert workers, and it is to be hoped that these will be forthcoming, and that they will have a freer hand in dealing with technical education problems than has hitherto been the case in the Indian educational administration. Steps should be taken to secure that expert educationists will be in a majority, and that their reports will not require to be made through alien departments. The example of Japan shows what is possible in Eastern countries, but Japan was initially guided by men of educational experience and scientific knowledge.

The issue of the *Oxford and Cambridge Review* for the Lent term provides a varied table of contents. In an article on some defects in the curriculum of the public schools and a suggested remedy, Mr. A. R. Gidney directs attention to certain resolutions adopted at last year's conference of headmasters, and the decision to appoint a committee to consider a scheme of studies for boys from the ages of nine to sixteen or thereabout. Against the present scheme of studies, says Mr. Gidney, three indictments may be brought:—it is surcharged with languages; it recognises inadequately the bent of individual boys; and it fails to arouse an intellectual interest in the majority of boys. Having dealt with the congested state of the present curriculum, the writer wisely insists that a selection of subjects must be made, and that in making it it must be remembered that the majority of boys have a greater ability for one class of studies than another, and that this ability, though innate, does not manifest itself usually with any clearness until a particular epoch in the boy's life. Most authorities will agree with these conclusions, but many will consider that Mr. Gidney gives too little prominence to the need for practical studies of several kinds in the scheme of education he outlines. Mr. Leonard Hill, F.R.S., contributes an article on oxygen for athletes, and after explaining and summarising some of the researches of Dr. John Haldane, Dr. Pembrey, Prof. Zuntz, Mr. Flack, himself, and other workers in connection with the inhalation of oxygen, he concludes his essay by remarking that he is "indifferent whether oxygen is used by athletes or not; if they choose to try they will soon find out whether the advantage gained is worth the trouble and expense." Mr. Hill "is content with the knowledge he has gained, that oxygen inhalation combined with exercise is a potent method of treatment in various pathological states." Mr. M. M. Pattison Muir writes on the abuse of the word "scientific."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 14.—"On the Depression of the Filament of Maximum Velocity in a Stream flowing through an Open Channel." By A. H. **Gibson.** Communicated by Prof. J. E. Petavel, F.R.S.

In a stream flowing through an open channel the filament of maximum velocity is not, as might be expected, in the surface and in the centre of the stream, but is usually at some distance below the surface. No satisfactory explanation of the reason for this has hitherto been given. In this paper the phenomenon is attributed to the effect of transverse currents which sweep up each side of the stream, along the surface towards the centre, down near the centre, and outwards near the bottom. These currents, the existence of which may be foretold from theoretical considerations, and which have been observed by the author in a number of streams and open channels, spread a layer of slowly moving water over the surface of the stream, and so depress the filament of maximum velocity.

This explanation also accounts for several subsidiary phenomena which are observed in river gauging, such as the effect of the roughness of the sides and of the bottom, and of the ratio of breadth to depth on the depth of this filament.

January 21.—"The Leakage of Helium from Radio-active Minerals." By the Hon. R. J. **Strutt,** F.R.S.

In a paper published in Roy. Soc. Proc., A, vol. lxxxi. (1908), p. 272, the author showed that phosphatised bones and similar materials were notably radio-active, and that helium could be detected in them. The quantity of helium found was not, however, uniformly greater in the geologically older materials than in younger ones of equal activity. This was hypothetically attributed to escape of helium in certain cases. The author desired, if possible, to observe directly the escape of helium from radio-active minerals at the ordinary temperature.

It was found that after a radio-active mineral had been powdered, helium was evolved from it, rapidly at first, then at a diminishing rate. The following observations illustrate this.

A quantity (337 grams) of monazite from the Transvaal was powdered and passed through a wire gauze sieve of 120 threads to the inch. This took about one hour. Immediately afterwards it was put in a bottle and the air pumped out. The rate of evolution of helium in cubic millimetres per day per kilo. of material was as follows:—

Time (days)	Rate
0·031	261
0·59	76·6
1·6	17·1
2·6	12·3
4·6	9·57
10·6	4·38
33·0	1·14

The whole quantity which has escaped while the mineral has been under observation is but an insignificant fraction (probably less than a 500th [1]) of the whole quantity present.

Moss (Roy. Dub. Soc. Trans., vol. viii., p. 153) has observed that quantities up to 1 per cent. of the helium contained in a mineral can be liberated by grinding in a vacuum. The present observations show that this is but the first rapid stage of a long-continued leakage of helium from the newly created surfaces. The view that heat generated in grinding is the important factor appears untenable, for in that case escape of helium should cease on cooling.

It was found that pieces from the same stock of monazite, about the size of a lump of sugar, which had not been fractured since they came into the possession of the author two years ago, evolved helium at the rate of 0·002 c.mm. per kilo. of material per diem.

This rate, though quite insignificant in comparison with that exhibited by the powdered material, is much in excess of the probable rate of generation of helium by radio-active change. It follows that the present stores of helium could never have been accumulated had the present rate of evolution prevailed throughout the life-history of the mineral.

[1] This sample of monazite was very poor in helium, containing only $\frac{1}{10}$ c.c. per gramme.

With the view of testing a mineral more nearly in its natural condition, experiments were made on thorianite, which occurs in gravels, in detached cubic crystals, washed out of their original matrix. This, too, showed a considerable leakage of helium (0·069 c.mm. per kilo. per diem).

Under laboratory conditions the rate of escape of helium from minerals always far exceeds the rate of production by radio-active change. Therefore the conditions under which the life of the minerals has been mainly passed, deep down in the earth, where atmospheric agencies have no place, must be supposed more favourable to retention of helium, for otherwise the present accumulation could never have been formed. The observations here recorded leave little room for surprise that fossilised bones and other materials do not always contain as much helium as would be expected from their radio-activity and geological age.

Geological Society, March 10.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Some notes on the neighbourhood of the Victoria Falls (Rhodesia): T. **Codrington.** An account is given of the way in which the basalt lies in the valley of the Zambezi below and above the Victoria Falls, and how this determines the features of the river is pointed out. The basalt through which the Batoka Gorge has been cut appears in the course of the Zambezi for two miles above the Victoria Falls, causing rapids. It then disappears, and the river above flows quietly between alluvial flats for five miles, the basalt being traceable here and there below the water until above Candahar Island it again rises and constitutes the bed of the river from bank to bank, causing rapids. The discovery of stone implements and artificially worked stones in the gravel and the bed of the Maramba is noted. The majority of flakes and flaked stones having no trace of design over those that can be considered as implements suggests that the manufacture of stone tools on a large scale was here carried on for use in the sand-covered country on both sides of the Zambezi, where there is no stone. There appears to be no evidence as to the age of the implements found near the Zambezi.—A contribution to the petrography of the New Red Sandstone in the west of England: H. H. **Thomas.** The paper is supplementary to one dealing with the mineralogical composition of the pebble-bed. A list of minerals identified, and tables showing their distribution, are given. It is suggested that anatase occurs both as detrital crystals and as crystalline groups formed in the rocks since their deposition. The forms presented by grains of staurolite, as well as certain crystals of tourmaline with an unusual habit, are described. It is recognised that the divisions of the New Red Sandstone, although linked together by a similarity of mineralogical composition, present differences indicative of variations in the source of supply and conditions of deposition. With regard to the vertical and horizontal distribution of minerals, staurolite is abundant in the Lower Breccias and Sandstones of the extreme south of Devon, but less plentiful northwards; garnet is present in all the New Red rocks of North Devon and Somerset, but in south and central Devon only occurs in the Lower Marls and in the Upper Marls and Sandstones.

Physical Society, March 12.—Dr. C. Chree, F.R.S., president, in the chair.—The effect of radiations on the brush discharge: A. E. **Garrett.** Willows and Peck in 1905 found that radium radiations can extinguish a brush discharge produced by a Wimshurst machine when the gap is greater than 3–4 cm. These experiments show that the phenomena can be produced by an induction coil giving a 6-inch spark. The observation that the β rays are responsible for the effects produced is confirmed. The effect of the nature of the anode on the sensitivity of the positive brush is dealt with. It has been found that the sensitive nature of the brush depends upon the oscillatory nature of the discharge, and probably a side discharge takes place when the brush is extinguished by the radium.—Pirani's method of measuring the self-inductance of a coil: A. E. **Snow.** In this method the coil the self-inductance L of which is to be measured is joined in series with a condenser of capacity C, and the combination forms one arm of a Wheatstone's bridge. The condenser is shunted by a non-inductive resistance r. The result $L=Cr^2$, whence the value found for L is independent of the inductance of the galvanometer, has been proved for the case in which the discharge of the condenser is continuous. In this paper the case in which the discharge of the condenser is oscillatory is dealt with, the applied E.M.F. being constant. It is shown that the discharge of the condenser is of the same nature as that through the galvanometer. In the case of an oscillatory discharge of the condenser the value found for the inductance of the coil is not affected by the inductance of the galvanometer. If the same method is applied to the case of an alternating E.M.F., a result is obtained which involves the inductance of the telephone used to indicate the current. From general considerations this can be shown to be impossible. The method used in the case of a constant E.M.F., therefore, is not available for the investigation of the case in which the E.M.F. is alternating.—Exhibition of a high-potential primary battery: W. S. **Tucker.** The object of the battery is to maintain at known potentials such conductors as the needle of the quadrant electrometer, for charging condensers in capacity and insulation tests, and so on. It is composed of a large number of elements in series, the elements consisting of carbon and pure zinc with a nearly saturated solution of calcium chloride as electrolyte. It is found possible to obtain 1·02 volts per element, so that a total of more than 900 volts is given. Since the terminals are well insulated, a very steady voltage is obtained, and this has been kept within one-tenth per cent. variation for two hours and 1 per cent. for half a day, the temperature of the room remaining steady. The battery has fitted to it an arrangement whereby any desired voltage from that of one to that of all the cells can be obtained by steps of one cell. A special feature of the battery is its careful insulation.—The least moment of inertia of an angle-bar section: H. S. **Rowell.**

Linnean Society, March 18.—Dr. D. H. Scott, F.R.S., president, in the chair.—The "dry-rot" of potatoes: Miss Sibyl **Longman.** The author pointed out, as the result of her researches, that the disease of the potato tuber, known as "dry-rot"—due to the fungus *Fusarium Solani*—is not necessarily preceded by "wet-rot," but may be set up in sound tubers by inoculation with spores or mycelium of *Fusarium Solani*, which species is not a parasite of the resting tuber only; it may also attack and kill the shoots of potato plants. The fungus, which probably exists as a widely distributed saprophyte in the soil, infects the growing potato plant *viâ* the root; it also spreads from tuber to tuber during storage, and diseased tubers may produce diseased plants. Heat sterilisation of the resting potato tuber, with respect to *Fusarium Solani*, is impracticable, for the death-temperature of the fungus is higher than that of the potato. A pycnidial stage occurs in the life-history of *Fusarium Solani*, which should therefore be placed in the highest group of the Fungi Imperfecti, the Sphæropsidaceæ, and not, as is the case at present, in the Hyphomycetes.—The structure and affinities of *Davidia involucrata*, Baill.: A. S. **Horne.** The paper deals with the structure and affinities of a genus referred to the natural orders Combretaceæ, Cornaceæ, and Hamamelidaceæ by various authorities, in the light of original observations carried out under the direction of Prof. J. B. Farmer, upon material brought by Mr. E. H. Wilson from Szechuen in 1904. Evidence is advanced in favour of interpreting the inflorescence as consisting of a number of congenitally fused, apetalous, multi-staminate male flowers, or of male and in addition a single obliquely situated, apetalous, hermaphrodite flower with epigynous stamens *arranged in series*. From a detailed study of the flower, ovary, ovule, and seed, the author is inclined to believe that Davidia is distantly related to Alangium and Nyssa, and still more distantly related to the Araliaceæ; that the genus occupies a somewhat isolated position owing to having pursued an independent course of development from the plexus of primitive groups, which included the ancestral forms of the Araliaceæ, Nysseæ, and Alangieæ.

Edinburgh.

Royal Society, March 1.—Dr. R. H. Traquair, F.R.S., vice-president, in the chair.—The systematic motion of the stars, second paper: Prof. **Dyson.** Following up a previous paper on the subject, the author, by application of a statistical method, found that the two streams were moving with velocities which were in the ratio of 2 to 3. The stars belonging to the two streams did not appear to have any other distinguishing characteristics.—Preliminary note on *Cynomacrurus Piriei*, a new deep-sea fish discovered by the Scottish National Antarctic Expedition: Prof. **Dollo.** This new fish, named after Dr. Pirie, surgeon and geologist to the *Scotia*, belonged to the Macruridæ, a family closely allied to the cod. The existence of Macruridæ within the Arctic Circle had been known since 1837, when Sven Lovén recorded *Macrurus burglax* from Hammerfest, Finmark. In 1899 Prof. Dollo recorded the first macrurid from the Antarctic, namely, the new species *Nematonurus lecontii*, brought home by the *Belgica*. The new species now described differs generically from these. It was obtained in lat. 71° 50′ S., long. 23° 30′ W., at a depth of 2102 fathoms.

March 15.—Dr. Traquair, F.R.S., vice-president, in the chair.—The glacial deposits of western Carnarvonshire: Dr. T. J. **Jehu.** The Lleyn promontory lay outside the paths followed by the native glaciers. Hence, instead of the lowest Boulder Clay of the district east of Snowdonia, there is a "rock rubble" or "head" which underlies all the drift deposits, and is the result of subaërial waste under severe climatic conditions. It is succeeded by (1) a Lower Boulder Clay with northern erratics and shells; (2) sands and gravels; (3) an Upper Boulder Clay with northern erratics and shells. The Lower Boulder Clay, which is the most widely spread of all these deposits, is the product of a *mer-de-glace* coming from the north, which overwhelmed Lleyn as far east as a line running from Carnarvon to Cardigan Bay, in the neighbourhood of Pwllheli. The sands and gravels were accumulated during a retreat of the ice, while the Upper Boulder Clay marks a re-advance. So far as Lleyn is concerned, the two Boulder Clays might be regarded as the product of one *mer-de-glace* which was subject to considerable oscillations, but a review of the Irish Sea basin as a whole renders it more probable that they are the products of the ice-sheets of two Glacial epochs separated by an inter-Glacial epoch.—The Glenboig fireclay: its halloysite and sideroplesite: Prof. J. W. **Gregory.** Evidence was adduced to show that this fireclay was laid down in a wide lagoon in the beginning of the Millstone Grit period. It contains lenticular crystals of sideroplesite, which have been built up by zonal deposition around rhombohedra, which probably crystallised in the water of the lagoon. The clay substance which forms the base of the fireclay is isotropic, and is referred to the mineral halloysite. The clay contains no kaolinite.—Tuesite, a Scottish variety of halloysite: Prof. **Gregory.** Tuesite was founded as a mineral species by Thompson in 1836 for material described as occurring in beds in the New Red Sandstone on the banks of the Tweed, and has been identified with kaolinite. The absence of china clay from Scotland has been used as a strong argument in favour of the pneumatolitic origin of that material, and the reported nature and occurrence of tuesite would have been inconsistent with that origin. Re-examination of the material shows, however, that the tuesite occurs as an alteration product in a volcanic neck; it is not kaolinite, but halloysite, and its formation is consistent with the deep-seated origin of the great china-clay masses found in many parts of the world.

Paris.

Academy of Sciences, March 15.—M. Bouchard in the chair.—Systems of homogeneous differential equations: Gaston **Darboux.**—The flow of rivers: Bouquet **de la Grye.** It is generally assumed in works on hydraulics that in water in motion under the action of gravity the elementary strips move in a straight line, the flow being expressed as a time function of the fall. This does not correspond with practice; the motion is in curved lines. By applying the principle of least action, it is found that the strips of liquid would have a tendency to turn to the side where the friction is a minimum.—The magneto-kathode rays: M. **Gouy.** The resistance of rarefied gas under the action of the magneto-kathode rays has been measured, and found to be much smaller than in the absence of the rays.—Remarks by M. B. **Baillaud** on the twentieth *Bulletin de l'Observatoire de Besançon.*—Comparison of the lines of the spectrum of the electric arc and of the sun. Pressure of the reversing layer in the solar atmosphere: Ch. **Fabry** and H. **Buisson.** The comparison has been made by the interference methods previously described by the authors, and only the finest lines in the spectrum were utilised. The numerical results accord with those of Jewell, and are not completely explained by the theory of displacement by pressure. Assuming the average displacement to be a pressure effect, it results that in the region of the solar atmosphere where the iron lines are absorbed the pressure is between 5 and 6 atmospheres.—Certain triple orthogonal systems: J. **Haag.**—The singularities of analytical functions beyond the circle of convergence: Paul **Dienes.**—The fundamental equations for the experimental study of aëroplanes: D. **Drzewiecki.**—Measurements of the coefficient of resistance of air carried out by means of experiments made on an aëroplane: A. **Etévé.** There is a large discrepancy between the coefficient k of the resistance of the air as determined by physicists and by experiments with aëroplanes, the latter number being about ten times the former. It is shown that this discrepancy is largely due to an unjustifiable assumption made in calculating k from the aëroplane results.—The decomposition of water by radium salts: A. **Debierne.** The author's experiments do not confirm the loss of the power to produce hydrogen and oxygen by a radium salt, recently announced by Sir William Ramsay. The amounts of hydrogen and oxygen evolved by a gram of radium have been found to be regular and of the order of 13 c.c. per day. Some of this is shown to be due to the action of the β and γ rays.—The chemical action of the penetrating rays of radium on water: Miroslaw **Kernbaum.** By the action of the β and γ rays on distilled water for one month, 200 cubic mm. of gas was obtained, which on analysis proved to be hydrogen. The residual water responded to the potassium iodide and starch test, from which the conclusion is drawn that hydrogen peroxide is formed simultaneously with hydrogen.—The question of the emission and absorption of incompletely polarised light in a magnetic field and on the Zeeman phenomenon in fluted spectra: Jean **Becquerel.**—The utility of the graphical method in the study of ancient musical instruments: M. **Marage.**—The electromotive forces of magnetisation: V. **Posejpal.** The electromotive force of a metallic thermocouple changes when the neighbourhood of the junction becomes the seat of an intense magnetic field. This change is not related to the presence of a ferromagnetic metal, and is independent of the direction of the field. The electromotive force thus produced increases with the strength of the field, but not proportionally.—The cryoscopy of colloids: Jacques **Duclaux.** The measurements of the osmotic pressure (P) and lowering of the freezing point (Δ) of colloidal solutions of the hydrates of iron and thorium satisfied the theoretical relation $P = 12{\cdot}2.\Delta$.—A new isomeride of indigo: A. **Wahl** and P. **Bayard.** Oxindol (the lactam of *o*-amidophenylacetic acid) reacts with aromatic aldehydes, forming compounds of the type

$$C_6H_4\begin{matrix}\diagup C \quad CH.R \\ \diagdown NH\diagup CO\end{matrix},$$

for which the name iso-indogenides is proposed.—The condensation of the mesoxalic esters with phenol ethers: A. **Guyot** and G. **Estéva.**—The action of caustic potash on borneol, camphor, and isoborneol: racemic campholic acid: Marcel **Guerbet.** The production of campholic acid by the interaction of borneol and anhydrous caustic potash has been described in an earlier paper. The only other substance obtained from the reaction product was thought to be unaltered borneol, but this has since been found to contain a considerable quantity of camphor.—The genesis and optical properties of the neogenic felspar of the sediments of the Paris basin: F. **Grandjean.**—The nitrification of soils: MM. **Pouget** and **Guiraud.**—The influence of mineral manures on some Cyperaceæ: J. B. **Gèze.**—The manostatic centres and the physiological treatment of arteriosclerosis: P. **Bonnier.**—Contribution to the study of hypo-anæsthetics: A. **Brissemoret** and J. **Chevalier.**—A parasitic microsporidian of *Frenzelina conformis*: L. **Léger** and O. **Duboscq.**—The Mosquero spider: Léon **Diguet.**—The Mosquero spider: Eugène **Simon.**—Extension of the Coal-measures under the Trias and Jurassic strata in the basin of Alais (Gard): G. **Fabre.**—The earthquakes of December 28, 1908, and January 23, 1909: D. **Eginitis.**—A luminous phenomenon observed at Brest on the night of February 22: Thierry **d'Argenlieu.**

March 22.—M. Bouchard in the chair.—Systems of homogeneous differential equations: Gaston **Darboux.**—Contribution to the search for planets beyond Neptune: A. **Gaillot.**—M. Termier was elected a member of the section of mineralogy in the place of the late M. A. Gaudry.—The spectrum of the comet 1908*c* (Morehouse): A. **de la Baume-Pluvinel** and F. **Baldet.** A continuation of work already published. In the later photographs a greater dispersion was obtained (10·9 mm. between F and H), and special arrangements were made to secure the yellow and ultra-violet ends of the spectrum. The greater part of the lines in the spectrum of this comet is furnished by a single gas, presenting a system of bands the heads of which follow the law of Deslandres. These bands cannot be identified with any known spectrum.—Another method of dealing with the problem of the integration of partial differential equations of the second order: E. **Goursat.**—An application of the functional calculus to the study of linear partial differential equations of the third order and hyperbolic type: R. **d'Adhémar.**—The stability and displacement of equilibrium: C. **Raveau.**—Particular solutions of the equation $\frac{\partial^2\phi}{\partial x^2} - \frac{\partial\phi}{\partial t} = 0$: Henri **Larose.**—Resonator sparks. Their spectroscopic analysis: G. A. **Hemsalech** and A. **Zimmern.** From the point of view of spectroscopic analysis, there is a great difference of constitution between the best long resonance spark and the short spark. The former is the capacity spark; the air lines predominating in the latter, there is a predominance of bands, the air lines being absent.—The normal and abnormal Zeeman phenomenon in vapour spectra. Reply to the note of M. J. Becquerel: A. **Dufour.**—The magnetic properties of some iron compounds: M. **Wologdine.** Results of the determination of the temperatures of magnetic transformations of magnetite, pyrrhotine, iron carbide, carbide of iron and tungsten, franklinite and phosphide of iron.—The approximation of black bodies used as receivers: C. **Féry.** A comparison of the behaviour of platinum black and lampblack as absorbents. The differences are shown graphically, and the conclusion is drawn that a re-determination of the coefficient in Stefan's law is necessary.—Contribution to the study of radiation: G. **Millochau.** The researches of the author, in collaboration with M. Féry, have led to a value of 9·5 for Stefan's coefficient, whilst Kurlbaum found in 1898 5·25 for the same coefficient and Scheiner (1908) 4·78. The causes of this divergence are discussed in the present paper, and it is shown that the actinometers in current use, in which the receiver is a thermometer covered with black, do not measure the absolute value of the radiation which they receive, but only a part of it. To obtain an absolute actinometer it must be furnished with a receiver really possessing the properties of an integral radiator.—The phosphorescence and combustion flames of sulphur: L. **Bloch.** The phosphorescence of sulphur is accompanied by the formation of ozone, and this in larger quantity than with phosphorus. This production is the more remarkable in that it takes place at a temperature (200°–250°) generally indicated as causing the destruction of ozone. At about 360° C. the blue flame of sulphur appears, and this flame is entirely deprived of electrical conductivity.—The experimental study of the coefficient of distribution and its application to the estimation of the volatile acids in wines: Philippe **Malvezin.**—A new method of preparation of the β-halogen derivatives of naphthalene: G. **Darzens** and E. **Berger.** The sodium derivative of β-naphthol is treated in boiling toluene solution with the phosphorus halide, the corresponding chlorine or bromine derivative of naphthalene being obtained. The best yield (55 per cent.) was obtained with phosphorus trichloride.—The function of magnesia in the transformation of saccharose at different temperatures: J. **Tribot.**—Biochemical researches on the development of anthocyanine in plants: R. **Combes.**—Study of the action of iron on wine: M. **Trillat.** In contact with iron or its salts, the production of aldehyde in wine is very rapid. The quantities produced are sufficient to precipitate the colouring matters of the wine.—The penetration of pulverised liquids into the respiratory tracts: M. **Cany.** The experiments were carried out on sheep which had inhaled arsenical water, and the results clearly showed that an increase in the normal amount of arsenic in the lungs was produced. It is necessary for the success of similar experiments that the drops should be of the smallest possible dimensions.—The skeleton of the posterior member of *Bradypus torquatus*: A. **Menegaux.**—The geology of the basin of Ogôoué: H. **Arsandaux.**—The age and the nature of the most recent folds of the interior reliefs of the eastern Tellian Atlas (Algeria): L. **Joleaud.**

Calcutta.

Asiatic Society of Bengal, March 3.—Studies in the experimental breeding of Indian cottons; an introductory note, part ii., on buds and branching: H. Martin **Leake.** The author has in hand observations on the effect of making crosses between types with the secondary branches sympodial and types with monopodial—observations of considerable importance, because early-flowering races are wanted for profitable cultivation in the neighbourhood of Cawnpur, and if the delaying of flowering, *i.e.* of forming main sympodial buds, should be dominant in crosses over the other condition, any other improvements brought in by the crossing would be rendered locally valueless. However, it was found that on crossing a monopodial by a sympodial, the offspring differed very slightly from the sympodial parent, though there might be some increase in number of secondary branches, and in the second (F_2) generation (the flower of the first generation being self-fertilised) the full sympodial type was dominant; but every proportion of sympodial and monopodial branches occurring on a single stem was found.—Notes on the theory of souls among the Malays of the Malay Peninsula: Dr. N. **Annandale.** A summary and revision of the author's views as expressed in an account of the animistic beliefs of the Patani Malays in "Fasciculi Malayenses."—Tamarisk manna: D. **Hooper.** Historical references to Gazangabin or Tamarisk manna in Persia and Arabia. Names and distribution of manna-yielding species of Tamarix in Asia. Chemical composition and properties of the manna.

DIARY OF SOCIETIES.

THURSDAY, April 1.

Royal Institution, at 3.—Aerial Flight in Theory and Practice: Prof. G. H. Bryan, F.R.S.

Linnean Society, at 8.—The Amphipoda Hyperiidea of the *Sealark* Expedition to the Indian Ocean: A. O. Walker.—The Marine Mollusca from the same Expedition: J. Cosmo Melvill.—The Land and Freshwater Mollusca of the Seychelles Archipelago: E. R. Sykes.—On a Blind Prawn from the Sea of Galilee, *Typhlocaris galilea*, g. et sp. n: Dr. W. T. Calman.

Institution of Electrical Engineers, at 8.—The Electrical System of the L.C.C. Tramways: J. H. Rider. (*Adjourned discussion.*)—The Theory and Application of Motor Converters: H. S. Hallo.

Röntgen Society, at 8.15.—The Origin, History and Development of the X-Ray Tube: J. H. Gardiner.

FRIDAY, April 2.

Royal Institution, at 9.—Electrical Striations: Sir J. J. Thomson, F.R.S.

Civil and Mechanical Engineers' Society, at 8.—Storms, and their Effect Upon the Sea Coast: Dr. J. S. Owens.

Institution of Civil Engineers, at 8.—Reinforced Concrete on Railways: W. E. R. Gurney.

Geologists' Association, at 8.—The Valleys of the Cotswold Hills: Prof. W. M. Davis.—The Ancient Land of Egypt: Mary S. Johnston.

SATURDAY, April 3.

Royal Institution, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

Essex Field Club (at Essex Museum of Natural History, Stratford), at 7.—The Head as an Index of Race: J. Gray.

MONDAY, April 5.

Royal Geographical Society, at 8.30.—The Scenery of Cuba, Haiti, and Jamaica: Sir Harry Johnston, G.C.M.G., K.C.B.

Royal Society of Arts, at 8.—Steam Turbines: G. G. Stoney.

Society of Chemical Industry, at 8.—Vapour Galvanising: S. Cowper Cole.—The Action of Sulphuric and Nitric Acids in the Nitration of Cellulose: C. N. Hake and M. Bell.

TUESDAY, April 6.

Zoological Society, at 8.30.—Notes on an Ichthyosporidian causing a Fatal Disease in Sea-trout: Muriel Robertson.—A Collection of Fishes made by Dr. C. W. Andrews, F.R.S., at Christmas Island: C. Tate Regan.—Description of a New Form of Ratel (Mellivora) from Sierra Leone, with Notes upon the described African Forms of this Genus: R. I. Pocock.—On some New and Little-known Hesperidæ From Tropical West Africa: H. H. Druce.

Royal Society of Arts, at 4.30.—Ceylon: Its Industries and Material Progress: Hon. John Ferguson, C.M.G.

Institution of Civil Engineers, at 8.—*Further Discussion*: Construction and Wear of Roads: A. Mallock, F.R.S.—*Probable Paper*: The *New York Times* Building: C. T. Purdy.

WEDNESDAY, April 7.

Society of Public Analysts, at 8.—The New Standards for Sewage Effluents: Dr. S. Rideal and W. T. Burgess.—The Determination of the 'Oxygen Absorbed' by Sewage and Effluents by a Modification of Kubel's Method: W. Carter.—A Note on Enkabang and Teglam Fats and Katio Oil, from Sarawak: C. J. Brooks.—The Composition of Milk: H. D. Richmond.

Royal Astronomical Society, at 5.

Geological Society, at 8.

Entomological Society, at 8.—On Reciprocal Mimicry: Guy A. K. Marshall.

CONTENTS.

THURSDAY, APRIL 8, 1909.

TELEOLOGY.

Design in Nature. By Dr. J. Bell Pettigrew, F.R.S. In three volumes; with nearly 2000 figures and three portraits of the author. Vol. i., pp. xxxi+421; vol. ii., pp. xi+425–1069; vol. iii., pp. ix+1073–1416. (London: Longmans, Green and Co.) Price £3 3s. net.

ALTHOUGH the manuscript of these three large volumes was completed by the author, it was not until after his death that the greater portion of the book passed through the press. In these circumstances nothing remained for the editors but faithfully to carry out the work of publishing "Design in Nature" in the form in which it was left, although, as they point out, many improvements would no doubt have suggested themselves to Prof. Pettigrew if he had lived to see the book in type. The aim and object of the work was to demonstrate the existence of a first cause, or Creator, from the study of the phenomena of the organic and inorganic worlds.

In attempting to deal with physics, chemistry, botany, zoology, anatomy, physiology, psychology and palæontology "more or less in detail," the author attempted a task which no one man could be expected adequately to perform. A discussion of such a wide range of subject-matter, to be really conclusive in its arguments, would have to run to the size of an encyclopædia, and, like the latter, be the work of a number of different contributors. As it is, the extent of knowledge covered may be described as being as broad as the ocean, but lacking in depth. Indeed, there is considerable want of uniformity, and many of the arguments are distinctly shallow. A large part of the work deals with anatomical, zoological, and physiological considerations, especially in relation to organs of reproduction, circulation, and locomotion, but other matters, such as the telephone, bones of the hand and foot, spiral formations, and new theories of matter, are dropped down rather at random in the middle of discussions with which they do not appear to have much connection. Moreover, the same subject is sometimes discussed in two widely different places.

It would be impossible to deal at any great length with the theoretical aspect of the book. We can only select one or two illustrations. On p. 767 are given fourteen "proofs that the brain is the organ, apparatus, or laboratory of the mind." Some of these are legitimate deductions from statements for which Prof. Pettigrew's authority affords sufficient guarantee, but the argument is surely weakened by the inclusion of the following:—

"1. The brain rests eight hours or so (period of sleep), and during that time the mind is a blank."

"4. The intellectual faculties are sluggish after a full meal. They are most active between meals. They are also more active during the day than during the night."

"6. When the brain is overworked during the day, sleep at night is difficult or impossible. The brain apparatus is excited, and endless mental pictures, known as dreams, are formed."

"8. Mesmerism is largely a physical condition."

"13. The brain can be trained and developed. It is impossible to train and develop what is immaterial."

"Weight, Momentum, and Power as Factors in Flight" is the heading of § 378, from which we extract the following:—

"The increase of power due to momentum in heavy bodies in motion is well illustrated in the start and progress of steamboats. In these the *slip*, as it is technically called, decreases as the speed of the vessel increases; the strength of two or three men, if applied by a hawser attached to the stern of a moderate-sized vessel, being sufficient to retard, and, in some instances, prevent, the starting. In such a case the power of the engine is almost entirely devoted to 'slip' or in giving motion to the fluid in which the screw or paddle is immersed. It is consequently not the power residing in the paddle or screw which is cumulative, but the momentum inhering in the mass. In the bird the momentum, *alias* weight, is made to act upon the inclined planes formed by the wings, thus adroitly converting it into sustaining and propelling power. It is to this circumstance, more than any other, that the prolonged flight of birds is mainly due, the inertia or dead weight of the trunk aiding and abetting the action of the wings, and so relieving the excess of exertion which would necessarily devolve on the bird." . . . "In the flight of the albatross, on the other hand, the momentum acquired by the moving mass does the principal part of the work, the wings for the most part being simply rotated on and off the wind to supply the kite surfaces and angles necessary for the inertia or mass to operate upon."

From these examples we can only advise the reader to regard "Design in Nature" as a memorial volume of the late Prof. Pettigrew, and not to attach too great scientific value to statements and conclusions which the author might have expunged or modified had he lived to complete his task.

Since the above criticisms were written, a fresh aspect of Prof. Pettigrew's work has suggested itself to the present reviewer. A large portion of the three volumes deals with matters anatomical. Now, anatomy is a subject which, for reasons that the psychologist alone is competent to explain, is not pleasing to the majority of individuals. It is highly desirable that the mind which controls the human mechanism should know as much as possible about the working of that mechanism as well as of those of other members of the animal kingdom; yet the parent's letter to the board school teacher, "Please don't learn my little girl any more about her inside; it does her no good and is rude," represents a widespread sentiment which, whatever its origin, is opposed both to the true scientific spirit and to considerations of expediency. Now Prof. Pettigrew certainly succeeded in associating a great deal of information on this usually unpalatable subject in connection with an appeal to one of man's highest sentiments—his appreciation of beauty and order in the universe, and his reverence for that first cause which must have produced the countless results that cannot be attributed to mere chance. Any reader, whether scientific or otherwise, who will study the book in this spirit, will, unless he has already specialised in anatomy, derive great benefit from the information which he will acquire on this particular branch of science.

A TREATISE ON THE PROTOZOA.

A Treatise on Zoology. Edited by Sir E. Ray Lankester, K.C.B., F.R.S. Part i., Introduction and Protozoa. First fascicle. Pp. xxii+296. (London: A. and C. Black, 1909.) Price 15*s.* net.

THE publication of the present volume completes the account of the Protozoa, the other sections of which were dealt with in the second fascicle, which appeared in 1903. An introductory chapter from the pen of the editor is followed by a series of separate treatises by various authors. To Prof. Hickson has fallen the task of dealing with a number of organisms, grouped into the class Proteomyxa, many of which have been seen only once and have been so imperfectly investigated that practically nothing is known of their nuclear condition. The author has given a systematic account of the organisms, which he has arranged into five groups. The structure and life-history of a few of the better-known forms, such as *Plasmodiophora brassicae* (the cause of "finger and toes" in turnips), are briefly considered.

The section on Heliozoa has been written conjointly by the late Prof. Weldon and Prof. Hickson. A clear account is given of the structure, fission, and nuclear changes seen in these Protozoa, particular attention being devoted to the observations of Schaudinn and R. Hertwig on the nuclear phenomena presented by Actinosphærium and Acanthocystis. The reproductive processes of the former organism are carefully considered in view of the statement that self-fertilisation appears to be of normal occurrence, but the facts are capable of other interpretation, as is clearly shown in the discussion of the published observations. Mr. J. J. Lister has given an admirable account of the Mycetozoa, organisms which usually receive scant attention in courses of zoology, but which are here brought before the notice of teachers and students in a manner which compels attention to the interesting phenomena they present.

The Lobosa are described by Prof. Hickson in an article which might well have been of greater length in order to permit the more detailed treatment of the life-histories of some of the organisms considered. The author has changed the spelling of the now well-known name Entamœba to Endamœba, but there is surely no warrant for such an alteration, which is to be greatly deprecated.

Dr. Gamble's clear and comprehensive account of the Radiolaria is deserving of high praise, especially for the prominence given to the biology and physiology of these organisms. Thalassicolla is chosen as a type for description, following which the chief modifications in structure of the Radiolaria are considered. An account is given of the recent observations on somatic variation and on somatic and gametic dimorphism, while flotation, the central capsule, nuclear and reproductive phenomena, the skeleton and its biological significance, subjects in regard to which the Radiolaria present special features of interest, are well treated. The author fully discusses the relation of the yellow cells to the organisms. He points out that, though nitrogenous excreta are formed in abundance, there is no accumulation in most Radiolaria of excretory substances, the absence of which, it is suggested, is due to the action of the yellow cells, which, attracted to their host chemotactically, derive their nitrogen from the urea and uric acid which they find therein. Support is afforded to this view by the fact that masses of granules—the phæodellæ—which are regarded as excretory by Borgert, do occur in quantity in the one division of the Radiolaria (the Phæodaria) in which yellow cells are constantly absent. The yellow cells of Spumellaria and Nassellaria are bounded by a cell wall and leave their host on the death of the latter, but those of Acantharia have lost the power of independent existence; they have become assimilating granules and are transmitted from parent to offspring.

Dr. Willey and Prof. Hickson have given a useful account of the Mastigophora. A little more extended reference to the characters and life-history (so far as it is known) of flagellates, such as Lamblia and Trichomonas, which are found in man and other animals, would have been helpful to many readers. *Trichomonas intestinalis* is mentioned as occurring in the intestine of mice; its occurrence in man is not referred to. The authors reject the genus Cercomonas; they should have at least indicated to which genus the well-known species associated with man should be referred. In the description of Euglena we miss reference to Wager's observations on the nature of the base of the flagellum.

Dr. Woodcock's section on the Hæmoflagellata, which is a critical summary of the extensive literature of this subject, will be of great service to students of zoology and of medicine. The author strongly upholds the status of the kinetonucleus as a true nucleus homologous with the trophonucleus, the two being specialised for different functions; the kinetonucleus is not merely an extra-nuclear centrosome as held by Moore and Breinl. The section on the life-history of trypanosomes presents a clear discussion of this difficult subject. The author announces (in a footnote, p. 239) that during the investigation of the hæmatozoa of the chaffinch he obtained unmistakable evidence that the trypanosome and halteridium of the chaffinch are ontogenetically connected, thus supporting the observations of Schaudinn on the corresponding organisms in the little owl. Dr. Woodcock gives a brief account of the "Leishman-Donovan-Wright" bodies, which he regards as intimately related to Piroplasma on account of their nuclear dimorphism and mode of fission. Attention is directed in this connection to the recent accumulation of evidence in favour of the flagellate affinities of Piroplasma. The author's discussion of the nature of spirochætes is too brief to give him the opportunity of dealing in an adequate manner with this vexed question, but he is evidently of the opinion that they are not Protozoa. The article concludes with a useful list of the known natural hosts of trypanosomes and allied forms.

A short appendix is added by Mr. J. J. Lister on Chlamydomyxa and Labyrinthula. He considers that the former is not allied to the Mycetozoa, but rather to the fresh-water forms with filose pseudopodia classed under the order Gromiidea, while Labyrinthula is regarded as a colonial organism the units of which remain in connection by means of their pseudopodia. Both organisms may be regarded as related in one direction to the outlying members of the Gromiidea and in the other to the Heliozoa and Proteomyxa. In a final appendix there is a brief notice of the Xenophyophoridæ, which were formerly regarded as sponges, but which, through the labours of F. E. Schultze, are shown to be more nearly related to the Foraminifera, to which subdivision they are now provisionally referred.

Throughout the volume the systematic characters of each group and of its constituent orders and families are given, and each section concludes with a well-selected bibliography. This volume worthily upholds the high standard attained in its companion fascicle, with which it forms a comprehensive treatise on the Protozoa of outstanding excellence.

THE TEACHING OF OPTICS.

Cours de Physique conforme aux Programmes des Certificats et de l'Agrégation de Physique. By Prof. H. Bouasse. Quatrième Partie: Optique. Étude des Instruments. Pp. 420. (Paris: Ch. Delagrave.) Price 13 francs.

PROF. BOUASSE has pronounced opinions on the subject of the teaching of optics, opinions which he is vigorous in defending—a defence which consists in a spirited attack on those who differ from his views—and in the application of which to the development of his subject he undoubtedly shows originality and independence of thought. Into the merits of his quarrel with the Sorbonne we have no inclination, nor is this the place, to enter; but his views on the presentment of optical theory and on the relative value of the "ray" and "curvature" methods touch on a question which has been discussed a good deal of late in this country, and are in themselves well worthy of attention.

The advocates of the "curvature" method of teaching optics proceed on the assumption that this method is based on a close representation of the actual physical phenomena, and that hence, if it can be applied in a simple manner to the deduction of the ordinary results of geometrical optics, it must necessarily and from the nature of the case have an advantage over any more artificial method. The curvature method undoubtedly has advantages, but they do not rest on the assumption thus made. The ray and curvature methods are alike based on an ideal representation of certain characteristics of the phenomena, and the proposition that the latter mode of representation has a greater physical significance than the former at least admits of argument. But whatever opinion may be held on this point, it will hardly be urged that the ray method, or an equivalent procedure, can be dispensed with in the handling of many not particularly advanced optical problems, and the view that it is desirable to limit the student to the one method of attack seems to be founded on a higher estimate than usual of his average stupidity. We learn through Prof. Bouasse that there exists at the Sorbonne a course of geometrical optics in which "rays of light" are not so much as mentioned. We can but trust that his information is incorrect.

The author himself urges strongly, whether from the physical or the purely ideal aspect, the importance of the ray in optical theory. He points out that the wave surface is defined by Fermat's principle of least distance independently of any theory as to the propagation of light; that the caustic, which is a locus of concentration of energy, has the immense advantage over the wave surface that it is directly determinable by experiment, and that it is this which is first naturally met with; but especially he insists on the convenience and clearness of the ray theory as a first approximation in the representation of the phenomena.

He is at some pains, too, to expose the inherent absurdity of the practice of avoiding, in optical and physical text-books, the use of such elementary mathematics as is really essential to the development of the subject. He points out that, so far as the use of certain mathematical functions is concerned, any person of average ability can readily make himself acquainted with their definitions and elementary properties sufficiently, at the least, to be able to use intelligently tables of their values. As to the general knowledge of mathematics required, he insists—with Prof. Perry—that it is the mathematicians who must mend their teaching, and that it is not the part of the physicist to attempt to make bricks without straw. His final plaint on this subject, "Je perds mon temps; les mathématiciens sont pleins de bonne volonté pour satisfaire nos désirs, mais ils ne les comprennent pas," is not, perhaps, altogether without application in Great Britain.

The views of Prof. Bouasse above referred to are laid out at some length in the preface, and, apart from their intrinsic interest, are pertinent to the present notice as indicating two main features of the book—adherence to the ray theory as the foundation of the earlier chapters on geometrical optics, and the use of rather more mathematics than is perhaps usual, where necessary for concise expression, and in a form which, we think, will appeal to the intelligent student.

The volume is one of a series of advanced physics text-books written to meet the requirements of the French public examinations. It suffers inevitably from many of the disadvantages of the examination text-book; it has, on the other hand, more than an average share of its merits. It is not a study of optical instruments, nor is it a text-book on practical optics; it deals with the theory of geometrical and physical optics so far as this is necessary as an aid to the study of optical instruments. Electro-optics is expressly reserved for another volume. On the other hand, many matters usually treated under the heading of meteorological optics—halos, the rainbow, coronas, scintillation—are dealt with, although necessarily very incompletely, yet almost too fully in view of the character of the book. Indeed, although for the first principles of the subject one is referred to an elementary treatise (this volume opens with a general exposition of the Gauss theory), its chief fault lies in the extent of the ground covered. On every topic it leaves the reader with a tantalising thirst for more information. It is, perhaps, only on the theory of caustics, here treated with exceptional fulness, that one comes away satisfied.

This is only to repeat that it is a text-book designed for class use. Such a book, which treats the theory from the point of view of a close interest in the practical questions involved, is undoubtedly stimulating and of high value in the hands of a capable teacher.

CHEMICAL CRYSTALLOGRAPHY.

Chemische Krystallographie. By Prof. P. Groth. Vol. ii., Die anorganischen Oxo- und Sulfosalze. Pp. vii+914; with 522 figures. (Leipzig: Wilhelm Engelmann, 1908.) Price 34 marks.

WITH this, the second, volume, Prof. von Groth completes that half of his great work which deals with inorganic salts. The fact that it has appeared within two years of the publication of the first volume is, even when every allowance is made for the assistance which we believe has been placed at his disposal, eloquent testimony to the remarkable industry displayed by the author. To absorb, digest, and arrange in orderly sequence such a mass of data is a gigantic task, and such rapid progress demands unremitting labour and indomitable perseverance. To the great services rendered by Prof. Groth to mineralogy and crystallography, and to those preeminent qualifications which mark him out as the obvious man to plan and carry through this important work, Dr. Tutton, in writing of the opening volume (Nature, 1907, vol. lxxv., p. 529), has referred in graceful and felicitous language. The present writer, who was privileged to serve his novitiate in mineralogical science in Prof. Groth's laboratory at Munich, feels it would be presumption on his part to add anything to those words beyond his cordial agreement with them.

To state that Prof. Groth's "Chemical Crystallography" meets a long-felt want is but a trite and inadequate way of expressing the situation. For years past, students of crystallised substances which are known to occur in nature have, in the well-known and invaluable "System of Mineralogy," which Prof. E. S. Dana prepared as the sixth edition of his father's successive treatises on mineralogy, had before them a coherent arrangement of minerals based upon their chemical and crystallographical properties, and they could readily ascertain what precisely was known with regard to the crystalline characters of any species. Prof. Groth himself has provided an admirable bird's-eye view of the grouping of minerals in his handy "Tabellarische Übersicht der Mineralien," and Prof. C. Hintze is rapidly nearing the final parts of his exhaustive "Handbuch." But the researches of chemists in the laboratory have brought about the formation of a vast number of crystallised substances which have never been found in nature, mostly because of their want of durability for some reason or other, and every year the need for a work that should group together all known crystallised substances, however formed, and give full details of their physical characters, has grown more urgent.

The general arrangement of the substances is exactly the same as that devised by the author in the "Tabellarische Übersicht" mentioned above. The nomenclature is chemical, but the mineral names of the natural species are given in brackets. For each species are given as far as possible the physical characters, viz. the specific gravity; the morphological constants—the axial ratios and the interaxial angles when differing from right angles—the type of crystalline symmetry, the mode of twinning, the directions of cleavage, and the indices of the forms which have been observed; the optical characters, including the principal indices of refraction for light of certain standard wave-lengths, the orientation of the optical indicatrix with regard to the crystal, the angle between the optic axes in the case of biaxial crystals, and occasionally the alteration in these constants caused by a rise of temperature. For artificial salts and mineral species recently discovered the information is somewhat amplified; the calculated and observed values of the principal measured angles are quoted, and illustrations of typical crystals are added, the authority for the determinations and the reference to the original paper being always stated. Dr. Tutton's classical researches upon certain salts of the alkali metals, potassium, rubidium, cæsium, and thallium, and of the ammonium radicle, may be cited as examples of an ideal crystallographical investigation; for the care in assuring purity of material, the high standard of the apparatus used, the pains taken in the observations, and the completeness of the determinations, they stand alone. But although it is rarely possible to obtain crystals large or perfect enough for such accurate work, it is not too much to say that at least the morphological constants of every crystallised substance should be determined, since such a determination, even when the dimensions of the crystals do not exceed half a millimetre, presents no serious difficulty with the instruments now available.

Prof. Groth prefaces each group with an introduction, in which, with his customary clearness of exposition, he discusses the relations subsisting between the component members, and indicates gaps in the data or doubtful points which call for further investigation. These illuminating discussions add greatly to the value and importance of the work, and impart to it an interest and a fascination that would be wanting in a dry compendium of figures and facts.

It would be impossible within the limits at our disposal to attempt any detailed discussion or give more than a broad outline of the contents of the present volume. It is devoted to the oxo- and sulpho-salts, and includes such important groups as cyanates, nitrites, nitrates, perchlorates, carbonates, silicates, sulphites, sulphates, polythionates, borates, phosphites, and phosphates, and, of course, the groups analogous to each of those mentioned; the sulphates, with their companion compounds, fill more than a third of the volume. A complete index giving the chemical and mineral names is appended. G. F. H. S.

NATURAL HISTORY OF TIERRA DEL FUEGO.

The Birds of Tierra del Fuego. By Richard Crawshay. Pp. xl + 158; illustrated. (London: Bernard Quaritch, 1907.) Price 3*l.* 13*s.* 6*d.* net.

IT was by accident and not by design that Mr. Crawshay visited Tierra del Fuego, and, spending six months there, has been able to give us this sumptuous natural history of a little-known land. His book was badly wanted, for the author is probably right when he doubts "if there is another land on earth concerning which more misconception prevails." From the description given it does not seem a very pleasant place to live in.

"It commonly freezes at midsummer. . . . There is the wind from the everlasting snows and glaciers, always blowing with terrific force and with cutting keenness, yet how invigorating and fragrant with forest and peat and seaweed."

Yet the author expresses himself fascinated by the country, and while allowing that it is no place for weaklings and for those who cling to luxury, he claims that, however rigorous the climate is, it is healthy. This seems to have been its character always, for Sir John Narborough is quoted as writing in 1670, "A man hath an excellent stomach here. I can eat foxes and kites as savourily as if it were mutton. Nothing comes amiss to our stomachs." This is saying a good deal.

Although the title of this fine volume would lead one to expect only an account of the birds, we referred to it just now advisedly as a natural history of the country. For the "preface" (which might perhaps have been more properly the "introduction") contains an excellent and most interesting account of the physical conditions of this remote spot, including the geology, botany (the flora is very much more extensive than might be imagined), the mammals (including the native races of man), fishes, insects, crustaceans, molluscs, &c. There appears to be only one reptile—a little green lizard—and no amphibian.

The birds dealt with in this work do not claim to represent every species occurring in Tierra del Fuego; but they are, the author believes, the most comprehensive collection yet made in the island, and include many recorded from there for the first time. Seventy-nine species are enumerated in the classified list or "index." The orders most numerously represented by species are Passeres, Limicolæ and Anseres. Psittaci and Pici are represented only by a single species. The woodpecker—a splendid scarlet-headed bird—does not seem to be common. The existence of a parrot in these high latitudes as reported by the early voyagers was for a long time discredited. It is common in flocks in the more open portions of the forest to the south of Useless Bay, but seems to be local and difficult to find. The majority of the species are, however, only summer visitors, and some of these we remember as winter visitors to Uruguay. Five species of goose visit the country or are resident therein, some of which "could hardly be numbered in figures short of millions." An account is naturally to be found of the race horse, loggerhead, or steamer duck, which has constituted one of the wonders of these waters from the time of the earliest navigators, and has been the subject of much controversy.

So little has been observed of the birds of Tierra del Fuego *in* the country that it was at first surprising to see so large a book on the subject. But the author has quoted very extensively from the writings of Azara, D'Orbigny, Darwin, Gould, and other voyagers and naturalists, although for the most part their accounts of the species treated of relate to other parts of South America and even more distant parts of the world. For instance, although the cosmopolitan barn owl is only doubtfully included, nearly six pages are devoted to it, and the article includes Waterton's well-known account of it in Yorkshire. In this way the author has given his readers a fairly complete and always interesting account of the birds on his list, a fact that will be much appreciated by those interested in birds and living in those remote regions into whose hands the book may by good fortune come.

The volume is well illustrated by twenty-one coloured plates of birds by Mr. Keulemans, and twenty-three plates of scenery and bird haunts, also a map.

OUR BOOK SHELF.

Handbook for Egypt and the Sudan. Edited by H. R. Hall. Eleventh edition, revised, largely re-written and augmented. Pp. xiv+613; with 58 maps and plans. (London: Edward Stanford, 1907.) Price 14*s.*

The first edition of this work—"Murray's Egypt"—appeared so far back as 1847, and was a reprint of Sir Gardner Wilkinson's earlier book, "Modern Egypt and Thebes," which had been revised by that great pioneer in Egyptian studies so as to meet, so far as possible, the requirements of a guide-book. From time to time since 1847 additions were made to the original edition, and in 1873, and again in 1880, it was thoroughly re-cast by the Rev. Greville Chester, the Rev. W. J. Loftie, Mr. Mitchell, and Mr. Phené Spiers, the latter of whom contributed many new architectural plans. Then followed the editions of 1896 and 1900, edited and revised by Miss Mary Brodrick, with the help of Prof. Sayce and Capt. H. G. Lyons, the director of the Geological and Land Surveys of Egypt. Unfortunately, these last two editions—the ninth and tenth—contained numerous errors and were far from satisfactory, so it is now a pleasure to be able to record the appearance of a new edition, under the editorship of Mr. H. R. Hall, which fully maintains the high standard of Wilkinson's original "Handbook for Travellers in Egypt."

Mr. Hall has thoroughly revised the archæological part of the work. The old division into two parts has been abolished. Many paragraphs have been with advantage deleted and new ones inserted. Several sections have been re-arranged and re-cast, while some—those on Cairo and Thebes, for instance—have been almost entirely re-written. A new section, necessitated by the opening up to tourists of the Upper Nile, deals with the Anglo-Egyptian Sudan, and thus we have, within the compass of a handy volume of 600 odd pages and a plentiful supply of maps and plans, a guide-book which will carry the traveller from Alexandria or Port Said to the frontier of Abyssinia and to the Uganda Railway and Mombasa. In a pocket of the cover Mr. Hall has added a small booklet of 35 pages of "Notes on the Arabic Language, with a Vocabulary of Words and Phrases," which ought to prove of much use to the amateur traveller.

In reading through the handbook we find that Mr. Hall has done the work on the archæological side most admirably, and there is little that he has added to the book which we should feel inclined to dispute. In his transliteration of the Egyptian hieroglyphs, however, we are sorry to note that he has adopted the unscholarly *tch* or *tj* for the serpent hieroglyph which, by English and German Egyptologists, is always rendered by *z* or *ḏ*. In any future edition of the handbook that may be issued, we hope the publishers will see that the section on geology is brought up to date, for in the edition before us no mention is made of Dr. Andrews' or Dr. Beadnell's recent discoveries in the Fayum, nor can we find any mention of the new Geological Museum, with its fine collection of fossils and minerals, now housed in a building in the garden of the Ministry of Public Works.

Index Kewensis Plantarum Phanerogamarum. Supplementum tertium nomina et synonyma omnium generum et specierum ab initio anni MDCCCCI usque ad finem anni MDCCCCV complectens. Ductu et consilio D. Prain confecerunt herbarii horti regii botanici Kewensis curatores. Pp. iii+193. (Oxford: Clarendon Press, 1908.) Price 28s. net.

Workers everywhere in systematic botany will welcome the appearance of this, the third, supplement of the Kew Index. We now have a register of the generic and specific names of seed-plants up to and including the year 1905—a boon to workers which only those can adequately appreciate who remember the period when there was no Kew Index. The supplement follows closely the plan of the original work—would that those concerned could be persuaded to make one small but valuable improvement! namely, the inclusion of the date of publication in all the references to the original descriptions, as is now done only in the case of periodicals.

The Index and its previously issued supplements are so well known and so generally used that a notice resolves itself into a few remarks and more or less petty criticisms. Thus we note that a fair number of genera are recognised which in the Index or its earlier supplements were regarded as synonyms; in these cases the genus-name formerly accepted is added in brackets followed by the letters I.K. Similar quotations, followed by the letters D.T. & H., look more mysterious, though, presumably, the valuable reference-list of genera by Dalla Torre and Harms will occur to most on reflection. In the absence of explanatory notes, it is not always easy to understand the reasons adopted for the recognition of some genera and not of others; why, for instance, is Limonium still relegated to synonymy as equivalent to Statice, Linn.? Linnæus included under Statice the sea-lavenders, for which the name has until recent years been generally retained, as well as our sea-pink (Armeria). But Miller in 1759 followed Tournefort in keeping the name Limonium for the sea-lavenders and regarding the sea-pink as a distinct genus, Statice, and it is generally agreed that the two genera are distinct. It is, of course, unfortunate that Statice should have been used so long for Limonium; Messrs. Groves, however, in the recent edition of Babington's manual, have accepted the original position, which is therefore no longer strange to British botanists. Limonium, by the way, is cited as of Tournefort, who established the genus before 1753, which is now taken as the starting point of botanical nomenclature; the genus should be credited to Miller (1759). Again, four species of Crassocephalum, described by S. Moore, are referred to Gynura; this reference may be justifiable, but it would be useful to know what standard has been adopted, especially in cases where there is no recent monograph of the family to which the genus belongs.

The supplement forms an interesting review of progress in systematic botany in the first five years of the present century, and is a tribute to the energy and devotion of botanists engaged in this branch of the science.

A. B. R.

Die Metamorphose der Insekten. By Dr. P. Deegener. Pp. 56. (Leipzig and Berlin: B. G. Teubner, 1909.) Price 2 marks.

This is an exceedingly elaborate discussion of the nature of the various processes involved in the transformations of insects. We should have preferred to see it in larger book-form, with headings and text-illustrations; but reference to the subjects discussed is facilitated by a table of contents prefixed to the work. The chief problems are, of course, presented by insects with complete metamorphoses, in which most of the larval structures are entirely dissipated during the pupa-state, and new ones formed for the use of the imago, whereas in the case of insects with incomplete metamorphoses the organs of the larva are gradually modified into those of the imago. It may be useful to condense Dr. Deegener's classification of larval organs:—

(1) Primitive organs. Those less complicated in the larva than in the imago; those about equally developed in larva and imago; and those wholly absent in imago.

(2) Organs rudimentary in both larva and imago.

(3) Organs inherited by the imago from the larva.

(4) Organs acquired by the larva independently of the imago, or which occupy a subordinate position in the imago. (Provisional organs of the first class.)

(5) Organs common to the larva and imago, but which follow a different course of development in each stage. (Provisional organs of the second class.)

(6) Primary organs, the development of which is retarded during the larval state.

Dr. Deegener points out that the larva is scarcely destitute of any organ present in the imago, whereas many organs present in the larva are wanting in the imago. Hence he concludes that the larva, as such, presupposes the pre-existence of the imago, and that the imago is phylogenetically older than the larva.

The origin of insects from lower forms is then discussed, and Dr. Deegener suggests that they have originated in a primitive Campodea-form, which has developed in one direction towards the imago and in another towards the larva. Other questions discussed are the various processes of metamorphosis, and the sexual relations of larvæ.

We have rarely seen so small and unpretentious a book which contained so much matter of scientific importance, and it has been impossible for us to do more than direct attention to a few salient points in this brief notice.

W. F. K.

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 intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

"Structural Geography."

I must thank the reviewer of my "Structural Geography" in Nature of March 11 for pointing out the accidental omission in printing of the red line that should have occurred over the course of the Apennines (Plate XVI.). If he thinks that Fig. 97 is really likely to hurt the feelings of the Polynesians, I may replace it by one with a more pleasing expression; but the other suggestions for the improvement of any possible second edition, which fill nearly three columns of Nature, I cannot accept. Thus the use of isobaths instead of actual figures on Figs. 37 and 38 would obscure the lessons those figures were inserted to teach. Where, as on Fig. 41, isobaths seemed more useful, they were used.

The "strange blunder" in the figures on pp. 84 and 85 exists only in my critic's imagination. In both diagrams the wind is correctly shown as blowing at a low level out of the high-pressure area, and not into it. This movement, of course, requires the replacement of the air by a high-level inflow, and that is also indicated on the diagrams. In support of this well-known fact reference may be given to a work on elementary physiography, which should be regarded as of authority by Nature. It says, p. 326:—"A barometer stands high . . . when in any way an upper current sets in towards a given area. . . ."

The reviewer remarks that it is not clear why certain branches of the subject are omitted or merely mentioned. That course was adopted deliberately. The object of the book was to supplement existing text-books, and, as stated in the preface, I omitted various "questions that are adequately treated in current elementary text-books."

My critic objects to the view that the Cotswold and Chiltern Hills show the geographical grain of England, as he says those hills are sculptural rather than structural; but the sculpturing in both cases has been determined by and displays the structural grain of the country.

The reviewer devotes most attention to Plate XVI., a diagrammatic map of Europe. He complains that the European plain is shown extending to County Clare, disregarding the Welsh and Wicklow Hills; but his statement is not correct. The name European plain is written only across Germany and Russia, and the text states (p. 132) that it is "the eastern extension of the eastern plain of England." The site of the Wicklow Hills is left white, and the boundaries of the English and Irish plains are not marked, for they were not needed for the map and were left unelaborated. No intelligent student is likely to include all the area left white in that map, including the Bay of Biscay, the Atlantic Ocean, &c., as belonging to the European plain.

Objection is also taken to the reference in that map to the Scottish Highlands and Scandinavia as parts of an Archæan plateau; but that they belong to a dissected plateau is explained in reference to Scotland on p. 105, and illustrated by a photograph (Plate XIII.), which, as the credit is due only to the photographer and the publishers, I may say is excellent. Then follows an objection to the Armorican and Variscan Mountains being differently coloured from the Central Plateau of France. That plateau has such a different geographical history that I think it is advisable to indicate its special importance by a different shade. The reviewer quotes the new Geological Survey map of France and some borings to confirm the connection of the Central Plateau and the Armorican Mountains. He might also have quoted the text of the book under review (p. 133):—"The southern border [of the Armorican Mountains] was to the south of Brittany and extended through the Vendée *into* that mass of old rocks known as the Central Plateau of France." The reviewer also attacks the representation of Spain on this map. It shows the essential feature in the Spanish Peninsula, which I still think it was desirable to show, viz. the divergence of strike between the mountains south of the Guadalquivir fault and that of the western Meseta. The Asturian nest and its "confocal parabolic curves" would not have made for clearness. His severest criticism of this map of Europe relates to Asia Minor. He notes one difference between the representation of Asia Minor on the maps of Europe and Asia. He could have noted others, for on the map of Europe no attempt was made to show the structure of Asia Minor, as it was included more suitably in the map of Asia (Plate XIX.), which includes both Naumann's Pontic and Tauric Mountains. (The reviewer refers to Naumann's paper in the *Geographische Zeitschrift*, 1896; anyone interested in the question will find a simpler statement of that author's view, in English, in his paper before the Geographical Congress of 1895, Report, 1896, pp. 662–8.) These features were omitted from Asia Minor on the map of Europe; all that was inserted there was a dotted line to show both the continuation of the Cyprus branch of the Tauric line and its passage into the mountain knot south of the Caucasus. The line would no doubt have been better if, as in the map of Asia, the curve at its eastern end had been somewhat sharper.

In the explanation of Fig. 83 it is pointed out that Japan is exaggerated in width, and a student may be trusted to apply that remark to the sea beside Japan.

My critic apparently doubts the Mongolian affinity of the Eskimo. It is true that some authorities regard the American aborigines as a distinct race-group from the Mongolian, but there is ample authority for the other view. The difference in opinion is indicated by the warning that the American Indians are "generally regarded" as a Mongolian race. No doubt the Eskimo of Greenland differs markedly from the typical Mongolian. Their extreme dolichocephaly is one of the best-known facts in American anthropology; but as this character diminishes to the west, the view that the Eskimo are a modified variety of the American section of Mongolians is at least reasonable. The Caucasian affinity of the Australian aborigines seems to me better established, and the view has been gaining ground since its first authoritative advocacy by Dr. A. Russel Wallace, who justly claims it as one of his chief contributions to science.

The "so-called tetrahedral theory" has been growing steadily into favour since 1899, when I happened to support it in a lecture to the Geographical Society. Although its advance has probably been hampered by my crude explanations, I am quite satisfied with its progress, otherwise I should not have included it in a text-book. It seems to me quite unnecessary to refer to the earlier theories, though perhaps my critic would have been less displeased if I had referred to one later theory.

One great difficulty in writing elementary text-books is the necessity for a shortness that must often seem dogmatic, and for unqualified statements that are therefore liable to the charge of crudeness; but, fortunately, one can usually trust as safely to the common sense of students and teachers as to the fair appreciation by critics of the difficulty of presenting in brief statement and graphic diagrams the complex and confused data that have to be summarised in geographical text-books.

J. W. Gregory.

4 Park Quadrant, Glasgow, March 16.

I fully acknowledge that the diagrams on pp. 84 and 85 are correct if taken by themselves, but in the explanatory letterpress given below Fig. 57 it is stated that the distribution of pressure is "owing *to the condensation of the cooler air over the sea and the expansion of the warmer air over the land.*" The necessary inference is that the area over the land is one of low pressure and that over the sea of high pressure, with the winds blowing into the latter. On examination of the diagram I see that this is opposed to the inference which may be drawn from the course of the "level" of equal pressure, and hence I conclude that the error arises from a misprint, which may be easily set right by transposing the words "sea" and "land" in the statement I have put in italics.

The omission of certain branches of the subject called for comment, because it is precisely these which, as a rule, are not adequately treated in English text-books. The ordinary text-books are out of date, and I cannot but think an excellent opportunity of supplementing their belated information has been missed. It would not prove a very easy task, however.

The map on Plate XVI. was criticised independently of the letterpress, because a map should speak for itself, and in some detail, because it represents that part of the world most familiar to us. I must confess that the more I study this map the less I like it. I do not know why the Guadalquivir fault is more "essential" than many other features of Spain, and the true form of the Meseta, which it helps to define, would have been better shown if the dislocation which forms the eastern boundary of the Meseta had been introduced. The "grain" of the land, shown by heavy blue lines like those used to express the Caledonian trend in Scotland, and not black like the Armorican in Brittany, is not correctly given even by those lines which are cut off by the fault; if they had been more precisely indicated and the Asturian curves added, a definite system, somewhat resembling a nest of parabolas, would have made itself manifest. The fundamental structure of the Meseta would then have been visible at a glance. Had only as much of these lines been introduced as is required to show their relation to the fault, the only objection that could have been raised would have been as to their incompleteness; as it stands, my comment that the map fails to express the true structure of Spain is a mild way of stating the facts. Passing to the Armorican peninsula, which, thanks to the observations of Barrois, is better known, we again find the trend lines out of drawing. It is difficult to know on what principle some have been omitted and others introduced; the omission does not make for clearness, and in this case, as in that of Spain, a truthful rendering would have simplified the facts by making them more intelligible. If the lines of Armorica had been properly generalised, we should have seen one of the most important of them (*axe de Cornouailles*) pointing straight at the Central Plateau, and the introduction of trend lines in the Central Plateau would have made clear the relation on which I insisted when pointing out that the connection of the trend lines of Brittany and the Central Plateau is no hypothesis, but a definitely known fact.

As it stands on the map, I still think the legend "Archæan Plateau of North-Western Europe" written across a tract showing strong Caledonian folding is confusing, and I cannot agree that anything in the subsequent history of this Central Plateau or of Spain calls for its distinction by colour from the rest of the Hercynian system; I am the more disposed to object to this colour scheme, since the same colour is used for Spain, the Central Plateau, and the so-called Archæan Plateau of the north, thus introducing a second source of confusion. It was not complained that the structure of Asia Minor is omitted from the map which bears the title "Europe," but that an important line common to Europe and Asia is wrongly drawn. The Cyprus-Taurus line is one of the most conspicuous on the map, and is rendered all the more so by the omission of other lines in Asia Minor. That part of it (in Transcaucasia) which is most erroneously drawn is not dotted in, but continuous; but even in Europe it does not run true, the relation of the Peloponnesus to Crete being inexactly indicated. In the map of Asia greater care is exercised over this and related lines, but if Oswald's account of Armenia is correct there is still room for improvement. I am unaware of the existence of a mountain "knot" south of the Caucasus.

The objection to the diagram section shown in Fig. 83 is that the vertical scale is somewhere between 50 and 100 times the horizontal. Geologists have long agreed that such exaggerations are to be deprecated.

Assuming that the Eskimo are modified Mongolians, how does the action of the environment, as asserted by the author, account for the chief modification which distinguishes them, that is, the elongation of their heads? and to this I may add now the length of their face and the narrowness of their nose. The question involved is the direct action of the environment, and in my opinion schoolboys should not be indoctrinated with notions of this kind. Again, admitting that the Australian aborigines are related to what the author calls "Caucasians," what reason is there for the assertion that they are "modified Caucasians"? This is to invert the order of facts. Numerous important anatomical characters stamp these people as a primitive race. The most plausible speculation would assign them a position near the root of the "Caucasian" stem, regarding them as an unprogressive survival of an ancestral stock rather than as one of the higher races "modified by adaptation to life in an arid region." But why introduce these jejune speculations at all?

The real gravamen of the criticism to which objection is taken lies in the remark that the author has not been sufficiently careful to distinguish between opinion and fact. The treatment of the whole question of the form of the earth is open to this charge. I do not understand the cryptic remark which the author interjects in his reference to this matter, but I may add that, in the opinion of competent mathematicians, there is no sound physics or dynamics at the back of the "tetrahedral" theory. It has proved wholly unfruitful, and has made no real scientific progress. That it has grown in popular favour is probably true, and its dogmatic presentation in a school text-book is calculated to advance it still further in this kind of progress; I cannot believe that this will be wholly to the satisfaction of the author, since I credit him with a juster appreciation of the responsibility which attaches to the instruction of youth. The Reviewer.

The Gases of the Ring Nebula in Lyra.

Every friend of astronomical research has learned with great pleasure the news that Prof. Wolf, of Heidelberg, has succeeded in proving by spectrum photography that the well-known ring nebula in Lyra consists of four different gases, which, owing to the rapid rotation of the ring, have been separated and concentrated in four different layers. On using the image of the ring itself instead of the slit of a spectroscope, photographic images of the rings corresponding to the different spectral lines were obtained on the plates, but the dimensions of the rings were found to be different and to correspond to four gases of which the ring nebula is composed. The smallest ring, A, representing the innermost part of the ring, is composed of an unknown gas; the next largest ring, B, is composed of hydrogen; the next largest ring, C, consists of helium; and the largest ring, D, consists of an unknown gas. The question arises, What is the nature of the two unknown gases?

Bredig found in 1895 that if a mixture of two gases is subjected to centrifugal rotation, the relative concentration of the gas of higher molecular weight (*i.e.* higher density) increases with the radius of rotation. We must, therefore, assume that in the series of our four gases A, B, C, and D, the density or molecular weight increases from the smallest value of A to the largest value of D, and this is, indeed, proved by the fact, found by Wolf, that the gas B consists of hydrogen, molecular weight $=2 \cdot 016$, and the gas C of helium, molecular weight $=3 \cdot 96$. From this it follows that the gas concentrated in the smallest zone of the ring A must have a smaller molecular weight than hydrogen. This gas has not yet been isolated upon our earth, but its existence and atomic weight were predicted by the great Russian chemist and natural philosopher Mendeléeff in a popular article published in Russian in 1902, the essential part of which was translated into English in 1904 under the title "An Attempt towards a Chemical Conception of the Æther."

Mendeléeff shows that if the elements of the rare or inactive gases He, Ne, Ar, Kr, and Xe, discovered by Rayleigh, Ramsay, and Travers, are placed in the well-known nought-group, we must expect the existence of elements of the same group possessing smaller atomic weights than helium and hydrogen. Mendeléeff assumes that in the first horizontal series of the system, on the left side of, or before, hydrogen in the nought-group, where we find hitherto an empty place, an element stands possessing an atomic and molecular weight of 0·4, and he adds that this element might be identical with Young's "coronium." This part of the periodic arrangement is:—

Series	Groups O	I
1.	? = 0·4	H = 1·008
2.	He = 4·0	Li = 7·00

As there must be a definite ratio between the densities of the four gases A, B, C, and D and their radius of rotation corresponding to their maximal molecular concentration, it is not impossible that from the data obtained by Wolf the density of the lightest gas, *i.e.* its molecular weight, which must be identical with its atomic weight, might be calculated. As regards the heaviest unknown gas, D, if this is not a gas of the helium-argon group we may be allowed to point out that the existence of a gas possessing a larger atomic weight than hydrogen and a smaller atomic, but a larger molecular, weight than helium is not absolutely excluded.

Bohuslav Brauner.

Bohemian University, Prague, February 27.

On the α Rays from Radium B.

A recent number of the *Physikalische Zeitschrift* (x., 46, 1909) contains an article, by Frederic A. Harvey, in which he states that radium B gives out α particles, the ionisation range of which in air lies between 2·6 mm. and 3·0 mm. In investigating these short-range α particles he used a modification of the method employed by Bragg and Kleeman (*Phil. Mag.*, x., 318, 1905), but on account of the limited range of the radiation he did not use a cone of rays.

Some time ago the writer (*Phil. Mag.*, xi., 806, 1906) investigated the same subject by an entirely different method, and reached the conclusion that radium B did not give out α particles with sufficient velocity to ionise the air. I have recently repeated Harvey's experiment, but have been unable to get any indication whatever of the presence of short-range α particles. In addition to this, I have employed a third method, which eliminated most of the difficulties inherent in the previous one.

The principle of the method is very simple, and involves no change in the position of the testing vessel or wire during the experiment; it is based on the fact that the range of the α particles is increased by reducing the pressure of the air. The two plates of my testing vessel were placed 5 mm. apart; the lower one, which was of wire gauze, was 5 mm. above the active wire. Now, if none of the α particles present had a range in air at atmospheric pressure of less than 10 mm., then the ionisation current should vary as the pressure. If, however, radium B gives out α particles having a range of about 2·5 mm., and if they produce about the same number of ions per cm. of path as the α particles from radium C, then, after the pressure is reduced to half an atmosphere, the short-range α particles will begin to enter the testing vessel, and the ionisation will remain constant until the pressure has fallen to a quarter of an atmosphere. At this point the path of these α particles will extend through the entire depth of the testing vessel, and as the pressure is still further decreased the ionisation will again become proportional to the pressure.

The results of this experiment have shown that the ionisation in the testing vessel is approximately proportional to the pressure of the air from 76 cm. to 3 cm. It would, therefore, seem fair to conclude that there was not present on the active wire any substance giving out α particles which had a range in air from 1 mm. to 5 mm.

It should also be pointed out that Harvey's reason for attributing the short-range α particles to radium B is at fault. He assumes that after 140 minutes radium B has practically disappeared, and that only radium C remains. The theory of radio-active transformations, however, requires that, after 140 minutes, the number of atoms of radium B and radium C changing per second shall be very nearly the same.

Howard L. Bronson.

McGill University, Montreal, March 20.

British Association—Winnipeg Meeting.

It is becoming more and more noticeable at the meetings of the association that communications are read which are of special interest to members of sections other than that to which each of the papers happens to be presented. In fact, there is little doubt that interests are now far too much subdivided at our meetings, and that one of the main purposes of the association is therefore unfulfilled. Many of us have felt the desirability of associating sections for the consideration of topics of common interest—not merely for set debates.

I am glad to say that the arrangement is being made that at Winnipeg Sections A and B shall sit together on the Friday; Sections B, K, and the Subsection of Agriculture on the Monday; Sections B and I on the Tuesday. *Wheat* is to be the main subject of consideration on the Monday, and *food* on the Tuesday. It is hoped that it will be possible to treat these two important topics somewhat fully, so as to present, in abstract form, a clear statement of our present state of knowledge, and thereby guide public opinion as well as influence inquiry.

Henry E. Armstrong.

Fluorescence of Lignum Nephriticum.

Musschenbroek, referred to by Mr. Shaxby in Nature of April 1 (p. 128), is evidently quoting from Boyle's memorable experiment, nearly a hundred years earlier. Mr. Shaxby will find it in the fifth volume of Boyle's works as follows:—

"If you make an infusion of *Lignum Nephriticum* in spring water it will appear of a deep colour like that of oranges when you place the vial between the window and your eye, and of a fine deep blue when you look on it with your eye placed between it and the window" ("Experimenta et Observationes Physicæ").

The history of the discovery is so fully dealt with in Tyndall's well-known lectures on light that it is surprising that anyone should imagine that Sir David Brewster was the first to observe fluorescence.

The *Lignum Nephriticum* is the Indian horse-radish tree, still cultivated for its fruit, which is eaten as a vegetable or pickled. The root has a flavour similar to that of horse-radish, and its title, nephriticum, is derived from the belief of the old pharmacologists that it was useful in cases of disease of the kidneys.

Charles E. Benham.

Essex County Standard Office, Colchester, April 3.

The Ancestry of the Marsupialia.

In the notice (Nature, December 24, 1908) of Prof. A. A. W. Hubrecht's paper on the early ontogeny of the Mammalia, the writer states that the view adopted by Prof. Hubrecht, according to which the Metatheria are the descendants of placental ancestors, is in direct opposition to my own. May I be permitted to correct this statement, and to point out that it is just this view which I have all along advocated, and still hold? As a matter of fact, the idea that the Metatheria and Eutheria may best be regarded as the divergent branches of an ancestral placental stock was first definitely expressed in a joint paper by Prof. J. T. Wilson and myself (Quart. Journ. Micros. Sc., vol. xxxix., p. 579).

Jas. P. Hill.

The Zoological Laboratory, University College, W.C., March 24.

I take Prof. Hubrecht to mean that the Didelphia (Metatheria) are descended from Eutheria, which is what Prof. Hill, in his own letter, refuses to admit.

The Writer of the Note.

ARCHÆOLOGICAL RESEARCHES IN GUATEMALA.[1]

The Peabody Museum of American Archæology and Ethnology of Harvard has already rendered signal service by publishing the results of Mr. Teobert Maler's journeys and researches among the ruins of ancient Indian towns and cities on the banks of the River Usumatsintla and the adjacent region. We are now favoured with the first instalment of the account of Mr. Maler's last expedition, describing the ruins of Yaxhá, Naranjo, &c. Although the expedition commenced with the explorations of the ruins of Tikál, the records of the second part of this expedition are given first, and the account of the exploration of Tikál is to be published later. However, there is no lack of interest in this first instalment, and Mr. Maler's photographs of the sculptured monuments are as excellent as those he made of Seibal, Piedras Negras, Yaxchilan (Menché), which is saying that they are as good as it is possible to make them.

Before passing on to the account of his discoveries, we must congratulate Mr. Maler (who commenced his connection with tropical America as an officer in the service of the Emperor Maximilian) on his pluck and endurance in undertaking and carrying to a successful issue such an arduous enterprise in the years 1904–5. He is, indeed, the well-tried veteran of Central American archæological exploration. Mr. Maler passes lightly over his hardships and discomforts, yet it needs but little personal experience to appreciate how great the discomfort can be in travelling through the low-lying and frequently flooded forests of northern Guatemala; but Mr. Maler's enthusiasm for his work and knowledge of the natives would carry him over obstacles which would daunt and discourage many a younger man. Food in that country is always scarce, and workmen to accompany the traveller are most difficult to obtain.

After completing his investigations at Tikál in November, 1904, Mr. Maler returned to the east end of Lake Petén and struck through the forest to the east for a distance of about fourteen leagues, following, when possible, the paths of the "chicle" gatherers, until he reached the shores of the Lake of Yaxha. Chicle is the gum which exudes when an incision is made in bark of the Chico Sapote tree, and is used as the basis of American chewing-gum. It is curious to note the complete demoralisation that chicle-hunting has entailed on the very scanty population of Petén. "No one will plant a milpa (a maize field), and even the poorest ragamuffin proudly refuses to do any work, saying 'I am a Chiclero and have no need to work for anyone.' The result is that a general famine occurs nearly every year in Petén, which would otherwise yield an over-lavish abundance. Hence all the Chicleros are poverty-stricken, and, being heavily in debt, from which they never free themselves, they no longer have huts or milpas and no regular wife or children; for this unsettled life in the forests, interrupted occasionally by debauches in this or that village, puts even the most unpretentious form of family life out of the question."

On an island named Topoxté, in the lake of Yaxhá, Mr. Maler discovered the remains of one temple of considerable size and several other buildings, and secured photographs of the fragments of some sculptured stelæ. Then directing his attention to the north shore of the lake, he explored a long line of ruined temples and other buildings extending for a distance of more than three kilometres, and found the broken remains of ten sculptured stelæ.

Mr. Maler makes a note of the fact that the waters of Lake Yaxhá have risen at least one metre during the last twenty-five years, and that the level of the water in the lake of Petén Itzá also shows a considerable rise during that period.

In January, 1905, Mr. Maler left Yaxhá for Benque Viejo, within the boundary of British Honduras, and in February returned through the forest to the ruin known as Naranjo, previously unexplored. This was indeed a considerable discovery, as the ruins are very extensive, and Mr. Maler was fortunate in discovering forty-three stelæ, many of them in good preservation and adorned with sculptured figures and hieroglyphic inscriptions. Unfortunately, the buildings are far advanced in ruin, and none of the rooms could be made available for habitation, and so Mr. Maler had to seek shelter during the three months of this stay in a small cave, and here, during the night time, he developed the splendid series of photographs which accompany his report.

Two of these photographs are here reproduced, one to show the excellence of the sculpture (Fig. 1), and the other (Fig. 2) to show the importance of the inscriptions and to emphasise the disappointment which must always be attached to the examination of carved inscriptions when photography alone is relied on for recording them. The inscription is weather-worn, but it is sure to be as perfect a photograph as could be obtained in the surrounding conditions, yet it would not be possible to analyse the inscription from this record alone. Paper moulds or squeezes are so perfectly suitable for recording sculpture of this character, and the Peabody Museum has already secured such a fine collection of casts of inscriptions by this method, that it is to be hoped they will do justice to Mr. Maler's discoveries by sending an expedition to make paper moulds of all the sculptures and inscriptions for careful study by the well-qualified staff of the museum.

Fig. 1.—Naranjo: Stela 21, South Side.

In digging round the fallen stelæ, several of the curiously shaped flint objects were unearthed like

[1] Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. iv., No. 2. Explorations in the Department of Petén, Guatemala and Adjacent Region. By T. Maler. Pp. 55–127+(14–44) plates. (Cambridge, Mass.: Published by the Museum, 1908.)

those discovered by Dr. Gann in a similar position in the ruin near Benque Viejo (Proc. of the Society of Antiquaries, May, 1895), and this fully establishes the connection of these curious objects with the builders of these now ruined cities.

On returning to British Honduras, at the frontier village of El Cayo Mr. Maler met Mr. Blancanaux, a well-known collector of natural-history specimens, who told him that in the year 1882 he had included among specimens forwarded from the Island of Cozumel to the British Museum, two ancient maps of Yucatan, drawn on bark or agave paper. Careful inquiries have been made at the British Museum, both at Bloomsbury and South Kensington, but no

Fig. 2.—Naranjo: Stela 30, East Side.

trace of their arrival can be found. There is very little probability of their having been overlooked, as is suggested, because they were packed among natural-history specimens, for ethnological and other objects are frequently sent with such specimens, and when unpacked are at once handed over to the department concerned with them, and that such a valuable prize as two manuscript maps on some form of native paper could be overlooked is hardly possible. However, Mr. Blancaneaux is being communicated with, and every effort will be made to clear the matter up.

The next instalment of Mr. Maler's work describing his explorations of Tikál, one of the most interesting ruins in Central America, will be looked for with the greatest interest.

ZOOLOGY OF THE ANTARCTIC.[1]

FROM first to last there was high courage in the *Scotia* voyage. Dr. Bruce organised it single-handed, backed, of course, by generous pecuniary help from Mr. Coats and others, and he brought it to a successful finish with a minimum of loss or wastage. We do not forget the wise and wary captain and his loyal crew, or the fearless company of scientific assistants, or those who have helped to work up the results; but as volume follows volume from the unpretentious, hard-working laboratory at Surgeons' Hall in Edinburgh, we cannot withhold our admiration for what has been accomplished *essentially* by Dr. Bruce's pluck and determination. Both these qualities will be needed, we fear, before the tale of the *Scotia* voyage is fully told, for working up and editing scientific results is an arduous and unremunerative business, requiring all the encouragement it can get and a great deal more. "More power to your elbow, sir, in this unromantic age."

The two volumes before us are very different. The first is an entertaining zoological log, as logs go, that is, illustrated with a hundred beautiful and interesting photographs, and introduced by a charming picture by an artist who has himself seen ice. The second is a collection of technical reports by a dozen different workers, and though it is quite as interesting as the log, it appeals to a smaller circle. The log would have stood some more proof-reading, but we are glad to say that no attempt has been made to touch it up. It is a field note-book of the natural history of the voyage and of the wintering in Scotia Bay, South Orkneys, and it is full of interesting facts. We do not depreciate its interest when we say that with its splendid series of illustrations it would make an admirable book for any boy-naturalist who likes to get into close grips with the real thing. We wish to direct attention to the very fine set of photographs of penguins, shags, skuas, petrels, seals, and sea-lions, taken on the spot, and to the exceptionally good photographs of starfish, isopods, alcyonarians, and so forth taken in the laboratory by Mr. T. C. Dey. As a sample of the log we quote from October 11, 1903:—"The adelia penguins were nearly all actively collecting stones or resting from their labours, sleeping near their little heaps, either upright or prone. Some were very active and moved over ten yards at times in search of a good stone to return with; they throw the stones down in no apparent order. Thieving was being carried on extensively. The intending thief moved towards a heap the owner of which was away or not looking, and if he saw his chance picked up a stone and returned with it; but if the owner turned and spotted the thief approaching, the intending culprit walked innocently by as if nothing was further from his intentions than stealing a stone. If a thief was caught, the owner bit at him viciously and thus warned him off for the occasion, but as soon as an opportunity again presented itself he returned once more on thieving bent. I noticed several adelias eating snow in large quantities."

The various reports in the more technical volume have been mostly passed through the Transactions of the Royal Society of Edinburgh, which has thus aided in the publication. They are interesting in many different ways. Sometimes it is an isolated fact of

[1] Report on the Scientific Results of the Voyage of S.Y. *Scotia* during the Years 1902, 1903, and 1904, under the Leadership of Dr. William S. Bruce. Vol. iv., Zoology. Part i., Zoological Log, by David W. Wilton, Dr. J. H. Harvie Pirie, and R. N. Rudmose Brown. Thirty-three plates and 2 maps, including 100 photographs by the Editor and the Authors; coloured frontispiece by William Smith. Pp. xiv+104. (Edinburgh: The Scottish Oceanographical Laboratory; Edinburgh: Thin; Glasgow: Maclehose, 1908.) Price 13*s.* net, cloth, or 10*s.* 6*d.* paper. Vol. v., Zoology. Parts i.-xiii., Invertebrates. Pp. xi+313; 36 plates. Price 23*s.* 6*d.* cloth, 21*s.* paper.

distribution that arrests one, as when Messrs. Thomson and Ritchie report the occurrence of the very beautiful *Umbellula durissima*, Kölliker, from 48° 0'·6 S., 10° 5' W.—a far cry from the south of Yeddo, where the *Challenger* found it. In other cases we get a useful general impression. Thus we find abundant evidence of the distinctiveness of many of the elements in the marine fauna of the Antarctic and sub-Antarctic regions, for instance, in the Tardigrada, which Mr. Murray disentombed out of a little moss from the South Orkneys; or in Dr. von Linstow's new Ascarido from the Weddell seal; or in the new turbellarians reported by Drs. Gemmill and Leiper, the first adequately described members of this class from the far south; or in Mr. E. T. Browne's new medusa, *Botrynema brucei*, from 64° 48' S., 44° 26' W. Most striking, however, is Prof. Koehler's fine memoir on the asteroids, ophiuroids, and echinoids, which deals with more than forty new species. The author indicates firmly that the Arctic and Antarctic echinoderms are completely different—that question is settled. The Antarctic echinoderm fauna is much richer than the Arctic, and more diverse. Dr. Koehler speaks enthusiastically of Dr. Bruce's "Collection d'Echinodermes antarctiques la plus importante qui ait été recueillie jusqu'à ce jour," and both in the text and in his beautiful plates he does justice to it.

In other cases we have to welcome a new type, like Sir Charles Eliot's Notæolidia, a genus of large nudibranchs linking the Æolididæ to such forms as Dendronotus and Lomanotus. The largest specimen of *N. gigas*, it may be noted, is no less than 122·5 mm. long. Interesting also is Mr. Ritchie's new hydroid Brucella, with two nematophores to each hydrotheca, and a beautiful, highly specialised coppinia or bunch of clustered gonangia. Not new, but very welcome, is a specimen of the hitherto unique abyssal gastropod *Guivillea alabastrina*, dredged from near the original *Challenger* locality at a depth of 1775 fathoms. Messrs. Melvill and Standen, who deal with the molluscs, direct special attention to some other benthal species from unusual depths, such as *Columbarium benthocallis*, n.sp., a "beauty of the deep," from 1775 fathoms, with a shell of papyraceous texture, as in many other abyssal forms. The bibliographical *résumé* given at the end of this report is to be commended. Among the remarkable types we must also rank the forgotten *Decolopoda australis*, a ten-legged Pycnogonid described by Dr. Eights some seventy years ago, and beside this there is now *Pentanymphon antarcticum*, which Mr. Hodgson found on the *Discovery* expedition. It is also represented in the large *Scotia* collection of Pycnogonids which Mr. Hodgson describes. He points out that the *Scotia* collection of Pycnogonids is "totally different from that made by the *Discovery* in the same region, but on the opposite side of the world."

Weddell Seal (*Leptonychotes weddelli*), male, off Coats Land, Antarctica. From vol. iv. of the Report on the Scientific Results of the Voyage of S.Y. *Scotia*.

A collection of the minute wingless insects known as springtails does not seem to the outsider of much geographical interest, yet if those who come to scoff at this sort of small game will read Prof. Carpenter's report on the Collembola of the South Orkneys, they will probably remain to pray—for more springtails. "For the wingless—primitively wingless, as we believe—condition of these insects, their frail integument, and their concealed mode of life make it highly unlikely that they can cross broad tracts of sea; therefore the presence of identical or closely allied species on widely separated islands or continents may safely be regarded as sure evidence of the antiquity of the insects, and of the former existence of land-connections to explain their present discontinuous range." There seems good reason to suppose that the Antarctic Continent, to which the South Orkneys once belonged, was formerly connected with the northern continents, probably by way of America.

Among the curiosities we may notice *Echinorhynchus antarcticus*, n.sp., from the stomach of the Weddell Seal, well described by Dr. Rennie, who compares it to a pipe with a short stem and a fantastic lid, and notes that the males are larger than the females.

We have not thought it necessary to do more than illustrate the varied interest of the reports which make up this volume, but we hope we have said enough to show that the *Scotia* has made contributions to zoology not less important than those of a meteorological kind already published. If we are to know our earth we must know the Antarctic, if we are to know the Antarctic we must know it all round, with its springtails as well as its magnetic mysteries, and we earnestly hope that Dr. Bruce, who is one of the most intrepid and disinterested of living geographers (in the wide and only true sense), will be encouraged by the reception given to his reports and will not be straitened in the publication of more.

INDIAN MINERAL RESOURCES.[1]

IN a recent article in an American journal, the editor remarked that "geology in Britain scorns the study of ore deposits, and it is deemed gentlemanly to investigate molluscs rather than ores, scenery rather than outcrops." Such a reproach would never have been just, though naturally certain branches of economic geology cannot be studied in this country through lack of necessary material, and Sir T. H. Holland's instructive "Sketch of the Mineral Resources of India" shows the increasing recognition by British geologists of the interesting problems of economic geology. This report is a concise summary of the mineral resources of India, and the use now made of them.

The most important Indian metalliferous minerals are now gold and manganese. The metallurgical industries for which India was once famous have been practically killed by the competition of European imports. The brass used is now all imported, and none of the old copper mines are worked, though efforts are being made to revive them. Lead ores are widely distributed, but none of them is mined. Sir Thomas Holland is careful to explain that the ruin of the local industries has been due less to the cheapness of the imported metals and chemical products than to their greater trustworthiness and uniformity.

The total value of the minerals for which returns are available amounted in 1906 to only 6,312,818*l*., of which gold yielded 2,230,284*l*. and coal 1,912,042*l*. The other important minerals are petroleum, manganese, salt, saltpetre, and mica; they range in value of output from petroleum, with a yield of 574,238*l*., down to mica, worth 259,544*l*. The mineral output compared with the size and population of India is, therefore, small, but Sir Thomas Holland points to a marked increase in value during the past five years, and is hopeful for its future.

The memoir opens with a short statement of the geology of India in relation to the distribution of its minerals. The author explains that, owing to the exceptional geological stability of the Indian peninsula, its rocks have been comparatively little mineralised; it is only in the very oldest that metallic ores occur in valuable quantities, and their discovery is often difficult, as they are buried under prolonged accumulations of weathered material. In the later rocks the only minerals of economic value are those found in beds, such as coal, rock-salt, clay, and laterite. Coal mining is unusually easy and safe, owing to the slight geological disturbance of the country. Coal is sold at the pit's mouth for 3*s*. 11*d*. a ton, the low cost being due to the shallowness of the mines, the deepest shaft being only 800 feet, the firmness of the roofs of the seams, and the freedom from explosive gases; underground fires due to spontaneous combustion are, however, troublesome.

The geological foundation of India is a series of Archæan schists and gneisses with infolded areas of schists that belong to the Dahwar group. Upon this foundation rest the rocks of the Purana group, which are perhaps all pre-Cambrian. The Lower Purana beds are sedimentary rocks and limestones, and they are known as the Cuddapah series in southern, and as the Bijawar series in northern, India. The upper Purana beds are the horizontal sandstones, shales, and limestones of the Vindhyans. Then, after a long break, follow the Gondwana beds, which range in age from the Upper Carboniferous to the Upper Jurassic; they contain the chief Indian coal-fields, and probably many that are still unknown, as they are buried under the Upper Cretaceous lavas of the Deccan traps.

The only important Indian gold-field is that of Kolar, in Mysore, where mining was begun in prehistoric times, and some of the ancient workings reached the depth of 500 feet. The present mines are 3000 feet deep, and it is interesting to hear, on Sir Thomas Holland's authority, that the lodes at that depth show "little diminution in value or width of the auriferous gold quartz" (p. 30).

The Indian iron ores are now comparatively little used. They are very widely distributed, and the chief ore is a quartz schist with layers of iron oxides, like the banded ironstones of Rhodesia. In most cases the ore is siliceous and of low grade. The author gives further information about the oft-reported vast block of almost solid iron (pp. 32–3) of Mayurbhanj; he tells us that one bore there gave a core of 120 feet of solid ore containing 68 per cent. of iron.

There is comparatively little information in his report on the manganese mines, the rapid development of which in recent years has been the most remarkable feature in Indian mining; but a monograph on these ores by Mr. Fermor, of the Indian Geological Survey, is announced as in the press.

Among the earthy minerals the most characteristic is mica, of which India produces half the world's supply; but Sir Thomas Holland predicts that unless better methods are adopted for its mining, the output must be greatly reduced. He deplores the practical absence of phosphates from a country where the agricultural industry is of primary importance. There is a short note on each of the gems, for which India was once famous; some diamonds are still obtained, but they are all alluvial.

The carbonaceous minerals include coal, amber, and oil. The coal is of fair quality, and now supplies practically all the fuel required on the Indian railways. Amber of the species free from succinic acid, and known as "burmite," is found in north-eastern Burmah, but the quantity is small, and most of the amber worked in India is succinite imported from Prussia. The author gives an interesting summary of the present development of the Burmese oil industry. The industry was begun by the natives, and wells are still dug by hand to the depth of 400 feet, the men wearing a diving dress for protection against the gases that collect in the shaft. The fields now yield 138 million gallons of crude oil a year,

[1] "Sketch of the Mineral Resources of India." By Sir T. H. Holland. Pp. xi+86; 3 maps. (London and Calcutta, 1908.)

the refined product of which is sold in China and India. The oil was until recently carried down the Irawadi in barges to the refineries at Rangoon; but a steel pipe ten inches in diameter and 297 miles long has been recently laid.

An oil-field occurs in Beluchistan and Persia in rocks of the same age as those of Burmah, but the geological conditions are unfavourable to the collection of the oil in natural underground reservoirs, and thus the western field has remained unimportant.

This valuable guide to the mineral fields of India closes with a summary of the mining laws, a bibliography, a full index, and three sketch-maps that show the distribution of oil in Burmah and of the metallic and earthy minerals throughout the Indian Empire.

J. W. G.

COTTON GROWING IN THE WEST INDIES.[1]

THE history of the modern cotton industry of the West Indies forms one of the most interesting chapters in the history of agriculture. When cotton was re-introduced some six years ago it was practically a new crop to all concerned. Managers of estates had to learn the methods of cultivation and management, and labourers had to be trained. The manurial requirements of the crop required to be studied, and insect and fungoid pests had to be dealt with as they arose, to prevent them killing off the new crop. Thanks largely to the staff of the West Indian Agricultural Department, to the enterprise of the planters, and to the assistance of the British Cotton-growing Association, the crop has now become a very important one, and has been the means of improving considerably the financial position of many of these colonies.

The bulletin before us contains several important papers discussing the various phases of cotton production. Perhaps the most striking feature is the rapidity with which the industry has spread.

Cotton was first planted on a commercial scale in 1902, when about 400 acres were put into cultivation. In 1903 this area was extended to 4000 acres, in 1904 to 7000 acres, in 1905 to 9500, in 1906 to 14,500, and for the season 1907–8 20,000 acres are under culture in this crop. In addition there has been a general improvement in the quality of the lint produced since the plants have become acclimatised, and the planters have gained experience in the methods of cultivation and preparing the products. Mr. Thornton, in his general review of the progress of the industry, adduces evidence to show that further progress is possible; numerous points remain to be settled, and still greater improvements can be anticipated.

Mr. Sands's paper on the cultivation of Sea Island cotton at St. Vincent forms very pleasant reading. St. Vincent had been reduced to very bad straits. There had been a severe hurricane in 1893, and the terrible eruptions of the Soufrière in 1902–3. The unremunerative prices for arrowroot and sugar, the staple products of the island, made it impossible for the planters to retrieve their disasters. In 1903, however, the cultivation of Sea Island cotton was introduced by the Imperial Department of Agriculture, and has proved to be the means of restoring prosperity to the island; the revenue is now exceeding the expenditure, exports and imports are rising rapidly, estates are in full cultivation, and there is full employment for the peasant and labouring classes. The value of cotton exported for the year 1905–6 was 6059*l*., for 1906–7 was 16,922*l*. The total value of the 1907–8 crop, including exports, value of seed, &c., is estimated at 45,000*l*.

In St. Kitts cotton is grown almost entirely as an intermediate crop with sugar-cane. Up to the present no injurious effect on the sugar-cane has been noticed, and with careful manuring there seems little risk in continuing this system of planting. An agricultural inspector has been appointed to instruct the smaller growers in the best methods of working, and the prospects are considered highly satisfactory. In others of the Leeward Islands Dr. Watts has an equally satisfactory report to make; the exports from this group rose from 383,477lb. of lint in 1904–5 to 526,382lb. in 1905–6, and 702,910lb. in 1906–7, while a further increase is anticipated during the current season.

The Imperial Department is studying the question of seed selection, which promises to lead to still further improvement. The manurial requirements of the crop are being investigated, and schemes devised for dealing with the pests. Mr. Ballon gives a summary of his experiments on the cotton-worm, the boll-worm, cut-worms, the stainers and other pests; constant vigilance will obviously be necessary, but with a strong Department of Agriculture there is no reason to fear that the pests cannot be coped with. The progress of the industry reflects the greatest credit alike on the Department and on the planters, and augurs well for the future prosperity of the West Indies.

E. J. R.

[1] "West Indian Bulletin. The Journal of the Imperial Agricultural Department for the West Indies," vol. ix., No. 3, 1908.

NOTES.

SIR RICHARD D. POWELL has been re-elected president of the Royal College of Physicians of London.

MR. T. EDISON has been awarded the gold medal of the Royal Academy of Sciences of Sweden for his inventions in connection with the phonograph.

PRINCE ALBERT OF MONACO, distinguished for his researches in oceanography, has been elected a foreign member of the Paris Academy of Sciences in succession to the late Lord Kelvin.

THE summer meeting of the Institution of Mechanical Engineers will be held this year in Liverpool, and will begin on Monday, July 26.

THE Royal Physical Society of Edinburgh—one of the oldest scientific societies in the kingdom—has now opened its doors to women members. At the March meeting of the society, Mrs. Elizabeth Gray, Edinburgh, Miss Marion I. Newbigin, D.Sc., Edinburgh, Mrs. Ogilvie Gordon, D.Sc., Ph.D., Aberdeen, and Miss Muriel Robertson, London, were elected ordinary fellows.

REUTER's correspondent at Sydney reports that during a violent storm in the New Hebrides on March 29, Teouma was swept by a huge wave, which caused great destruction. The Government buildings at Vila were destroyed, and many vessels were stranded.

THE New York correspondent of the *Times* announces that Dr. W. H. Edwards died at Coalburo, West Virginia, on April 4, at the age of eighty-eight years. Dr. Edwards was the author of "The Butterflies of North America," a standard work on the subject, and contributed many papers on entomology to various scientific periodicals.

FROM Honolulu is reported the death, in his seventy-third year, of the Rev. Dr. Sereno E. Bishop, who had spent fifty-six years as an American missionary in the Hawaiian Islands. He was a frequent contributor to scientific journals on subjects relating to volcanic action, and in 1883 he discovered the corona caused by the Krakatau eruption, since known in Europe as "Bishop's Ring."

A general meeting of the American Philosophical Society will be held in Philadelphia on April 22–24 inclusive. The preliminary programme includes particulars of forty-three papers, on a great variety of subjects, by distinguished American men of science. On the evening of April 23 a commemoration of the centenary of Charles Darwin's birth and the fiftieth anniversary of the "Origin of Species" will be held. Dr. James Bryce, British Ambassador at Washington, will speak on personal reminiscences of Darwin and the reception of the "Origin of Species." Prof. G. L. Goodale will give an address on the influence of Darwin on the physical sciences, and Prof. J. M. Baldwin will speak on Darwin's influence on the mental and moral sciences.

The council of the Royal Geographical Society has resolved to award Lieut. Shackleton a special gold medal for his Antarctic work, and silver replicas to his fourteen companions who were with him throughout his expedition. With the approval of the King, the two Royal medals have been awarded to Dr. M. A. Stein, for his extensive archæological and geographical explorations in Central Asia, and Colonel M. G. Talbot, for his extensive surveys on the North-West Frontier of India and in the Anglo-Egyptian Sudan. The Victoria research medal has been awarded to Prof. Alexander Agassiz. Other awards are:—the Murchison bequest, to Captain C. G. Rawling; the Gill memorial, to Commander B. Whitehouse; the Cuthbert Peek fund, to Captain R. Ommanney, R.E.; and the Back bequest to Rai Sahib Lal Singh.

Reuter's Agency is informed that Dr. W. Bruce, of the Scottish Oceanographical Laboratory, has made more detailed plans of another Antarctic expedition to leave this country in 1911, the cost of which is estimated at 50,000*l.* It is proposed to carry on extensive oceanographical work in the South Atlantic Ocean between and south of Buenos Ayres and Cape Town, as well as in the Weddell and Biscoe Seas; to map the coast-line of Antarctica to the east and west of Coats Land, and to investigate the interior of Antarctica in that longitude. Part of the project includes a journey across the Antarctic continent, starting at some suitable base in the vicinity of Coats Land and emerging at McMurdo Bay, Victoria Land, or King Edward Land. The programme includes a circumpolar bathymetrical survey, especially in relation to the study of former Continental connections. Reuter's correspondent at Berlin announces that Mr. C. E. Borchgrevink will conduct a new expedition to South Polar regions some time during the summer. The expedition, the financial and other details of which have already been settled, has been arranged under the auspices of the International Polar Exploration Commission at Brussels.

Continuous efforts have been made by the Hampstead Scientific Society during the past year to find a suitable site for the establishment of a small astronomical observatory and meteorological station near the summit of Hampstead Heath. It is now proposed to rent, at a nominal charge, a portion of the top of the reservoir near the Whitestone Pond, to build there an observatory house, and to erect the 8-inch reflecting equatorial telescope presented to the society by Dr. F. Womack; also to establish on the same area a meteorological station. A sum of about 250*l.* will be required for the purpose of preparing the site, building the observatory house, and procuring the meteorological instruments. An appeal has been made for donations to the fund being raised for this purpose. The report of the society for 1908, which has just been issued, shows that the society is doing good work to promote interest in science by means of lectures, classes, and field meetings. One of the honorary secretaries of the society is Mr. C. O. Bartrum, 12 Heath Mansions, Hampstead, N.W.

The Lord Mayor presided at a large meeting held on Monday at the Mansion House in support of the objects of the Aërial League of the British Empire, "a non-political organisation to secure and maintain for the Empire the same supremacy in the air as it now enjoys on the sea." In a letter read to the meeting Lord Curzon said:—"While other countries have been perfecting their scientific and mechanical inventions we have accomplished little, and the popular inclination has been to regard the navigation of the air as a harmless but unpractical whim. This can no longer be said to be the case. Aviation has taken its place among the sciences, and whether it be regarded as a means of communication or as an instrument of warfare, it will undoubtedly admit of development in which nations as well as individuals will compete, and in which the superiority will rest with those who possess the greatest enterprise, resting upon a foundation of technical proficiency and scientific research." The speakers included Lord Montagu of Beaulieu, Dr. Hele-Shaw, Major B. F. S. Baden-Powell, and Sir Hiram Maxim, and the following resolution was carried unanimously:—"That this meeting of the citizens of London, held at the Mansion House, regards with considerable anxiety the rapid development of the science and practice of aërial navigation by other nations, and deplores the backwardness and apathy shown by this country regarding this new means of communication, which is of vital importance from a commercial as well as from a national defence point of view, and pledges itself hereby heartily to support the objects of the Aërial League of the British Empire."

On April 1 Count Zeppelin's airship, carrying the Count, eight other passengers, and a crew from the Army Balloon Corps, accomplished a voyage of about 100 miles, from Friedrichshafen to Munich. According to the *Times* correspondent, the airship travelled along a considerable curve, and completed the voyage in five hours. As the airship approached Munich, a strong south-west wind prevented a landing upon the Oberwiesenfeld, as had been arranged. The airship failed to make headway against the wind, and drifted with the wind to a place near Dingolfing, about forty miles from Munich, where a landing was effected. On April 2 Count Zeppelin sailed from Dingolfing about 11.30 a.m., and arrived at Munich shortly before 2 p.m., where a successful landing was effected. At 9 a.m. on April 5 the airship started upon another voyage; it returned to the balloon shed at Friedrichshafen at 7.30 p.m., after about 10½ hours' sailing, coming gently down in front of the shelter with perfect precision. From the Berlin correspondent of the *Westminster Gazette* we learn that, while Count Zeppelin has been practising with his reconstructed old airship, his newest, *Zeppelin II.*, has been nearly finished. Only some of the rudders and stability planes are lacking. The new ship is 136 metres long, 13 metres in diameter, and holds 15,000 cubic metres of gas. The aluminium frame is divided into cells, holding altogether seventeen separate balloonets, all except one being of rubbered cotton. The exception is made of English gold-beater's skin, which is an experiment. There are two gondolas, each fitted with rubber buffers, to take up the shock when descending on dry land. The Daimler motors are those used in the former *Zeppelin II.*, destroyed last August, developing 110 horse-power. The gondolas are connected by a gangway, but there is no covered cabin, as in the former ship. The newest feature of *Zeppelin II.* is a vertical shaft going through the hull, equipped with a ladder, so that it is possible to reach easily the top of the hull and there to make observations of position.

THE relative size of the frontal lobe of the brain in the two sexes, in men of genius, and in the lower races has attracted the attention of many anatomists. The smaller frontal lobe in women and in negroes, and the larger in men of genius, would prove, it is believed, that this portion of the brain is the chief seat of a good mind. In the February number of the *American Journal of Anatomy* Prof. Franklin P. Mall, of Johns Hopkins University, brings forward evidence to show that no such unequal distribution of brain substance exists. The brain of woman, it is often stated, is of a simpler type than that of man; but if weight is not considered, it is questionable, says Prof. Mall, whether a collection of brains could be assorted according to sex with any degree of certainty. It is generally believed, also, that the brains of men of genius are of complex configuration, and those of lowly races of a simple type; but facts do not bear this out, and such statements are only misleading. Prof. Mall concludes that "arguments for difference due to race, sex, and genius will henceforth need to be based upon new data, really scientifically treated, and not on the older statements."

IN its report for 1908 the Rugby School Natural History Society announces a change in the presidency, and likewise the appointment, for the first time, of vice-presidents. A gratifying increase in the number of associates is recorded, the names on the list now for the first time exceeding four hundred.

COCCIDIANS inhabiting the intestine of a nemertine worm of the genus Cerebratulus form the subject of a paper, by Mr. S. Awerinzew, in vol. xxxix., part i., of the *Comptes rendus* of the St. Petersburg Academy. They are stated to present certain interesting features in their development.

THE birds and mammals collected during the Alexander Expedition to south-eastern Alaska in 1907 form the subject of a paper by Dr. J. Grinnell and others, issued as vol. v., No. 2, of the University of California Zoological Publications. The expedition was financed and headed by Miss A. M. Alexander, to whom the University is indebted for the gift of the large series of specimens collected. Several species and subspecies of mammals and birds are described as new, and notes on the habits of several species, especially beavers, are given.

To the first part of vol. xxxix. of Gegenbaur's *Morphologisches Jahrbuch* Mr. Carl Dilg, of Cologne, contributes an important paper on the post-embryonal development of the Amazonian manati (*Manatus inunguis*), together with notes, accompanied by maps, on the distribution of this species and *M. latirostris*, and of the Sirenia generally. The author's observations on the skull-structure apply in the main to the genus, and not specially to the Amazonian species. In the young the brain-chamber and the enclosing portion of the skull are elongated, and it is not until mature life that they attain the characteristic elongation. The foramen magnum is always oval, and not, as has been stated, round in *M. inunguis*. It does not seem possible to distinguish the sexes (*Geschlecht*) by the dentition. The tympanic and petrosal do not fuse to form a petro-tympanic. The molars of Manatus resemble the milk-molars of Lydekker's *Prorasthomus veronense* of the European Oligocene. The dentition of the manatis is of a secondary type, so far as the exceptional number of cheek-teeth is concerned, while the extension of the skull in the line of the body-axis, the marked forward inclination of the orbital region, and the small orbits are all features indicative of adaptation to an aquatic life; the comparative lateness of this adaptation being indicated by the preservation of the original condition in the structure of the internal ear. The author agrees with Messrs. Thomas and Lydekker in regarding Prorasthomus as the ancestor of Manatus. As regards distribution, *M. inunguis* is now mainly confined to the Amazon basin, although it still survives in the Rio San Francisko; it was formerly met with for a considerable distance along the Brazilian coast. *M. latirostris*, on the other hand, is chiefly a Central American species, ranging but little south of the main stream of the Orinoco. For an undescribed Cretaceous sirenian from Parà the author proposes the name Trachypleurotherium.

AN account by Mr. C. K. Subba Rao of the cultivation in the Madras Presidency of the leguminous plant *Crotalaria juncea* is published as vol. iii., Bulletin No. 59, by the Department of Agriculture, Madras. The plant is grown either for the sake of the fibre known as sunnhemp or as a fodder crop. The fibre is chiefly used for weaving locally, but a certain amount is exported to the United Kingdom and Italy.

THE outstanding feature of the report for 1907–8 on the experiment station at Tortola, in the Virgin Islands, is the large increase in the cotton crop of the islands, shown by a rise in the export from fifty-one bales in 1907 to 162 bales in 1908. Good results have been obtained at the station with Liberian coffee, onions, cassava, and seedling sugar-canes; the report from London on a small quantity of cacao grown and cured locally indicates that there is an opening for an industry in this product.

THE annual report for 1908 of the Rothamsted Experimental Station contains a brief summary of salient features in the series of manurial experiments and of the papers published by members of the staff during the year. It is noted that the grass plot, which receives a large dressing of nitrate of soda, and has become strongly alkaline, is being overrun by *Lathyrus palustris*. A new line of research regarding the existence and nature of land "sickness" was started, and in connection therewith an examination was begun of the changes taking place in soil when heated to the temperature of boiling water or partially sterilised by treatment with volatile antiseptics. The improvement is apparently due to a re-distribution of the bacterial flora, and partially to chemical change.

AN article is contributed by Dr. H. Marzell to *Naturwissenschaftliche Wochenschrift* (March 14) on the subject of plants which have been popularly endowed with magic qualities. The chief of these is undoubtedly the mandrake, *Mandragora officinalis*, the cultivation of which dates back to very ancient times, and spread from the East to various European countries, so that in the fourteenth century the sale of the roots was interdicted in Paris. Another plant, known as "moly" (μωλυ), frequently mentioned in the classics, because it was given to Ulysses to protect him from the wiles of Circe, is generally regarded as a species of Allium. Reference is also made to an old English cantation, "The Song of the Nine Herbs," and to the superstition connected with "fern seeds," *i.e.* fern spores, which are supposed to render the bearer invisible.

A preliminary note by Mr. B. W. Bezenov, communicated to the *Bulletin de l'Académie impériale des Sciences de St. Pétersbourg* (series vi., No. 1), furnishes a calendar of algal growth in the bay of Sebastopol. *Ceramium rubrum*, *Cladostephus verticillatus*, species of Callithamnion and Porphyra persist through the year, but start fresh growth in February. The hot-weather algæ, *e.g.* *Chondria tenuissima*, *Padina pavonia*, *Dictyota Fasciola*, and *Arthrocladia villosa* appear in April or May, and persist until August or November. *Porphyra leucosticta*, *Scytosiphon lomentarius*, and *Ulothrix implexa* show an active period of growth from November to February, and die down in April. Contrasting these periods with the periods for the same algæ in the Mediterranean, it is found that the seasonal growth generally begins later and sometimes persists longer in the North Sea.

The prickly pear—a general name for the flat-jointed members of the genus Opuntia—is used as cattle food to an increasing extent in certain of the United States, and investigations into its composition have been made at the New Mexico College of Agriculture. Recently (Bulletin No. 69) the digestibility by steers was determined, and was found to be not unlike that of ordinary green fodders. The results were:—

	Water	Ether extract	Protein	Nitrogen free extract	Fibre	Ash	Total dry matter
Composition	83·41	0·31	0·75	9·41	2·64	3·48	16·59
Per cent. digestible	—	67·90	58·25	82·59	41·32	34·68	65·86

It is stated, however, that the digestibility is increased when prickly pear is fed with other foods.

The Linnean Society has published a very interesting memento of the Darwin-Wallace celebration held on July 1 of last year. It will be remembered that an account of the proceedings on that occasion appeared in Nature for July 9, 1908. The present volume contains a complete record of the meeting held in the theatre of the Institution of Civil Engineers under the presidency of Dr. D. H. Scott, with full reports of all the speeches then delivered; a list of those present at the dinner given to the medallists and foreign guests; the programme of the reception held at the rooms of the Linnean Society, with an account of the exhibits and lantern demonstrations then shown; the minutes of the meeting held on July 1, 1858, and a reprint of the papers by Darwin and Wallace that were read on that famous occasion, together with the joint letter from Lyell and Hooker by which the communications were introduced. Dr. Wallace himself has contributed to the volume an interesting note, embodying passages from Malthus's "Principles of Population," which illustrate the influence of that work in suggesting the idea of natural selection. Excellent portraits are given of Charles Darwin and of the recipients of the Darwin-Wallace medal, and good reproductions are included of the medal itself and of the beautifully illuminated address presented by the Royal Academy of Science, Stockholm. The whole forms a complete and valuable record of a momentous occasion.

The *National Geographic Magazine* for February is largely devoted to papers on western Asia, of which the most important is that by Mr. E. Huntingdon on the mountaineers of the Euphrates. The original population of this region consisted of Kurds, who were conquered by Armenians, and these in their turn by the Turks. The Turks, as a rule, now confine themselves to the richest plains and the cities; but the areas occupied by the three races are not clearly defined, and when they settle in the same village their quarters are separate. The permanent hostility of these peoples is the cause of the present dangerous political situation. The Kurd hates the Turk because he has been often defeated and is rigorously taxed; he despises the Armenian because he is a Christian, and can be ill-treated with impunity whenever the Turk gives permission. The Armenian hates and fears both Kurd and Turk. The Kurd, in fact, is a pagan, with an outward veneer of Islam. The Kuzzilbash, or "red-head" Kurds of the Dersim district between the two main branches of the Euphrates, are neither good Mohammedans, good Christians, nor good pagans, and another cause of religious animosity is that, being by name of the Shiah sect, they are detested by the Sunni Turks. The illustrations to this paper admirably depict the modes of transit on the Euphrates by means of rafts made of inflated sheepskins. The numerous Hittite inscriptions in this region would attract archæologists if only the new Turkish administration could enforce a semblance of order in this interesting and little-known country.

The title of a memoir by Mr. Gilbert Walker, F.R.S., on "Correlation in Seasonal Variation of Climate," in vol. xx. of the Memoirs of the Indian Meteorological Department, is somewhat misleading, as the present part is of an introductory character only, and is confined to a deduction of the correlation coefficient, the regression equations for two or more variables, and the remaining formulæ of greatest importance in the theory of correlation, on lines that are for the most part simple. The author proceeds by assuming that the departures of one variable, x, are made up of a portion governed by, and a portion independent of, the second variable, y, and that the portion determined by y may be taken as ky if y be small; in order to determine a good value of k, it will be as well to weight each observation equation by the value of its y, as the equations dependent on small values of y are untrustworthy. It will be seen that this amounts to a way of suggesting the formation of the normal equations of the method of least squares.

The thirty-first annual report of the Deutsche Seewarte, for 1908, like those of all establishments dealing with meteorology, shows increased pressure in various directions. In the department of maritime meteorology the chief events have been the publication of monthly pilot charts of the Indian Ocean (see Nature, February 11, p. 443), and the preparation of an atlas of the currents of Indian, eastern Asiatic, and Australian waters. The number of observers in the mercantile marine cooperating with the Seewarte at the end of the year was about 1000; these receive publications in exchange, and a few medals are awarded annually. In the department of weather telegraphy and storm warnings several improvements have been introduced; the change of hour from 8h. a.m. to 7h. a.m. at British stations has been of great advantage to the German service. Some 6000 storm-warning telegrams were issued during the year, but the percentage of success is not stated. Experiments in the use of wireless telegraphy for weather forecasts have been arranged, with the cooperation of the London Meteorological Office. About 200 kite ascents were made during the year, eighty-six of which exceeded an altitude of 2000 metres; observations with registering balloons have also been regularly made at the times arranged for international ascents. The discussion of observations at over-sea stations forms an important part of the useful work of the Seewarte; returns from twenty-one places were received, irrespective of the stations in German East Africa, the results for which are being prepared for publication, as in previous years. The departments dealing with the supply and verification of instruments and the preparation of hand-books for seamen also show great activity.

A simple method of illuminating opaque objects is described by Mr. J. E. Stead, F.R.S., in the Journal of the Royal Microscopical Society (February). With low-power objectives a cover-glass is placed at an angle of 45° in front of the objective, and reflects light on to the object from an electric lamp. For higher powers the reflector is always placed in a slit in the objective above the lens.

Dr. Emilio Oddone, applying the methods of Kövesligethy and Rudsky to the recent Sicilian earthquake, computes the depth of the epicentre at about 9 kilometres. The corresponding result for the Calabrian earthquake of 1905 was 7 km., and the author refers to Mallet's result of 10 km. for the Neapolitan earthquake of 1857, pointing out, however, that other methods lead to much higher values. Dr. Oddone's note is published in the *Atti dei Lincei*, xviii., 4.

In a communication to the *Atti dei Lincei*, xvii. (2), 12, Prof. Augusto Righi integrates, for a particular case, the equations of motion of an electron describing an orbit about an ion in a magnetic field. The case considered is that in which the mass of the ion is so large in comparison with that of the electron that its velocity is practically uniform, and the plane of the orbit is perpendicular to the lines of magnetic force. The problem reduces to a simple one in particle dynamics, and gives for the relative orbit a conic described about the focus. The author discusses the conclusions to be derived regarding the effects of the field in assisting or impeding the separation of the electron from the ion in the case of collisions.

No. 5, vol. xxviii., of the *Astrophysical Journal* contains a paper, by Messrs. G. Duffield and R. Rossi, on the emission spectrum of silver heated in a carbon-tube furnace in air. Previous work by Mr. Duffield having led to the conclusion that a more complete knowledge of the band-spectrum of silver was desirable, the authors employed a similar furnace to that used by Dr. King in his investigations of various spectra at the Pasadena Observatory. The large number of lines observed suggested that the spectrum was not due to silver alone, but comparative experiments with tin and other metals brought out none of the lines. One or two of the flutings observed, in the region λ 5370 to λ 5750, are of doubtful origin, but no opportunity of obtaining definite results presented itself. None of the lines, however, occurs in the arc or in the spark spectrum of silver, although Hartley detected three faint lines in that region of the flame spectrum. The general conclusion is that the oven spectrum of silver differs markedly from the spectra of silver produced by other methods. The experiments were carried out in the physical laboratory of the Manchester University.

Ion for February devotes a dozen pages to a report, by Prof. R. Gans, of the University of Tübingen, on recent advances in ferromagnetism. The subject-matter is arranged under the following heads:—methods of measurement, permeability and hysteresis, influence of frequency, alloys, crystals, influence of temperature, strain and magnetisation, molecular theories of magnetisation. References to more than 100 papers published during the years 1907–8 are given, and a glance through the list shows that the great bulk of them deal with questions which have arisen in practice, and that very little has been done towards a scientific explanation of magnetic processes. This undue devotion to practical problems the author regrets, and he expresses the view that it is to the interest of all that the purely scientific side of the subject should not be neglected in the quest for material with low hysteresis losses.

No. 43 of the occasional publications of the Conseil international pour l'Exploration de la Mer contains an account of the measurements of the compressibilities of pure water and of sea-water undertaken by Dr. V. W. Ekman, of the central laboratory at Christiania, at the request of the council. The method depends on the measurement of the quantity of mercury forced by pressure into a glass vessel containing the water, through a narrow tube connecting the vessel with another containing mercury and open to the pressure. In the deep-sea instrument the mercury forced in is tilted into a pocket by inclining the vessel. In the laboratory instrument a weighed amount of mercury is placed in the outer vessel, and makes an electric circuit until it is forced past a platinum contact in the narrow tube connecting the two vessels. The compressibility of the glass of the vessels was known, and that of the mercury was found by a separate experiment. The results are given in the form of an expression for the compressibility in terms of temperature and concentration which is valid between 0° C. and 20° C., and up to pressures of 600 atmospheres.

The new calcium-carbide factory at Odda, on the Sondrefjord, Norway, forms the subject of an interesting article in *Engineering* for March 26. This factory is the property of the Alby United Carbide Factories, Ltd., and has been organised by a British company with British capital in order to ensure a regular supply of calcium carbide, the absence of which was interfering with their business as manufacturers of a special acetylene plant. The potentialities of Norway for industries requiring much power are very great, many waterfalls being splendidly placed for the production of hydraulic power by means of turbo-generators. In the present case, a hydro-electric power installation has been already constructed giving 23,000 E.H.P., and 75,000 to 80,000 horse-power are available in the water supply. The total producing capacity of the new factory is 32,000 tons of calcium carbide and 12,500 tons of nitrolim (for use as a fertiliser) per annum. Care has been taken not to interfere with the amenities of the district, which is a tourist resort. The water-collecting area is 380 square kilometres, from which hundreds of small streams discharge into the Ringedalsvand. As there is only a distance of 3·5 kilometres between this lake and the fjord where the power-station is situated, it will be seen that the conditions are very favourable for the construction of a pipe-line to the power-station.

The current number of the *Zeitschrift für physikalische Chemie* contains a paper, by J. G. L. Stern, on the application of the platinum resistance thermometer to the determination of molecular weights in fused potassium nitrate as a solvent. The modified form of thermometer used was capable of estimating temperature differences of 0°·04 at a temperature of 335° C. The sulphates, chlorides, and nitrates of the alkalies and alkaline earths were used as solutes. The values obtained for potassium nitrite appeared to show the existence of double molecules; potassium chloride was normal, and sodium, silver, barium, and strontium nitrates were nearly normal, showing a slight dissociation. Sodium chloride behaved as though dissociated into two, barium and strontium chlorides into three parts, whilst the figures for potassium and sodium sulphates were quite abnormal, being split up into more than three parts.

In response to a widely expressed request, Dr. H. O. Forbes, director of museums and reader in ethnography in the University of Liverpool, has agreed to publish, in book form, the course of lectures recently delivered by him in the Museums Theatre, on "The Reindeer Hunters: the Golden Age of the Cave-dwellers." The volume will be issued in the autumn.

We have received a copy of the list of publications already issued by the Carnegie Institution of Washington. The list includes particulars of 118 monographs and other works, many of which have been reviewed in Nature from time to time, and it provides further evidence of the excellent work which the institution is accomplishing in disseminating a knowledge of recent progress in science. The editions of each book are restricted, and as soon as a volume is issued copies of it are sent gratuitously to a limited number of the greater libraries of the world, while the remainder of the edition is placed on sale at a price sufficient only to cover the cost of publication and of carriage to purchasers.

A new and revised edition of Prof. W. Bölsche's book, "Haeckel: his Life and Work," has been published by Messrs. Watts and Co. for the Rationalist Press Association, Ltd. The book is published at the price of 6*d*., and is provided with an introduction and supplementary chapter by the translator, Mr. Joseph McCabe.

Messrs. Cassell and Co., Ltd., have commenced the issue, in fortnightly parts, of Prof. Percy Groom's beautifully illustrated "Trees and their Life-histories." The price of each part is 1*s*. net, and there will be thirteen of them to complete the work. The same firm is issuing Prof. F. E. Hulme's "Familiar Wild Flowers" in fortnightly parts at 6*d*. net each, and there will be forty-five parts.

A fourteenth edition of Mr. W. T. Lynn's "Remarkable Comets" has been published by Messrs. Samuel Bagster and Sons, Ltd. In this issue, particularly, the author has endeavoured to bring the information carefully up to date. The price of the little book is 6*d*. net.

OUR ASTRONOMICAL COLUMN.

Positions of Daniel's (1907*d*) and Morehouse's (1908*c*) Comets.—Comet 1907*d* having been observed during the opposition of 1908, Herr H. H. Kritzinger has calculated an ephemeris for the coming opposition, and publishes it in No. 4317 of the *Astronomische Nachrichten*. The ephemeris position for April 16 is 15h. 20·2m., −7° 50′, and the estimated magnitude is 14·3, but the comet may be as much as 3·8 magnitudes fainter than this. There is just a possibility, however, that it may be re-observed by long-exposure photographs.

An ephemeris for comet 1908*c*, prepared by Dr. Ebell, appears in No. 4309 of the *Astronomische Nachrichten*, and gives the positions and estimated magnitudes of the comet up to the end of June. From this we see that the comet will not rise in these latitudes until about the end of May, and will then be only about one-third as bright as it was when discovered.

Sun-spots and Solar Temperature.—In the March number of the *Observatory* Mr. Evershed continues the discussion as to the interpretation of the phenomena of the sun-spot spectrum with regard to temperature. In a previous letter Prof. Whittaker suggested that the tube-furnace phenomena observed by Dr. King might be produced by the direct action of the radiation absorbed from the heated walls of the solid tube rather than in consequence of the collisions between the molecules of the gases themselves. This suggestion Mr. Evershed believes to be unnecessary for the explanation of the radiations observed, and he adduces evidence showing that the molecules of the gases, when excited thermally, are capable, by their mutual collisions at high velocities, of producing the radiations.

In regard to Prof. Whittaker's second suggestion, that the increased intensity of spot lines may be due to enormous pressures obtaining in the lower parts of the chromosphere, Mr. Evershed quotes experimental results showing that such pressures are unnecessary for the production of the intensifications, and then shows that the evidence for the existence of the pressure-differences required by this hypothesis is insufficient. He mentions, parenthetically, that he has observed what appears to be a minute pressure effect on certain lines measured at the sun's limb, and suggests that further observations of this phenomenon may lead to conclusions regarding the various levels at which absorption takes place.

The Apparent Dispersion of Light in Space.—In an article appearing in the March number of the *Astrophysical Journal* (vol. xxix., No. 2, p. 101) Prof. Lebedew criticises the conclusions arrived at by Belopolsky, Nordmann, and Tikhoff concerning the dispersion of light in interstellar space.

In the first place, he shows that if the delay found by Tikhoff and Nordmann were due to ponderable matter, the absorption produced by such matter would be so great as to render the sun and stars invisible to us. There remains the possibility that the æther itself disperses, without absorbing light, but this entails an attack on the electromagnetic theories of light, which Prof. Lebedew believes to have been too firmly established, by theory and experiment, to allow of any attack being made simply to explain a series of astronomical observations.

Prof. Lebedew then shows that Tikhoff's assumptions are unsafe, and that his results do not agree sufficiently closely with those of Nordmann to produce conviction, and, finally, he shows that in the case of such systems as those of β Aurigæ and R.T. Persei physical processes sufficient to produce the phenomena observed may be readily conceived.

Coloured Stars in the Globular Cluster M 13.—In the October number of the *Astrophysical Journal* for 1900 Prof. Barnard directed attention to some "abnormal" stars observed by him in the globular cluster M 13 Herculis, such stars being relatively much fainter visually than photographically.

Since the publication of this result he has found other stars of this class in the same cluster, and also in M 5 Libræ. On comparing a photograph of the cluster taken with the Potsdam refractor with one taken with the Yerkes 40-inch refractor fitted with a yellow screen, he was surprised to find that there were many more of these "blue" stars than he had hitherto found; further, a large number of the stars of this cluster must be yellow, for they are relatively much brighter on the Yerkes than on the Potsdam photograph.

Thus, while it is impossible visually to observe any difference in the colours of the stars of M 13, the above comparison shows that great differences of colour, and hence of spectral type, do exist, and Prof. Barnard now gives tables showing which are the blue and which are the yellow stars; he also mentions one or two striking examples of colour-difference, and briefly discusses the variable stars hitherto discovered in this cluster (*Astrophysical Journal*, vol. xxix., No. 1, p. 72).

THE UNITED STATES NAVAL OBSERVATORY.—The report of the U.S.A. Naval Observatory, Washington, for the fiscal year ending June 30, 1908, contains several important announcements, and gives the record of the work done during the year.

Rear-Admiral Walker having retired from the superintendentship on November 13, 1907, Captain W. J. Barnette was appointed to the position, and submits this report.

Having asked a board of astronomers to report on the state of the observatory and the most proper work for it to perform, he received a report in which it was laid down that astronomy of position, rather than astrophysics, should be the principal work of the observatory. In order to secure the continuity and coordination of the work, an astronomical council, consisting of the officers of the observatory, was appointed, and will in future act as an advisory council in connection with all the work, astronomical and administrative, of the observatory.

The climatic and terrestrial conditions at Tutuila, Samoa, having been found too unfavourable, the branch observatory established there in 1904 has been discontinued.

SCIENTIFIC AGRICULTURE.[1]

THE bulk of this work is taken up by the reports on economic zoology and mycology; the remainder comprises reports from the veterinary, chemical, and botanical departments, and the farm report.

FIG. 1.—Photograph of a growing potato plant attacked by the "Black Scab." At × is a diseased shoot above ground; several young disease d potatoes can be seen below.

The determination of the digestibility of feeding stuffs, giving, as it does, an insight into Continental methods, is of exceeding interest to all scientific agriculturists. Prof. F. V. Theobald's work is well known, and in his contribution to the journal the notes on the damage to hops by *Entomobrya nivalis*, Linn., and on the occurrence of *Rhagoletis cerasi* in imported cherries, are worthy of

FIG. 2.—A branch of seedless Golding Hops.

special mention. Most of the illustrations in this section are excellent.

The report on economic mycology contains articles on American gooseberry mildew and on black scab, among others, illustrated by a series of twenty-six splendid plates, one of which is reproduced here. This shows very plainly the peculiar warty outgrowths to be found, not only on the tubers, but on the shoots and leaves of potatoes attacked by *Chrysophlyctis endobiotica*. Hops, as is fitting in a hop-growing district, receive attention, and the article on the value of the male hop, illustrated by most lucid plates, is by no means the least important item in the journal. The plates illustrating "seeded" and "seedless" Golding hops, taken from the same bine, show one of the effects of fertilisation, viz. that "growing out" takes place along with seed production; in fact, the investigations carried out at Wye prove beyond question that only "seeded" hops will grow out properly. The "growing out" takes place immediately after fertilisation, thus obviating a long "burr" period, a period in which there is the greatest danger of attack by "mould."

The amount of resins, too, is increased by more than one-half as a result of fertilisation: in fact, the quantity and quality of hops is improved by the presence of the male hop. This was shown in a practical manner by the fact that samples of "seeded" and "seedless" hops, grown in the college hop-garden, were submitted to the hop-factors for valuation, and it was found that the "male plant had increased the value of the crop (at the price of hops then current) by the sum of 24*l*. 10*s*. per acre." Such investigations are not only of absorbing interest, but of the greatest possible utility.

One always looks for good work in the veterinary department, and the present report is no exception, but mention can only be made of the discovery of *Strongylus*

[1] The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 17. Pp. 478. (London and Ashford: Headley Bros., 1908.) Price 6*s*.; Residents in Kent and Surrey, 3*s*.

ostertagi, new to this country, and large numbers of the rare *Sclerostoma hypostomum*.

Exigencies of space forbid the mention of other contributions.

FIG. 3.—A branch of seeded hops produced on the same bine and under identical conditions as those shown in Fig. 2, except that pollen was supplied to the "burr."

The letterpress and plates are alike excellent, and, as a year's record of all that is best in scientific agriculture, the Journal of the South-Eastern Agricultural College should find a place on many bookshelves.

C. A. E.

THE ROYAL PRUSSIAN AËRONAUTICAL OBSERVATORY'S AËROLOGICAL EXPEDITION TO TROPICAL EAST AFRICA.

THE Royal Prussian Aëronautical Observatory, Lindenberg, supported by the active interest of some "friends of science," sent out in June, 1908, an aërological expedition to tropical East Africa under the direction of Prof. Berson, first observer at Lindenberg, accompanied by Dr. Elias, formerly assistant, and Mr. Mund, balloon superintendent of the observatory. At the end of December last they returned safely, and in possession of a good amount of interesting data.

In consideration of the proximity of the region explored to British possessions in East Africa, and also in recognition of the help and protection given to our work by the English authorities, I asked Prof. Berson to write a special report for NATURE, believing that there are British readers who take interest in our work.

I am therefore glad to offer the following account of the work by Prof. Berson. R. ASSMANN.

Director of the Royal Prussian Aëronautical Observatory, Lindenberg.

Much good work has been done lately in the exploration of the upper atmosphere in the region of the trade winds, more particularly the Atlantic trades, where men of science of Germany, the United States, and France have been making investigations, trying above all to elucidate the very important question of the anti-trade. But in the Indian Ocean and the adjacent regions, the realm of the most powerful and persistent monsoonic system of the globe, with the exception of a few ascents from the German ship *Planet*, carried out in the southern and eastern portions of the ocean, only the Indian meteorologists, Mr. Walker and Mr. Field, had applied the new aërological methods for the study of the monsoon phenomena, the work in the south-west monsoon proving especially difficult on account of the stormy and rainy character of the weather prevailing during its sway.

Very naturally the idea occurred to try similar explorations on the east African coast and the waters washing it, the region lying at the starting point or (in the case of the Indian "winter monsoon") at the extreme limit of these peculiar wind-systems. It might be expected that there would be less difficulty to be encountered here than in India proper, especially if the work were carried out on the water, where self-registering balloons might be found easier, by means of a small steamer chartered for the purpose, and the wind, if too weak or too strong for kite ascents, increased or lessened by the motion of the vessel.

This plan once conceived, it occurred to us that some 600 miles further inland there was situated a vast sheet of water—the Victoria Nyanza—on the surface of which all the above-named advantages might be met for balloon as well as for kite work, thus affording the possibility of efficient and fruitful aërological research *in the heart of a tropical continent*, even in the middle of the equatorial belt, a unique spot of similar convenience to be found on the surface of the globe.

The Royal Prussian Aëronautical Observatory, the well-known creation of Prof. Assmann, took the matter in hand, and after having overcome a rather lengthy series of difficulties—above all, naturally enough, of a financial character—chiefly by the persistence of Prof. Assmann and the generosity of a few wealthy friends of scientific work we succeeded in carrying out our plan, at least in the leading features. This had in itself a double bearing. The first item consisted in an investigation of the monsoons, more particularly of the conditions of their change in the north-hemispheric autumn, and the intervening land and sea breezes, on the coast of British and German East Africa, as well as on the neighbouring sea (as a matter of fact, the work was carried far beyond the limits of the monsoons, down to the tropic of Capricorn). The other point was the "study of the *tropical*, or, more exactly speaking, the *equatorial continent*"—in contrast to the ocean of the same latitudes—from the aërological point of view, over the Lake Victoria, implying the research of the vertical distribution of temperature, the question of the "upper inversion," the study of the winds prevailing in the different strata, and, in addition, a comparative investigation of the land and sea breezes of the lake in analogy to those on the coast of the ocean.

For scientific and practical reasons, though, the experiments had to be executed in the inverse order; we began by the ascents on the large "inland sea of Central Africa," and wound up by research on the ocean.

The writer, as leader of the expedition, accompanied by Dr. Elias, and a technical assistant, left Europe in the middle of June, and managed, after some little delay at Mombasa and Nakuru, to arrive, *viâ* Uganda Railway and the lake, with all our cargo of windlasses, kites, balloons, chemicals, instruments, and personal equipment, on July 24 at Shirati, in German East Africa, situated on the east coast of the Nyanza, in 1° 7′ S. lat.

That all the difficulties which, of course, did not fail to arise could be overcome with so little loss of time is to a large extent due to the extreme courtesy, or in many cases even most helpful assistance, with which the expedition met everywhere in British East Africa. For this the observatory is largely indebted to Dr. Shaw, the director of the Meteorological Office, to the Colonial Office, and to all the authorities, Imperial as well as local, in British East Africa and Uganda. We beg to express our feelings of sincere gratitude to all of them, most particularly to Dr. Shaw and to the officials of the Uganda Railway, the custom and port officers in all those places, and the officers of the steamers plying on Lake Victoria.

Owing to this loyal help we succeeded in securing a small craft, the 45-ton steamer *Husseni*—owner, Mr. Allidina Vishran, of Entebbe, Uganda—for two months, in lieu of the intended *Heinrich Otto*, of Muanza, which, though otherwise likely to answer our purposes, unfortunately had broken down just when on the way to meet us. This delay, of some four days, was the reason that, contrary to our decided intentions, we only were capable of a very insufficient collaboration during the international series of ascents of July 27 to August 1.

After having got through the starting difficulties usual with African work we managed to execute in the time from the end of July until the middle of September twenty-three ascents of self-registering balloons, of which fifteen were retrieved with their apparatus, and registered curves of pressure, temperature, &c., whereas eight instruments were lost; but even the lost balloons furnished highly valuable data for the direction and velocity of wind in the alternate vertical strata, since nearly all the balloon flights were studied by means of theodolites from a fixed point on the shore.

A large number of smaller or larger pilot balloons carrying no apparatus, and some of them ascending to enormous heights, were inserted between the ascents of the self-registering tandem systems to complete the exploration of the wind, so important in these latitudes. A dozen or more kite ascents served the purpose of furnishing details about the lower parts of the atmosphere, particularly during the sea breeze, not exceeding in elevation 3000 feet to 4000 feet above the level of the lake, where the breeze disappeared altogether, thus rendering higher kite ascents impossible.

There can be no question as yet, having only just returned home from Africa, of giving a summary of the meteorological results; this must be reserved for some months later. We can only mention here crudely a few of the most striking points.

The highest self-registering balloon recovered rose to an elevation of 65,000 feet (19,800 metres), where a temperature of $-84°$ C., $=-119°$ F., was encountered, a lower temperature than ever registered at equal or even greater heights over Europe! Two other ascents reached 55,000 feet to 56,000 feet, with variable, although also comparatively low temperatures.

These very low temperatures confirmed the similar results obtained by MM. Teisserenc de Bort and Rotch on the *Otaria* in the equatorial regions of the Atlantic; but over continental East Africa we found also, occasionally, the "upper inversion of temperature" not encountered in the high strata of the atmosphere above the corresponding latitudes of the ocean west of this continent—certainly a feature of great importance.

While omitting the enumeration of many other interesting results, we at present only desire to point out the surprising fact that several times there was found an uppermost current of air blowing nearly from due west, and flowing above the regular easterly current of the equatorial region. The lower strata, underlying the regular east trade, were dominated by diurnal (at the very bottom) and seasonal winds.

After the middle of September we made a cruise on the lake, crossing it for the first time from east to west (from Shirati to Bukoba). The interior of the lake proved to be devoid of islands and uniformly deep.

The end of September and beginning of October were devoted to simultaneous ascents on the coast—at Mombasa—where experiments with kites and pilot balloons were carried out, and on the borders of the Nyanza, where Dr. Elias remained for a couple of weeks and made a series of pilot-balloon ascents, no kite work being possible there, since the little steamer had to be given up.

From October 9 until December 5, when the expedition definitely started on its homeward voyage, Dr. Elias preceding the other members by three weeks, the headquarters of our work was transferred to Daressalam. In this whole space of time there was hardly a day without a kite ascent, and besides these quite a series of pilot-balloon experiments was carried out. Part of the kite work was executed on the ocean south of Zanzibar from the little Government steamer *Rovuma*, in order to reach greater elevations; several of those higher ascents—a few exceeding 10,000 feet—were made at the end of October in the time between the two monsoons, the others in the first days of December, the north-east monsoon blowing then steadily.

We had at first the intention of making in the month of November simultaneous researches on the coast of the continent and on the Seychelles Islands, situated in mid-ocean, some 1000 miles to the eastward. This plan had to be given up for meteorological and practical reasons; we succeeded, though, in replacing it, at least to a certain extent, by two of us going on board the small German cruiser *Bussard* to the south as far as Delagoa Bay, and making a couple of *ballons-sondes* and several kite ascents from this ship, on the ocean as well as in the bay of Inhambane, 24° S. lat. Dr. Elias, who had remained at Daressalam, made in the meantime simultaneous kite and pilot-balloon ascents there and on the sea.

In this whole series of experiments on or near the ocean, forming the second part of our work, the kite and "pilot" experiments prevailed, whereas ascents of self-registering balloons, forming the chief feature of the investigations on Lake Victoria, could only be carried out in two cases in the months of October and November. The higher reached 13,300 metres, =nearly 44,000 feet, the kite ascents, as mentioned, reaching some 10,000 feet, =3200 metres; but the highest pilot balloon soared up to an elevation of about 21,000 metres, =nearly 70,000 feet, before it burst, yielding most interesting data about the superposition of the wind systems and the westerly air-drift in the highest strata of the atmosphere in those regions.

A. Berson.

THE INSTITUTION OF NAVAL ARCHITECTS.

The annual meetings of the Institution of Naval Architects opened on Wednesday, March 31, and were continued on Thursday and Friday, the rooms of the Royal Society of Arts being used, as on previous occasions. Owing to a family bereavement, Lord Cawdor, the president, was unable to be present, and the chair was taken by Sir Wm. White, K.C.B. The institution, having been founded in 1860, will complete its fiftieth year in 1910, when it proposes to commemorate the occasion by an international congress to be held in London.

The programme comprised eighteen papers, together with an additional paper by Sir Philip Watts on trials of torpedo-boat destroyers in waters of various depths. Limitations of space will permit of only a few of these to be noticed here.

Lord Brassey contributed the opening paper, on types of warships omitted in recent programmes of naval construction. Every maritime Power is now building Dreadnoughts; the needs of different countries may differ, but almost identical types are being produced, unanimity having been attained by imitation of British design. Types other than the Dreadnought, however, are of great value for the line of battle. Armoured cruisers have disappeared from the latest programmes, being too vulnerable to be reckoned as fighting ships. It is a waste of public money to keep such ships as the *Powerful* and the *Terrible* in commission. The naval experience and professional skill which we have available should now be directed to the creation of a type specially designed for the inshore squadron. The Dreadnoughts are essentially ships for the open sea, beyond the range of torpedoes and free from the danger of floating mines.

In closing the discussion on this paper, Sir Wm. White pointed out that the responsible naval architect had to produce designs to fulfil conditions laid down by the Admiralty. The *Powerful* and the *Terrible* had been designed to deal with some large Russian cruisers which had been built for the purpose of harrying our commerce, and would certainly have done so satisfactorily had occasion arisen. Although ships should be put out of service when twenty years old, it did not follow that such ships then disappeared for all practical purposes. In 1884 the speaker had designed two cruisers for the Japanese, and these ships destroyed Russian cruisers in 1905, when, of course, they ought to have been non-existent. Two matters had to be specially considered in modern policy—power of concentration and power of distribution.

An interesting paper was contributed by Prof. J. B. Henderson on the elasticity of ships as deduced from experiments on the vibration of dynamical models. A dynamical model of the ship is constructed out of a bar of steel of uniform thickness and varying breadth, and is loaded with lead weights soldered on. The conditions are that the model must have a load curve similar to the load curve of the ship, and also a curve of moments of inertia of cross-sections about the neutral axis similar to the corresponding curves for the ship. The scale for the load curve need not be the same as that for the moment-of-inertia curve. The model has its frequency measured stroboscopically when supported at two nodes, the vibrations being maintained electromagnetically. Experiments have been made at the Royal Naval College, Greenwich, on models representing H.M.S. *Pathfinder* and the *Lusitania*, giving results for Young's modulus of 21,000,000 lb. and 23,000,000 lb. per square inch respectively for these ships. The method seems likely to be useful in dealing with other forms of riveted structures, such as bridges. Prof. Henderson also showed in his paper how the causes of vibration in a ship may be located from an analysis of the pallograph record, and applied the method to the records of the *Lusitania* and *Mauritania*. It must, of course, be understood that no criticism is being directed at special vibration in either of the last-mentioned vessels.

Some useful information on the applications of the internal-combustion engine to marine propulsion was given in two papers, one by Mr. H. C. Anstey and the other by Mr. F. R. S. Bircham, the latter having special reference to submarines. Mr. Anstey deals with questions of economy of fuel, weight, and space, and, using certain data, estimates that with powers of, say, 500 horse-power on one shaft, it seems reasonable to expect 12 horse-power to 15 horse-power per ton of machinery weight for a complete installation of oil engines without auxiliaries. The weights would be greater with gas engines on account of the necessity for installing gas producers. The author also deals with a method of splitting the power into a number of convenient units, and transmitting the energy to the propeller electrically. This method has not commercial advantages sufficient to warrant its use for mercantile work, and for naval work could not compete with existing machinery in the considerations of weight and space. Mr. Anstey considers that the installing of internal-combustion engines would, in general, save space, but no great saving in weight would result. The difficulties of producing very large gas engines of a type trustworthy enough for marine purposes were pointed out by Prof. B. Hopkinson, who referred especially to the difficulty of efficiently keeping large cylinders cool. The Marquis of Graham gave an interesting illustration of a vessel in which he had the reciprocating engines taken out and gas engines and producers substituted. He was satisfied with the trustworthiness of the new plant, and found that the radius of action of the vessel was doubled, on account of the lower fuel consumption per horse-power. The total horse-power in this instance was about 500. Sir Wm. White thought that progress in this matter must be gradual, and deprecated the popular exaggeration of the size of engine which could be installed.

Mr. Bircham discussed the advantages and disadvantages of the system of propulsion for submarines in which internal-combustion engines are used when on the surface and electric power when submerged. In Del Proposto's alternative method, one cylinder of a four-cycle four-cylinder Diesel engine is used as an air compressor when running on the surface in order to charge storage bottles to a high pressure, the remaining cylinders propelling the boat and driving the compressor. When submerged, this cylinder is used as an air engine, exhausting into the boat and keeping the air therein fresh. In Mr. Bircham's modification of this plan the internal-combustion engine is coupled to a multi-stage compressor, which is run as an air engine of the multi-expansion type when the boat is submerged; the exhaust is used by the internal-combustion engine, a part being turned into the boat to renew the air therein when required. Efficient cooling of every part of the internal-combustion engine is necessary, the cylinders being entirely jacketed and the exhaust pipes water-cooled to the boat's skin. This paper is illustrated with several working sections of engines suitable for submarine propulsion.

Lieut.-Colonel G. Rota, R.I.N., described some trials which he has made on a steamer in the Royal Dockyard at Castellammare di Stabia, first with a single screw and afterwards with two contrary turning screws of different diameters on a common axis and having a constant pitch, and also with another pair having increasing pitch in accordance with Prof. Greenhill's rules given in 1888. One of the propeller shafts was tubular, the other rotating inside the first, both driven in opposite directions from an ordinary reciprocating engine. The author of the paper found that a reduction of power required to maintain the same speed was obtained of from 30·5 per cent. to 26·8 per cent. for speeds of from 5 to 7 knots respectively, the comparison being between double propellers of constant pitch and a single-screw propeller. The gain with double propellers of increasing pitch at the same speeds amounted to 23·8 per cent. and 17·3 per cent. as compared with that required with a single propeller in use. The experimental vessel had a length of 46 feet, a breadth of 11 feet 9 inches, and a displacement of 25 tons. The gain is evidently due to the better guiding of the stream of water reaching the propellers, which are of smaller diameter when double than that required for a single propeller; the gain in wake is considerable. In this respect the effect of the fore propeller, acting as a guide to the water on its way to the after propeller, may be compared with that of the fixed guide-blades of a steam or hydraulic turbine. The author also points out the adaptability of turbines for driving the shafts, and thus dispensing with gearing; a special turbine for reversing would also not be required.

A note on a mechanical method for determining the thrust of propellers was contributed by Mr. J. H. Heck. In this method one of the tunnel shafts is utilised to form the ram of a hydraulic press, and a slight separation is allowed between two of the tunnel-shaft flanges, these being enclosed within a hollow cylindrical casing in which the shafting can revolve. The casing is fixed in the tunnel, and is made water-tight by means of stuffing-boxes. Water is supplied to the casing by means of a small force pump, and its pressure is indicated by a pressure gauge or recorder. On pressure being applied by means of the pump, the propeller shaft will be slightly forced out of the casing, and, on releasing the pressure, the thrust of the propeller will push it in again. The mean of the gauge readings during both movements of the shaft is taken in order to eliminate frictional effects. This mean pressure, when multiplied by the cross-sectional area of the shaft at the place where it is revolving in the stuffing-box, will give the total thrust of the propeller. The author describes some experiments made with this apparatus.

The offer made by Mr. A. F. Yarrow a year ago to defray the cost, up to 20,000*l*., of establishing an experimental tank at the National Physical Laboratory will be remembered, and the report of the experimental tank committee is of interest. A building subcommittee has been at work, the members being Sir Wm. White, Mr. R. E. Froude, Dr. Glazebrook, and Mr. W. J. Luke. At present 1240*l*. out of the guarantee fund of 2000*l*. per annum required for maintenance under the terms of Mr. Yarrow's offer has been secured, and it is hoped that the total amount will be shortly made up. Meanwhile, in order to avoid delay, the executive committee of the National Physical Laboratory has guaranteed 800*l*. per annum, and has entrusted Messrs. Mott and Hay with the preparation of plans. The committee has considered the question of the management of the tank, and proposes an advisory committee, appointed by the governing body of the National Physical Laboratory, consisting mainly of representatives of the Institution of Naval Architects. Steps will be taken to preserve the confidential character of all work done at the tank for private firms, as well as the arrangements for problems of general interest to be taken up, and the publication of the results of these Dr. Glazebrook has visited the most recent establishments of the kind in this country, and also in France and Germany, and the results of his visits of inspection are included in the report. The suggested dimensions of the

Bushy tank are:—effective length, 500 feet; depth of water, 12·5 feet; breadth of water, 30 feet; area of cross-section, 40 square yards; breadth of building, 42 feet; breadth of carriage, 31 feet; weight of carriage, 10 tons; velocity of carriage, 25 feet per second; horse-power on carriage, 50. The opinions expressed by the members at the meeting indicate that they are satisfied that these dimensions will amply provide for, not only ordinary commercial problems, but also for any special problems that may arise. One of the first systematic researches after the tank has settled down to its work will be the investigation of the many propeller problems regarding which little or no knowledge exists.

RURAL EDUCATION IN ITS VARIOUS GRADES.

THIS subject was discussed at a conference of the County Councils' Association held at Caxton Hall, Westminster, on March 31, under the presidency of Mr. Henry Hobhouse. The conference had been convened at the request of the Central Land Association, the Central Chamber of Agriculture, and the Farmers' Club, and was in every sense thoroughly representative.

A resolution was moved by Sir J. Cockburn to the effect that local education authorities should aim at securing better instruction in rural subjects, and that the teaching should be adapted to the circumstances of country life; school gardens and equipment for manual instruction should be provided, and elementary-school teachers should be specially trained for their work. The resolution was referred to a special committee.

To those unacquainted with country schools it must come as a surprise that such a resolution should be necessary nearly forty years after elementary education became the business of a Government department. Yet, as a matter of fact, it is only within quite recent years that the education of the country child has begun to have any sort of relation to his environment; he has been taught the same subjects as the town child, and in the same way, but often not quite as well. The teaching has been didactic, and has not necessarily involved any observation by the child of the things happening outside the school doors. For this the teacher has not been to blame, for country teachers, as a class, have as keen a professional spirit as town teachers, but the system has been at fault. Country children are sometimes said to be less intelligent than town children of the same class. This is emphatically not the case; on the contrary, the country child has often a larger stock of experience than the town child, and a proper system of education, based on his experience and dealing with the things about him, ought to give admirable results. It is much to be hoped that Sir J. Cockburn's resolution will be acted upon by those in authority.

After-education was also dealt with. The more promising children, it was urged, should be sent to secondary schools, where nature-study and elementary science teaching were given in close connection with practical work in the workshop and garden. The idea is admirable, but there would be considerable difficulty in getting to the school, especially in winter; while, if the children had to board at the school, the numbers would necessarily be very limited. Both elementary and secondary schools would remain under the Board of Education, but the more special agricultural education, the conference considered, should be dealt with by the Board of Agriculture. It was proposed that each group of counties should be connected with some agricultural college, which should be responsible for educating the students sent there, and for giving lectures and other instruction to farmers who cannot attend college. This system is already at work in some places, and was discussed in NATURE for March 25.

It will be observed that the resolutions were very comprehensive in their scope, and adequately covered the various problems of rural education. Whether the Boards of Education and of Agriculture could carry through so bold a scheme remains to be seen; it is undoubtedly to the interests of rural districts that they should.

To those wishing to learn the present position of higher agricultural education in England, a White Paper (Cd. 4569) issued by the Board of Education, giving certain tables of expenditure, will be useful. It was not possible to ascertain the exact amount spent on higher agricultural education, because in many cases agriculture only forms part of the work, and a fine estimate of what it receives is impossible. The Board of Agriculture grants are, of course, entirely *ad hoc*, but the Board of Education grants are for the whole institution. We find that the former Board gives 8800*l.* a year to colleges of university standing in England and 3350*l.* to smaller colleges and schools. The Board of Education gives 72,856*l.* and 25,496*l.* respectively. In one way and another the County Council grants must be considerable, but as a whole institution is often involved it is impossible to work out the exact share that agriculture gets. Four counties, viz. Bucks, Cumberland, Herefordshire, and Wiltshire, all active in providing rural education, spend between them about 10,000*l.* annually. The paper goes on to point out that the Board of Education is prepared to give still higher grants when a properly coordinated scheme is submitted to it, and we should imagine that considerable advantage will be taken of the offer.

SOME MARINE AND FRESH-WATER ORGANISMS.

IN the first part of vol. xcii. of *Zeitschrift für wissenschaftliche Zoologie*, Mr. L. Luders gives a full description of the wonderful ostracod crustacean described by Müller in 1895 under the name of *Gigantocypris agassizi*, together with a brief reference to the second species of the same genus. The first evidence of the typical species was a specimen dredged in deep water off Prince Edward's Island during the cruise of the *Challenger*, which indicated a veritable giant in the group, the shell measuring no less than 25 mm. in length and 16 mm. in width. Of the soft parts only the head was preserved, but this and the shell were sufficient to indicate the distinctness of the species from all shallow-water forms, and it was suggested at the time that it might prove to represent a new family group. In 1891 other examples were dredged by the *Albatross* off the Pacific coast at depths of as much as 1700 fathoms, and these were duly described and named by G. W. Müller. Another specimen was obtained by the Prince of Monaco off the Azores, while later still several others were dredged in deep water by the *Valdivia*. It is these last which form the subject of Mr. Luders's paper, where full details of the external form and anatomy of the species are given. One of the specimens collected by the *Valdivia* was dredged in the Gulf of Guinea, while the others were obtained in widely separated localities. This, together with the structure of the shell, suggests that it is a deep-sea pelagic organism, which does not, like other ostracods, live in sand.

In connection with the foregoing may be conveniently noticed a paper by Dr. Esther Byrnes on the fresh-water species of Cyclops of Long Island, published in No. vii. of Cold Spring Harbour Monographs. The observations in this monograph, which are based on several years' work, have special reference to the variability displayed by the fresh-water species of these crustaceans. Those from Long Island agree generally with the forms from the western lakes, and indicate their wide distribution. Variation of a varietal type is strongly developed, but much more so in some species than in others; it attains its maximum in the forms inhabiting stagnant waters, which can only exist at all by the power of readily adapting themselves to environment. Size is largely dependent upon habitat.

The American snapping shrimps of the genus Synalpheus form the subject of a memoir by Mr. Henri Coutière, published as No. 1659 (vol. xxxvi., pp. 1–93) of the Proceedings of the U.S. National Museum. Previous to the appearance of this paper six American species of the group were nominally recognised, under the generic title of Alpheus, but the author is unable to retain more than three of these names. On the other hand, he names a considerable number of new species, not only from American waters, but from other parts of the world. In No. 1663 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 173–7) Miss H. Richardson describes a specimen, from Wood's Holl, Massachusetts, of the isopod crustacean *Ancinus depressus* (=*Noesa depressa*, Say), of which only two examples were previously known.

To the third part of the *Bergens Museum Aarbog* for 1908 Mr. Alf Wollebœk contributes an important and lavishly illustrated article on the decapod crustaceans of the North Atlantic and the Norwegian fiords. The article commences with an elaborate account, illustrated by eight out of the thirteen plates, of *Caloxaris crassipes*, for which the new subgeneric term Calocarides is proposed. The rest of the article is devoted to various species of Macrura, with special reference to their distribution, both horizontal and vertical, and their habits and life-histories.

In the serial last quoted, No. 1658 (vol. xxxv., pp. 681–727), Prof. C. C. Nutting reviews the alcyonarians of the coast of California, the paper being based on the collections obtained during the cruise of the *Albatross* in 1904. Out of a total of thirty-eight species, twenty are referable to the pennatulid group. Many of these species are described for the first time, and the memoir is illustrated with a large number of figures. The writer saw only two kinds of alcyonarians in shallow water—both pennatulids; and as the coast appears to form an ideal habitat for such organisms, their rarity requires explanation.

No. 2 of vol. vi. of the Zoological Publications of the University of California is devoted to the Leptomedusæ of the San Diego region. Of eleven species of these jelly-fish recognised by the author, Mr. H. B. Torrey, in the collection of the Marine Biological Association of San Diego, no fewer than ten are described as new, two of these indicating new generic types, namely Tiaropsidium and Phialopsis.

The last paper on our list is the first portion of a memoir by Mr. W. Gariaeff, of the Zoological Laboratory at Villafranca, on the histology of the central nervous system of the cephalopods, published in vol. cxii. of *Zeitschrift für wissenschaftliche Zoologie*. In this instance the author deals with *Octopus vulgaris*.

THE INFLUENCE OF MOISTURE ON CHEMICAL CHANGE.[1]

THE influence of a trace of water vapour on a chemical reaction was first noticed by Prof. H. B. Dixon in 1880. He found that it was possible to pass electric sparks in a mixture of carbon monoxide and oxygen without explosion if the mixture had been very carefully dried. Shortly afterwards Cowper proved that dried chlorine had little or no action on several metals. Further observations were made by Prof. Dixon's pupils, the author in 1884 showing that carbon could be heated red hot in dried oxygen, that sulphur, and even the very inflammable phosphorus, could be distilled in the same gas without burning. Later experiments proved that ammonia and hydrogen chloride gases could be mixed without uniting, and that the readily dissociated ammonium chloride could be converted into a true vapour, and sulphur trioxide could be crystallised on lime, provided always that moisture was, so far as possible, removed. In 1902 it was shown that tubes containing very dry and pure hydrogen and oxygen could be heated to redness without any explosion resulting, and in 1907 that nitrogen trioxide could exist in the gaseous state if carefully dried.

Taken altogether, some twenty-five simple chemical actions have been shown to be dependent on the presence of moisture, and a few only, the burning of cyanogen, carbon bisulphide, and some hydrocarbons, seem to take place as easily when dried as when moist. In 1893 Sir J. J. Thomson showed that a potential difference of 1200 volts was unable to cause the passage of electric sparks through very dry hydrogen, and in the same year the author was able to stop the passage of the discharge from an induction coil by carefully drying the gas between the platinum points.

The amount of water necessary for the bringing about of chemical action is extremely small, less, in all probability, than one part in three hundred thousand of the reacting gases. Many hypotheses have been suggested for the explanation of its action. Prof. Dixon believed, in the case of carbon monoxide and oxygen, that the water vapour acted as a carrier of oxygen by alternate reduction and re-oxidation of the hydrogen. Traube imagined an alternate formation and decomposition of hydrogen peroxide. Dr. Armstrong in 1884 suggested a theory of "reversed electrolysis," the impurity of the water vapour rendering it a conductor. Sir J. J. Thomson in 1893 published a paper showing that if the forces holding the atoms of a molecule together were electrical in their nature, these forces would be very much weakened in presence of liquid drops of any substance of high specific inductive capacity such as water.

In 1895 it was shown that the newly discovered Röntgen rays were able to cause a gas to become a conductor of electricity, and it was thought, at that time, that the molecules of the gas were split up into atoms by this agency. If this were so, it seemed likely that in these circumstances chemical action would take place in absence of water, but a joint paper of Prof. Dixon and the author, in 1896, showed that the Röntgen rays, at the ordinary temperature, had no measurable effect on the combination of dried gases. Since that time, however, the researches of J. J. Thomson, Rutherford, Townsend, and others have proved that the ionisation of gases is of a different character.[1] The negative ions are extremely small particles of the mass of about 1/1000th part of the mass of an atom of hydrogen, the positive ion being the residue, but whether it is the residue of a molecule or of an atom seems to be still doubtful.

With the view of illustrating the influence of ionisation of gases on chemical change, the author devised a new experiment. It is known that mercury vapour, in ordinary circumstances, contains only atoms of mercury, which exhibit little tendency to combine with oxygen. The vapour, however, is ionised in the mercury vapour lamp, and when the current is cut off and oxygen is admitted shortly afterwards, the mercury becomes covered with a layer of mercuric oxide. Since the temperature of the lamp is much below that at which ordinary mercury vapour combines with oxygen, it is evident that in this case ionisation can bring about chemical action.

It is probable that this ionisation of mercury is different from the ordinary ionisation of gases. It may be regarded as the splitting off of an electron from the atom as distinct from a molecule, and the charged atom of mercury can then enter into union with oxygen. The cases mentioned above of combustions in oxygen which are apparently unaffected by the absence of moisture are perhaps to be explained in the same way. The gases are readily broken up into their elements, and it has been shown that carbon bisulphide breaks up at a lower temperature than that required for its burning. When these gases are heated charged atoms are probably formed, capable of direct union with oxygen.

To test further the question as to whether the ionisation of molecules, as distinct from atoms, as in the case of mercury vapour, can bring about chemical change, some recent experiments have been performed in which radium bromide was used as the ionising agent. Small quantities of this salt, contained in open silica tubes, were sealed up in tubes containing mixtures of hydrogen and oxygen and carbon monoxide and oxygen, the gases being very dry in some cases and moist in others. In no case was any chemical action observed, although the tubes were allowed to stand at 20° for more than two months. By means of a vacuum gauge the combination of 1/10,000th of the whole could have been detected. Another experiment showed that radium bromide was able to produce ionisation in very dry air, so that the want of chemical action in the above experiments must have been due to the fact that ionisation cannot of itself produce chemical action. There remained, however, the possibility of ionisation increasing the rate of union of two gases which were otherwise under conditions which would produce a slow chemical action between them. The reaction between nitrous oxide and hydrogen was found to be a suitable one for investigation, since it takes place

[1] Abstract of the Wilde lecture, delivered before the Manchester Literary and Philosophical Society on March 9, by Dr. H. Brereton Baker, F.R.S.

[1] The author finds that liquid water invariably collects in tubes containing salts of radium, though these salts are not at all deliquescent. In one experiment 10 mg. of radium bromide increased in weight by 1·5 mg. when allowed to stand for two days in an atmosphere saturated with moisture at 0° C. Examination of the crystals under the microscope showed that their edges were quite sharp, showing that the absorption of water was not due to deliquescence.

slowly and uniformly at 530°. It is known that many substances will, when heated, ionise gases. Lime is fairly effective in this respect, thoria to a much greater extent, and radium bromide is the most effective of all. Accordingly, tubes containing the mixture of not very dry hydrogen and nitrous oxide were prepared. One contained a little lime, a second some thoria, and a third some radium bromide. These tubes were heated in an electric resistance furnace side by side with comparative tubes containing the same gases in which was a small quantity of powdered Jena glass to make the conditions as similar as possible. It was found that the rate of combination was much quickened by the presence of lime, much more by the presence of thoria, while the gases in contact with radium bromide, directly the combining temperature was reached, combined with explosion.

When a tube containing thoria and the same mixture was dried for ten days by phosphorus pentoxide, the gases showed no measurable combination when heated for five minutes to 530°.

Hence increasing the ionisation in presence of moisture increases the rate of chemical change, while in absence of moisture it apparently has no effect.

An experiment of rather different type was shown which illustrates the way in which the ionisation of gases may exert its influence. A mixture of sulphur dioxide and sulphuretted hydrogen can be kept unchanged although water vapour is present in some quantity. If, however, liquid water is introduced, separation of sulphur is immediate. A small open tube of radium bromide was placed in such a mixture, and after standing some time the whole of the gases condensed in the small tube of radium bromide in the form of sulphur and water. There is little doubt as to what happens in this case; the water vapour condenses in liquid drops on the ionised particles in the radium tube, and in these drops the reaction between the two gases is completed.[1] In the other chemical changes at high temperatures it is conceivable that condensation to some form approaching the liquid state might take place, in which case Sir J. J. Thomson's theory would apply.

In support of this view must be mentioned some very recent experiments of Prof. J. S. Townsend, which show that a very great diminution in mobility of negative ions is produced when a mere trace of water vapour is added to a dried gas ionised by Röntgen rays. If there is any truth in this provisional working hypothesis, it should be found that ions and water vapour (or some similar substance) must both be present in a mixture of gases if action is to take place. Experiments already in progress seem to show that this is the case, but they have not been sufficiently often repeated for it to be desirable to publish the results at this stage.

The lecture was illustrated by experiments showing the influence of small quantities of moisture on chemical actions.

FUNCTIONS OF A UNIVERSITY.[2]

I AM often asked, What will the University of Bristol be, and what will it do? The obvious, if not very enlightening answer is, It will, in large measure, be and do that which the citizens of Bristol shall, in their wisdom, determine that it shall be and do. Bristol will have to show the educational stuff of which it is made. It must rise to the great occasion, and prove itself equal to the responsibilities of a city of the first rank.

A university is not primarily a place, or a group of buildings, or a board of examiners. A university is first of all a corporate body of men, and with us of women too, associated together for a definite purpose, and united by a common aim. A university is, or should be, I take it, a guild of learners. Mark you, I do not say a guild of so-called learned folk. I trust there will be learned folk in our guild, and I trust there will be those rarer folk, men of wisdom and character; but though learned men, and wise men, and men of character, help to make a university, they do not constitute the university which, as a guild of learners, is founded on a broader basis. Nor do the teachers constitute a university, though they too help to make a university of the first rank. The learners constitute the university, and when the teachers cease to be learners they ought also to cease to be teachers. If then the university, as a corporate body, is a guild of learners, and its buildings a temple of learning, all should be welcome in the university who desire to learn, and who have given evidence of adequate breadth of previous education, and the requisite ability to learn at the relatively high level which ought to characterise university work. That is the real and only value of the matriculation test. Each stage of a degree should guarantee not only a higher level of attainment, but also a further ability to learn, and to utilise what has already been learnt.

A university, then, is a guild of learners united together in a corporation in which, as Huxley put it, "thought is free from all fetters, and in which all sources of knowledge, and all aids to learning, should be accessible to all comers without distinction of creed or country, riches or poverty."

The university is not, and cannot be, a place for all; it must be a place for the *selected few*, those only who are capable and willing to do university work. What we have to secure is that there shall be equal opportunities for all, without distinction of riches or poverty. Like the polishing of gems, the higher education is a costly and a lengthy process. It is worth while to spend two years in fashioning a Cullinan diamond, and its value is thus enormously enhanced. To expend this time and labour on mere glass or paste would be a grave economic blunder. In the university we must select the material on which the time and labour of our educational lapidaries is to be bestowed; and it is worth while to take the most anxious care to find your precious stones if only they are true gems. If, say, within the next ten years the University of Bristol can find and fashion but one lad of real genius, who would otherwise be cut off from the highest training, Mr. Wills's investment of 100,000*l.* in the University will be economically justified. That is not merely an opinion of mine. Some of you may remember what Huxley said:—"I weigh my words when I say that if the nation could purchase a potential Watt, or Davy, or Faraday at the cost of a hundred thousand pounds down, he would be dirt cheap at the money. It is a mere commonplace and everyday piece of knowledge that what these three men did has produced untold millions of wealth, in the narrowest economical sense of the word." This is a point on which I feel strongly. As a matter of economic policy, from the national standpoint, I am convinced that 1000*l.* spent by a local education authority on the highest training of the best student will bear far higher interest to the community than the same sum spent in giving a smattering of education to a thousand evening students. Do not, however, misunderstand me. I am not denying that the latter expenditure is of value to the community. All I say is, this ought ye to do, and not to leave the other undone; but I do venture to add that we are not wise in the way in which we manage our national investment in education. As a nation we invest annually between thirteen and fourteen millions in elementary and secondary education in England and Wales. What is the amount of the Treasury grant to university education? About 142,000*l.*, a little more than 1 per cent.

The chief thing that should be learnt in a university is how the problems which arise in all serious work are to be approached, to be grappled with, and, if possible, to be solved. That is really the first and foremost thing to be learnt. A leading man of business, whom I met some years ago in the United States, told me that most of the younger men employed in responsible positions in his office held a university degree. I asked wherein lay the practical value of the degree for his purposes. He replied that such men had been trained to face and tackle problems, and he added that it did not much matter in what faculty they had been trained, or, in other words, what line of investigation they had followed during their university career. He contended that the university degree was the

[1] Since the phenomenon in gases is admittedly different from that in electrolysis, it is much to be regretted that the same term, ionisation, is retained for both.

[2] From a speech on the University of Bristol delivered by Prof. C. Lloyd Morgan, F.R.S., at the tenth annual dinner of the University College Colston Society, Bristol, January 14.

mark of a live man, and what he wanted in his business was live men. That was only one way of expressing the doctrine you have all heard preached. That doctrine concerns the value of research. For, after all, what is meant in this connection by research is just this, that the student is brought face to face with some of the living problems on the growing edge of his subject, and is shown how to deal with them. Such a training is invaluable; but it cannot be adequately tested by a written examination, nor even by a practical examination lasting only a few hours. Hence the importance of giving the teacher who has watched and supervised such work a voice—not, of course, the sole voice, but still an effective voice—in the selection of those on whom a degree is to be conferred. In all the provincial universities the teacher cooperates with the external examiner in gauging the capacity of an undergraduate, and so it will be in Bristol.

It must be remembered that the training of undergraduates, though an important part of the work of a university, is not its only work. A university is not only a place where knowledge is imparted, but where knowledge is made. Apart from the minor researches of undergraduates—which really constitute a training in research—there are the major researches of the staff and of post-graduate students. If the University of Bristol is to take its proper place in the community of provincial universities, the professors and lecturers must have the capacity, and must be given the requisite time, for such research. I will not enlarge upon this subject. I will only direct attention to the fact that there are important agricultural problems and some fishery problems which await solution in the district round us, and to the solution of which I trust the University of Bristol will contribute. The university should be regarded as the natural centre of research in such matters. There must be a great number of commercial problems on which skilled work is required. I should like to see the University specialise on some of these. We shall need, too, some local colour in our University. I cherish the hope that a Cabot chair of geography may be founded in Bristol, where a carefully organised training in this subject, both in its more academic and in its commercial aspect, will be developed.

I have, so far, refrained from making any reference to the system of education which has of late years been developed in Germany. Nor do I now propose to trouble you with statistics and details. On one salient characteristic I venture to comment. Mr. Haldane has directed attention to what he regards as a growing feature of German life, which finds expression in "the double aim of the German university system—pure culture, on the one hand, and on the other the application of the highest knowledge to commercial enterprise." Germany has realised, as England is only beginning to realise, and that somewhat slowly, that the application of the highest knowledge to commercial enterprise is the secret of industrial success. In England the university professor is too often regarded by practical men as an upper schoolmaster, whose doctrinaire notions are of little value outside his class-room or his laboratory; but when some months ago the Chancellor of the Exchequer went into one of the largest workshops of Germany, he was taken round by a professor. He asked what a professor had to do with it, and was told, "the professors are our experts." The Germans, Mr. Lloyd George said, get their ideas from their professors. He regarded the universities as factories where the future of the country is being forged, and he gave it as his opinion that there is no investment that will produce such a return, not to the investor, but to generations to come, as the endowment of higher education.

That, then, is one aspect of the function of a university. It should contribute to the work of the world at the highest level of efficiency. Twenty years ago Lord Salisbury said, "Man's first necessity is to live, his first duty is to work, and the object of education is to fit him for his work": but man does not live by work alone. To achieve success in commercial warfare in the field of industrial competition is not the sole aim of education. This alone will not make a nation great. You will perhaps pardon one who is, in part at least, a philosopher by trade, for quoting Aristotle:—"The whole of life," we read in his "Politics," "is divided into two parts—business and leisure, war and peace—and all our actions are divided into such as are necessary and useful, and such as are fine. We have to be busy and to go to war, but still more to be at peace and in the enjoyment of leisure. We must do what is useful and necessary, but still more what is fine. These are the aims we have to keep in view in the education of our children, and people of every age that require education." This is the doctrine of culture, a doctrine which, I trust, the University of Bristol will strive to carry out in practice not less sedulously than that of the application of the highest knowledge to commercial enterprise.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At the monthly meeting of the governors of the Imperial College of Science and Technology on April 2 it was decided, subject to the approval of the King in Council, to recognise the metallurgical department of the University of Sheffield as being in association with the Imperial College of Science and Technology for the advanced metallurgy of iron and steel, as provided for in the charter.

On April 2, at Edinburgh University, the honorary degree of LL.D. was conferred upon Mr. J. G. Bartholomew, hon. secretary Royal Scottish Geographical Society; Prof. A. Crum Brown, F.R.S.; Prof. W. Burnside, F.R.S., Royal Naval College, Greenwich; Prof. Taylor; Sir Alfred Keogh, K.C.B., Director-General of the Army Medical Service; Prof. C. H. Kronecker, University of Berne; and Dr. J. E. Sandys, Public Orator in Cambridge University.

Among recent gifts to higher education in the United States, *Science* announces a donation of 35,400*l.* from Mr. J. D. Rockefeller to the University of Chicago. The New York *Evening Post* states that the University of Missouri will receive 100,000*l.*, for the assistance of needy students, by the will of the late Mr. C. R. Gregory, of St. Louis. The Weyerhauser interests of St. Paul have given to the University of Minnesota 2200 acres of land in Carlton County for the use of experiments by the forestry department.

A committee has been appointed by the Treasury to consider the statements of claims to additional State assistance and estimates of the amounts needed for the respective services, which have been supplied by the Scottish universities at the request of His Majesty's Government; and to report as to what assistance, if any, should be granted from public funds in the interests of the proper development of the work of the universities, due regard being had to the coordination of their work with that of other institutions in Scotland giving instruction of a university standard. The committee is composed of the following members:—the Earl of Elgin and Kincardine, K.C. (chairman), Miss Haldane, Sir Kenelm Digby, G.C.B., Principal Sir Harry Reichel, Mr. C. M. Douglas, Prof. A. R. Forsyth, F.R.S., and Prof. G. Sims Woodhead.

Somerville College, Oxford, is offering, for the third time, a research fellowship of the annual value of 120*l.*, tenable for three years, for which application must be made before May 15 to Miss H. Darbishire, Somerville College, Oxford. The fellowship is now, for the first time, open to women students of Cambridge and Trinity College, Dublin, as well as of Oxford. The two fellows hitherto elected have done valuable original work. Miss E. Jamieson was engaged in researches among the archives in Monte Cassino, La Cava, and Sicily, with a view to the constitutional history of the reign of Roger II. of Sicily. Miss F. Isaac has been engaged in research on the nature and properties of supersaturated crystalline solutions and mixtures, and the results of her work have been published in the Proceedings of the Royal and other scientific societies.

The Board of Education has published a volume which contains particulars of the application of funds by local authorities in England and Wales to the purpose of education, other than elementary, in the financial year ended March 31, 1907. The returns deal with secondary education—including, not only secondary schools, but also the instruction of pupil-teachers—the training of teachers, the provision of scholarships, evening schools or the various forms of technical instruction, and higher education in science and in art generally. A diagram has been introduced into the Blue-book this year showing graphically, for three years, including 1906–7, the comparative rise and fall of certain selected items of expenditure, other than out of loans, of local authorities for classified groups of areas. The income from all sources for meeting the year's expenditure showed a total increase, as compared with the previous year, 1905–6, of nearly 213,000*l.*, and the increased amount raised from rates was equivalent to about 97 per cent. of that total. The total expenditure on higher education, as already defined, was, during the year, 3,680,718*l.*, as compared with 3,355,434*l.* in the previous year. In 1906–7 the expenditure under various headings was as follows:—for secondary education, 1,068,655*l.*; for evening schools and institutions for higher and technical education, 1,475,358*l.*; for exhibitions, including scholarships, bursaries, and the payment of fees, 448,769*l.*; for training of teachers other than pupil-teachers, 98,599*l.* In addition to these items, administrative and legal expenses accounted for 198,073*l.*, other expenses amounted to 120,320*l.*, and 220,480*l.* was paid in respect of loans.

The thirty-sixth annual dinner of the "Old Students" of the Royal School of Mines was held on March 30, under the chairmanship of Mr. F. W. Rudler, supported by many distinguished guests and old School of Mines men, as well as old students of the Royal College of Chemistry and Royal College of Science. The "Royal School of Mines" was proposed by Sir William H. White, who referred to the admirable record of the school and to the intention of the governing body that its reincarnation should render it second to none in the world. Mr. Rudler, in replying, referred to the early history of the school and to the necessity for combining theory with practice on the lines which had been laid down in drawing up the plans for the new laboratories and testing floors, and expressed the hope that it might be possible to found a chair of economic geology. The toast of "The Visitors," proposed by Mr. Bedford McNeill, was responded to by Mr. A. H. Dyke Acland, who pointed out that "character and grit," as well as the admirable training in the re-organised Royal School of Mines, are essential to a student's success. In concluding, Mr. Acland referred to the proposed students' union building, which he hopes will worthily represent the governors' desire for the bodily and mental welfare of the students, both of the Royal School of Mines and of the other colleges, &c., connected with the Imperial College of Science and Technology. In replying to the toast of "The Chairman," Mr. Rudler referred to the loss sustained by the mining and metallurgical professions by the death of Bennett H. Brough. Provision for the widow and children has been made by the Iron and Steel Institute, and it is now proposed to invite subscriptions for an entirely different purpose, which is for the formation of some permanent memorial to perpetuate the memory of one who was widely honoured and loved. Notices will be sent out shortly with the view of the foundation of a scholarship at the Royal School of Mines. All who knew Brough will agree that such a scholarship is the very thing which he would have desired, and that a more fitting occasion could not have been chosen for this—the first official announcement of what had been in the minds of so many since the death of their old friend.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 21.—"The Photo-electric Fatigue of Zinc.—II." By H. Stanley **Allen**. Communicated by Prof. H. A. Wilson, F.R.S.

In a former paper (Roy. Soc. Proc., A, vol. lxxviii., 483, 1907) an account was given of the way in which the photo-electric activity of zinc diminishes when the metal is exposed to light from a Nernst lamp.

The experiments described in the present paper were carried out to determine whether the results were similar when using a source of light giving far more ultra-violet radiation than the Nernst lamp. A mercury-vapour lamp of fused quartz was employed.

The method of experimenting was similar to that described in the previous paper, but the testing cell, consisting of the zinc plate and a positively charged sheet of wire gauze, was in the open air instead of being enclosed in a brass case.

Conclusion.—The photo-electric activity of a zinc plate decays in such a way that it can be represented as the sum of two exponential terms. The constants of change are but little altered by considerable variations in the character and intensity of the illumination employed, though the value of the photo-electric current is changed considerably. The rate at which the surface is altered is not greatly affected by using a mercury-vapour lamp in place of a Nernst lamp.

Royal Microscopical Society, March 17.—Mr. E. J. Spitta, vice-president, in the chair.—The optical examination of a crystal section in a rock slice: Dr. J. W. **Evans**.—*Synchaeta fennica*, sp.n., and on the resting-egg of *S. pectinata*: C. F. **Rousselet.**

Mineralogical Society, March 23.—Principal H. A. Miers, F.R.S., president, in the chair.—A stage goniometer for use with the Dick pattern of microscope: Prof. H. L. **Bowman.** The form of goniometer, intended to be screwed to the stage of a microscope with rotating Nicols, which was designed by Principal Miers, has been slightly modified by the author with the view of securing increased rigidity and ease of control. The instrument is adapted for supporting and manipulating a small crystal during the examination of etching-figures or other features requiring high magnification, as well as for the determination of its optic axial angle in air or oil, and the extinction angles and other optical characters of the various faces. It is provided with screw motions for adjusting and centring the crystal, and for regulating the height of the axis above the stage.—The electrostatic separation of minerals: T. **Cook.** Conductivity is a much more important factor than specific gravity in determining the behaviour of mineral fragments under the influence of an electrostatic charge. The greater susceptibility of good conductors as compared with bad conductors can be made still more pronounced by providing for the escape of the repelled opposite charge, which takes place rapidly in good conductors and slowly in bad conductors. It was shown that, in consequence of this fact, grains of such good conductors as ilmenite, pyrites, galena, or wolfram can be easily separated by means of a rubbed piece of sealing-wax from admixed grains of bad conductors, such as calcite, quartz, fluor, or monazite. Minerals having a metallic lustre are good conductors, whereas those which are colourless and highly transparent are bad conductors. It is suggested that there is probably a much closer connection between the conductivity of a mineral and its general optical properties than has been hitherto suspected.—The identity of guarinite and hiortdahlite: Dr. F. **Zambonini,** with chemical analysis by Dr. G. T. **Prior.** The rare mineral guarinite, which occurs sparingly in small yellow crystals in the sanidinite bombs of Monte Somma, has been hitherto regarded as orthorhombic, and as essentially a complex silicate of lime, alumina, and soda. A new investigation made by the author on crystals showing terminal faces shows that the mineral is really triclinic, and identical both crystallographically and optically with hiortdahlite. Crystals of guarinite show polysynthetic twin lamellæ with oblique extinctions like those exhibited by crystals of hiortdahlite. The chemical analysis showed that the mineral is essentially a fluo-silicate and zirconate of lime and soda, practically identical in composition with hiortdahlite, although the percentage of fluorine was lower than that given in Cleve's analysis of the latter mineral. The numbers obtained in the analysis correspond closely to a formula

$$3CaSiO_3.Ca(OH,F)Na.ZrO_3.$$

—Note to a paper on the comparison of refractive indices of minerals in thin sections: Dr. J. W. **Evans.** Parallel Nicols are placed so as to bisect the angle between the directions of vibration in the adjoining crystal sections which make the smaller angle with each other, so that the Becke effect is mainly due to the relation between their indices of refraction. The author discusses in detail the effect of the refractive indices of the different directions of vibration on the result.

Geological Society, March 24.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Glacial erosion in North Wales: Prof. W. M. **Davis.** An excursion around Snowdon in 1907, followed by another in 1908, led the author to think that a large-featured, full-bodied mountain of pre-Glacial time had been converted by glacial erosion during the Glacial period into the sharp-featured, narrow-spurred mountain of to-day. The indifference of topographic form to the trend of formation boundaries and the insequent stream arrangement are what might be expected as the result of prolonged erosion upon a mass of complicated and resistant structure. The author is of opinion that the upland deserves classification rather with peneplains; he suggests for it a Tertiary date, and argues that Snowdon had a relief of some 2000 feet above the plain. It is considered that the dissection of North Wales must have been less developed in pre-Glacial times than in Devon to-day. On this assumption it is possible to make a tentative restoration of the pre-Glacial form of Snowdon. The chief abnormal features of Snowdon are the following:—Alongside the summit and slopes of a "moel" stand the head-cliffs of a rock-walled cwm, in the floor of which talus is accumulating. The cwm-floors are generally stepped, and the streams cascade down into the valleys. The slope of the main valleys occasionally decreases even to the point of reversal, as where lakes occur, and in the immediate neighbourhood of smoothly graded, waste-covered slopes, knobby or craggy ledges and bars of rock often appear. Two out of four possible hypotheses put forward are discussed—"that glaciers are essentially protective agencies" or that they "are active destructive agencies." It is found that certain facts, and especially those relating to rock-steps, cannot be explained on the protection theory, while the theory of a destructive agency seems to explain most of the facts. There is no systematic relationship between the height of the cwm-cliffs and the distance of the front rock-step; the serration of "cribs" or *arêtes* cannot be explained by pre-Glacial or post-Glacial weathering, according to the protection theory. No consistent explanation of the valley-steps can be found under the theory of ice protection, whereas they are explicable on the assumption of glacial erosion. The catenary curve of the cross-section of such valleys as those containing Llyn Gwynant and Llyn Cwellin might be expected to result from long-continued ice erosion, and the occurrence of great cliffs on the sides of these valleys is not inconsistent with such an origin. The most striking case of a glacial overflow is that at the head of the Nantlle valley, which appears to have carried much of the west Snowdon ice. The head of the pass would seem to have been farther westward and higher in pre-Glacial times.

Dublin.

Royal Dublin Society, March 23.—Prof. A. F. Dixon in the chair.—Black scab or potato-wart (*Chrysophlyctis endobiotica*, Schilb.), and other Chytridiaceæ: Prof. T. **Johnson.** The author gave an illustrated account of the origin, structure, and conditions of germination of the multisporous resting sporangia of the parasitic fungus *Chrysophlyctis endobiotica*, Schilb., the cause of black scab or black wart in potatoes. The successful germination of the "resting spores" was announced in a letter to Nature in November, 1908. The author, basing his observations on the examination of type-material from M. Trabut, compared beet-tumour, due to Urophlyctis or *Cladochytrium leproides*, with potato-wart, and showed how they differ. He also discussed Magnus's views on the genus Urophlyctis, and stated that flax yellowing caused by *Asterocystis radicis*, de Wild., not uncommon in Ireland a few years ago, is now kept in check by potash manuring. *Eurychasma Dicksonii* (Wright), Magnus, and *Olpidium sphacellarum*, Kny, two Irish marine Chytridiaceæ, the latter being hitherto unrecorded for Ireland, were described.—The Scandinavian origin of the hornless cattle of the British Isles: Prof. James **Wilson.** The common opinion is that the British hornless breeds of cattle originated either as reversions to an older hornless type or as spontaneous variations, as Darwin believed, from the horned to the hornless condition. Both these theories are wrong, for these reasons:—(*a*) the self-same variation occurred in too many places—twelve or fifteen at least—in Britain; (*b*) it ought to have occurred as frequently among similar cattle elsewhere, in the Low Countries, for instance; and (*c*) it has ceased to occur within what might be called bovine historic time. The first suggestion that the British hornless cattle are of Scandinavian origin comes from the localities in which they were found in the eighteenth century. These were what might be called pockets round the coasts of Britain and in Ireland, viz. Suffolk, Holderness, Forfarshire, Aberdeenshire, Morayshire, Sutherland, Skye, Galloway, Somerset, Devon, and the north and west of Ireland. Besides being hornless, these coast cattle agreed in several other characteristics—they were light dun in colour, or bore colours derived from light dun; they were small, narrow chined, short legged, sickle-hocked, and good dairy cattle. They arrived in Britain before 1066, and not before the end of the Anglo-Saxon invasion. Cattle of the same kind were found in other Norse settlements, viz. Normandy, the Channel Islands, north Holland, Orkney, Shetland, and Iceland, and cattle of the same kind are still to be found from Norway to north Russia. In all probability they are descended from the cattle of the Scythians, referred to by Herodotus, and may be traced back either to Egypt or western Asia.—The osmotic pressures of the blood and eggs of birds: W. R. G. **Atkins.** The blood of *Gallus bankiva*, *Meleagris gallopavo*, Anas, Anser, and *Rhea americana* was examined, and the freezing point of the blood of each species was found to be almost constant, the variations being of the same order as those met with in mammals. The eggs of Gallus and Anas were studied; they are not isotonic with the blood, freezing at $-0^\circ{\cdot}45$ C., while the blood freezes at $-0^\circ{\cdot}61$ C. and $-0^\circ{\cdot}57$ C. respectively. This difference in the freezing point is more than accounted for by the diminution in inorganic salts in the egg as compared with the blood.

Paris.

Academy of Sciences, March 29.—M. Bouchard in the chair.—Complement and summary of the observations made at Meudon Observatory on Morehouse's comet: H. **Deslandres,** A. **Bernard,** and J. **Bosler.** After summarising the work which has been done on this comet, the following are mentioned as noteworthy points:—the presence of three new lines or bands ($\lambda\lambda$ 456, 426, and 401) of unknown origin, noticed for the first time in the tail of Daniel's comet; the presence of only one group of cyanogen bands; and the presence of a characteristic nitrogen band.—The diffraction of Hertzian waves: H. **Poincaré.** A mathematical investigation which throws light on the striking effects of diffraction obtained in wireless telegraphy over great distances.—Some extremely simple formulæ relating to the coefficient of self-induction and to the time constant of a very long bobbin: Marcel **Deprez.** The formula given for the coefficient of self-induction is L^2/a, in which L is the total length of wire wound on the bobbin, and a the length of the bobbin.—Concerning *Trypanosoma pecaudi*, *T. dimorphon*, and *T. congolense*: A. **Laveran.** Two sheep inoculated with *Tr. pecaudi* became infected; at the end of six months they were cured, and were completely immune against this organism. Inoculated then with *T. dimorphon*, they were infected like new animals. One of these, after cure, had not acquired immunity against *T. dimorphon*, but the other proved to be immune. The latter animal, then inoculated with *T. congolense*, contracted the infection. All these observations confirm the original view that these three trypanosomes belong to entirely independent species.—M. Boudier was elected a correspondant in the section of botany in the place of the late M. Masters.—Certain cyclic systems: G. **Tzitzéica.**—A general principle of uniformisation: Paul **Koebe.**—An arrangement for measuring very small displacements of the lines of the spectrum : H. **Buisson** and Ch. **Fabry.**—The hydrolytic dissociation of chloride of bismuth : René **Dubrisay.** If the equation usually given for dissociation,

$$BiCl_3 + H_2O = BiOCl + 2HCl,$$

the solution should be divariant at constant pressure; from thermochemical data an elevation of temperature ought to correspond with a diminution in the degree of dissociation. Both these conclusions have been experimentally confirmed.—The calculation of molecular weights by means of vapour densities. The case of toluene : A. **Leduc.** The author has applied the formulæ developed by him in previous papers to the experimental data of Ramsay and Steele for toluene vapour. The molecular weight thus deduced is 92·083, as against 92·088 deduced from the atomic weights, the difference being less than the experimental error. The method of reduction used by Ramsay and Steele gave a result nearly 0·5 per cent. different from this.—The radioactivity of the thermal springs of Bagnères-de-Luchon : Charles **Moureu** and Adolphe **Lepape.** The radioactivities of the gases given off spontaneously by the waters, and those of the waters themselves, have been determined. It is noteworthy that, in spite of the close analogy in composition and geological origin of these twenty springs, the radio-activities found are very unequal, and cannot be connected with any other physical or chemical property of the waters.—The impossibility of predicting by thermochemistry the relative stability of comparable compounds of lead and silver : Albert **Colson.** A study of the comparative stability of the carbonates and nitrates of lead and silver. The results obtained do not correspond with the heats of formation of these salts.—The preparation of some new silicon chlorides of the silicomethane series : A. **Besson** and L. **Fournier.** When the silent discharge is passed through a mixture of silicochloroform and hydrogen a reaction takes place, an oily liquid being deposited. From this the authors were able to isolate $SiCl_4$, Si_2Cl_6, Si_3Cl_8, all of which have been previously described. In addition to these, two new compounds are obtained, possessing the composition Si_5Cl_{12} and Si_6Cl_{14}. The method of preparation ensures the complete absence of oxychlorides.—The purification of hydrated sulphuric acid from arsenic by freezing : M. **Morancé.** A crude acid was partially frozen, the crystals formed being about one-half the weight of the acid employed. The percentages of iron and arsenic in the solidified acid were much less than in the original sample.—The colouring and tinctorial properties of picric acid : Léo **Vignon.** The coloration of solutions of picric acid in various solvents varies in the same sense as the electrical conductivity of these solutions.—The condensation of methyldiketobutyrate with hydrocarbons and with aromatic amines : A. **Guyot** and V. **Badonnel.** This ester undergoes condensation readily with dimethylaniline, diethylaniline, and toluene. The chief properties and reactions of the compounds thus made are given.—Allylcarbinol. Passage to the furfurane series : H. **Pariselle.** An improved method of preparing this compound from magnesium, trioxymethylene, and allyl bromide is described. The addition of bromine to the allylcarbinol gives

$$CH_2Br.CHBr.CH_2.CH_2OH,$$

and this, under the action of caustic potash, gives monobrom-tetrahydrofurfurane.—The cyclisation of the acyclic diketones : E. E. **Blaise** and A. **Koehler.**—The hybrids of barley and the law of Mendel : L. **Blaringhem.**—The natural immunity of snakes against the venom of batrachians, and in particular against salamandrine : Mme. M. **Phisalix.**—The incoagulability of the blood resulting from the ablation of the liver in the frog : M. **Doyon** and Cl. **Gautier.**—A method of coloration of the myelin of the peripheral nerve fibres, and on certain analogies between the microchemical reactions of myelin and mitochondria : Cl. **Regaud.**—Proof of the presence of *Treponema pallidum* in the cephalorachidian liquid arising from acquired syphilis of the nervous centres : E. **Gaucher** and Pierre **Merle.**—The therapeutical activity of d'Arsonvalisation : E. **Doumer.**—General experimental infection with hepatic localisation : A. **Le Play.**—Orientation in certain molluscs : Georges **Bohn.**—Cochineal of the south of France and Corsica : Paul **Marchal.**—A new genus of Zeinæ : A. **Cligny.**—The composition of the Lower Eocene in the south and centre of Tunis and Algeria : J. **Roussel.**—The Cretaceous escarpment of the S.W. of the Paris basin : Jules **Welsch.**—The age of the Primary limestones of the eastern Pyrenees : O. **Mengel.**—The Upper Cretacean of the basin of Seybouse (Algeria) : J. **Blayac.**—Analysis of the Arctic submarine deposits : J. **Thoulet.**—Lithological study of the deposits of the pool of Thau : L. **Sudry.**

DIARY OF SOCIETIES.

FRIDAY, April 16.

Malacological Society, at 8.—Description of *Pomatias Harmeri*, n.sp., from the Red Crag of Essex : A. S. Kennard.—Fossil Pearl Growths : J. Wilfred Jackson.—The New Zealand Athoracophoridæ, with Descriptions of Two New Forms : Henry Suter.—On the Family Ampullariidæ, No. 1, Ampullarina (*sensu stricto*), List of Species, Varieties, and Synonyms, with Descriptions of New Forms : G. B. Sowerby.

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THURSDAY, APRIL 15, 1909.

POPULAR SCIENCE.

(1) *Astronomy of To-Day. A Popular Introduction in Non-Technical Language.* By the late Dr. Cecil G. Dolmage. Pp. 362; illustrated. (London: Seeley and Co., Ltd., 1909.) Price 5*s.* net.

(2) *Scientific Ideas of To-Day. Popularly Explained.* By Charles R. Gibson. Pp. 344; illustrated. (London: Seeley and Co., Ltd., 1909.) Price 5*s.* net.

(1) WHILST possessing a thorough knowledge of any science, it is often found to be a difficult matter to coordinate one's facts so that the novice shall be at once sufficiently interested and efficiently instructed; but the former of these two works demonstrates to us that the ideal is not unattainable; the late Dr. Dolmage succeeded in a task in which so many writers have failed.

By the arrangement of the various branches of the subject, the reader is ever led from coordinated generalities to the more specific details, and is always prepared for what he is reading by the knowledge acquired from the previous chapters. Thus, while the general features of the solar system are expounded in the third chapter, the various members of it are not discussed in fuller detail until chapters xii.–xviii., the reader meanwhile being prepared for this fuller treatment by carefully reasoned chapters on gravitation, celestial distances and magnitudes and their measurement, eclipses, the evolution of methods of observation, and spectrum analysis.

Occasionally it appears that the endeavour to employ only popular language has resulted in some ambiguity. Thus the term "thicker" is applied to the sun's successive layers when, as shown in the succeeding paragraph, "denser" was presumably intended; but such slips are few in number and, to the general reader, comparatively unimportant.

In describing the planets the author accepted the conventional terminology, but protested against the use of "inferior" and "superior" instead of the more generally descriptive terms "interior" and "exterior"; certainly for the general reader the latter terminology appears to be preferable.

The discussion of Martian features, and their imports, is a difficult one for any writer of the present day to tackle, but in this volume the reader is given a very clear and concise statement of the various theories and their corroborative observations.

The chapters which follow deal in the same popular—yet scientific—manner with comets, meteors, the stars and the universe, and an interesting volume is brought to a close by two chapters dealing respectively with the beginning and the ending of things, the latter containing a graphic, if terrifying, picture of the collision of a dark sun with the solar system.

The twenty-four illustrations and twenty diagrams have been carefully chosen and well reproduced, and, with the clear statements of the text, they should certainly open the eyes of the "general reader" to most of the wonders of the universe surrounding him.

(2) Mr. Gibson's work, a companion volume of the "To-Day" series, is also intended for readers whose acquaintance with the latest concepts relating to the matter and motion around them is of the "general" order, and a great deal that has been said above concerning the good arrangement and clear statements of Dr. Dolmage's work may also be said of this volume.

The author's ideal is to explain in popular language how the matter around us is built up and how the energy affecting that matter is transformed, transmitted, and received. No previous knowledge of science or mathematics is assumed; all that the reader has to do is to take the subjects in the order in which they are discussed; he will then find that no serious difficulties occur because his previous reading has prepared him for what follows.

A marked feature of this book is the number of analogies by which the various actions and interactions are illustrated. These are selected from everyday life, and are always apt and illuminating, so that totally new ideas concerning, say, the construction of the atom, the nature of electricity, the causes of radio-activity, and like subjects are always clothed in a familiar garb.

The subjects dealt with are too diverse to treat *seriatim* in a brief notice, but they may be classified under the headings matter and its construction, the nature, measurement, and perception of various forms of radiation, energy and its transmission, gravity, the *aether*, and the origin of life. We are thus introduced to the latest ideas concerning electrons, the dissociation and association of atoms, radioactivity, spectrum analysis, action at a distance, and the origin of life and matter. In every branch the author remembers that he is endeavouring to reach minds previously ignorant of such matters, and is, therefore, very careful in his selection and definition of terms. Thus, for example, in order to avoid any possible ambiguity, he prefers "electrons" to "corpuscles," and employs "*aether*" instead of the "ether" now so often used, and in these and similar cases he discusses the reasons for doing so.

Four appendices give further information on various subjects, and should prove very useful in supplementing the necessarily brief explanations in the book itself. The first of these gives the ingredients of the world, *i.e.* the elements, their atomic weights, and the order, with dates, of their discovery. That these lists have been carefully prepared is illustrated by the fact that, in the last, helium is mentioned twice; discovered in the sun, by Lockyer, in 1868, and on the earth, by Ramsay, in 1895. Appendix ii. outlines the history of the modern theory of light, iii. gives particulars of *aether* waves, and iv. describes, more fully, the methods by which invisible electrons are counted and measured.

The forty illustrations are admirable; instead of the old-fashioned diagrams, with which he has been regaled so often, the general reader will find here reproductions of actual photographs, either of working apparatus showing just how the experiments are performed, or illustrating clearly the results obtained.

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These, with the concise and illuminating descriptions in the text, should give any reader of ordinary intelligence a very fair idea of the marvellous discoveries of modern science regarding the things and movements around him.

William E. Rolston.

RARE ELEMENTS.

Introduction to the Rarer Elements. By Dr. Phillip E. Browning. Second edition, thoroughly revised. Pp. x+207. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 6*s.* 6*d.* net.

During the last few years our knowledge of the chemistry and properties of the rarer elements has been largely developed, and the scientific and commercial interests connected with them having assumed considerable importance, the publication of a second edition of the above useful handbook is to be welcomed.

The scheme of the work remains the same as in the edition of 1903; with each element an account is given of its discovery, occurrence, extraction, properties, &c., concluding with more or less voluminous details of experimental research work. The revision has been very thorough; some matter dealing with supposed elementary substances, the existence of which has since proved more than doubtful, has been removed—for example, the so-called elements etherion, lucium, glaukodymium, &c. A chapter on radio-elements by Dr. B. B. Boltwood is included, and the section on rare earths has been largely increased, and much valuable matter added to it.

The description of niobium and tantalum has been brought up to date, and all that is known of the latter interesting and very valuable metal, with its chemistry and unique properties, is given. The gases of the atmosphere, argon, helium, krypton, neon, and xenon, with their history and properties, are described in detail, and several pages are devoted to an account of some of the technical applications of the rarer elements which greatly emphasises the importance of research among these practically unknown substances; the book concludes with a series of tables for the qualitative separation of the rarer elements.

Speaking generally, as might be expected from the repute and position of the author, the work is thoroughly practical and trustworthy, and is confined to a brief description of known facts, the author having wisely refrained almost completely from touching upon the huge mass of speculative matter that has unhappily been woven into this branch of chemistry; no mention is made of the alleged transmutation of copper into lithium by radium emanation, and no surmises are given of the results that may be expected to follow the production of so many pounds of radium, &c.; in fact, the brevity is carried to an extent that is almost to be regretted, but what is given is to the point. The chapter on the radio-active elements commences with a brief account of the discovery of radio-activity by M. Henri Becquerel, and of radium by P. and S. Curie and G. Bemont, with the properties of uranium, ionium, actinium, thorium, &c., and the section concludes with a table of radio-activities giving the "radiation emitted," "disintegration constant," and "half-value time period" for all the known radio-elements.

Much valuable matter has been added to the section on rare earths; a list is given of more than 170 rare-earth minerals, with the composition, percentage of yttria, ceria, thoria, and zirconia, so far as is known in each case; and in the portion dealing with the chemistry, a diagrammatic scheme for their separation is shown; this diagram is a novelty, and will be found a distinct help in elementary work on rare earths, but considering the obscurity that undoubtedly still surrounds the reactions of many of these bodies it can only be taken as suggestive.

It is much to be regretted that little or nothing is said about the spectra of these obscure bodies, particularly as it is by the study of their spectra that most of them have been recognised and isolated; the extremely characteristic spark spectra of yttrium, samarium, europium, ytterbium, scandium, and other elements are passed over without notice; when we take as only one instance the fact that the very rare element scandium can be directly detected in minerals containing it by a single observation, this is the more remarkable.

We may give as an instance of the present activity of research among the rare earths the fact that since this edition went to press the announcement has been made by G. Urbain and by Auer von Welsbach of the decomposition of ytterbium into two distinct substances.

It is a very great pity that the work has not been properly indexed; brevity in this direction is a decided disadvantage, and takes much from the usefulness of the work.

J. H. G.

A GENERAL HISTORY OF SCIENCE.

Aus der Werkstatt grosser Forscher. Allgemeinverständliche erläuterte Abschnitte aus den Werken hervorragender Naturforscher aller Völker und Zeiten. By Dr. Friedrich Dannemann. Dritte Auflage. Pp. xii+430. (Leipzig: W. Engelmann, 1908.) Price 6 marks.

Dr. Dannemann's book represents an attempt to trace the gradual growth of scientific knowledge by a superficial examination of critical epochs in which some new discovery has been made available or some truth apparent. It seems a very desirable, as it is a very pleasant, task to survey the whole history of natural science, to recall the men whose genius and achievements have widened the outlook, and given force and direction to new researches. Such a study may be pleasantly impressive and momentarily stimulating, but while it lacks in thoroughness and precision its educational value must be small. A student of a particular department of science should know, it is true, the successive stages by which that subject has advanced, and the author is quite justified in intimating that the study of the original memoirs in which the great masters have developed their results, in the language in which they have expressed themselves, is eminently calculated to present the clearest insight into the processes that have been employed and the reason for the direction which progress has taken. It is a long cry from the ancient Greek to the modern physicist, from Aristotle to Pasteur, and by a few scanty references to the work of eminent men in past centuries we do not get any continuous picture of the growth of any one science, be it physics or chemistry, zoology or botany, geology or astronomy, for all these and some others figure within the modest compass the author allows himself.

A comparison with Ostwald's "Klassiker der Exacten Wissenschaften" would be inevitable, even if the author had not frequently directed attention to that work, and occasionally availed himself of its contents. Such comparison is, however, to the disadvantage of the present work. In that case, the classics of science hitherto accessible only to the few were made available to the many. Specialists, each eminent in his own branch of science, were responsible for the presentation of the work, each in his own department, to which ample space was allotted. But here the only arrangement that can be recognised is roughly chronological, and the student is led from subject to subject without leisure to concentrate his attention upon any. Perhaps there is no great reason to quarrel with the choice of researches the author has made in order to illustrate particular phases in the history of discovery. No selection could be entirely satisfactory when there is overlapping of research or contemporaneous advance. Why, for example, should Torricelli be omitted and Guericke appear, or Celsius be chosen in preference to Reaumur? Sir William Herschel finds a place, Bradley does not; Chladni discusses the origin of meteors, Schiaparelli is passed over in silence. One might ask whether Humboldt and Goethe fairly come within this scheme, or whether Darwin is adequately represented by an extract from the "Journal of the *Beagle*," or Helmholtz by a quotation from a popular lecture? But it would be unfair not to remember and admit that this work is only a portion of a larger treatise. It is the first volume of a "Grundrisz einer Geschichte der Naturwissenschaften," and possibly if the whole treatise were before us the scheme could be better appreciated.

SANITARY SCIENCE.

The Essentials of Sanitary Science. By Gilbert E. Brooke. Pp. xii+413. (London: Henry Kimpton, 1909.) Price 6*s.* net.

THE author of this work states in his preface that he hopes it will meet its aim of covering all the necessary ground for the student preparing for the diploma of public health, and that he has endeavoured to make it as useful in the laboratory as in the study; furthermore, he hopes it may also be useful to sanitary officers and medical officers of the public services. A glance suffices to make it plain that he has not achieved his aim. He has failed because he attempted the impossible when he set himself the task of covering the whole range of the science and practice of hygiene and public health within the narrow compass of a small, handy volume. The work is, in fact, little more than a digest or summary, which is not suited to the student's needs, and the lack of detail is also an essential respect in which it will fail to meet the needs of the public-health official. It is not sufficient, for instance, to tell the student for the diploma of public health that in reference to the working of a barometer, corrections have to be made for capillarity, temperature, and altitude (p. 29), when his examiners expect him to know how these corrections are made; nor is it sufficient to offer a sanitary official, presumably for reference purposes, a digest of sanitary law in which the whole of the important and complicated subject of legislation dealing with the food supply is dismissed in a page and a half of printed matter.

Although the general scrappiness of the information so materially limits the value of the book to the student and practitioner alike, it possesses some good points which add to one's regret at having to criticise unfavourably the work as a whole. Little fault can be found with the selection made of the material dealt with. Indeed, for the most part it is wise and in good proportion; but a glaring exception to this rule is to be noted in the case of tuberculosis, which is not mentioned in the index, and is only referred to in connection with dust and milk in the text of the book. Again, there are few instances of inaccuracies the faults of commission, in fact, sink into insignificance before the all-prevailing faults of omission; but an insufficient statement of the subject is often responsible for leading the student by implication to erroneous conceptions. In this connection the author's attention is directed to the fact that for the purpose of aërobic bacteriolysis it is not usual to put a layer of sand on the top of the filter and another layer at the bottom immediately over the effluent pipes; nor is the average composition of crude sewage in this country represented by albuminoid ammonia in the amount of 0·28 of a part per 100,000.

It is conceded that a vast amount of information is comprised within the small compass of the work, but it is information of a scrappy and incomplete order, and information in respect of which essentials, both from the standpoint of the student and practitioner, are omitted. As evidence of the justice of this statement it is not necessary to do more than direct the reader's attention to the fact that the bacteriological examination of water is dismissed in three and a half pages, or not much more than 100 lines of print; that to the chemical examination of disinfectants three-quarters of a page of printed matter is devoted, and carbolic acid is the only disinfectant dealt with; and that the important subject of school hygiene, the importance of which to the public-health student cannot well be exaggerated now that the Education (Administrative Provisions) Act is a force in the land, is dismissed in four pages.

Dr. G. E. Brooke has had experience both as a health officer and a teacher, and is the author of one or two useful handbooks, and he must realise that this work stands in need of a considerable extension if it is to meet the objects for which it was designed.

CRUSTACEA OF NORWAY.

An Account of the Crustacea of Norway. By Prof. G. O. Sars. Vols. i.–v. Vol i., Amphipoda. Pp. 708; 248 plates. Vol. ii., Isopoda. Pp. 270; 104 plates. Vol. iii., Cumacea. Pp. 115; 72 plates. Vol. iv., Copepoda Calanoida. Pp. 171; 108 plates. Vol. v., Copepoda Harpacticoida. (Bergen: Published by the Bergen Museum, 1890–1908.)

THE monumental work under the above title by Prof. G. O. Sars, of Christiania, is still being added to, although the first parts appeared so long ago as 1890. It is indeed no small task that the distinguished author has set himself. From the first he proposed to give a description of all the species of Crustacea hitherto known from Norway, and furthermore, to accompany the diagnoses by accurate figures of all the forms. There was no doubt that a work so extensive and so profusely illustrated would prove of great value to all systematic workers, but there was also little doubt that the publication would spread over years, and the work extend to hundreds of pages and a great number of plates. This has proved to be the case, for the most recent parts published (parts xxiii. and xxiv. of vol. v., 1908) bring the total up to 1540 pages of letterpress and 724 plates.

It is seldom that a work of this kind has been so lavishly illustrated, but Prof. Sars rightly urged that trustworthy figures enable a species to be indentified much more easily than the most elaborate descriptions. The plates have been produced by the "autographic" process, and while this falls short of first-class lithography, the figures are all of a good size, and quite sufficiently illustrate the points at issue. Those who have had occasion to use the plates for purposes of identification will agree as to the accuracy and care with which the drawings have been executed.

The first volume of this work—that on the Amphipoda—was published by a Christiania firm during the years 1890–95. The publisher not wishing to continue, there was some danger that the account would come to a premature end, until the Bergen Museum, with commendable public spirit, stepped in and undertook the responsibility of publishing the remaining volumes.

The scientific study of fishery problems is of comparatively recent growth, but nowadays a knowledge of the smaller Crustacea, which are so important a part of the food of fishes, is essential, and it is precisely these forms which Prof. Sars is making recognisable by his valuable work. British fishery experts cannot fail to find these volumes indispensable, for they refer to species a large proportion of which occur also in British waters.

It has been far too generally assumed that the Copepoda is a group containing principally pelagic forms. That this is by no means the case is emphatically shown in the present work. Vol iv., dealing with the Calanoida, which are in the main plankton forms, contains descriptions of sixty-eight species. The yet incomplete fifth volume, devoted to the Harpacticoida, which are mostly true bottom forms, has already treated of 182 species, without by any means exhausting the subject. When completed this will furnish the first adequate account ever published of this very extensive and important group.

Besides giving descriptions of a considerable number of new genera and species, the author has rendered perhaps even greater service by furnishing us for the first time with the means of identifying numerous species established by other writers, but only briefly described, and either unfigured or figured very imperfectly. It cannot be doubted that this work is one of the most important contributions ever made to our knowledge of the Crustacea, and that Prof. Sars deserves the thanks of the scientific world for publishing it in a manner which renders it so readily accessible.

W. A. CUNNINGTON.

BRITISH FUNGI.

Synopsis of the British Basidiomycetes: a Descriptive Catalogue of the Drawings and Specimens in the Department of Botany, British Museum. By Worthington G. Smith. Pp. 531; 5 plates and 145 figures in text. (London: Printed by order of the Trustees of the British Museum, 1908.) Price 10s.

A MODERN handbook dealing in a concise form with all the larger British fungi has long been desired by mycologists in this country. The appearance of Mr. Worthington G. Smith's "Synopsis" meets this desire in so far as it contains in one volume descriptions of all the British Basidiomycetes (*sensu* de Bary).

The new work is of a more popular character than either Lister's monograph of the Mycetozoa or Crombie's Monograph of the British Lichens, references to literature and synonymy being omitted. The genera are provided with keys to the species, and the latter bear numbers which correspond to those of Mr. Smith's fine series of coloured drawings in the British Museum. The descriptions are almost without exception confined to field characters, and are for the most part brief. Each genus is illustrated by line drawings. The derivation of both generic and specific names is given, and a full glossary is appended.

As stated on the title-page, the synopsis is a descriptive catalogue of the drawings and specimens in the department of botany in the British Museum, and for this reason the sequence of genera is practically that of Fries's *Hymenomycetes Europoei* (1874). In Fries's arrangement of the Agaricaceæ the large genus Agaricus (comprising groups of subgenera arranged according to their spore-colour) is placed first, followed by a number of other genera, also grouped together according to the colour of their spores. Modern writers have given Fries's subgenera generic rank, and have modified his arrangement so as to bring all the genera together according to their spore-colour. The author of the present work treats Fries's subgenera as genera, but leaves them in the same sequence as the *Hymenomycetes Europoei*. To a number of amateur mycologists who are accustomed only to the more modern method, this arrangement will probably be somewhat inconvenient.

Spore-measurements are omitted throughout the entire work, the author regarding the existing records as untrustworthy. This has to be admitted to a certain extent, but could some of the spore-measurements from recent critical work have been included, the value of the descriptions would have been much increased. Everyone who has paid serious attention to the spores of the larger fungi knows that these structures are often of the greatest help for systematic purposes, and it is to be hoped that before long spore-characters will always form an essential part of the diagnosis.

Novelties in the form of new genera and species are few. Attention may be directed to the new genus Togaria, into which the author has placed all the terrestrial species of Pholiota. The recent additions to the British flora have been incorporated, but it is to be regretted that names now known to be synonyms still figure as independent species. A very large number of changes will be observed in the authorities quoted for the Agaricaceæ. This is due to the fact that the author has followed the Vienna rules with regard to the raising of subgenera to the rank of genera.

The book will be of most help to the beginner, and should prove a useful introduction to the study of Basidiomycetes. In the case of the Agaricaceæ several seasons' experience will be necessary before the student acquires much confidence in determinations derived from book descriptions. The diagrams at the end of Smith's synopsis should aid in grasping the generic features, and the numerous keys should save much time in identifying the species.

A. D. C.

OUR BOOK SHELF.

The Planning of Fever Hospitals and Disinfecting and Cleansing Stations. By Albert C. Freeman. Pp. viii+165. (London: The Sanitary Publishing Company, Ltd., n.d.) Price 7s. 6d. net.

This is a work compiled by an architect more particularly for reference purposes by other architects. It provides a practical guide to the planning of fever hospitals, disinfecting and cleansing stations. It contains a large number of plans showing in detail the construction of many fever hospitals which have been provided during recent years; and although the object of the author has been to place before his readers only those examples which demonstrate the most approved principles of design or other points of special interest, several of the plans reproduce the features of other designs and present no essential differences in the details of construction. Mr. Freeman devotes about thirty-five pages to a consideration of the general principles of design and construction in reference to fever hospitals, disinfecting and cleansing stations, and then devotes the rest of the book to the plans and more important features of construction above referred to. The scheme is a good one; but it is a question whether the purpose of the book might not have been even better served if the author had extended his statement upon the most approved features of design and construction, by giving the reader the benefit of more of the opinions and criticisms of one who has evidently made a special study of this matter, and then presenting the plans and details of construction of about a dozen existing hospitals which are specially commended.

The manual embodies much useful information, and it cannot fail to be of value to those who are called upon to design and construct hospital buildings. On the subject of disinfecting stations the work is not likely to be so generally useful. This section of the book stands in need of extension, and here and there of slight amendment. If, for instance, the various types of steam disinfectors are to be dealt with in such a book, the present statement is insufficient. One of the less well-known steam disinfectors (the Velox) is the only apparatus illustrated, and, indeed, the only one which is fully described. The description, moreover, is not so clear as it might be. On p. 148 it is stated that among the practical advantages claimed for this type of machine is the fact that there is no boiler to require scaling, whereas it is stated in the next paragraph that there is a boiler employed to raise steam.

Photographic Optics and Colour Photography, including the Camera, Kinematograph, Optical Lantern, and the Theory and Practice of Image Formation. By Dr. George Lindsay Johnson. Pp. xii+304. (London: Ward and Co., 1909.) Price 7s. 6d. net.

The author is "examiner in photography and theoretical and applied optics to the Spectacle Makers' Company," and states that the primary object of this volume is to cover the ground of this company's examination. The first chapter deals with cameras in a popular rather than a scientific manner. The next two chapters constitute about half the volume, and deal with photographic lenses and the optics relating to their manufacture and use, including the consideration of shutters and artificial illumination. The remaining sections of the book deal with sensitometers, and the other subjects mentioned in the title.

With the exception, perhaps, of the strictly optical part, the various items receive very unequal treatment. Although a whole chapter is devoted to sensitometry, Hurter and Driffield's method, which is the only method stated to be "largely used," is disposed of in the following sentence:—"A sensitometer consisting of a rotating sector, furnished with a ring divided into steps, is now largely used in England, and was invented by Messrs. H. Hurter and Driffield." Dr. Hurter's Christian name was Ferdinand, and his is not the only name given incorrectly. We should like to know what the author means, when referring to the action of light upon a sensitive plate, by the statement that "the light acts on the gelatine substratum and starts freeing the hydrogen." There are many other parts that will certainly mislead the student as they now stand, as, for example, two pages devoted to what appears to even a careful reader to be an attempt to prove by calculation that the focal length of a lens has a direct influence on the relative proportions of the images of objects at different distances. We notice, too, errors in some of the illustrations. The volume needs a thorough revision.

Untersuchungen fossiler Hölzer aus dem westen Vereinigten Staaten von Nordamerika. By Dr. Paul Platen. Pp. xvi+155; with three plates. (Leipzig: Quelle and Meyer, 1908.) Price 3 marks.

The Tertiary rocks of some of the south-western portions of the United States have been long known to be remarkable for the abundance and diversity of the silicified trunks of Coniferous and Angiospermous woods, often beautifully preserved, which they have yielded. In this dissertation Dr. Paul Platen, a pupil of Prof. Felix, of Leipzig, whose work on the anatomy of petrified woods is widely known, has described the structure of a considerable number of trunks, for the most part of Tertiary age, from California, Nevada, Texas, Arizona and elsewhere, including also two specimens from Alaska. The great majority of the woods have proved to be Angiospermous, and two new genera, with many new species, are attributed to the families Quercineæ, Simarubaceæ, Araliaceæ and Platanaceæ among others.

Several Coniferous trunks of the Pityoxylon, Cupressinoxylon and other types are also described, and the author contributes some interesting diagnostic conclusions respecting a comparison of the structure of the wood of the recent Sequoia and Taxodium with the fossil stems known as Cupressinoxylon. Certain pathological features observed in some of the Coniferous woods, and in one case the presence of a parasitic fungal mycelium, are also noted.

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 intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Rate of Fall of Fungus Spores in Air.

In the year 1905 I made what I believe was the first direct test of Stokes's formula for the fall of small spheres in air by using spores liberated spontaneously from the pilei of the mushroom and of allied fungi. The conclusion to which I then came was that the spores of these fungi fall at a rate which is roughly in accordance with Stokes's formula, and this fact was announced by Prof. A. J. Ewart in his translation of Pfeffer's "Physiology of Plants" (vol. iii., 1905, p. 416). The results of further observation were communicated to the Royal Society in 1907 in a paper which I subsequently withdrew.[1]

Recently, Messrs. Zeleny and McKeehan,[2] of the University of Minnesota, have announced that they have made a direct test of Stokes's formula by using lycopodium powder. Their method of measuring terminal velocity consisted in allowing the powder to fall in wide tubes and noting the rate of movement of the centre of the cloud. They came to the conclusion that, for lycopodium spores, the formula gives velocities 50 per cent. in excess of those observed.

In view of the fact that a correct determination of the rate of fall of small spheres in air has now become of considerable importance in connection with the cloud method used by Sir J. J. Thomson and Dr. C. T. R. Wilson for investigations upon the electronic charge, and also because the full details of my experiments will not be published for some months, I have thought it advisable to make a preliminary statement with regard to my methods and results.

The following equation represents what is known as Stokes's law for the fall of small spheres in a viscous medium :—

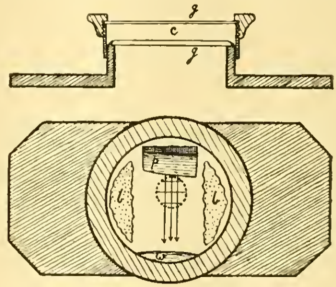
$$V = \frac{2}{9}\frac{\rho - \sigma}{\mu} g a^2,$$

where V = the terminal velocity, ρ the density of the falling sphere, σ the density of the medium, g the acceleration due to gravity, a the radius of the falling sphere, and μ the viscosity of the medium. The new data which were required for testing the law for the fall of small spheres in air by my method were the terminal velocity, the density, and the radius of the fungus spores.

After a considerable amount of preliminary experimentation, the spores of *Amanitopsis vaginata* were chosen for a critical test of Stokes's law, for the following reasons :—

(1) they are spherical, except for a tiny "tail," and smooth-coated; (2) they are sufficiently large, so that one can measure their diameters, which are about 10 μ, very accurately; (3) their density is almost that of water, and can be measured within 1 per cent. of accuracy; (4) they can easily be procured.

The average diameter of the spores was obtained by measurements made with the Poynting plate micrometer as applied to the microscope. The density of the spores was determined by the heavy fluid method. Drops containing the spores were placed in the tiny chamber of an apparatus used for counting blood corpuscles, and observations were made as to whether the spores rose or sank in the fluid. The terminal velocity of fall was found in the following manner. A small piece of a pileus of *Amanitopsis vaginata*, including portions of three gills, was placed in a compressor cell in the position shown at p in the accompanying figure. To prevent the falling spores from drying, two pieces of soaked blotting-paper or cotton wool, b, and a drop of water, w, were then added. Upon the cap being adjusted, the piece of fungus became fixed by slight compression and hermetically sealed in the disc-shaped chamber, of which the base and top were of glass (g). The compressor cell was then placed in a vertical position, so that the gills came to look downwards in the natural manner. Thus enclosed in the chamber, the gills continued to rain down spores for some hours. With a horizontal microscope having a magnification of about 25 diameters, a field was focussed just beneath the gills, and the spores were observed crossing the eye-piece



Plan and Section of the Compressor Cell.

lines. In the figure the field is shown by the dotted ring, and the course of three falling spores by arrows.

On viewing the field just below the gills, spores can be seen as distinct, but only just visible, minute, dark objects steadily crossing the field in a vertical direction. Every spore so falling is not in focus, but when the fungus material is in good condition spores in focus come into view at least every five seconds. Convection currents in the tiny chamber are reduced to a minimum, and produce no disturbing effect on one's observations. Even with the minute spores of *Collybia dryophila*, which take about eleven seconds to cross a field 4·55 mm. wide, the direction of fall is vertical, and there is practically no swerving from the course. The records of the velocity of fall of the spores were made with the aid of a large drum, which was driven by electricity, and was provided with a delicate regulator. To the recording fountain pen was attached an electric tapping key, by the depression of which with the finger the passage of each spore across the field of view became recorded on the drum paper. The drum records of the fall of 100 spores served to give the average time taken by the spores in falling a distance of 4·55 mm.

The following table gives a summary of the data obtained in testing Stokes's law. The velocities were the average velocities of 200 spores in Specimen I., of 100 in Specimen II., and of 50 in Specimen III. The densities are doubtless correct to within 1 per cent. The diameters are the average diameters for at least fifty spores. The

[1] The paper, which was partly botanical and partly physical in character, was accepted for publication in the Philosophical Transactions of the Royal Society on conditions which I was unable to accept. This paper, together with other researches, is in course of publication in a book called "Researches on Fungi. The Production, Liberation, and Dispersion of the Spores of Hymenomycetes treated Botanically and Physically, &c." (Longmans, Green and Co.).

[2] "An Experimental Determination of the Terminal Velocity of Fall of Small Spheres in Air." A paper read before the American Association for the Advancement of Science. Abstract in *Science*, March 19.

chamber was closed in each case for half an hour before observations of velocity were made.

Fruit bodies of fungus	Density of spores	Diameter of spores in μ	Observed terminal velocity in mm. per sec.	Calculated terminal velocity in mm. per sec. for a sphere with density and diameter equal to those observed for the spores	Actual terminal velocity exceeded calculated by a percentage of
Specimen I.	1·02	11·65	6·07	4·14	47
Specimen II.	1·02	10·19	4·85	3·21	51
Specimen III.	1·02	10·87	5·11	3·64	40

From the results just given it is clear that the figures obtained by observation for the rate of fall of the spores are of the same order of magnitude as those demanded by Stokes's law. However, the law is not confirmed in detail, for, as an average of the three experiments, it was found that the actual velocity of fall of the spores was 46 per cent. greater than the calculated. I have not been able to find any satisfactory explanation for the discrepancy between observation and theory.

My method for testing Stokes's law appears to have various advantages over that used by Zeleny and McKeehan, for the following reasons:—Amanitopsis spores have smooth walls, and are practically truly spherical, whereas lycopodium spores have sculptured walls, and are four-sided. Amanitopsis spores have a diameter only one-third as great as lycopodium spores. In the tube method convection currents cannot be eliminated, and it must surely be somewhat difficult to decide the exact centre of the spore clouds. By my method of using a very small chamber the difficulty of convection currents was reduced so as to be negligible, and the velocities of the individual spores could be measured with considerable accuracy. Amanitopsis spores are liberated spontaneously by the fungus, whereas lycopodium powder requires to be set in motion by artificial means.

In conclusion, I wish to thank Prof. J. H. Poynting for permitting me to carry out the experiments here recorded in the physics department of the University of Birmingham, and also Dr. Guy Barlow for valuable criticism.

A. H. Reginald Buller.

The Botanical Department, University of Manitoba, Winnipeg, March 25.

Ionisation by Röntgen Rays.

The relative ionisations produced in different gases by beams of X-rays have been found by many investigators to depend so markedly on the penetrating power of the X-rays used that no regularity in behaviour has been discovered (see Mr. Crowther's paper "On the Passage of Röntgen Rays through Gases and Vapours," Roy. Soc. Proc., January 14).

Recent experiments which I have made upon homogeneous beams have, however, shown the connection between ionisation, secondary radiation, and absorption in a most striking way. As in the case of absorption phenomena (see letter to Nature, March 5, Barkla and Sadler), a knowledge of the secondary radiation characteristic of an element is essential and sufficient to explain many of the phenomena of ionisation.

In order to test if such a connection existed, the first substance experimented upon was ethyl bromide—a substance which has been investigated in some detail by Mr. Crowther.

By using homogeneous beams of X-rays, I found that all radiations experimented upon which are not more penetrating than the secondary radiation characteristic of bromine (coefficient of absorption in Al = about 50) produce ionisations which are proportional, or at least approximately proportional, to the ionisation produced by the same beams in air.

When the radiation passed through the vapour was made more penetrating than the radiation characteristic of bromine, the ionisation rapidly increased—that is to say, the ratio of the ionisation in ethyl bromide to that in air rapidly rose to several times its original normal value. It was found to be essential to the production of what may be called the abnormal ionisation simply that the primary radiation be more penetrating than the secondary radiation which bromine emits. This result must be connected with the results of experiments on absorption and secondary radiation.

Thus, when an X-radiation incident on a substance R is softer than the secondary radiation characteristic of R, it is absorbed according to a simple law, the absorption being approximately proportional to the absorption in any other substance in which a characteristic radiation is not excited; it produces no appreciable quantity of this secondary radiation, and it produces what may be called a normal ionisation in R. When the incident radiation becomes more penetrating than the secondary radiation characteristic of R, it is absorbed by an amount greater than given by the law stated; it begins to excite the secondary radiation in R, and it produces an increased ionisation in R. The absorption and ionisation increase to several times their previous value, while the intensity of secondary radiation becomes very great.

As the penetrating power of the incident radiation is increased still further, the absorption by R diminishes, and the secondary radiation excited in R diminishes at the same rate as the ionisation produced by the incident radiation in a thin film of air.

(It should be pointed out that the great increase in ionisation is not due to the secondary radiation.)

In a similar manner, from a knowledge of the secondary X-rays emitted by iodine, the variable behaviour of methyl iodide may be explained. The effects of the lighter elements are comparatively small in all the three phenomena of absorption, secondary radiation, and ionisation.

Very many of the apparently complex results, obtained by experiments on the transmission of heterogeneous beams through compound substances, may be explained in terms of a few simple laws which have been obtained by the more fundamental experiments on elementary substances with the use of homogeneous beams.

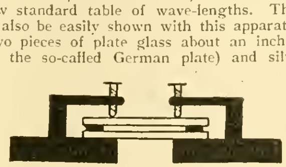
Charles G. Barkla.

University of Liverpool, April 7.

A Simple Fabry and Perot Interferometer.

During a course of experiments with interferometers it was found that a very simple and inexpensive Fabry and Perot instrument could be constructed of plate glass which gives results almost as good as the costly interferometer. The construction of this apparatus for demonstration purposes will well repay the teacher and student. The sharp-coloured interference rings obtained by using luminous gases in vacuum tubes as sources are extremely beautiful. The D lines from a sodium burner are easily separable. If the interference pattern, using a copper or iron arc, is focussed on a wide slit of a single-prism spectrometer, a section of the interference rings is seen in the various spectrum lines, illustrating the method of Fabry and Buisson, and Eversheim, for the determination of the new standard table of wave-lengths. The Zeeman effect can also be easily shown with this apparatus.

Take two pieces of plate glass about an inch square (I have used the so-called German plate) and silver[1] them



until one surface of each plate cuts down the intensity of the transmitted light to about a quarter of the incident light. Separate these silvered surfaces by two strips of cardboard. A useful thickness to begin with is about 0·45 mm., as this will clearly separate the D lines. Mount these plates over a half-inch hole in a metal plate by means of three pressure screws, two of which are shown in the above diagram, being a section through

[1] For silvering solutions see the appendix to Baly's "Spectroscopy."

the centre. The third screw is midway between the other two, and at the end of the plates.

Looking normally through the plates at the glowing filament of an incandescent lamp, a number of images of it will probably at first be seen. Adjust the pressure screws until these images are in juxtaposition in the line of sight; the silvered surfaces are then approximately parallel. Place the instrument in a clamp stand, and focus the light from a sodium flame or a vacuum tube upon the plates, and look at the interference bands with a small laboratory telescope focussed for infinity. Usually the eye-piece has too large a magnification for the above retardation, and it is better to use in place of it a single lens of focal length about 2 inches. At first only a small section of the interference pattern is seen, but with a little careful adjustment of the pressure screws the whole ring system is obtained in sharp focus. Removing the telescope, and with the above lens used as eye-piece, focus the interference system from the above sources, or an arc upon the slit of a spectroscope. The bands in the different spectrum lines are thus observed with the telescope on the spectrometer.

For further suggestions regarding the adjustments and other experiments for which this apparatus can be used reference may be made to an article by the writer in the *Philosophical Magazine* for May, 1904.

JAMES BARNES.

Bryn Mawr College, Bryn Mawr, Pennsylvania.

An Ornithological Coincidence.

ON September 18, 1908, a fine, typical male of *Anthus bertheloti*, Bolle, the common Canary Islands pipit, was caught near Cremona, the first of its kind obtained in Italy. I received the interesting specimen "in the flesh." On March 16 of this year Mr. W. P. Pycraft presented at the meeting of the Zoological Society of London an account of the fossilised remains of a small Passerine bird from the "Gabbro" (Lower Pliocene) near Leghorn, which he identified as those of Berthelot's pipit (see NATURE, p. 119). The coincidence is certainly worth noting.

I may add that last autumn, during the later migrations, we had in Italy an unusual inflow of western species of birds, and amongst others and the above-mentioned pipit I received, also "in the flesh," a fine specimen of the large variety of the wheatear (*Saxicola leucorrhoa*, Gm.), known to breed in Greenland and to migrate southwards along the extreme west of Europe into Senegal. The specimen, a female, is the first registered in Italy; it was captured, also near Cremona, on November 7 last.

HENRY H. GIGLIOLI.

Royal Zoological Museum, Florence, March 29.

April Meteors.

MOONLIGHT will not hinder observations of the Lyrids and other shooting stars in the latter part of April in the present year. The following are the principal meteor showers that become due during the period April 19–30. The times of the various meteoric events as calculated by the writer are expressed in Greenwich mean time.

Epoch April 19, 12h. Shower of eighth order of magnitude, the maxima of which occur on April 20, 10h. 45m., 22h. 30m., and April 22, 6h. There is also another smaller shower connected with this having its maxima on April 20, 12h., April 21, 18h., and April 22, 7h.

Epoch April 25, 1h. This shower, which is of the thirteenth order of magnitude, has its principal maximum on April 27, 14h. Secondary maxima take place on April 25, 14h. 30m. and 20h. 30m.

Epoch April 29, 18h. Shower of seventh order of magnitude. Its principal maximum occurs on April 27, 9h. 45m., and there are other maxima on April 27, 23h. 45m., and April 29, 3h.

From the foregoing it seems that meteors should be found especially numerous on the nights of April 20 and 27. On the latter night there are two principal maxima occurring at times very suitable for observation.

April 12. JOHN R. HENRY.

THE GRAMOPHONE AS A PHONAUTOGRAPH.

IT is well known that during the last few years the gramophone (invented by Berliner in 1887), in its more complete and expensive forms, has been so much improved as to have completely eclipsed the phonograph. It is now an instrument that not only records pitch and intensity, but also quality to a surprising degree, so that one can listen to orchestral music in which the quality of each musical instrument is rendered with much fidelity, and also to the fine voices of many of the most celebrated vocalists of the day. Chorus effects are also remarkable, and one can, for example, enjoy the Soldiers' Chorus from *Faust* or the Wedding Chorus from *Lohengrin*. The nasal effects, the thin reediness of the voices, the alterations in quality, so characteristic of the phonograph, and of the gramophone in its earlier stages, have now almost entirely disappeared; indeed, it is no exaggeration to say that no scientific instruments have made greater progress since the inception of the phonograph a little more than thirty years ago.

Certain interesting data regarding the gramophone disk are worth recording. These I have determined on one of the smaller disks having a diameter of $10\frac{1}{2}$ inches, with the record beginning $\frac{1}{4}$ inch from the margin. The record then traces its spiral groove until it is $2\frac{1}{4}$ inches from the centre, so the record has a breadth of a little more than $2\frac{3}{4}$ inches, or, say, 3 inches. The diameter at the beginning of the record is 10 inches, in the middle 7 inches, and at the close of the spiral, towards the centre of the disk, 4 inches. Multiplying each by 3·14 gives the circumference of the circle as 31·4 inches, in the middle 21·98 inches, and in the centre 12·56 inches, or, together, 65·94 inches, giving a mean of 21·98 inches, or, say, 22 inches. There are 100 grooves per inch from the centre towards the circumference; $100 \times 22 = 2200$ inches; the breadth of the record $=3$ inches; therefore $2200 \times 3 = 6600$ inches; or 550 feet, or 183 yards, is the average length of the record groove. That is to say, in reproducing Waldtenteufel's waltz, *Estudiantina*, the needle, in 205 seconds, ran over a distance of 550 feet. This gives a rate of 32·2 inches per second. With disks of a larger diameter, the length the groove in a long record may be more than 200 yards.

But when this record was reproduced (it is a remarkably good orchestral record) the disk travelled at the rate of 76 revolutions per minute, or 0·8 second per revolution. At the beginning of the record, therefore, 1 inch was covered in 3/100 second, at the middle in 4/100 second, and at the close of the record in 6/100 second. In other words, the needle traverses a shorter and shorter distance, but in the same time, in passing from the circumference to the centre. Consequently there is no alteration in pitch. It follows also that, given vibrations of the same frequency for a note sounding at the beginning of the record and at the close, the marks of each vibration must be closer together at the centre than at the circumference. Thus, supposing a frequency of 200 per second, there would be about six vibrations in an inch at the beginning (outer circumference) and twelve in an inch at the end of the record (centre). A note of 1000 vibrations per second would have thirty in an inch at the beginning, and sixty in an inch at the close of the record. I was able substantially to verify this by placing the disk under a microscope, with a low power, and counting the number of marks in a lineal inch. This also gives a convenient method of determining the pitch of any note, provided one can count a sufficient number of marks in an inch, or in the fraction of an inch. Thus, suppose ten marks in one inch, then the frequency would be more than 300 vibrations per second. A difficulty arises when we find a complete vibratory period not represented by one wave, but possibly by three, one, the first, large, and the other two smaller. Then, to ascertain the real pitch, only the large marks must be counted.

Many attempts have been made to obtain an enlarged record of the wave-forms on the phonograph and gramophone, and much success was attained long ago by Fleeming Jenkin and Ewing, and, in later times, by Hermann, Scripture, and myself. Still, none of these were *facsimile* tracings. It seems to me that the gramophone, in its present condition, holds out the hope of an experimentalist being able to obtain from records tracings on a smoked glass circular plate travelling at the same rate as the record. Then, by placing the plate in a lantern, we should see a representation of the waves amplified, but amplified in all proportions. This I have succeeded in accomplishing, with a considerable measure of success, after a trial of a good many methods.

(1) Place a smoked glass plate, 10 inches in diameter, with a hole in the centre, on the platform of the gramophone (the recording of waves on a smoked glass plate was a method employed by Berliner in his early experiments). As the swinging arm (or taper arm, as it is technically called) of the gramophone tends to swing outwards, and as the outer lip of the groove on the record tends to draw it inwards, and thus to follow the spiral, the needle, if placed on the smoked plate, will not move inwards. To overcome this I attached by a thread the swinging arm to a very slow-moving train of wheels, driven by an old phonograph, and thus I gradually drew the swinging arm inwards, so that a spiral was made on the smoked glass having a thread of about fifty to the inch. I was unable with my apparatus to obtain a slower motion. Then I removed from the gramophone the large horn, and sang, spoke, or shouted into the tube at the end of the swinging arm. The disk of the gramophone vibrated, and the needle described minute waves of various forms on the glass plate. I found, however, that when a cord connected the taper arms of the two gramophones there was not a continuous pull, but a rhthymic oscillation, producing a tracing showing light and dark bands, as the oscillations of the arms of the gramophones had not the same period. A beautiful tracing was thus obtained, showing, at regular distances, light bands owing to the lines becoming very close together, giving a figure such as one has seen for the illustration of waves of sound, or such as occurs in Crova's disks. By this method and the use of an eccentric arrangement, Crova's disks might be prepared. These light and dark bands were got rid of by connecting the arms of the two gramophones by a rigid rod. The finest gramophone needles were used for recording.

I also, by this method, caused a loud phonograph to act, by a connecting tube, on the mica disk of the gramophone, through the tube of the swinging arm, and I obtained tracings.

(2) Another method was unsuccessful, and had to be abandoned, both owing to difficulties of adjustment and because it gave incorrect results. It consists of elongating the vertical rod in the centre of the gramophone platform. A glass plate, smoked, is then fixed to the rod by passing the rod through a hole in the centre and through a collar, that can be clamped. The plate is of the same diameter as the gramophone disk record; it is smoked on its under surface, so that, when matters are adjusted, the disk of the gramophone is directed upwards and the smoked surface downwards, and about $2\frac{3}{4}$ inches above the record. A firm upright bar of steel is soldered to the outer surface of the end of the spring attached to the needle of the sound-box, and this bar carries vertically a very fine needle. The point of this needle is brought with a minimum of friction against the under surface of the smoked disk. The gramophone is then started, and the platform with the central rod carries both the record disk and the smoked glass disk. The tracing so obtained was not satisfactory.

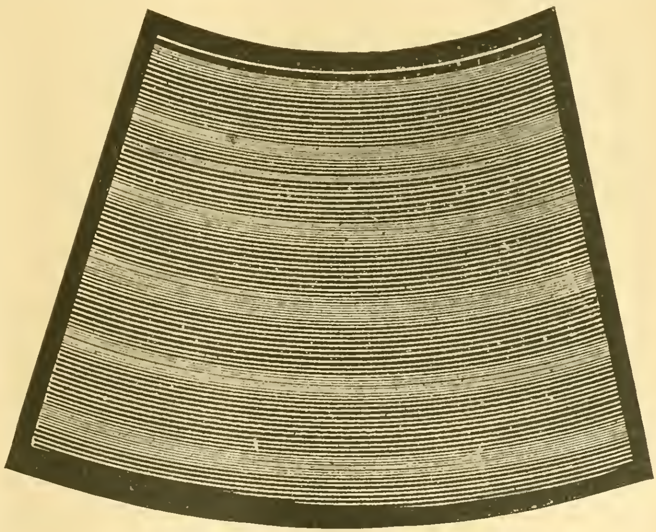


Fig. 1.—Portion of gramophone disk showing the oscillatory periods of the taper arms of two gramophones. No sound vibrations. Examine with magnifying glass.

(3) I obtained the best tracings by causing one gramophone to sing or play at the usual rate, and, at the same time, by a rigid rod connecting the two arms, to draw towards itself the arm of a second gramophone on which was placed a circular smoked glass plate. The needle of the second gramophone described a spiral with intervals between successive spirals of 1/100 inch, exactly similar to the spirals on the record of the first gramophone; but, before

starting, the resonator of both gramophones was removed, and the circular openings at the base of each taper arm were connected by a wide tin tube. When the first gramophone acted the sound waves passed, not out by the resonator, as usual, but along the transverse tin tube to the other gramophone, the sound disk of which then vibrated and wrote the tracings on the blackened glass plate. This method, apparently so simple, gave rise to great

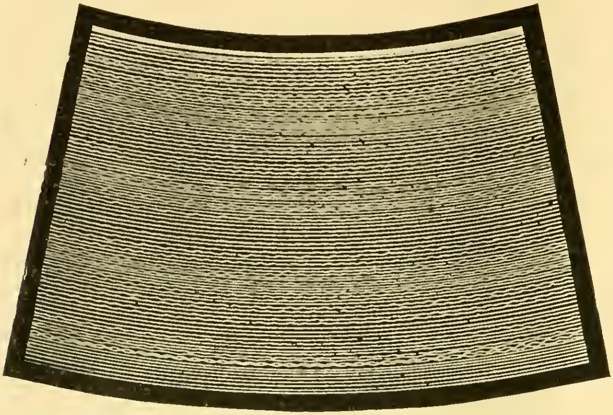


FIG. 2.—Portions of the record of a powerful bass voice (Oreste Luppi, of Milan) singing *La Calunnia* from *Il Barbiere di Siviglia*. Examine with magnifying glass.

trouble owing to the sound-box of the second gramophone being so heavy as to damp or obliterate many of the vibrations transmitted from the first gramophone. I substituted for the sound-box of the second gramophone (1) one of Pathé's simple reproducers, having, by a cork, a needle attached to the centre of the disk; (2) a very delicate tambour made by Albrecht, of Tübingen, used in Heurthle's ingenious arrangement for recording the sounds of the human heart; (3) one of Brodie's tambours, made by C. F. Palmer; and (4) a capsule, made by Joos, of Frankfort, for Marbe's method of recording the vibrations of König's flames. The first gave the best results, but was not quite satisfactory. Nos. 2, 3 and 4 were of no service, as they were too mobile, and too susceptible of vibrations due to inertia. The same objection applied to the needle in No. 1. After a great deal of trouble, however, I found the ordinary sound-box of the gramophone most effective after suspending it so as to remove weight, and so as to allow the needle to touch the smoked glass plate with a minimum of friction. In these experiments one had a striking illustration of the delicacy of the movements of the drum-head of the ear. The more delicate tones, or, rather, the weaker tones of a fine voice, on which expression so much depends, were not recorded by any of my mechanical appliances, and only loud, strong, rich tones (like those of a powerful orchestra) left their traces. When the record was made by the gramophone operators, say, of the sounds of an orchestra, air currents carried the vibrations against the diaphram of the recording instrument with sufficient intensity to enable the recording needle to cut its way into the soft matrix employed; but the energy of tones coming from the sound-box of the *reproducing* gramophone (that is, the gramophone working on the disk)[1] was, of course, very much diminished; still, sounds were heard (the drum-head was moved), although no movements of the disk of the second gramophone could, by the above method, be recorded. The amplitude of the movements of the drum-head must be inconceivably small, and yet they are sufficient to transmit pressures to the nerve terminations in the cochlea.

These experiments were made at home and without the appliances of a laboratory, and as, owing to circumstances, I cannot continue them, I will be glad if the method or methods above described are taken up by a younger worker. The sound waves may also be *seen* by the ingenious method of reflecting a beam of light from a small mirror attached to the diaphragm on to a revolving Wheatstone mirror. This method was invented by Mr. Bowron. Several years ago Dr. James Erskine Murray showed me an arrangement of his own of a similar kind.

(4) The gramophone is an excellent phonautograph. Take two gramophones; one to draw the needle over the smoked glass plate on a second gramophone; remove the resonator of the second gramophone; suspend the sounding box of the second gramophone until the needle barely touches the smoked glass plate; and then, through a wide tin

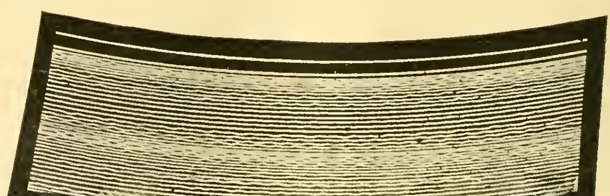


FIG. 3.—Record of vibrations of human voice, in the experiment of using the gramophone as a phonautograph. Examine with magnifying glass.

tube, having a diameter the same as that of the opening at the end of the taper arm of the second gramophone, speak or sing into the second gramophone. Thus the vibrations are recorded, while the speed of the smoked glass plate is known. Long ago I traced vowel curves and other sounds (using a phonograph recorder) on a vertical smoked glass plate moving

[1] For an account of the gramophone, see an interesting paper by Mr. Lovell N. Reddie, read before the Royal Society of Arts, May 6, 1908.

rapidly horizontally, but by this method I could only record in each experiment during the time of the movement of the glass plate—about one second. By the gramophone, records of vocal sounds might be taken during a period of three minutes.

An inspection of the curves so obtained of a voice or of an orchestra only makes the performance of a gramophone more wonderful and more difficult to understand. We see a long series of waves of various forms which the eye cannot follow; but when these waves appeal to the ear, then music starts into life. Each sense has its own beat.

John G. McKendrick.

THE POISONS OF THE PHARMACY ACT.

ONE of the minor legislative achievements of last session was an amendment of the Poisons and Pharmacy Acts. So far as poisons are concerned, it may be noted that these Acts restrict the facilities for obtaining certain substances which experience has shown to be often responsible for fatalities, whether by accident or by intentional administration. Besides the commoner violent poisons—the arsenic and strychnine of the wilful poisoner, the prussic acid and carbolic acid of the suicide—there are milder varieties of toxic substances which may lead to fatal results through ignorant or careless usage, and which should therefore not lightly be dealt out to ignorant or careless users. Such, for instance, are the narcotics, as morphine and sulphonal; the emetics, *e.g.* tartar emetic; and the abortifacients, such as ergot and savin.

What is a poison? Precise definition is difficult. Very largely it is a matter of quantity; most medicines are poisonous if taken in excess. Personal idiosyncracy and immunisation are also factors. The proverb "One man's meat is another man's poison" contains at least the half-truth characteristic of proverbs; and the Styrian arsenic-eaters, as Sir Henry Roscoe showed nearly fifty years ago, can easily withstand doses of arsenic which would be fatal to ordinary people.

In the Act before us the legislature defines its poisons by enumerating them. To toxicologists and pharmacists the list is no doubt familiar enough. To other readers, however, it may be of interest to glance at the list of articles now included in the schedule of poisons. These, as explained below, are only to be sold under certain specified conditions.

Part i. of the schedule is concerned generally with the more active poisons, upon the sale of which the more stringent restrictions are naturally placed. The buyer must be known to the seller, or must be introduced to him by a third person known to both; the sale must be recorded in a special book and the entry signed by the purchaser, and the purpose for which the drug is required must be stated.

Arsenic, alkaloids, and the poisonous cyanides form most of this first division. Several of the alkaloids—aconite, aconitine, atropine, belladonna, strychnine, and morphine—are specifically named; but there is also a general category of "all poisonous vegetable alkaloids," which brings in any not otherwise enumerated. Coca, cantharides, corrosive sublimate, tartar emetic, ergot, picrotoxin, and savin complete the list as regards part i.

Part ii. of the schedule contains a list of articles which (1) are to be sold only by registered chemists, and (2) must be labelled as poisons when sold. It includes oil of almonds (unless deprived of prussic acid), antimonial wine, carbolic acid and its homologues, chloral, chloroform, digitalis, the iodide, sulphocyanide, chloride, and oxides of mercury; poppies, strophanthus and sulphonal, together with all preparations which contain a poison within the meaning of the Pharmacy Acts and are not otherwise dealt with.

Most of the foregoing articles are well-known poisons, and the reasons for including them are, perhaps, sufficiently obvious. But a few notes upon the less familiar of them may not be without interest.

One of the most noteworthy is the drug coca. This, the source of the alkaloid cocaine, consists of the dried leaves of *Erythroxylon coca*, a shrub which flourishes on the slopes of the Andes. It has been used as a nerve stimulant by the Peruvian and Bolivian natives from time immemorial. Furnished with a small stock of the leaves to chew, they will work or travel without food from morning until night. As there is no appreciable amount of nourishment in the leaves, the sustaining effect is regarded as probably due to the nerves of the stomach being locally benumbed by the drug, thus preventing the feeling of hunger. Although habitual excessive use of coca brings on insomnia, dropsy, and death, yet a single large dose is said, in the case of the natives, to give a sensation of peculiar physical beatitude. Joyous visions and brilliant phantasmagoria are recorded as the result of a very large dose in one case. On Europeans, however, the action appears to be curiously different from this, fear and terror rather than joy having been noted in numerous cases of coca poisoning.

Cantharides, the Spanish blistering fly, is the dried beetle *Cantharis vesicatoria*. It comes chiefly from Spain, Italy, and Russia. Internally, the drug acts as a powerful irritant, with a peculiar direction to the urinary and genital organs; externally it is used as a blister and rubefacient.

Ergot is the sclerotium of a fungus, *Claviceps purpurea*, arising in the ovary of the rye plant. It is scarcely a poison in the ordinary sense of the word, as most persons—the exceptions being women in pregnancy—can take large doses without fatal effect. Nevertheless, epidemics of poisoning on the Continent have been ascribed to the use of rye-bread contaminated with the fungus. Medicinally it produces contraction of those muscles which act involuntarily, and slows down the action of the heart.

A poison which is said to have been used as a hop-substitute in malt liquors has a place in the schedule. It is picrotoxin, a bitter, crystalline substance obtained from the berries of *Cocculus indicus* (*Anamirta paniculata*). The drug is a potent poison, producing convulsions and violent peristalsis. Savin has been much used in uterine affections. It consists of the dried tops of the shrub *Juniperus sabina*, Lin., a native of southern Europe and the United States. The volatile "oil of savin" obtained from it is a powerful local irritant which has been employed, often with fatal results, in producing criminal abortion. Strophanthus, the seeds of *S. Kombé*, is notable as the source of the Kombé arrow-poison, used in Senegambia, Guinea, and other parts of Africa. For the rest, space allows only a brief mention of sulphonal, which is a soporific drug (dimethyl-methane-diethyl sulphone) synthesised from acetone and mercaptan. Its narcotic action is usually quiet, without disagreeable after-effects; but chronic poisoning and fatal results have frequently accrued from long-continued and injudicious use of the drug.

A large number of deaths by accident and suicide are yearly attributable to poisoning by mineral acids. Restrictions are therefore now placed by the Act upon the sale of hydrochloric, sulphuric and nitric acids, as also of soluble oxalates. These articles must be labelled as poisonous, and bear the name and address of the seller; but the latter need not be a registered chemist, as in the case of the scheduled poisons.

On the other hand, greater facilities are given for obtaining certain toxic substances used in agriculture and horticulture. In country places there has often been difficulty in obtaining poisonous insecticides, fungicides, and bactericides, as also sheep-dips and weed-killers containing arsenic or nicotine; it has consequently been enacted that these articles may henceforth be sold by any persons duly licensed for the purpose by the local authority. No doubt this provision will be a convenience in rural districts, and will to this extent assist the farmer in dealing with the pests which encumber agriculture.

C. Simmonds.

RAINFALL IN ITALY.[1]

THE Italian Meteorological Department has issued an important work on the rainfall of Italy. The tabular matter contains the total precipitation and the number of rain-days for each month of the twenty-six years 1880 to 1905 for 215 of the 700 rainfall stations in connection with the Italian office. The records are not complete in all cases, but fifteen years is the shortest period dealt with. The largest annual total is 90 inches, at Gemona, near the Austrian frontier, the smallest 18·6 inches, at Foggia. On looking through the tables we are struck by the fact that no attempt seems to be made to secure uniformity of exposure for the gauges. The heights above the ground vary between 60 metres and half a metre. A set of excellent coloured plates shows the average rainfall conditions for each month, each season, and for the whole year.

The seasonal variation of rainfall differs widely in different regions. In the extreme north we have a single very pronounced maximum at midsummer, while in Sicily there is an equally pronounced mid-winter maximum. The one curve is almost exactly the reverse of the other. Over the northern plains and in the northern half of the peninsula there are two maxima, one in May, the other in October or November, the latter being the more pronounced. Over the southern half of the peninsula the winter rains make themselves felt, and we find a principal maximum in October and secondary maxima in January and April. The preparation of the work has been in charge of Dr. Filippo Eredia.

SIMPLE STUDIES IN NATURAL HISTORY.[2]

THE subject of forest trees is such an attractive one and is just now so much to the fore that the little book at the head of our list ought to have a warm reception. It is well illustrated by thirty-two coloured drawings of trees, their leaves, flowers, and fruits, and the text is simply and well written. For children such a work is invaluable, and will enable them to identify trees with great ease. At the present time, when so much ruthless destruction is being effected in country districts by the wholesale felling of young and old timber, it is urgently necessary to emphasise the value of trees. This little book should be especially useful, not only in teaching the different kinds and their uses, but also in nurturing that affection for the noblest of plants which must be more widely entertained if the policy of devastation is to be checked.

Mr. Westell's stories form a complete contrast to this unassuming work on trees. They consist of reprints from publications of the Society for the Prevention of Cruelty to Animals, and contain a series of sketches of animal life that is disjointed, unorganised, and sententious. There are so many good books on this subject suitable for children that it is difficult to see on what grounds this series has been resuscitated. The affection of the author for flies is

Drinker moth (*Odonestis potatoria*) just emerged from Cocoon. From Prof. Ainsworth Davis's "Nature Study."

not a very discriminating one. The pupal stage of the house-fly does not last "some weeks," nor is the blue-bottle fly a desirable acquaintance. The style of the author may be judged from the following reference to the feet of the house-fly:—"The adhesive power of our little feet is not impaired when atmospheric pressure is removed," a sentence that is followed by the naïve remark, "I have tried to make (this explanation) as simple as possible, and trust I have succeeded"; or, again, *àpropos* of the lapwing, "Notice the lapping movement carried out, after which we have been accorded one of our English names," a sentence that is as cryptic as it is ungainly.

[1] "Le precipitazioni atmosferiche in Italia dal 1880 al 1905." Annals dell Ufficio Centrale Meteorologico e Geodinamico Italiano, vol. xxv., parte i.

[2] "Trees shown to the Children." By Janet Harvey Kelman, and described by C. E. Smith. Pp. xiv+131; with 32 coloured plates. (Edinburgh and London: T. C. and E. C. Jack.) Price 2s. 6d. net.

"Animals at Home." By W. P. Westell. Pp. 240; 24 plates. (London: Dent and Co., 1908.) Price 3s. 6d.

"Nature Study." By J. R. Ainsworth Davis, M.A. Pp. xii+274. (London: Dent and Co., 1908.) Price 2s. 6d.

Principal Davis's little book consists of two parts. The first, devoted to plants, gives an admirable *résumé* of their being and well-being, their varieties and adaptations. The second treats in systematic fashion the chief groups of animals, and, though less "biological," is well arranged and packed with information. The illustrations throughout are most attractive, and the plan of the text well designed. For schools the book is certain to be found useful, and the only faults we have to find with it are the attempt to explain everything and the absence of any attempt to give practical directions for the simplest experiment. The first is certainly a serious mistake. The too ready application of the magic word "protection" in regard to colouring, for example, is frequently unjustified, and the bald statement, *e.g.*, that birds are derived from reptiles that rose on aëroplanes, is at least a daring one when its speculative nature is not hinted at. Phylogenetic speculation should be rigorously excluded from elementary teaching.

The absence of experimental advice is a too common drawback to books of this kind, and yet perhaps no method is equal to this one in value. With animals there is always a difficulty in suggesting an experiment that has not an unnatural or even a cruel look, but plants are made for experiment, and a training in that branch of work is one that can be effected cheaply and conveniently. These defects do not, however, prevent this little book from being a fund of attractive information on both animals and plants. The subject-matter is highly compressed, and teachers will find that a single paragraph has to be expanded and illustrated before it can be properly grasped by their pupils. Such compactness is, however, inevitable in a work of such small size and wide compass.

INTERNATIONAL CHART OF THE HEAVENS.

THE permanent committee of the Astrographic Congress of 1887 will meet at the Paris Observatory, April 19 to 24. Our readers will remember that the great international undertaking—the Carte du Ciel—was inaugurated at a congress held at Paris in 1887. No astronomer who attended the meeting can forget the man whose name will ever be associated with that work—Admiral Mouchez, then director of the Paris Observatory. But for his earnest and sympathetic character and genial influence it is doubtful if this great work could have been launched at all; it certainly could not have been so with the same prospect of success without his tactful and energetic cooperation.

At that congress a scheme was prepared and a permanent committee appointed to carry the work into execution. The committee in question consisted of eleven members, selected by vote, together with the directors of observatories cooperating in the work whose names did not appear in the original list. This committee met at intervals of from two to four years at Paris until the year 1900 inclusive, but since that time no further meeting of the permanent committee has taken place, and we shall see presently how urgent is the need for the coming meeting.

Broadly speaking, the programme entrusted to the committee was as follows:—

(1) To construct charts of the entire sky, each map measuring 2°×2°, and containing all stars to the thirteenth magnitude.

(2) To catalogue the exact positions and magnitudes of all stars to the eleventh magnitude.

At first the chart appeared, even to some astronomers, to be the more important object to be realised, but there has been a growing conviction that, for the broad fundamenta of astronomy, the catalogue, though by far the more laborious, is infinitely the more important of the two objects.

The chart, it is true, preserves a permanent record of the state of the sky for a mean epoch about 1900, to which reference can be made, as occasion may arise, in connection with variable stars and the appearance of new stars, and, *after special measures*, it will yield the places of stars fainter than the eleventh magnitude which may be suspected of large proper motion, &c.

But, with the completion of the catalogue, astronomers will be provided with absolute places of all the stars down to the eleventh magnitude, and this will enable them, when the work has been repeated after a sufficient interval, to derive the proper motions of all stars to the eleventh magnitude in the most simple and direct manner, and so to investigate such problems as the precession, the solar motion in space, star-drift, &c., and to discuss the general problems of sidereal astronomy with a completeness unattainable in any other way.

By the complete execution of our present programme we lay upon astronomers of the future the moral compulsion to execute a similar work, say, one hundred years hence, and, in addition, to derive from the three or four millions of proper motions so obtained the broad cosmical conclusions which must follow from the proper discussion of these motions.

This, surely, is a large enough task to bequeath to futurity—a noble bequest indeed if it be left in the complete, permanent and accessible form of a printed catalogue of positions and magnitudes. To leave it in any other form would be to endanger the permanent value of our work by throwing such an undue share of labour upon our successors as almost to justify them in refusing to utilise what we have done.

The work of the chart and of the catalogue was originally divided amongst sixteen observatories, and naturally has proceeded at different rates in different observatories according to their opportunities, the varied energy of their directors, and the means at their disposal. Practically the work has now continued for nearly twenty years, but, of course, a good deal of time was lost at first in the construction of instruments and in experimental research before definite routine work was commenced.

But whilst some of the observatories have nearly completed their share of the work, others are far behind, and it will be an important duty of the present meeting to inquire into the progress of each zone, to divide up the unexecuted work amongst the more active observatories, and to take such other steps as are necessary to bring the whole to an early and satisfactory completion.

In a circular letter addressed to the directors of the cooperating observatories and to others invited to attend the present meeting, M. Baillaud, director of the Paris Observatory, and president of the permanent committee, makes the following requests, viz.:—

(α) That each observatory which, up to the present time, has cooperated in the work, shall prepare a report showing the amount of work done, not only in taking the plates, but in the measurement, reduction, and publication of the results.

(β) That those astronomers who find themselves in a position to aid in the completion of zones which have fallen into arrear either in the matter of taking the plates or in their measurement and reduction, should intimate their readiness to assist in the work.

In entering into the whole question of the present state of the work, and taking such farther steps as shall ensure its completion, the present meeting of the permanent committee has a most practical and important duty before it. But it has still further matters of interest and importance to deal with.

First, as regards the chart and catalogue, it must be remembered that to a great extent the sixteen observatories have been working independently, and it is impossible that, in existing circumstances, these results can be entirely homogeneous.

For example, at some observatories the diameters of the star-discs have been measured; at others, the magnitudes have been estimated by comparison with sets of photographed images assumed to represent stars of known magnitude. It will be the business of the "Magnitudes Committee" to devise effective means for reducing these measures of diameter and miscellaneous estimates to a uniform and absolute system of magnitudes. Another committee will deal with the systematic errors which have been found to exist in the coordinates of star-images measured in certain series of plates. In some cases these errors depend on the magnitude of the star, in others on its distance and position angle from the centre of the plate. The optical committee will have to trace, so far as possible, the origin of these errors, and devise means for eliminating their effects from the final results.

The coordinates of the star-images measured on the plates are of no value for the purposes of fundamental astronomy unless the system of the coordinates of each plate is referred to a number of stars the absolute positions of which on the sphere are known. In the case of some of the zones the places of the reference stars depend on meridian observations, few in number and made a considerable number of years ago; in other cases they depend on recent but only locally observed zones. It is essential that not only should adequate provision be made for proper meridian observation of the zones, but also for their coordination to a common system on the plan so far carried out by Dr. Kastner at Bonn. The arrangement of this part of the work will rest with the fundamental stars committee.

At the last meeting of the permanent committee in 1900, a good deal of time was given to consideration of the steps to be taken for the observation of the then recently discovered planet Eros, at its opposition at the end of 1900. The bureau of the committee has published a large number of the observations of Eros that were secured at the opposition of 1900, as well as the results of meridian and photographic observations of the comparison stars, and an accurate ephemeris of the planet for that opposition. The unique characteristics of the orbit of Eros present conditions which are exceptionally favourable for researches of extraordinary astronomical interest and importance, viz. for the trigonometrical determination of the solar parallax and mass of the moon, and for the dynamical determination of the mass of the earth by the perturbations which it produces in the motion of Eros. In 1900 Eros approached the earth within one-third of the earth's mean distance from the sun, but at the opposition of 1931 it will approach the earth within half that distance, viz. within one-sixth part of the earth's mean distance from the sun. It is not, even now, too soon to begin preparation for this unique opportunity, and accordingly an Eros committee will be appointed for the following purposes:—

(*a*) To receive reports on the actual state of the reductions of the past observations of Eros, and to prepare a report upon them.

(*b*) To take steps for the preparation of an approximate ephemeris of Eros at the opposition of 1931 of sufficient accuracy to permit the selection of the most suitable comparison stars.

(*c*) To discuss the best methods of observing the opposition in question, especially with a view to avoid systematic error in the final results.

(*d*) To discuss the basis of the choice of comparison stars, and how to ensure their proper observation.

(*e*) To devise means for the regular observation of Eros from this time forward in order to perfect the ephemeris that will be finally employed in the definitive reduction of the observations of 1931, that is to say, for the direct determination of the solar parallax and mass of the moon, and also for the ultimate determination of the mass of the earth by means of the perturbations which it produces in the motion of Eros.

There can be no doubt that all these objects can only be attained by international cooperation, and that they furnish ample material for an interesting and important meeting. The following astronomers have accepted M. Baillaud's invitation on the part of the French Government to be present on the occasion:—

Prof. Andoyer, Paris; Ch. André, Lyon; M. Angot, Paris; T. de Azcarate, San Fernando; O. Backlund, Pulkova; B. Baillaud, Paris; J. Baillaud, Paris; H. G. van de Sande Bakhuyzen, Leyden; Le Général Bassot, Nice; de la Baume Pluvinel, Paris; M. Bayet, Paris; G. Bigourdan, Paris; G. Boccardi, Turin; Prince Roland Bonaparte; F. Boquet, Paris; H. Bourget, Marseilles; Sir W. H. M. Christie, Greenwich; W. E. Cooke, Perth, W. Australia; M. Cosserat, Toulouse; M. Deslandres, Meudon; A. Donner, Helsingfors; F. W. Dyson, Edinburgh; John Franklin-Adams, London; A. Gaillot, Paris; P. Gautier; Sir David Gill, London; M. Gonnessiat, Algiers; G. E. Hale, Mount Wilson; M. Hamy, Paris; A. R. Hinks, Cambridge; S. S. Hough, Cape Town; Fernand Jacobs, Brussels; J. C. Kapteyn, Groningen; E. B. Knobel, London; M. Kromm, Bordeaux; F. Küstner, Bonn; Le R. P. Laïs, Rome; I. Lagarde, Paris; A. Lebeuf, Besançon; G. Lecointe, Brussels; G. Leveau, Paris; M. Lumière, Lyon; Major P. A. MacMahon, London; J. Palisa, Vienna; C. D. Perrine, Mount Hamilton; L. Picart, Bordeaux; A. A. Rambaut, Oxford; H. Renan, Paris; A. Ricco, Catania; J. Scheiner, Potsdam; M. Stéphan, Marseilles; E. Strömgren, Copenhagen; H. H. Turner, Oxford; F. Valle, Tacubaya; M. Verschaffel, Abbadia; W. Zurhellen, Bonn.

DR. ARTHUR GAMGEE, F.R.S.

HIS numerous friends and fellow-workers in science, both in this country and abroad, will hear with deep regret of the unexpected death of Dr. Arthur Gamgee, in Paris, on March 29. He was in his sixty-eighth year, and though not a young man was in full possession of an exceptionally endowed intellect which was ever urging him on in the path of research. Throughout a somewhat unsettled life his enthusiasm for research never waned from the time of his early student days, when he followed his natural leanings towards original physiological work, to which his exact knowledge of physics and chemistry was to be applied with a success that gained for him a wide and well-deserved reputation.

To many of the younger physiologists Dr. Gamgee was personally unknown. He was born in 1841, in Edinburgh, a younger son of Joseph Gamgee, a distinguished veterinary surgeon and pathologist, whose work, particularly that on rinderpest, was well known in England and on the Continent. An elder brother, Joseph Sampson Gamgee, long connected with the general hospital in Birmingham, was a man of great mental gifts and remarkable personality, who made a name for himself in his profession, and will be remembered for the introduction of improved methods in the treatment of wounds in the pre-antiseptic days of surgery. Educated at University College School, Arthur Gamgee subsequently entered Edinburgh University, and came under the influence of John Goodsir and Christison, for both of whom he retained a warm affection throughout his life. After taking his medical degree in 1862, the subject of his thesis, for which he was awarded a gold medal, being "An Inquiry into the Physiology and Pathology of Fœtal Nutrition," he became assistant to Maclagan, who was at that time professor of medical jurisprudence. Ten years later, after the publication of several physiological papers, among which the most important are those on the action of nitrites on hæmoglobin, on the development of heat in the process of arterialisation of the blood, which Mario Camis has only recently shown to be an exothermic reaction (*Mem. Real. Acc. del Torino*, 1908, 58, pp. 141–69), and, with J. Dewar, on the constitution of cystine—urinary calculi being at that time the only known source of this amino-acid, Gamgee was elected a Fellow of the Royal Society. He was at that time thirty-one years of age. In 1873 he became the first Brackenbury professor of physiology in Owens College, Manchester, where he founded the school in this subject, and as Dean of the medical school actively assisted in the transformation of the college into the Victoria University. His work in this direction seems to have been most unaccountably ignored, for his name is not even mentioned in a recently published history of the development of the university. From 1882 to 1885 he was Fullerian professor of physiology in the Royal Institution. A few years after leaving Manchester in 1885 Gamgee was elected assistant physician at St. George's Hospital, where he lectured on pharmacology and materia medica, and then, having decided to reside abroad, he practised as a consulting physician in Switzerland at Lausanne, and for several years at Montreux. During this time he was also actively engaged in research, and on his return to England in 1904 he continued his original work in Cambridge and in the physiological laboratory of the University of London, where, indeed, he was at work on the morning of the day of his departure for Paris. On two occasions, in 1902 and 1903, he was invited to America, and his first visit was undertaken with the view of reporting upon the present state of our knowledge of nutrition, a subject which was being elaborately investigated by Chittenden, Atwater, and Benedict. From the Universities of Edinburgh and Victoria he received the honorary degrees of LL.D. and D.Sc., and during the last few months of his life was engaged in furthering the success of the International Congress of Applied Chemistry, which meets on May 26; of this he was vice-president of the physiological chemistry section. The council of the Royal Society chose him to represent the society at the celebration of Albrecht v. Haller's bicentenary at Berne last year.

The twelve years during which Dr. Gamgee worked in Manchester were in some respects the period of his greatest activity. Owens College was the foremost scientific institution in this country at that time, which was one of stress and strain for all who had the real interests of scientific work at heart. The paramount influence of Owens College in the 'sixties as a centre of scientific thought is hardly realised to-day, when the struggle from which an entirely new type of education was to be evolved is over, indeed is almost forgotten. The names of Sir Henry Roscoe, Balfour Stewart, Stanley Jevons, Boyd Dawkins, and Julius Dreschfield occur to us, among others, whom Gamgee found as his colleagues and friends, and he will always be associated with them as aiding in making the college the most conspicuous school of scientific research in the country.

The science of physiology, which has actually arisen and developed in this country within the last three decades, and become a school which easily ranks with any on the Continent or in America, owes much to its real founders, Michael Foster, Burdon Sanderson, and Arthur Gamgee, who were all well acquainted with the work of Claude Bernard, Carl Ludwig, Du Bois Reymond, Helmholtz, and Kühne, and had recognised that only by an application of the experimental method to physiology, which was a subject that must be studied in adequately equipped laboratories, was there any probability of bringing this subject into line with other experimental sciences. In the development of this movement Arthur Gamgee took his share, and brought an acute intellect and a highly trained knowledge of chemical and physical methods to bear on the study of physiology. Apart from the original work which was done under his direction, the publication of the first volume of the "Text-book of the Physiological Chemistry of the Animal Body, including an Account of the Chemistry of Pathological Processes," marks an epoch in English physiology. This volume was dedicated to Christison. It at once established Gamgee's reputation, and even to-day remains one of the most accurate and valuable works in medical literature. The subject is treated from the biological rather than from the purely chemical point of view; it involved a vast amount of experimental work, and the book was what the author claimed it to be, an original work, and not a compilation of facts obtained by the evisceration of pre-existing treatises on physiological chemistry. The book will long remain a lasting credit to British physiology. Thirteen years later a second volume, which dealt with the chemistry of digestion, appeared, and, like its predecessor, this gave a complete survey of what was known at that time on the subject; that portion of the work which treated of the bile, jaundice, and the formation of gall-stones was of particular excellence. His address in 1882, when as president of the Biological Section of the British Association it fell to his lot to express the loss which science had suffered by the deaths of Darwin and F. M. Balfour, was an historical account of the growth of our knowledge on the process of secretion. This address may well be studied by those who wish to grasp clearly the literary and scientific qualities of Gamgee's mind.

The application of physical and chemical methods to physiology was well seen in Gamgee's work. In the Croonian lecture before the Royal Society in 1904 he gave a full account of his life-long researches on hæmoglobin—the dextro-rotatory properties of this pigment, its absorption bands in the violet and ultra-violet portions of the spectrum, the para-magnetic property of hæmin and hæmatin, together with the demonstration that hæmoglobin falls as a coloured cloud in the colloidal state through a clear supernatant liquid in the anodic compartment of an electrolytic cell. These additions to knowledge we owe entirely to Gamgee. In later years his attention was devoted to the solution of a problem which had occupied his mind from the early days when he worked in Tait's laboratory, and in a paper published in the Philosophical Transactions for 1908 he showed for the first time how, by the employment of special thermoelectric junctions, improved thermostats, and the photographic recorder or the string recorder devised by Horace Darwin, a continuous or quasi-continuous registration of the diurnal curve of the fluctuations in the body temperature of animals could be obtained. He completely solved this problem, and believed that this method was destined to prove an indispensable aid to clinical diagnosis. In this we do not think he was mistaken, though the technical difficulties in carrying out the method are considerable.

Dr. Gamgee, as is well known, was a man of the most affectionate disposition, enthusiastic in his work, a good linguist, a fluent speaker, and an excellent classical scholar. The simplicity of his mind and his single-heartedness of purpose endeared him to a wide circle of friends by whom he will be sincerely mourned; for those even nearer and dearer to him, his wife and children, his loss is great and irreparable. G. A. B.

NOTES.

Prof. H. G. van de Sande Bakhuyzen has retired from the directorship of the Leyden Observatory. His place as professor of theoretical astronomy in the University is to be taken by Dr. W. de Sitter, of the Groningen Astronomical Laboratory, whilst Mr. E. F. van de Sande Bakhuyzen is to succeed him as professor of general astronomy and director of the observatory.

Prof J. Bauschinger has been appointed to succeed Prof. E. Becker as professor of astronomy and director of the university observatory at Strassburg, and Prof. Becker asks that all communications for him should now be addressed to Freiburg i. B., Reichsgrafenstrasse, 17.

With regard to the expedition for the exploration of the Charles Louis Mountains in New Guinea, announced in our issue of March 11, we are asked to state, on behalf of the subscribers, that this expedition is being sent out under the auspices of the British Ornithologists' Union in commemoration of its jubilee, held last December, and described in Nature of December 24 (vol. lxxix., p. 238). It was then decided that this expedition should be known as "The British Ornithologists' Union Jubilee Exploration of the Charles Louis Mountains."

Arrangements have been made for a visit by Count Zeppelin in his airship to the International Aëronautical Exhibition to be opened at Frankfort in July next. The airship will be accommodated during the exhibition in one of the large halls now being built in the grounds, and ascents with it will be made.

We learn from the *Times* that a wonderfully vivid mirage was witnessed from Grimsby on April 8 in the evening. The Humber is six miles wide there, and beyond is three miles of land. This appeared to be lifted high into the air and reversed, the trees inland having the appearance of growing upside down. The Spurn Lighthouse, reversed, was seen four miles from its position, and below the reflection of the land was the North Sea, on which were large steamers, with masts and funnels downwards, passing to and fro.

The Health Congress, Leeds, 1909, organised by the City and the University of Leeds, with the cooperation of the Royal Sanitary Institute and the Royal Institute of Public Health, will be held on July 17–24. The president is Colonel T. W. Harding, J.P., D.L., and the general secretaries are Dr. Spottiswoode Cameron and Mr. Robert E. Fox, the medical officer of health and town clerk respectively of Leeds. A programme of the preliminary arrangements is published in the Journal of the Royal Sanitary Institute for April (xxx., No. 3).

One of the special features of the great Missionary Exhibition, entitled "Africa and the East," which will be held at the Royal Agricultural Hall from June 8 to July 3, under the auspices of the Church Missionary Society, will be a special exhibit of outfit suitable for missionaries and travellers, which will be shown in a special outfit section. One of the special features of this section will be an exhibition of the various methods of protection from mosquitoes and other insects, which play an important part in the spread of many tropical diseases. The organiser of the section is Dr. C. F. Harford, principal of Livingstone College, Leyton, E.

To encourage enterprise and experiment in British aviation, the *Daily Mail* offers a prize of 1000*l.* to the aëroplanist who, within twelve months of April 7, flies a distance of one mile either in a circuit or from a given point to another and returns to the starting point without touching the ground. The other conditions of the award are:—(1) that the motor, planes, propellers, and all other parts be entirely of British manufacture; (2) that the inventor and the aëroplanist be British subjects, and by British subjects we naturally include those in British colonies; (3) the flight shall take place within the British Isles, and be approved by officials of the recognised aviation organisation. Other prizes offered by the *Daily Mail* are:—10,000*l.* for a flight by a heavier-than-air machine from London to Manchester with not more than two stops to take in petrol. Offered in November, 1906; and open to aëronauts of all nations. 1000*l.* for a flight across the Channel by a heavier-than-air machine before the end of 1909. Open to all nations.

Dr. William Jones, assistant curator of the Field Columbian Museum of Chicago, has been murdered by tribesmen in the Philippines about fifty miles south of Echague. He had gone to the islands in 1906 on a four years' expedition to study the life of the Ilingots. Dr. Jones had Indian blood in his veins, and was born among the Sauk and Fox Indians of Oklahoma about thirty-four years ago. He was educated at the Indian school at Hampton, at Andover Academy, and at Harvard, where he had a distinguished career. He took a post-graduate course at Columbia University, and was then engaged by the Carnegie Institution at Washington on ethnological investigations. His success in unravelling many mysteries of Indian religions led to his appointment at Chicago. According to his chief, Prof. G. A. Dorsey, he was the most promising student of ethnology in America, and a similar opinion has been expressed by the head of the Federal Bureau of Ethnology. The day before the receipt of the cablegram announcing his death, Prof. Dorsey had heard by letter from Dr. Jones of his intention to leave the friendly tribe with whom he had been living in order to pursue his researches in a remote section of the country, which would necessitate his passing through a hostile territory.

The geological department of the British Museum (Natural History) has received from the National Museum of Natural History, Paris, a plaster cast of the finest skull and mandible of the long-chinned mastodont, *Tetrabelodon angustidens*, from the Middle Miocene of Sansan (Gers), France. The specimen has just been mounted for exhibition with Dr. Andrews's well-known models of the skull and mandible of Mœritherium and Palæomastodon from the Upper Eocene of the Fayum, Egypt. These three specimens are arranged in series with the American Pleistocene *Mastodon americanus*, so that the principal stages in the evolution of the proboscidean head can now be studied in one view. They show very clearly the lengthening of the symphysis of the lower jaw, which must have been accompanied by an elongation of the soft face, as the mastodonts increased in size in successive geological periods. In the latest genus, Mastodon proper, this elongated soft face, no longer supported by an extension of the lower jaw, must have formed a hanging proboscis, as in the true elephants.

We regret to announce the death, at the age of sixty-eight years, of Prof. F. E. Hulme, author of several works on botany of a popular character.

The annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers on May 13 and 14, when the following papers may be expected to be submitted:—On the production of iron sheet and tubes in one operation, by S. Cowper-Coles; on the preservation of iron and steel, by A. S. Cushman; on the manufacture of peat fuel, by Dr. M. Ekenberg; on the chemical physics involved in the decarburisation of iron-carbon alloys, by W. H. Hatfield; on the relation of the solubility of iron and steel in sulphuric acid to its heat treatment, by Prof. E. Heyn and O. Bauer; on high-tension steels, by P. Longmuir; on the Bristol recording pyrometer, by P. Longmuir and T. Swinden; on a heat-treatment study of Bessemer steels, by Prof. A. McWilliam and E. J. Barnes; on the Roechling-Rodenhauser electric furnace, by W. Rodenhauser; on the value of physical tests in the selection and testing of protective coatings for iron and steel, by J. Cruickshank Smith; on further experiments on the ageing of mild steel, by C. E. Stromeyer; on a comparison of the methods of determining the hardness of iron and steel, by Prof. T. Turner; on the rusting of iron, and modern methods for its prevention, by Prof. W. H. Walker. A supplement to the report on the determination of carbon and phosphorus in steel, presented by the special committee appointed in 1901, will be submitted by Mr. A. A. Blair. The autumn meeting of the institute will be held in London on September 28, 29, and 30.

On Tuesday next, April 20, Prof. F. W. Mott, F.R.S., will begin a course of two lectures at the Royal Institution on "The Brain in Relation to Righthandedness and Speech," and on Thursday, April 22, Mr. J. Paterson will deliver a lecture on "How a True Art Instinct may be best Developed," being the first of three lectures on "Aspects of Applied Æsthetics." On Saturday, April 24, Mr. R. T. Günther will begin a course of two lectures on "The Earth Movements of the Italian Coast, and their Effects." The Friday evening discourse on April 23 will be delivered by Mr. Alexander Siemens on "Tantalum and its Industrial Applications," and on April 30 by Dr. Edmund Gosse on "Pitfalls of Biography."

On April 7 the Guernsey States or legislative assembly rejected a proposal to introduce daylight-saving legislation by a practically unanimous vote. A proposal that Guernsey standard time should be Greenwich mean time was adopted.

A conference of members of the Museums' Association and others interested will be held at Towneley Hall, Burnley, on Saturday afternoon, May 15, for the purpose of discussing subjects of interest to those concerned in the work of museums, art galleries, and kindred institutions. Offers of papers or suggestions of suitable subjects for discussion should be sent to the hon. secretary, The Sycamores, Burnley.

A committee, consisting of the members of the scientific staff of the Royal Observatory of Belgium at Uccle, is undertaking the preparation and publication of a list of magnetic and seismological observatories, and this list is to be followed by another dealing with the societies and periodicals particularly concerned with magnetism, seismology, and atmospheric electricity. Such lists will prove of great assistance to physicists occupied with these subjects, since by their aid reference to the researches of other workers will be facilitated greatly. To assist in the work which has been undertaken, the Belgian committee would be glad to receive information from the officials of scientific societies concerned with the physics of the globe. The committee desires to be informed as to the rules of such societies, the date of their foundation, the place of meeting, the subscription, the number of members, the frequency of the meetings, the names of the executive committee, and the publications of the society, and would be greatly assisted by receiving specimen numbers of these. Communications should be addressed to the committee at the observatory.

For some time past very alarming reports have been in circulation as to the work on the Panama Canal, and especially as to the stability of the proposed great dam at Gatun. Three years ago it was settled, after an exhaustive inquiry by a commission of engineers, that, taking everything into consideration, and under the special conditions that prevail on the Isthmus of Panama, it was desirable that the canal should have locks in preference to being made throughout at sea-level. There has, however, since that decision was arrived at, been a continuous agitation kept up in the American Press impugning the recommendation of the commission, and alarmist reports have been circulated, especially with reference to the safety of the Gatun dam. About three months ago another commission was appointed by President Roosevelt to inquire into this matter and generally to report as to the works. The main findings of this commission are a full endorsement of the scheme and works as now being carried out, and an expression of confidence in the engineers entrusted with the work. The dimensions of the locks as finally settled are to be 1000 feet in length and 110 feet in width. It is now estimated that the cost of the canal will be seventy-two millions sterling, whereas a sea-level waterway would cost upwards of one hundred millions. It is anticipated that the lock canal will be completed in five years' time, whereas a sea-level canal would take several years longer. From 40,000 to 50,000 men are now employed on the canal. Owing to the very efficient sanitary arrangements that have been carried out, the district has now become fairly healthy, and yellow fever and other diseases common to a tropical swamp, which formerly prevailed, have almost entirely been stamped out.

Among the contents of No. 5 of the Bulletin of the Imperial Academy of Sciences of St. Petersburg for 1909 is an article, by Dr. W. Salensky, on the development of the nemertine worm *Prosorochmus viviparus* (=*Monopora vivipara*). As the result of the author's investigations, it appears that the proboscis is in no wise concerned with the formation of the œsophagus; the proboscis and the œsophagus are, in fact, developed independently of one another, and only later come into mutual connection; and, finally, the atrium of the proboscis in Prosorochmus (and very probably also in all metanemertines, in which the mouth-opening lies in a so-called rhynchodæum) forms, not only a portion of the proboscis, but also a part of the œsophagus.

The parasites of the cotton-worm are under investigation in the West Indies, and a report of some of Mr. Jemmett's work thereon appears in a recent issue of the

Agricultural News. The two parasites dealt with are *Chalcis ovata* and a Spirochalcis. The latter was found to be parasitic on the Sarcophagidæ, which in turn are parasitic on the cotton-worm, but whether they attack healthy or only damaged pupæ is not yet clear.

The February number of the *Journal of Agriculture of South Australia* contains the results of manurial experiments on wheat made at certain centres in South Australia. Small dressings of superphosphate were found to give remarkable increases in crop, but neither nitrate of soda nor sulphate of potash had much effect. These results are so unusual that it would be interesting to know the composition of the soil and the meteorological data at the various centres.

A pamphlet was recently issued by the Midland Publishing Company, Cradock, Cape Colony, on lucerne, in which the characteristics of this valuable crop are set out in detail. The methods of cultivation and of dealing with the pests to which it is liable are described; sections are also devoted to discussing the value of lucerne as food and as green manure. For the South African farmer lucerne has the double advantage of being a leguminous crop, and therefore increasing the amount of nitrogenous organic matter in the soil, and of withstanding drought, because of its deep-rooting habit.

The rainfall conditions of many districts of the Transvaal are not altogether favourable for vegetation; the fault does not lie so much in the amount of the rainfall as in its irregular distribution. Similar conditions exist in parts of the United States, but have been overcome by special methods of cultivation, and "dry farming" is now extensively practised. The essential part of the scheme is to plough the soil deeply and cultivate the surface frequently, but to keep the subsoil compact; in these circumstances the water is found to remain near the surface, and is not readily dissipated by evaporation. Mr. Macdonald, the official of the Transvaal Agricultural Department who devotes himself to dry farming, has given in the current number of the *Transvaal Agricultural Journal* an interesting account of the various methods adopted and the principles on which they are based.

Bulletin No. 5 of the Sleeping Sickness Bureau contains a summary of various papers on the development of trypanosomes in, and mode of transmission of trypanosomes by, tsetse-flies, on treatment, on human trypanosomiasis, &c. Now that so much is being written on this subject, it is very useful to have a summary of this kind.

Tuberculosis is the subject of two papers in the March number of the Bulletin of the Johns Hopkins Hospital (xx., No. 216). One, by Dr. Kober, deals with the influence of sewerage and general sanitation on the prevalence of the disease; the other, by Dr. Moss, outlines a plan of study of tuberculosis in all its bearings, and is well worthy of consideration. The place of protozoology in the medical curriculum is also discussed by Dr. Schultz, and the ground such a course should cover is indicated.

The influence of radium rays on germination and other life processes in plants is discussed by Prof. C. S. Gager in the *Popular Science Monthly* (March). Experiments were made with sealed glass tubes containing radium bromide of different degrees of activity, and with a rod coated with radium bromide. It was found that radium of strong activity or a long exposure produced retardation of growth, or even killed the plants, but emanations of less activity, in certain cases, produced acceleration of growth.

An article on sand-binding plants is published in the *Indian Forester* (February), in which the author, Mr. V. Subramania Iyer, furnishes an ecological account of the plants growing on the Coromandel coast. The ten species noted as typical sand-binders are *Spinifex squarrosus, Cyperus arenarius, Ipomoea biloba, Canavalia obtusifolia, Hydrophylax maritima, Spermacoce hispida, Launaea pinnatifida, Pupalia orbiculata, Pandanus odoratissimus,* and *Casuarina equisetifolia.* It is mentioned that *Cyperus arenarius* throws out shoots to a distance of 50 feet, and an underground stem of *Ipomoea biloba* measured 40 feet, with internodes averaging 6 inches in length.

The hardness of oil-palm kernels might well be proverbial, so that the reported discovery on the West Coast of Africa of a variety with soft shells has aroused much interest. Information on the subject, received from various British and foreign colonies along the coast, has been collated in the *Kew Bulletin* (No. 2). The reports confirm the existence of such a variety in the various countries from the Gold Coast to the Cameroons, and point to its being a botanical variety, *microsperma*, of *Elaeis guineensis.* It is doubtful whether this variety comes true to seed, and in this connection experiments are necessary to ascertain whether the plants are generally self-pollinated or if cross-pollination occurs.

The account of a South African bamboo, contributed by Dr. O. Stapf to the same number of the *Kew Bulletin*, illustrates the difficulty of naming some of these grasses. It has been known for seventy years that a bamboo grows in Cape Colony, but the reference to a genus was uncertain until flowering specimens were collected recently on the Drakensberg above an altitude of 5000 feet, when it proved to be an Arundinaria. Mr. J. M. Hillier supplies an article on the lalang grass, *Imperata arundinacea*, distributed through Ceylon and parts of Asia, where it is regarded as a veritable pest. In the search for plants which might provide the material for paper pulp, samples of lalang were submitted to analysis and manufacture. The paper produced was very suitable for a wrapping paper, and was somewhat improved by the addition of cotton.

In the April number of the *Reliquary* Mr. W. Turner describes a collection of Roman metal-work found at Deep Dale Cave, about three miles from Buxton. The objects seem to have belonged to a party of Roman-Britons who were massacred here by some invading host, possibly Picts or Scots. It is almost certain that the victims met a violent death, because in the talus of the cave hundreds of human teeth were found, but very few interments, indicating that the bodies were devoured by beasts and birds. The objects discovered consist of various fibulæ, one of Celtic origin, with the head of a dragon, or, as some say, of a sea-horse; a lady's toilet appliances hung on a ring; a Celtic penannular brooch; a ring and tweezers—all these articles being of bronze. An iron spear-head was found in a part of the cave near a human interment. The collection, which belongs to Mr. Micah Salt, of Buxton, resembles in many respects the articles found by Prof. Boyd Dawkins at the Victoria Cave, near Settle, and it is believed to be the largest assortment of Romano-British remains found in any single cave in England.

The Francis Galton Eugenics Laboratory (University College, London) has commenced the issue of a new periodical under the title of the *Treasury of Human Inheritance*, in which will be given collections of pedigrees illustrating the inheritance of various characters in man. In the first double part, which is before us, the pedigrees, collected from various sources, relate to the transmission of diabetes insipidus, pulmonary tuberculosis, chronic hereditary trophœdema, split foot, polydactylism, brachydactylism, deafmutism, and ability. Each group of pedigrees is accompanied by an introductory memoir by the contributor, giving a brief description of the character itself, illustrated in several cases by very finely executed plates, a verbal description of the individuals referred to in the pedigrees, and a bibliography. The pedigrees themselves, of which there are seventy-four, are given on large plates, special symbols being used to denote individuals possessing or not possessing the character, or showing it only to a modified degree. The *Treasury*, which is published by Messrs. Dulau and Co., promises to be of the highest value, and Prof. Karl Pearson, who acts as general editor, is to be heartily congratulated on his adoption of the scheme. Anyone who has attempted to trace the published pedigrees relating to the transmission of any one character knows how much labour is involved in the search, and the collection of such pedigrees, both new and old, into one publication will render inestimable service to all those who are interested in the study of heredity.

The summary of the weather for the week ending April 10, just issued by the Meteorological Office, shows the period to have been quite phenomenal for the duration of bright sunshine. The sky was almost cloudless, especially over England and Wales, where the maximum shade temperatures generally exceeded 70°, whilst at night there were sharp radiation frosts. Over the kingdom generally the week was reported as among the brightest ever recorded, the possible duration amounting to 89 per cent. in the east of England, 87 per cent. in the south-east of England, and 82 per cent. in the English Channel. The highest percentage of the possible amount reported from individual stations was 93, at Lowestoft, Yarmouth, Felixstowe, Tunbridge Wells, and Worthing. At Greenwich Observatory the sunshine for the week was 90 per cent. of the possible duration. The thermometer in the sun's rays at Greenwich was 110° or above each day, and on April 9 registered 130°. The week was rainless in most parts of the kingdom.

We have received a copy of the international balloon observations made by the Bavarian Meteorological Service at Munich in 1908, compiled by Dr. A. Schmauss. They are given in the form of the publications of the Aëronautical Committee, and the separate ascents are generally accompanied by useful remarks and deductions. The results for the year have also been carefully discussed; the following are some of the conclusions arrived at, which agree with those obtained in previous years:—(1) The zone of least variation of temperature is in the region of the upper inversion, while the greatest amplitudes of temperature are recorded at the surface of the earth and at a height of about 8 kilometres; between these places, at about 3 km. above sea-level, a relative minimum is found. (2) The temperature gradient has a maximum variation where, generally speaking, it has the smallest values, viz. at the earth's surface and in the region of the upper inversion, and a minimum in the strata of greatest decrease of temperature, viz. from 3 km. to 9 km. (3) The boundary of the upper inversion is higher in summer than in winter; the lowest temperature occurs, on an average, in summer at 14 km. and in winter at 13 km. (4) The summer temperatures in the inversion are generally 3° C. to 4° C. higher than in winter.

In the *Atti dei Lincei*, xviii., 4, Prof. P. Pizzetti discusses the theorem according to which the mean value of a continuous function V of the coordinates over the surface of a sphere of radius R is $(\sinh R\nabla/R\nabla)V_0$, the suffix referring to the centre of the sphere and ∇^2 being Laplace's operator.

The *rôle* of thermal analysis in many metallurgical and chemical problems is so important that considerable interest attaches to the report on methods of obtaining cooling curves, by Mr. George K. Burgess (Reprint No. 99, Washington Bureau of Standards). Using a thermocouple and a galvanometer, the method of obtaining photographic records is fairly obvious; for autographic records the friction of the pen is obviated by limiting the tracing to a series of dots. The paper is illustrated by curves representing the relations between temperature and time, differential, rate of change of temperature and reciprocal of the latter, for typical transformations, one being isothermal, another exothermous, and the last endothermous.

A number of papers have recently appeared dealing with electromagnetic theories, and in particular with the impossibility of explaining electrical and mechanical actions on the hypothesis of a continuous medium. This question forms the subject of a paper, by Dr. Hans Witte, in the *Annalen der Physik*, xxvi., and contributions on pure electromagnetic fields, by Prof. Tullio Levi Civita (*Atti del R. Istituto veneto*, lxvii. [2]) and Leonella Caffaretti, of Rovigo (*Nuovo Cimento*, xv., xvi.). In two contributions to the *Atti dei Lincei*, xviii., 2, 3, Prof. Levi Civita obtains asymptotic expressions for the action of currents and for electric radiations, while the dispersion of energy due to moving charges is described by Dr. Hannibal Comessatti in the *Nuovo Cimento*, xvi.

We have received the first two numbers of the *Internationale Revue der Gesamten Hydrobiologie und Hydrographie*, a journal specially devoted to the study of oceanography and limnology in all their branches. Prof. Weismann contributes an introductory article, and amongst the authors of original papers are Sir John Murray, Drs. R. Hertwig, Raffaele Issel, A. Nathansohn, Alfred Fischel, C. Klausener, and Gustav Götzinger. An important part of the magazine is a series of reports on recent work and summaries of new publications, by experts. The editor is Dr. R. Woltereck, of Leipzig, and the appearance of the journal, as Sir John Murray justly says, "is a very important event for the future progress of these sciences, and may possibly mark an era in the development of knowledge concerning the Hydrosphere as a whole." We wish our new contemporary every success.

By the courtesy of Mr. Alfred E. Dean, of 82 Hatton Garden, who is the London agent of Messrs. Jougla, we have been able to try a sample of the "omnicolore" plate to which we referred on February 4 (vol. lxxix., p. 409). These, like other colour-screen plates, contain in themselves all that is necessary for the photography of objects in "natural colours." The general character of the plate we have already given, and as Lumière's autochrome plates have been in common use for a year or two, it is natural to compare new-comers with them. The procedure recommended by the makers of the omnicolore plate is much simpler than the method of working the autochrome; indeed, it is the simplest possible, considering the general principles involved. The plate, after exposure, is developed, rinsed, placed in an acidified solution of potassium bichromate to dissolve away the silver image, rinsed, returned to the original developer to reduce the silver salt to the metallic state, rinsed, fixed, and washed. Intensification is not necessary, for the sensitive film gives ample density without it; no clearing baths are necessary, and the original developer works excellently for the second treatment—in all these details the manipulation of the new plate is simpler than what is desirable, if not necessary, in the case of the autochrome. The colours of the omnicolore plate are much more transparent than those of the autochrome, being applied as paints or varnishes instead of being absorbed by translucent starch granules; but this method has its drawbacks as well as its advantages, for the density of the colour is not even all over each little patch of red and green. The colour is lighter towards the margins of the patches, and their shapes, too, are rather irregular, but doubtless improvements will be made in these directions. The plates, as they are, are simple and easy to manipulate, and give results that must be distinctly useful to those who wish to reproduce, or, more correctly, to imitate, by the simplest known method, the colours of the objects they photograph.

OUR ASTRONOMICAL COLUMN.

Observations of Comet Morehouse.—Comet 1908c was observed, with the 284 mm. Amici equatorial, at Arcetri on forty-one days between September 4 and December 7, 1908, and 127 determinations of its position were made with the micrometer. These are now recorded by Prof. Abetti in No. 4316 of the *Astronomische Nachrichten*, together with a valuable set of notes describing the comet's visual appearance on a number of days.

Mr. Metcalf's note and excellent photographs are also reproduced, from the Harvard Circular No. 148, in the same journal.

A series of six photographs taken at the Dominion Observatory, Ottawa, between October 6 and November 26, is reproduced and described by Mr. Motherwell in No. 1, vol. iii., of the Journal of the Royal Astronomical Society (Canada). The comet was visible at Ottawa for more than three months, but dense smoke and unusual cloudiness prevented an extensive series of photographs from being obtained. Those reproduced show similar knots in, and displacements of, the tail-matter, as previously recorded. On October 20 the head of the comet passed over an eighth-magnitude star without perceptibly dimming it.

Observations of the comet, made with a sextant on board the German steamship *Paranaguá*, are recorded in No. 4317 of the *Astronomische Nachrichten*.

Measures of Double Stars.—The micrometer measures of double stars made by Dr. Lau and Herr Luplau-Janssen at the Copenhagen Observatory during 1908 are recorded in No. 4315 of the *Astronomische Nachrichten*. The stars observed chiefly lie between declinations 0° and 20°, special attention having also been paid to neglected pairs. In addition to the date, position-angle, and distance, the authors give brief notes concerning the colours of the components, and, where possible, compare the values obtained with those computed from previously published elements.

Diameter and Position of Mercury.—In these columns on December 24, 1908 (No. 2043, vol. lxxix., p. 232), we noted the corrections to the diameter and position of Mercury, derived by Prof. Stroobant from the observations of the transit of the planet, on November 14, 1907, made at thirty-three observatories. Since the publication of the memoir in which he gave those corrections, Prof. Stroobant has received observed values from eleven additional observers, and has incorporated them in the final results which appear in No. 4317 of the *Astronomische Nachrichten*.

These show, from the time between first and second contact, that the planet's apparent diameter was $9''\cdot166$, whilst the observations of the third and fourth contacts give, similarly, $9''\cdot092$. These values correspond to diameters, at unit distance, of $6''\cdot20$ and $6''\cdot15$ respectively, the latter being probably the more correct.

The corrections to the equatorial and ecliptical co-ordinates are found to be $\Delta\alpha = +0\cdot070$s., $\Delta\delta = -0''\cdot25$, and $\Delta\lambda = +1''\cdot03$, $\Delta\beta = +0''\cdot02$, respectively, in the sense observed-calculated.

The agreement of the Italian observations of this passage of Mercury with the data given in various ephemerides is discussed by Signor Pio Emmanuelli in No. 110 of the *Revista di Fisica, Matematica e Scienze Naturali* (Pavia) for February.

The Vatican Observatory.—We learn from the *Times* Milan correspondent that the inauguration of the new section of the Vatican Observatory, which was to have taken place on March 18, was postponed because one of the components of the 40-cm. object-glass for the new equatorial refractor was found to be defective, and has to be re-cast.

When this new section is complete the Gregorian Specola will be abandoned, and the whole of the observatory will be located on the summit of the Vatican hill, 100 metres above the square of St. Peter's, where Father Lais has been engaged, since 1891, in taking the photographs for the International Astrographic Chart (the *Times*, Engineering Supplement, April 7).

PRODUCER GAS FOR ENGINES.

I.—Processes and Plants.

It is well known that what is technically called "producer gas" has been in use for many years in connection with furnace work. Herr Bischof, of Mägdesprung, was the first to use an internally fired gas producer for this purpose in 1839; but little progress was made in our country until 1857, when the late Sir William Siemens introduced the combined gas producer and regenerative furnace with which his name is associated. Some twenty years later it occurred to me that a gas engine might be worked with producer gas if a suitable plant were devised. For furnace work the hot gas is taken direct from the producer to the furnace without cooling or cleaning, and the condensable hydrocarbon vapours, which usually accompany the gas, and add appreciably to its value, are burnt. But for engine work it is essential to wash and clean the gas, especially as it must be free from tar. It is also desirable that the gas should be cool when it enters the cylinder of the engine. Incidentally, this involves the removal by condensation, &c., of the condensable hydrocarbons which leave the producer, and after their removal the gas must still be strong enough to fire well and give good working results in the engine. I succeeded in making a suitable plant, and it was first tried with a small Otto engine in 1879; the results were good, and they encouraged the makers of the engines to build them of larger size so as to compete favourably with steam-power. Many thousands of horse-power are now working with gas plants of this type, and during the last few years a still further impetus has been given to the subject by the use of a modified plant, which is known among engineers as a *suction plant*, and which will be more fully described later.

For the moment we will consider briefly the process of making producer gas, and some of the chemical reactions involved. Producer gas is made by forcing or drawing air, with or without the addition of steam or water vapour, through a deep bed of incandescent fuel in a closed producer. Usually the fuel is fed in at the top, and the currents of air, or of steam and air, enter at the bottom, the gas outlet being near the top. An important characteristic of the process is that no external heat is applied to the producer, as in the case of an ordinary gas retort. When once the burning of the fuel *inside* the producer has been started, the air which is used to make the gas keeps up a continuous process of combustion, and a sufficiently high temperature is maintained to decompose the steam and to effect other necessary reactions.

We know that if there were a shallow fire of carbonaceous fuel and a sufficient supply of air, the carbon would be completely oxidised. The product of this complete combustion would be carbon dioxide, with the development of a large amount of sensible heat; but if there were a considerable depth of carbon in the producer (as there should always be in practice) the resulting gas would be carbon monoxide instead of carbon dioxide, for when there is an excess of highly heated carbon the dioxide formed in the lower part of the fire is reduced to the monoxide. Carbon monoxide may also be formed by the direct combustion of the carbon with oxygen, and actually both these reactions may, and probably do, occur. Theoretically, if we were dealing only with carbon and air, about 30 per cent. of the heat of combustion would be liberated in the producer, and about 70 per cent. would be liberated when the carbon monoxide is afterwards burnt to carbon dioxide in a furnace or engine, &c.; the practical result, however, is still less favourable, and *primâ facie* the conversion of solid fuel into gas does not seem a promising performance.

It is true that not all the heat set free in the producer need be lost if the gas can be used while it is hot (as in furnace work); but for gas engines it must be cold. Apart from this, the liberation of so much sensible heat in the producer overheats it, and indirectly it promotes the formation of clinker, which is a practical drawback. To avoid these and other difficulties, the almost invariable practice is to add a certain proportion of steam or aqueous vapour to the air sent into the producer.

It should, however, be clearly understood that from the point of view of the heat quantities involved, the use of steam in a gas producer is simply a means for absorbing the sensible heat developed by the partial combustion of the fuel, and storing it for future use. Obviously there can be no actual increase of the total amount of heat which can be obtained from a given quantity of fuel. Besides avoiding excessive heat in the producer, the use of steam has the further practical advantage that a gas of considerably greater calorific power per unit volume can be obtained than is possible when air alone is used. The use of air necessarily involves the presence of the diluent nitrogen, and when steam is decomposed the resulting hydrogen and carbon monoxide displace some of the nitrogen.

With the exception of coke and charcoal, all ordinary fuels give off volatile substances when subjected to heat; and in a gas producer, working in the ordinary way with an upward draught, each fresh charge of fuel is heated, and is then subjected in some degree to a process of distillation before it descends into the zone where partial combustion takes place. The gas actually obtained may

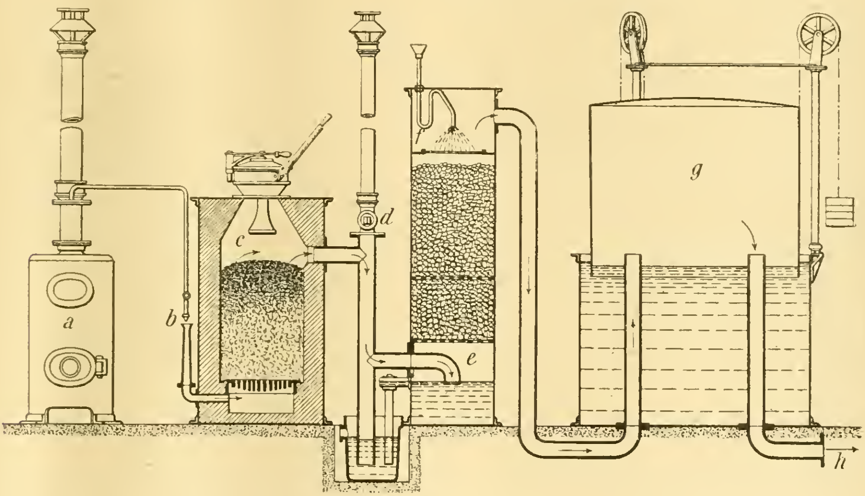


FIG. 1.—*Steam-jet pressure plant.* *a*, superheating steam boiler; *b*, steam jet and air injector; *c*, gas producer; *d*, waste cock and pipe; *e*, coke scrubber with water seal; *f*, water sprayer; *g*, gas-holder and tank; *h* gas outlet.

We are therefore led to consider how steam reacts with the carbon with which it comes in contact. If the carbon is at a sufficiently high temperature, the steam (H_2O) is decomposed, and an equal volume of hydrogen is produced; the oxygen of the steam combines with the carbon to form either carbon monoxide or carbon dioxide, according to the conditions under which the reaction takes place. When hydrogen combines with oxygen to form water vapour heat is liberated, and when this water vapour is decomposed by the reaction of highly heated carbon (or by any other means) an equal amount of heat is absorbed. The combination of the oxygen of the steam with the carbon is accompanied by the evolution of heat, but the quantity of heat thus evolved is much less than the quantity of heat absorbed by the decomposition of the steam, and this is why the addition of small quantities of steam to the air going into the producer reduces the working temperature. Part of the sensible heat is absorbed by the reactions which take place between the steam and the incandescent carbon, so that the gas leaves the producer at a lower temperature than is the case when air alone is used; the heat so absorbed is stored up in the gas, and is again set free when the gas is burnt.

therefore be regarded as producer gas obtained from carbon, mixed with the volatile substances given off by the distillation. The actual composition of the gas depends a good deal on the nature and amount of these volatile substances, and they vary considerably, the fuels used being chiefly anthracite, coke, and bituminous or semi-bituminous coal. Both these coals give off a considerable quantity of tarry matter, which may represent as much as 8 per cent. or 9 per cent. of the total heat value of the fuel. When the gas is cooled and scrubbed before use, the tar which is removed has little value; it is therefore desirable that producers should be designed to burn the tar in the producer itself, or to decompose it and convert it into combustible gases which will not condense at ordinary temperatures. Even anthracite when heated yields both hydrogen and methane, and this is why it makes a better gas than coke.

In Fig. 1 we give a typical example of a gas plant in which the producer is worked with a jet of superheated steam which injects the air required.

In some plants the steam required is produced by the sensible heat of the gas after it has left the producer, and this effects a certain saving; but even then the gas must leave the steam-raising apparatus at a higher temperature than that of the steam, and there is still a considerable loss of heat when the gas is cooled for use in an engine. There is also the loss due to radiation from the producer. Other conditions which have to be considered are the depth of fuel, its porosity, the size of the pieces used, and the velocity of the air blast—all are interdependent; for example, the depth of fuel required to give the best results will depend on the nature of the fuel, its size, and the velocity of the currents passing through it. It is obviously desirable that this velocity should not be excessive, and the producer should have a sectional area large enough for a given maximum rate of production.

The fuel consumption and the cost of repairs with a gas engine worked with a pressure plant, as shown in Fig. 1, have been much lower than can possibly be obtained with the best steam engines and boilers of the same horse-power; but in recent years the modification called a suction plant has given even better economical results for moderate powers. In some of the early gas producers for furnace work air was drawn into the producer by suction, instead of being forced in under pressure, and the idea of working the producer by suction has been reverted to in connection with gas engines. In 1862 Dr. Jacques Arbos, of Barcelona, patented a combination of gas plant and gas engine in which the latter drew gas direct from the producer. It was not a very practical arrangement, and the charge of gas and air was not compressed before ignition, but it deserves to be mentioned as one of the early suction plants devised. The first to give effect to this idea in a practical way, in a compression engine, was M. Léon Bénier, of Paris. His first patent was in 1891, and he afterwards took out others; the engine had a suction pump by the side of the motor cylinder, and this pump was connected by a pipe with the outlet of the gas plant. As soon as the fire was lighted it was blown up with a hand-power fan, and when the gas was good enough to work the engine the latter was started. The pump on the engine then drew gas from the producer and forced it into the motor cylinder. This suction of gas from the producer lowered the pressure in the latter, and as a consequence air from the outside flowed in. Steam was produced in the apparatus and mixed with the air, so that both steam and air were drawn together into the fire. By suitable adjustments the volume of air drawn in varied with the rate at which gas was consumed in the engine; in other words, the rate of producing the gas was governed automatically by the engine itself, and the gasholder and the independent boiler used in a pressure plant were dispensed with. As this plant, and those of which it is the type, work by suction, they are now generally known as suction plants, to distinguish them from pressure plants worked by air and steam at pressure.

The results obtained with this combination of gas plant and engine were disappointing, and the fuel consumption with a full load was greater than with a pressure plant; with a low load it was relatively worse. The gas was poor in quality compared with that made in a pressure plant, and there were other drawbacks: but the idea was an ingenious one, and it was seen that the working of a plant by suction, in combination with an engine, would have distinct advantages if the practical details could be worked out satisfactorily. Several engineers gave their attention to the subject, and the next step of importance was to do away with the pump on the engine and to use the suction of the engine itself, *i.e.* the suction caused by the out-stroke of the piston in the motor cylinder, to draw gas from the gas plant. This reduced appreciably the loss from friction. Various methods have also been devised for producing the steam required and for removing the clinker formed in the producer, as those adopted by M. Bénier were not satisfactory. In Fig. 2 we give a typical example of a modern suction plant.

The production of the steam required to make gas of good quality and to keep the temperature of the fire low enough to prevent the formation of an excessive amount of clinker, presents many difficulties. Steam at pressure is not needed, and some makers have a water vapouriser inside the producer, sometimes near the bottom of the fire, but more often near the top. They heat it by the fire or by the hot gas which leaves the fire, and in some cases both these sources of heat are used. On the other hand, some makers prefer to have the vapouriser outside the producer, and to heat it by the sensible heat of the gas after it has left the producer. The latter system has the advantage of cooling the gas more, but the amount of steam raised is less than in other systems, and there is the risk that gas will not always be hot enough to make the full quantity of steam required. This not only affects the percentage of hydrogen, &c., in the gas, but has an important bearing on the formation of clinker.

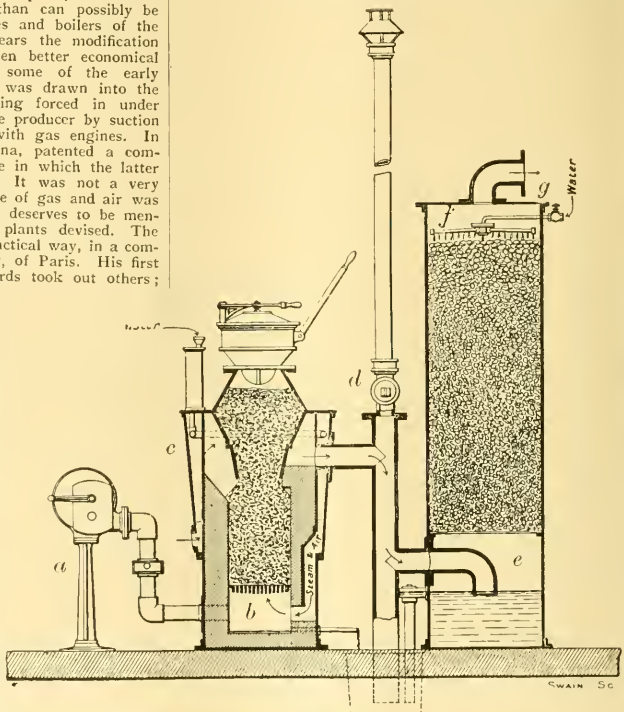


FIG. 2.—*Suction plant.* *a*, starting fan; *b*, gas producer; *c*, water vaporiser; *d*, waste cock and pipe; *e*, coke scrubber with water seal; *f*, water sprayer; *g*, gas outlet.

Apart from producing a sufficient quantity of steam when the maximum volume of gas is required, there is the further necessity for regulating the quantity of steam drawn into the fire when the load on the engine is variable. By some it has been supposed that when less gas is produced, *i.e.* when less air is drawn into the fire, the lowering of the temperature which follows causes less steam to be produced, and that in this way the quantity of steam produced is proportional to the quantity of gas required. This is only partly true, as actually the temperature of the fire does not vary as quickly as the load on the engine may vary, and although there may be a considerable fall in the load, there is usually heat enough in the fire to produce more steam than is then desirable. If this excess of steam continues, it not only causes an excess of carbon dioxide to be formed, but it damps down the fire. Then, when the load is increased suddenly, the temperature of the fire is not high enough to develop the power required. Some makers of suction plants try to get over this difficulty by having regulating valves worked by the engine, by means of which the admission of steam to the fire is governed by the engine. Some merely allow a vent in the vapouriser for the excess of steam to escape when the load is reduced, some make no special provision at all, while others use the suction of the engine to draw water into the vapouriser in very small quantities, just enough at each suction-stroke to give the steam required for the quantity of gas to be consumed. This can only be done provided the vapouriser flashes the water into steam; if the vapouriser holds a body of water, as in a boiler, steam is given off continuously, and although there might be a governing of the feed-water, the quantity of steam produced would not be governed. J. EMERSON DOWSON.

(*To be continued.*)

THE SCOPE OF EUGENICS.

THE first edition of the Robert Boyle lecture "On the Scope and Importance to the State of the Science of National Eugenics," delivered by Prof. Karl Pearson in 1907 before the Oxford University Junior Science Club, being out of print, the author has re-issued the same through Messrs. Dulau and Co. as the first of a "Eugenics Laboratory Lecture Series," intended to place the purport of the investigations conducted in that laboratory before the public in a simple form. The series should serve a useful purpose, as many of the original memoirs are somewhat repellent even to a reader of rather more than average intelligence owing to the use of highly specialised statistical methods. A translation of the lecture into German, by Dr. H. Fehlinger, has been published by the firm of Teubner (Leipzig and Berlin) in the *Archiv für Rassen- und Gesellschafts-Biologie.*

In the present lecture Prof. Pearson gives in brief the whole eugenics argument. "The Darwinian hypothesis asserts that the sounder individual has more chance of surviving in the contest with physical and organic environment. It is therefore better able to produce and rear offspring, which in their turn inherit its advantageous characters. Profitable variations are thus seized on by natural selection, and perpetuated by heredity." If these ideas apply to the case of man, "we must have evidence (1) that man varies; (2) that these variations, favourable or unfavourable, are inherited; (3) that they are selected." On the first head special evidence is hardly necessary; our own eyes afford evidence day by day that man varies, but there is plenty of definite knowledge also as to the amount and magnitude of variation. There is similarly a growing mass of evidence that such variations are not mere individual fluctuations, but are heritable. On the third head, however, the evidence is weaker and somewhat conflicting. In the population at large, natural selection appears to be operative to a greater or less extent, as we find that the age at death is inherited. It would be quite possible, however, for that selection to be ineffective if the weaker stocks nevertheless survived to a sufficient age to reproduce their kind as freely as the stronger stocks, and this seems to be the case to a large extent. The families of deaf-mutes, the tuberculous, and the mentally defective are as large as those of normal individuals, and the lower we go from one social grade to another the higher does the fertility rise. In these facts lies the stimulus to possible action directed towards the betterment of the race, negatively by placing hindrances in the way of the reproduction of the hopelessly unfit, positively by creating an altered tone and public spirit which may lead to a more normal and less restricted reproduction of the prosperous and the intellectual classes.

If one sentence may be cited with special approval, it is a statement near the commencement of the lecture:—"Our science does not propose to confine its attention to problems of inheritance only, but to deal also with problems of environment and of nurture." The improvement of the environment is as much a method of improving the qualities of future generations as the method of selection, not, of course, because somatic variations are heritable (which we do not believe that they are), but because the improvement of the environment endures. In so far as housing, education, and the treatment of the diseased are improved in this generation, the next starts from a fresh basis. Eugenic and eugeic methods should aid each other, and racial improvement be based on care of both the seed and the soil. Hitherto the methods have been too often treated as if they were opposed.

SCIENTIFIC WORK OF THE LOCAL GOVERNMENT BOARD.

THIS report[1] of the Local Government Board is the first to be submitted by Dr. Newsholme, and in the introduction he pays a graceful tribute to the work of the retiring principal medical officer, Sir William Power.

The vaccination returns show a slight increase in the percentage of births vaccinated and of infants exempted under certificates of "conscientious objection."

In the appendix on auxiliary scientific investigations carried out for the Board, Dr. Klein has continued his studies on immunity in plague, and shows that a watery extract of the liver and spleen of a rabbit which has recovered from an attack of plague possesses curative properties.

Drs. Andrewes and Gordon contribute a report on the defensive mechanisms of the body against infection by the pyogenic cocci, and, while admitting that the chief means of defence is a phagocytic one, conclude that the bacteriolytic power of the body fluids is by no means negligible.

Dr. Andrewes has also investigated the micro-organisms present in sewer air, with the result that the bacteria of sewage are to be found in the air of sewers and drains, and that therefore sewage in certain circumstances gives up its bacteria to sewer and drain air, though such bacteria ordinarily form but a small proportion of those present in sewer air. So far, the organisms detected are not in themselves known to be prejudicial to health, but their presence suggests that the more harmful sewage-borne microbes may likewise gain access to sewer air.

Dr. Savage submits a report dealing with the bacterial contamination of milk as obtained from healthy cows, and with the examination of milk samples obtained from cows suffering from an inflammatory disease, garget (mastitis), of the udder. In another report he details the results obtained in an examination of the intestinal contents of domestic animals for bacteria belonging to the Gaertner group—organisms which cause certain outbreaks of meat poisoning. From three bullocks and six pigs the results were negative, but from a calf numerous organisms belonging to this group were isolated.

Of late the view has been gaining ground that acute rheumatism is a microbial disease, and various organisms have been described by investigators. Dr. Horder contributes a report on the subject, but his results are mainly negative, and further research is evidently called for.

The action of the *Streptococcus faecalis* and of its chemical products has been investigated by Dr. Sidney Martin. The organism is capable of producing various disease conditions in man, such as cystitis and septicæmia. Preliminary experiments on the toxin of the microbe suggest that the main poisonous product is an endotoxin.

In an appendix Dr. Blaxall and Mr. Fremlin record experiments on the effect of cold on the potency of vaccine lymph, and show that a temperature of $-180°$ C. has no effect, and that lymph stored at $-5°$ C. for a year suffered no diminution in potency.

It will thus be seen that the volume contains papers of considerable importance in scientific medicine and hygiene.

R. T. H.

[1] Thirty-sixth Annual Report of the Local Government Board, 1906–7. Supplement containing the Report of the Medical Officer for 1906–7.

GERMAN ANTHROPOLOGICAL PAPERS.

THE two volumes, xciii. and xciv., of *Globus* for 1908 are especially interesting for the numbers of papers dealing with South American ethnography. The more important of these are:—Dr. T. Koch-Grünberg's articles on fishing and hunting among the natives of north-west Brazil, in which the implements employed are fully and carefully illustrated; the arrow release is described, and details given of large communal fish-traps and private tackle, the blow-pipe, arrow-poison, and a variety of weapons in use on the Upper Amazon tributaries. G. von Koenigswald's series of papers on certain tribes of southern Brazil deal somewhat briefly with the Botocudos, and more exhaustively with the Cayuas, a nomadic hunting tribe of the Guarani family. Weapons, lip-ornaments, physical types, and other points are figured. Freiherr von Nordenskiöld contributes an account, with carefully executed figures, on tobacco-pipes of South America. He concludes that they occurred sporadically before the *Discovery*. The tubular pipe, the most primitive form, is discussed and compared with the North American varieties. H. Beyer gives an account of the Mexican "dragon," in which he states that the god Quetzalcoatl, who is identical with Xiuhcoatl, is represented not only as human, but as a feathered snake. He is the most important deity in Mexico. The feathered snake was probably a sign of the ecliptic or of the zodiac, and Quetzalcoatl would thus be not only the deity of time, but also, like Xiuhcoatl, the symbol of the year.

T. von Koenigswald's series of articles is continued in vol. xciv., valuable and copiously illustrated descriptions being given of the Coròados and Carayas, hunting, fishing, and agricultural tribes who have resisted European influence to a very large extent. Prof. V. Giuffrida-Ruggeri, of Naples, gives an account of Florentino Ameghino's discoveries in Patagonia, which point to South America as the home of the "half-apes." He discusses the remains of the various strata, but says that the question must now be left for geologists to decide. He defines the genus Homunculus, and figures the skull of *Homo pampaeus ameghinoi*.

The German colonies are represented in vol. xciii. by well-illustrated papers by Dr. R. Pöch on New Mecklenburg (New Ireland) and Kaiser Wilhelm's Land. As regards Africa, negro music and musical instruments in Togo are described in two papers by Smend, in which variations in the musical bow, primitive harp, drum, and trumpet are described and figured. An account is given by Missionary B. Gutmann of curses and blessings of the Wadschagga. Dr. H. Krauss contributes an illustrated article on the household utensils of the German East African coast negroes. Vol. xciv. contains a brief description (with figures) by Missionary C. Spiess of the secret Yevhe and Se cults among the Evhe of the Guinea Coast. The origin of these mysterious objects, possessed of magical significance, has not yet been ascertained. B. Struck describes and figures some of the really able topographical efforts of King Ndschoya, of Bamum, West Africa. The Jabim shields of German New Guinea are described by B. Geisler, with illustrations of the method of giving a permanent warp to the shield and of the ornamentations on it. The hitherto uninvestigated natives of the Tanga Islands, off New Mecklenburg, are the subject of a short illustrated paper by Dr. O. Schlaginhaufen.

Europe is not neglected. To vol. xciii. Dr. A. Baldacci contributes an account of the Slavs of Molise (central Italy), and Dr. M. L. Wagner gives notes of a trip in Sardinia (continued in vol. xciv.). An appreciation is given by H. Seidel of Robert Townson, an eighteenth-century traveller in the Tatra, Hungary.

Vol. xciv. contains a beautifully produced copy of Sebastian Münster's map of Germany, recently brought to light after long oblivion; Dr. A. Wolkenhauer gives a most interesting explanation of the astronomical devices with which the sixteenth-century topographist and astrologist accompanies his map. In the same volume Dr. V. Lazăr contributes an account of marriage customs among the southern Roumanians.

As regards Asia, in vol. xciii. F. Grabowsky gives an interesting account of rice-culture among the Dayaks of south-east Borneo. In vol. xciv. we have a description by Prof. G. Behaghel of his travels in the Chinese province of Fokien. Dr. Ten Kate furnishes further points of Japanese popular belief in regard to omens, dreams, astrology, and mythology. Dr. M. Moszkowski gives a short illustrated account of the modified Danigala and Hennebedda Veddas, and a more detailed description of the inland tribes of east Sumatra.

Among the folk-lore articles in vol. xciii. mention must be made of Dr. Emil Fischer's description of the Paparudă procession among the Roumanian peasants, which takes place on the third Tuesday after Easter or after continued drought, when girls go round the village singing the rain-song. He cites another instance of southern Slav influence in the Scaloian procession, when children, mostly girls, form a mock funeral procession about a clay figure in a coffin, singing a dirge; the Scaloi, of which an illustration is given, is supposed to personify the drought which will end with its funeral. Prof. Mehlis describes the "Hexenhammer" of Dörrenbach (Palatinate) and other Neolithic implements still associated with thunder and magic by the peasants of those parts; he also alludes to the nomenclature of these objects in the Greek and Roman authors.

For Africa other than the German colonies, reference must be made to F. J. Bieber's paper in vol. xciii., on the political organisation of Kaffa, which lies in the south-west corner of the north-east African highlands, north of Lake Rudolf. With regard to Australia, vol. xciv. contains an account, by Frh. v. Leonhardi, of dog-figures of the Dieri tribe in central Australia; they are painted red and black, and are thought to represent the dogs of various tribal ancestors. These animal figures are apparently unknown among the neighbouring Aranda and Loritja tribes.

Of general interest are Dr. J. H. F. Kohlbrugge's discussion of red hair and its significance in vol. xciii. He compares the occurrence of erythrism and albinism in mammals and man, and discusses the question of pigmentation. In conclusion, he expresses the hope that the question may be more thoroughly investigated in the future, and alludes to E. Fischer's work on the subject, published after his article was written. In vol. xciv. Dr. C. Kassner gives a number of illustrations, with brief descriptions, of Bulgarian clapping-boards, salt-mill, wells, church taper-stand, and a variety of objects of antiquarian interest. Dr. S. Weissenberg discusses the problem of growth in human beings according to age, sex, and race. Tables are given illustrating the comparative annual growth of both sexes, of Jew and Jewess, Russian boy and girl, English boy and girl, Belgians, also of annual increase in weight, height, and size according to external circumstances. In conclusion, he points out that the third period of life, from ten or twelve to seventeen or eighteen years of age, is the crucial time of development, as it is then that racial, sex, and individual differentiation sets in.

NEW CRUCIBLE SUPPORT AND FURNACE.

MESSRS. J. J. GRIFFIN AND SONS, LTD., have sent us for examination a universal crucible support. It consists of three iron rods, which pass obliquely through the legs of an iron tripod and are held firmly in the correct positions by the action of brass springs. The three rods have fitted over them quartz tubes drawn out into pointed ends. By simply pushing in or drawing out the rods can be adjusted to take either small or large crucibles—up to three inches in diameter. Quartz fusing at a higher temperature than platinum, this crucible support is very handy, and is much cheaper than using a platinum tripod. The heating of the crucible is also more uniform, as it is held in position simply by the pointed ends of the quartz tubes. There is therefore no necessity to turn the crucible about in order to make sure that the whole of its contents are completely and uniformly ignited.

We have received from the Cambridge Scientific Instrument Company a small crucible furnace heated with a Méker burner, and called the Méker furnace. We have tested the furnace and find it very efficient, as within a few minutes there is no difficulty in melting copper. The main features of the new burner are the careful and exact proportioning of the size of the air inlet holes and of the gas injector, thus causing a perfect mixing of the air and gas for combustion. The lower part of the burner is constricted and the upper part enlarged so as to allow a thorough mixing of the gas and air before combustion. The top part of the burner is furnished with a deep nickel grid to prevent back-flashing of the flame. This nickel grid is of very stout make, and is about 1 cm. deep, thus making it practically impossible for the flame to flash back. Although the burner gives a very hot flame, the amount of gas used is by no means excessive, and as metals are very rapidly melted, and other operations, such as fusion and reduction, carried out very quickly, the gas consumption for a given operation is less than with other burners.

One of the greatest advantages is that, by using the Méker burner, operations which used to require a large amount of leg-work with the blow-pipe can now be carried out without employing a blow-pipe at all. In order to obtain very high temperatures another form of the Méker burner is arranged for use with the blow-pipe or compressed air.

These burners are made in a large variety of sizes and shapes, and from our experience with them we shall expect to see them largely employed in the future.

THE DEFECTS OF ENGLISH TECHNICAL EDUCATION AND THE REMEDY.[1]

WHEN writing the paper which I am going to read to you I have rarely been free from the oppressive thought that many of my audience will justly consider it forwardness, bordering even on arrogance, on my part to lecture to an association of English technical teachers on the defects of English technical education. Not only have I been interested in this subject merely for a few years, whereas many of my audience have spent a lifetime in it, but I am not an Englishman myself.

Your secretary, however, insisted that the exceptional opportunities which I have had of becoming acquainted with technical education as it affects, not only the lecturer and the student, but also the employer of labour, in this country as well as in Germany, would carry weight with you and would assure your serious consideration of my views; but further, standing as I do outside the teaching profession, and having no private interests to serve, I thought that, whatever criticism I might experience, I should not be suspected of any ulterior motive if I came forward to point out what, to my mind, are the weaknesses and faults of our present system, and to advocate what appears to me the only right course to adopt. So I accepted your secretary's invitation, and will, with your permission, now proceed to place my somewhat unconventional views before you.

The importance of technical education for any modern nation, but most particularly for England, cannot easily be overestimated, a fact which is being pointed out so frequently and acknowledged so generally that I need not dwell upon it at any length. There is not a student of national economy who fails to realise that Germany and the United States, now serious rivals to English trade, owe their rapid industrial and commercial development largely to the magnificent system of technical education which they have established.

Indeed, the recognition of this fact by all thoughtful men has led to vigorous efforts being made during the last ten years or so, and to a prodigious amount of money now being annually spent in this country for the purposes under discussion.

No one will deny that a very great deal has been accomplished, and personally I should be the last to underrate the value of the work now being done in numerous institutions, or to belittle the services of so many pioneers, to whom, indeed, the nation owes a debt of gratitude. Nevertheless, it must be, and is, widely recognised that technical education is only in its infancy, that it is as yet far from exercising to the full and in an efficient manner that propelling influence on the industries of the country which is its aim and duty.

Almost invariably, however, when this fact is recognised and pointed out, on whatever occasion it may be, the conclusion is drawn from it that the people of England must be prepared to spend more money in erecting and thoroughly equipping technical colleges and universities.

The main object of this paper is to prove the fallacy of that conclusion, and that every new college erected is another stone round the neck of technical education. It is, in my opinion, certainly not lack of money which is to blame for the admittedly unsatisfactory state of affairs. From the statistical data contained in the Government Blue-books and Budgets I have made a calculation as to the total expenditure of public money in England and Wales as compared with Prussia. The two countries are similar in industrial activity and in the character of their population. Prussia, with its highly efficient educational system and its technical institutions admired by all the world, spends roughly 600,000*l.* per annum on current expenditure. The statistics available for England, particularly as to local contributions, are rather scanty, but from a very moderate estimate I find that at least 1,000,000*l.* is annually spent for equivalent purposes. Taking into account the larger population of Prussia, we arrive at the result that England already spends about twice as much money as Prussia, reckoned per head of population, with educational results which—I say it without hesitation—will not bear any comparison. If one would compare the extraordinary expenditure incurred in building and equipping new institutions, the result, I believe, would be even more unfavourable to England.

Neither lack of money nor of effort is the fault, but the fundamental principle is wrong on which rests the whole structure of technical training in this country.

Technical education is not a private or local, but by its very nature a national affair, and the most essential condition for efficiency and economy is that it should be established on the basis of systematic national organisation, and that it should be nationally managed.

The numerous objections raised by employers and the general public against technical colleges, and the still more numerous grievances of those actively engaged in technical training, are largely, if not solely, connected with the present unsound foundation.

With the object of proving the truth of these sweeping statements, let us briefly consider what are the complaints I refer to.

(1) The number of day students in all institutions, and consequently the attendance at the majority of classes, is far too small. Taking the figures given by the British Education Section of the Franco-British Exhibition for 1908, there were in England and Wales forty-five technical and agricultural colleges, with a total attendance of 3344 day students. This corresponds to an average of seventy-five students per college, or approximately six students per class. These figures do not include the technical students of universities and university colleges, but, nevertheless, the facts are even worse, because the large number of smaller technical institutions providing for day instruction is omitted from the list, and the preponderance of students in the first-year courses must also be kept in mind; and, further, even in the largest colleges, in such institutions as the Birmingham University and the Manchester Municipal School of Technology, the attendance of day students bears no proportion to the cost of their beautiful equipments. Manchester, for instance, reports a total attendance in all departments of 165 full-course day students during the present session. In numerous institutions it is by no means an exception to find classes, especially in more advanced subjects, consisting of two or three students, and many classes only exist on paper, there being no students at all to take advantage of the facilities offered to them.

(2) The average education of day students entering for technical instruction is poor, and the diversity of their previous training so great, that the gravest educational difficulties result. This is only partly due to the unsatisfactory state of primary and secondary education. The

[1] Paper read before the Association of Teachers in Technical Institutions (West Yorkshire branch) in Huddersfield, on March 27, by Dr. Robert Pohl.

chief reason is the scarcity of students, which leads to little regard being taken of the previous education of a would-be day student.

(3) The undue importance attached to external examining bodies, and the consequent variety of examinations to which the training must be adapted, detract from a concentration of effort and uniformity of purpose.

(4) The usual management of municipal institutions by a committee, the constitution and policy of which may change every year, and which only too often consists of a number of private gentlemen more or less strangers to technical education, is unsound and wasteful. It often stultifies the really enthusiastic teacher by delaying necessary and urgent improvements.

How long will this country continue to leave the management of so vital a matter as day technical education largely in the hands of amateurs?

(5) The equipment provided in individual institutions cannot be kept up-to-date, owing to lack of funds and of students.

All these serious obstacles result in financial wastage as well as educational inefficiency, the latter all the more, as they make it exceedingly difficult for a teacher to find that amount of satisfaction in his work necessary to keep alive his enthusiasm and that of his students.

Coming to the attitude of the employers of labour toward technical education, it is not altogether surprising to find that little importance, as a whole, is attached to college training.

A comparison of the advertisements for vacant posts appearing in English and German technical papers will prove this better than anything else.

Generally speaking, there appears to be amongst employers a lack of interest in technical education, and not much willingness to cooperate with technical institutions. This impression I have received in numerous conversations and inquiries concerning this subject. Specific complaints there are few; I have occasionally heard it stated that day technical training is not of a sufficiently practical character, that day colleges not rarely fail sufficiently to impress on the minds of the students the importance of practical experience, and that, thereby, they indirectly make them look down on shop-trained men and unwilling to adapt themselves to the routine of the workshop and to acquire practical knowledge and skill; that technical teachers are often recruited from the ranks of those day students who have found it too difficult a task working themselves up to a good position in practical life; this, in turn, is said to be the cause of the colleges remaining alienated from practice. Finally, the statement is sometimes made that too little original work, especially such as requires experimental research, is carried out by the staffs of day colleges.

My personal opinion as to these points is that none of them is quite without justification, though specific cases are often exaggerated and unduly generalised. It is certainly a great mistake permitting students to remain as assistants in the college after their final examination, and gradually to work themselves up into the position of lecturers in technical subjects, without having ever entered into practical life.

The main cause for such complaints, however, lies in the fact that even in the technical universities the number of students is not sufficient to permit of a number of specialised experts being appointed in each department, as is the practice in Germany. The professor or lecturer in an English college is expected to deal with a variety of subjects, each of which is a science in itself, and his spare time is very limited. Personally, I think it is surprising that so much original work is done in spite of such adverse circumstances.

Evening classes stand in greater favour with employers, being considered a necessary complement to the day-work of apprentices. Complaints are made, however, on account of the heavy nervous strain imposed on youths. Only quite recently two cases of nervous collapse have come to my notice which, according to the doctor, were without doubt due to excessive strain imposed by the college work, which consisted of lectures on three nights a week and a large amount of home-work. Proper cooperation between the employer and the college would have secured the amount of relief during daytime necessary for the physical and mental well-being of the boy. Such cooperation is absolutely necessary in connection with all evening work.

Coming, finally, to the general public and its attitude towards technical education, I need hardly refer to the cry heard throughout the length and breadth of the land that the technical schools impose a far too heavy burden on the ratepayer, a burden altogether out of proportion to the work accomplished, both qualitatively and quantitatively. We hear that cry every day. I am afraid, however, of losing your sympathy altogether when I state it as my opinion that these complaints of the ratepayer are fully justified. I consider some of the figures which were recently published as to the cost of technical education per student-hour are absurdly high, and a conclusive proof of the inefficiency of our present system; but, apart from that consideration, the ratepayer contributes about 75 per cent. of the cost of technical education, whereas it is only just that the bulk of it should come from national sources.

This list of defects of technical education could be still further extended, but I have only referred to the most important ones, the majority of which are felt in all technical schools and colleges, and on which I believe we are agreed.

Now, I venture to submit to you that all these defects could be removed by placing technical education on a national basis.

Day technical teaching, to be efficient, must, in my opinion, be thoroughly organised all over the country, so that a limited number of excellently equipped colleges, with a very large number of students and a corresponding number of specialised lecturers in each department, will satisfy the needs of their correspondingly large districts. That is the secret of Prussia's success; and though many English people, justly proud of their free institutions, may look down on Prussia as a State governed by army officers and policemen, so much they will have to admit, that England not only can, but must and will, learn a good deal from Prussia in regard to the organisation of education.

May I, for example, refer to the Charlottenburg College, about which so much was said and written in connection with the founding of the Imperial College of Science and Technology? Very rarely have I found that the English admirers of Charlottenburg understood the real difference between the German and any corresponding British technical college. It is this: technical education being nationally organised in Prussia, there exist only four technical universities in the whole country, with a population of 38,000,000 people. The average number of day students is about 2500 per day. Charlottenburg, the largest of them, is the technical university, not only for the whole of Berlin, but in addition for a district of some 40,000 square miles. The number of its students, which, of course, are all day students, is about 5000, and the most stringent regulations as to their previous training are in force. With such an attendance the State can afford to appoint for each department a number of professors, each of whom is a recognised authority in some branch of that department. As an example I may mention that there are at Charlottenburg not less than seventeen professors and lecturers in electrical engineering subjects alone.

Instead of this, what do we find in England? The British Government has chosen the easier course of leaving the founding and management of technical institutions to the enterprise of charitable private persons, corporate bodies, and the local authorities. As a result, there are—not in greater London, but in the administrative County of London only—at least six colleges of university standing and six day colleges recognised by the Government as technical institutions competing with one another, not to mention ten other institutions with day technical classes and eighteen schools of art. Similarly, in the provinces quite a number of lavishly equipped university colleges have been founded, and technical day schools have sprung up like mushrooms, their number now being many times in excess of the well-understood needs of the country. Many of these institutions are in close proximity to and competing with one another.

The educational consequences require no repetition. You may go through all the defects which we have considered, and you will easily see that every one of them is directly attributable, not to lack of energy or ability on the part of the technical teacher or to unwillingness of the British rate- and taxpayer to part with his money, but to the absence of national organisation and the consequent disastrous competition between the existing schools.

Money can build the most beautiful edifices and buy the most excellent equipments, but it will not cure this evil. Technical education will, in my opinion, never to the full exercise its highly important functions in the life of the nation until the Board of Education awakens to its duty and establishes a sound national system of technical education; and such system will require to be enforced, as the petty jealousies invariably found to exist between neighbouring corporations do not permit of any hope that a similar result may be obtained by voluntary cooperation.

To this you will reply that the establishment of a national system of technical education would be a revolutionary and almost impossible step in England. I beg to disagree, and to believe that technical education can be far more easily organised on the basis of a national system than, for instance, primary education. In fact, I even doubt as to whether any new legislation would be required for the purpose. The pressure which the Board of Education, by means of the grant alone, can bring to bear on the governing bodies will prove sufficient to bring the majority, if not all, of the existing schools into line with a national scheme, and to make them take up the position assigned to them in it. I will go further, and venture to prophesy that before many years have passed the Government will have to take this matter up, under the combined pressure of the two parties chiefly interested in efficiency and economy, *i.e.* the technical teacher and the ratepayer.

It will, on this account, not be a waste of time to consider briefly the question as to an ideal system for England. I am well aware that any such system could only very gradually be developed out of the present chaos. A definite, practical scheme, however, even if not fully attainable, always serves as an invaluable and unfailing guide.

Naturally, opinions on this question will differ very greatly, and all I have to say must be taken merely as a suggestion towards a very careful and exhaustive investigation of the subject, which, I think, this association ought to carry out.

Let me state, first of all, that I should not recommend an imitation of any existing foreign system, not only because I am unaware of any system that could not be materially improved upon, but chiefly because the educational system of any country must, of course, be adapted to its particular industrial and educational conditions; and, again, far from condemning the present English system root and branch, I consider that some of its features are most excellent, and should be maintained and further developed—features which are entirely absent, for instance, in the Prussian system. I refer, first, to the evening courses, which are doing exceedingly good work, and are deserving of the highest praise, and, secondly, to its democratic spirit, which shows itself in the low fees for evening instruction and in the extensive system of scholarships. I am well aware that complaints are often voiced against the methods now adopted in the awarding of scholarships, to the effect that they do not effectively prevent the tremendous leakage in the nation's brain resources. Still, I think it will be possible to modify it in such a manner as really to detect the very best brains of the whole country, wherever they may be found, and to lead them up to the highest possible development, to the benefit, not only of themselves, but of the whole nation. These factors, I suggest, should form two of the corner-stones of a national system.

However, in discussing these matters we are really taking the second step before the first. Before erecting corner-stones we ought to remember that no superstructure, however well designed, can stand erect unless it rests on sound foundations; and this leads me to what is perhaps the most important consideration in connection with this subject.

Unless English primary education is put into a much more satisfactory condition, technical education must remain severely handicapped. Does it not almost amount to a national crime that many thousands of children are permitted to leave school when only twelve years of age, and when the instruction is just becoming most valuable? Words fail in face of such overwhelming evidence as is contained, for instance, in a report of the Huddersfield Education Committee, issued a few months ago, of which the following is an extract:—"His Majesty's Inspector conducted a labour certificate examination. 162 candidates were examined, 136 passed and 26 failed. Of those who passed, 125 were between the ages of twelve and thirteen, and only 11 were over thirteen years of age." It is the duty of this association and of all individual technical teachers to work for the final abolition of the half-time system, the extension of the age limit for compulsory school attendance to fourteen years, and also for the stopping of street hawking and other exploitations of child labour. All men interested, not in cheap labour, but in the well-being of the nation, are agreed upon the desirability, and even the absolute urgency, of these reforms. Surely if other and less wealthy nations can afford carefully to educate every future citizen until he or she be at least fourteen years of age, England would not overtax her resources by doing likewise; indeed, she would make a step towards true economy.

A Children's Bill was passed during the last session of Parliament containing, I admit, some excellent provisions; but it passes my comprehension how the Government can be as proud of its "Children's Charter" as it seems to be so long as no attempt whatever is made towards the above indicated reforms, so highly important and so long overdue.

In addition to the extension of the school age, primary education should, in my opinion, be rounded off by compulsory attendance at evening continuation schools for three years.

On the basis of sound primary education, the structure of technical training which I wish to suggest is as shown in the following diagram, which indicates the various ways leading up to the technical university:—

Years of age				
20	Technical University	Second year Technical University	Technical University	
19 18 17	Apprenticeship and Evening Technical School	Apprenticeship and Evening Technical School	Pupilage	Pupilage
16 15 14	Apprenticeship and Evening Continuation School	Trade School	Trade School	Grammar School or Equivalent Secondary School and Primary School
13 12 11 10 9 8 7 6	Primary School			

A boy of fourteen, leaving the primary school and wishing to go in for a technical trade, has two courses open to him. If his parents cannot afford to let him continue in the day school, he should be apprenticed and should attend the evening continuation school up to his seventeenth year. He may then obtain a more specialised technical education, according to his requirements, by attending the technical evening classes for another three or four years, proper cooperation with the employers being an essential condition if success is to be obtained; and should his teachers find that his is a brain of exceptional ability, deserving and desiring to be developed as highly as possible, I suggest that an extensive system of national maintenance scholarships should enable him then to enter the technical university.

This is not the place to discuss the details of conditions and requirements. I only wish to emphasise that the son of even the poorest parents should not, by reason of his leaving school at fourteen, lose his opportunities of reaching the very top of the educational ladder; and I am anxious to lay the greatest stress on the desirability of extensively drafting the very best evening students into the technical universities.

The second alternative for the boy of fourteen is to continue his school life in a trade school to his seventeenth year, when the final certificate will give him access to the technical university after an apprenticeship or pupilage of at least one, better two, years. This would be the easiest and the more general road to the technical university; but, again, on leaving the trade school the student may be apprenticed for three years, attending also the evening classes, and he may qualify for the second year of the technical university, or even obtain a maintenance scholarship.

The third way of reaching the technical university would be through the grammar school or equivalent secondary schools. The certificate of having passed a certain standard either on the modern or the classical side would, again, without further entrance examination, be accepted as sufficient proof of adequate education, though for engineering, building, and textile departments at least one, but preferably two, years' practical work should precede the university studies.

The above forms an outline, though a very rough and compressed one, of my ideas. Let us, in conclusion, consider the most important question as to how the general introduction of any such national scheme would affect existing schools, and also the position of the technical teacher.

The majority of the existing technical day institutions would cease to exist as such; they have given conclusive proof that they have no right of existence. They would be transformed into trade schools for the daytime. The evening technical classes, however, would not only be maintained, but further developed, as they would grow enormously in general importance.

A number of the existing colleges and universities, spread at sufficiently large intervals over the country, would be developed into technical universities of the highest order, challenging comparison, not only as regards equipment, but in every other respect, with the very best institutions of other nations. According to the nature of the district, such technical university might be split up, where necessary, and an engineering college be established in one centre, a textile college in another, a mining college in a third, &c. Thus regard could be paid to local requirements to a considerable extent, while at the same time abolishing the present disastrous multiplication of efforts. The technical university should in its management be independent of local authorities; it should be entirely self-governing, and be under the direct control of the Board of Education. It should be permeated by a thoroughly democratic spirit, and those recruited from the technical evening classes by means of maintenance scholarships should form a very large percentage of its students.

Now, as to the position of the technical teacher, will it suffer or improve under such a scheme?

The answer is obvious if we will only consider what it is at present. The technical teacher is overburdened with day and with evening work, in addition to which, as is well known, he must spend a great deal of spare time in private study if he wishes to keep up to date in his rapidly progressing subjects; but, in spite of this, his salary, on the whole, is hardly better than that of the elementary teacher. In the endeavour to economise at all costs, corporations seem more and more inclined to consider the salaries of technical teachers as the most appropriate subject for curtailment; and, further, it seems to me, the technical teacher does not stand very high in the estimation of either the general public or the employer of labour.

Summing up, I find that his position is far from being in accordance with the importance of his work with regard to the life and development of an industrial nation. The reason is obvious. As yet technical education itself occupies a position far below that which is its due, and, of course, the technical teaching profession is inseparably connected with it. By lifting technical education up to its proper level and making it a national affair you would make the technical teacher a national or, to use the ordinary term, a Civil Servant, and the technical teaching profession would receive the recognition which it deserves, and which it receives in other countries.

That is, in my judgment, the only way in which English technical Education may be enabled to exercise that amount of guiding and enlightening influence which it must possess if this industrial country wishes to maintain its front seat in the council of the nations.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At a meeting of the East Lancashire Branch of the Association of Teachers in Technical Institutions on April 17 at the Municipal School of Technology, Manchester, Prof. W. W. Haldane Gee will open a discussion on "The Optical Lantern and the Microscope, with Special Reference to their Educational Uses."

During the last three years an investigation has been in progress in the United States to trace the cause of the failure of the physics teaching in the secondary schools of the country, and the educational journals have devoted much space to the question. It now seems possible to give a summary of the most important facts which the inquiry has brought to light. When physics was first introduced into American secondary schools, a distinct effort was made to present it as a means of explaining the various natural phenomena witnessed by the pupil in his daily life. Few experiments were performed, and those by the teacher with the simplest possible apparatus. Then came the decree that methods must be changed so as to meet the requirements of college entrance examinations, and, as a result, pupils were on the one hand forced into "inductive" or first-hand work, for which they were quite unsuited, and on the other were overwhelmed with mathematical formulæ, in which the physics was buried past disinterment. Now there is a strong desire to return to the ideals which prevailed in the past, to sever the school teaching from college control, to reduce the emphasis now laid on mathematical formulæ and on extreme accuracy in experimental work, and to base the subject on the daily experience of the pupils. The national commission has our cordial support in its efforts at reform.

The March number of the *Psychological Bulletin* is devoted to child and educational psychology. Prof. O'Shea writes of progress in this field, and puts his finger definitely upon the necessity for the establishment of institutions for educational research in which children of every age will be available for observation and experiment. There are many psychological laboratories, but no institution in which the resources of the experimental psychologist are solely devoted to the problems of the teacher. Perhaps the nearest approach to this ideal is to be found in Leipzig, where the enterprise of the teaching profession has established a centre for scientific research into those unknown forces with the behaviour of which the schoolmaster is expected to have expert knowledge. Prof. Bagley's article, on the psychology of school practice, gives an excellent summary of recent work in this field, and admits the importance of the evidence, which is steadily accumulating, in favour of the doctrine of formal training, albeit in a form less crude than that against which the Herbartian has always tilted. The survey of work in Germany, France, and elsewhere is useful, though the omission of the name of Binet from that part which deals with French activity in this direction is surprising. Prof. Earl Barnes writes of England, and finds our national activities taking traditional forms—Royal commissions, congresses, interdepartmental committees. Public interest in psychological questions is steadily growing in our country, forced upon us "by a disorganised school system, by industrial stagnation and an army of unemployed people, by the agitation for woman's suffrage and by the unrest in India." Truly outsiders see most of the game!

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, March 30.—A new electrical hardening furnace: E. **Sabersky** and E. **Adler**. The furnace consists of a fireclay crucible containing a bath of metallic salts. By means of an electric current these salts are melted and kept at any desired temperature up to 1400° C. An alternating current of a voltage not exceeding 70 is employed. The process consists in heating the steel to a temperature above the transition line and then rapidly cooling it down. The cost of operating this electrical furnace is lower than that of gas-fired muffle or bath furnaces.—The relation between composition and conductivity in solutions of *meta*- and *ortho*-phosphoric acids: Dr. E. B. R. **Prideaux**. The results of simultaneous determinations of amounts of HPO_3 and H_3PO_4 and of the electrical conductivity show that the conductivity of the changing solution decreases at first slowly and then more rapidly, and then more slowly again.—The electro-analysis of mercury compounds with a gold kathode: Dr. F. Mollwo **Perkin**. The results obtained were always slightly too high, from 0·5 per cent. to 1 per cent. This was at first attributed to occluded hydrogen, but this was finally not considered to be the cause, and no good explanation could be found. With silver kathodes similar results were obtained. Two new quartz vessels for depositing mercury on a mercury kathode were also described. It is considered that for mercury determinations a mercury kathode with rotating anode should be employed.

Royal Astronomical Society, April 7.—Prof. H. H. Turner, F.R.S., vice-president, in the chair.—Description of a Chinese planisphere: E. B. **Knobel**. This planisphere had been exhibited at the Franco-British Exhibition as "a bronze compass," believed to be Japanese. It was undoubtedly Chinese. The stars are shown by raised dots, linked together in groups, forming the Chinese asterisms, each of which consists of one or more stars. These asterisms do not represent areas of the heavens like our constellations, with which they have no relation. The Chinese "sīou," or lunar mansions, were explained and described.—The 60-inch reflecting telescope of the Mount Wilson Observatory, California: Dr. G. W. **Ritchey**. The mirror was successfully cast in France, and figured and polished at Pasadena, in the observatory workshops, where the Cassegrain mounting was also constructed. Details of the whole work were given and illustrated by lantern-slides. The great difficulties connected with the transport of the mirror and mounting to the summit of Mount Wilson were overcome, and the telescope is now mounted in a 50-feet dome erected for it. Dr. Ritchey is now on a visit to Europe arranging for the casting of the disc for a still larger reflector, 100 inches in diameter, which has presented considerable difficulties.—Photographs of comet Morehouse: S. S. **Hough**. These have been taken at the Cape after the comet's perihelion passage, and show that the remarkable changes of form exhibited by the comet from September to November have continued after its perihelion passage.—Astronomy in Australia: W. E. **Cooke**. An account was given of the conditions for astronomical research, and the difficulties experienced in maintaining the efficiency of the public observatories.—Photographs of Jupiter taken at the opposition of 1908–9: J. H. **Reynolds**.—The number of faint stars with large proper motions, and further note on the position of the sun's axis of rotation: H. H. **Turner**.—The orbit of the eighth satellite of Jupiter: A. C. D. **Crommelin**. The orbit, as determined by Messrs. Cowell, Crommelin, and Davidson, was in good agreement with the observed positions of the satellite, but must at present be considered as provisional, and did not form a closed curve.

MANCHESTER.

Literary and Philosophical Society, March 23.—Prof. A. Schuster, F.R.S., in the chair.—The moving force of terrestrial and celestial bodies in relation to the attraction of gravitation: Dr. H. **Wilde**. Reference was briefly made by the author to the historic controversy which exercised the minds of distinguished men of science and learning for more than two centuries as to whether the force of a body in motion by the free action of gravity is simply as the velocity, according to Descartes and Newton, or as the square of the velocity in agreement with Leibnitz and proved experimentally by Smeaton, Wollaston, Ewart, Dalton, Joule, and others; but no attempts have been made to extend the results of these experiments to the motions of celestial bodies. The author has demonstrated that the moving force, and the attraction of gravitation, are alike inversely proportional to the square of the distance, and are correlated equally in amount to maintain and retain the moon and other celestial bodies in their orbits during their revolutions round their primaries.—The action of hydrogen on sodium: A. **Holt**, jun. Some experiments were described on the action of hydrogen on sodium which, when considered with the work of Moissan and of Troost and Hautefeuille, point to the conclusion that the hydride Na_2H described by these latter authors should probably be regarded as a solid solution of the hydride NaH in sodium, and not as a definite compound.—Differences in the decay of the radium emanation: Prof. E. **Rutherford** and Y. **Tuomikoski**.

PARIS.

Academy of Sciences, April 5.—M. Bouchard in the chair.—Observations on *Lepidostrobus Brownii*: R. **Zeiller**. The specimen, a detailed study of which is given in the present paper, was collected at Cabrières by M. l'Abbé Théron.—Remarks by M. **Carpentier** on a set of standards of length, presented by M. Johansson. These standards are in the form of parallelepipeds, two faces of which are rigorously plane and parallel, and the distance between these two faces is known to 1/100,000th of its value. Any length between 1 mm. and 200 mm. can be built up, the error being less than 1 micron. A smaller set of standards have an accuracy of 0·1 micron. These standards are manufactured on the commercial scale, and represent a surprising advance on any test-pieces hitherto obtainable.—A new general method for the preparation of the alcoholic amines: Paul **Sabatier** and A. **Mailhe**. In a previous paper the authors have described the catalytic decomposition of alcohols by certain oxides, such as alumina, thoria, and the blue oxide of tungsten. If, in this experiment, the alcohol vapour is replaced by a mixture of dry ammonia and alcohol vapour, no ethylenes are produced, but the action which predominates is the formation of the amine. Details are given of the method, which is extremely simple, the reaction product containing unchanged alcohol, ammonia, primary amine, secondary amine, and a little tertiary amine.—M. Wiesner was elected a correspondant in the section of botany in the place of the late M. Clos.—Contact transformations: S. **Lattès**.—The representation of the solutions of a linear equation of finite differences for large values of the variable: M. **Galbrun**.—The radiation and temperature of the flame of a Bunsen burner: Edmond **Bauer**. Two methods of measuring the flame temperature, the measurement of the ratio of emission to absorption and the reversal of the D ray, gave identical results, about 1760° C., for the Meker burner. The author comes to the conclusion that temperature is the essential factor in the emission of line spectra by flames.—The radiation of potassium salts: E. **Henriot**. It has been shown that potassium salts possess a distinct, although very small, radio-activity. It has not yet been settled whether this radio-activity is due to the presence of traces of one of the radio-active bodies already known. From the experiments described in the present paper, it would appear that this is not the case; the observed radio-activity must be either due to the potassium itself or to an unknown body associated with it.—A new type of magnetic decomposition of the absorption bands of crystals. The simultaneous production of systems circularly polarised in opposite senses: Jean **Becquerel**. The line 625 $\mu\mu$ of tysonite, at the temperature of solid hydrogen, −253° C. to −259° C., gives a quadruplet formed of two doublets polarised in opposite senses. The effects observed can be explained by the hypothesis of the existence of both negative and positive electrons, and the author replies to some objections raised by M. Dufour concerning the theory of positive electrons.—The determination of the constant of Stefan's law: C. **Féry**. In a preceding note it has been shown that in measurements of radiation it is absolutely essential to use an integral receiver. In the present paper a form of receiver is described satisfying the necessary conditions, and with this apparatus the exactitude of Stefan's law has been proved. The constant found is $6{\cdot}30 \times 10^{-12}$ watt/cm.^{2}, as against the earlier figure of 5·32, for πa, from which a is 2×10^{-12} watt/cm.^{2}—The atmosphere of rooms for the inhalation of mineral water in the form of fine spray. The identification of the mineral water spray with the water of the spring: M. **Cany.**—The formation of graphitic oxide and the definition of graphite: Georges **Charpy.** Brodie's reagent, fuming nitric acid and potassium chlorate, may be replaced by other oxidising mixtures, such as concentrated sulphuric acid and potassium permanganate or chromic acid. The reaction is accelerated by a rise of temperature, but with loss of carbon as carbon dioxide. The definition of graphite based on the action of such oxidising mixtures is unsatisfactory.—The preparation of pure iodic anhydride: Marcel **Guichard.** The iodic acid prepared by the action of sulphuric acid on barium iodate is not pure, containing either barium iodate or barium sulphate, according as the salt or the acid is in excess. Iodic acid is very soluble in water (187·4 per 100), but is much less soluble in nitric acid (S.G. 1·4), and advantage is taken of this fact for the purification of iodic acid. A better method is the oxidation of iodine with nitric anhydride; a yield of 40 per cent. of the theoretical is thus obtained.—The complete synthesis of laudanosine: Amé **Pictet** and Mlle. M. **Finkelstein.** This synthesis of laudanosine (methyltetrahydropapaverine) is the first artificial preparation of an opium alkaloid.—The catalytic preparation of the ketones: J. B. **Senderens.** The catalytic production of ethers by the action of alumina on the alcohols has been found to be limited in practice to methyl and ethyl ethers, other condensation products appearing with the higher alcohols. The corresponding reaction for the production of ketones, on the other hand, is much more general. Anhydrous thoria is used as the catalytic agent, and the fatty acid is found to give good yields of ketone at a temperature of about 400° C. A description is given of the preparation of diethylketone, dipropylketone, and di-isopropylketone by this method.—The formation of peroxides in the oxidation of the organo-magnesium compounds: H. **Wuyts.**—The tetrahydronaphthylglycols (*cis* and *trans*) and their combination: Henri **Leroux.**—A new region with sodic rocks in Auvergne. Tephrites and nephelinites in "la Comté": J. **Giraud** and A. **Plumandon.**—The composition of bauxite: M. **Arsandaux.**—Some variations of *Monophyllaea Horsfieldii*: M. **Chifflot.**—The sexual reproduction of *Endomyces Magnusii*: A. **Guilliermond.**—The exact estimation, by gasometry, of urea and urinary ammonia: M. **Florence.**—New analogies between the natural and artificial oxydases: J. **Wolff.**—Animal invertins and lactases: H. **Bierry.**—Bovine piroplasmosis in the neighbourhood of Algiers: H. **Soulié** and G. **Roig.**—The calcification of tuberculous lesions in bovine animals: their richness in Koch bacilli: M. **Piettre.** Calcification of tuberculous lesions is no sign of cure, and any therapeutic method based on the introduction of calcium salts into the economy is illusory.—The palleal cavity and its attachments: Rémy **Perrier** and Henri **Fischer.**—The fossil Bryozoa of the Middle Miocene of Marsa-Matrouh: Ferdinand **Canu.**—The cause of the heat developed in the terrestrial rocks: J. A. **Le Bel.** The effect observed appears to be due to radiation, and not to radio-activity.

DIARY OF SOCIETIES.

FRIDAY, APRIL 16.

MALACOLOGICAL SOCIETY, at 8.—Description of *Pomatias Harmeri*, n.sp., from the Red Crag of Essex: A. S. Kennard.—Fossil Pearl Growths: J. Wilfred Jackson.—The New Zealand Athoracophoridæ, with Descriptions of Two New Forms: Henry Suter.—On the Family Ampullariidæ, No. 1, Ampullarina (*sensu stricto*), List of Species, Varieties, and Synonyms, with Descriptions of New Forms: G. B. Sowerby.

TUESDAY, APRIL 20.

ROYAL INSTITUTION, at 3.—The Brain in Relation to Right-handedness and Speech: Prof. F. W. Mott, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The *New York Times* Building: C. T. Purdy.

ROYAL SOCIETY OF ARTS, at 4.30.—South Africa: Hon. C. G. Murray.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Blackfeet Indians of Montana: W. MacLintock.

WEDNESDAY, APRIL 21.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Percolation, Evaporation, and Condensation: B. Latham.—The Meteorological Conditions in the Philippines, 1908: Rev. José Algué, S.J.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Recent and Fossil Foraminifera of the Shore-sands of Selsea Bill, Sussex: E. Heron-Allen.—The Disappearance of the Nucleolus in Mitosis: E. J. Sheppard.

THURSDAY, APRIL 22.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Dynamic Osmotic Pressures: The Earl of Berkeley, F.R.S., and E. G. J. Hartley.—(1) The Theory of Ancestral Contributions in Heredity; (2) The Ancestral Gametic Correlations of a Mendelian Population Mating at Random: Prof. Karl Pearson, F.R.S.—The Intracranial Vascular System of Sphenodon: Prof. A. Dendy, F.R.S.—On the Graphical Determination of Fresnel's Integrals: J. H. Shaxby.

MATHEMATICAL SOCIETY, at 5.30.—The General Principles of the Theory of Integral Equations: F. Tavani.—The Equations of Electrodynamics and the Null Influence of the Earth's Motion on Optical and Electrical Phenomena: H. R. Hassé.—The Solution of a Certain Transcendental Equation: G. N. Watson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electrical System of the London County Council Tramways: J. H. Rider.

FRIDAY, APRIL 23.

ROYAL INSTITUTION, at 9.—Tantalum and its Industrial Applications: A. Siemens.

PHYSICAL SOCIETY, at 5.—On a Want of Symmetry shown by Secondary X-Rays: Prof. W. H. Bragg, F.R.S., and J. L. Glasson.—Transformations of X-Rays: C. A. Sadler.—Theory of the Alternate Current Generator: Prof. T. R. Lyle.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Development of Hydro-electric Power Schemes; with Special Reference to Works at Kinlochleven: J. M. S. Culbertson.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Presidential Address: J. A. F. Aspinall.

CONTENTS.

THURSDAY, APRIL 22, 1909.

MAN'S HAIRY COVERING.

Beiträge zur Naturgeschichte des Menschen. Lieferung i., Das Wollhaarkleid des Menschen (7 coloured and 3 uncoloured plates); Lieferung ii., Das Dauerhaarkleid des Menschen (6 coloured and 7 uncoloured plates); Lieferung iii., Geschlechts- und Rassenunterschiede der Behaarung, Haaranimalien und Haarparasiten (9 coloured and 4 uncoloured plates); and Lieferung iv., Entwicklung, Bau und Entstehung der Haare, Literatur über Behaarung (7 coloured plates). By Dr. Hans Friedenthal. Pp. 31+39+49+57. (Jena: Gustav Fischer, 1908.) Prices of volumes: 10, 20, 20 and 15 marks respectively.

THE distribution of the hair, its characters, and the curious phases of its growth present such obvious features of contrast between man and the other hair-clad vertebrates, as well as such marked differences in the various races of mankind, that they have formed a very frequent theme—the author of the work before us quotes the titles of more than 1270 memoirs, and says that the list is far from complete!—for the anatomist, zoologist, and anthropologist. Moreover, the anomalies of growth and distribution of hair are often forced upon the attention of pathologists and medical practitioners.

The author of this bulky monograph on the human hair calls his work a research on the physiology of "Behaarung," and explains his purpose by the statement that a knowledge of mankind which deals with morphology only and does not include physiology in its scope cannot be other than partial and unsatisfactory. His aim in this work has been to explain the interdependence of structure and function; to show that the position of man as a being set apart from other mammals, so far as many features of his hair equipment are concerned, is correlated with the correspondingly distinctive nature of his φύσις; and to indicate that anthropology is a field of research for the physiologist.

It is a well-known fact that the growth and distribution of the hair may be strangely influenced by internal secretions, especially of the genital glands. The development of the distinctive arrangement of the "terminal" hair at puberty is determined by the activity of these glands. Premature stimulation of the ovary, as, for example, by a malignant growth, leads to a precocious development of pubic hair. Malformations of the generative organs are sometimes associated with an altered distribution of hair resembling that of the other sex. After the hair distinctive of sexual maturity is fully developed, the ovary seems to exercise a restraining influence on the further growth of the body-hair (in contradistinction to the influence of the testicle in the male), for when the influence of the ovarian secretion is withdrawn at the menopause there is often a renewed activity in the growth of hair on the face and body in women.

But the physiological study of hair is not limited to the examination of such phenomena. According to Dr. Friedenthal, the intimate relationship that exists between the hair and the nervous system is responsible for the result that the emotional state of the individual is able to exert an influence on the growth of hair by reflexly affecting the blood supply of the hair roots. Moreover, in addition to this little-recognised relationship between hair-growth and the emotional life, there is a further intimate correlation between man's mental isolation and his physical isolation as a relatively hairless primate. The hairy covering of the body, which is necessary for the protection of most mammals, interferes with the sensitiveness of the skin as a tactile organ. By such an argument Dr. Friedenthal pretends that the height of man's intelligence is associated with his isolation among hairy mammals as a relatively hairless being, because the fulness of his mental life stands in intimate relationship with the number of impressions pouring into his brain. I need not follow him in his further flights into the psychological significance of hair, except to mention his curious conception of one of the uses of the woolly hair (lanugo) of the unborn child as an instrument for "reinforcing the feeling of contact between mother and child" and awakening the maternal instinct!

On the purely morphological side the author has made some very interesting observations. At the present time, when Schwalbe, Kohlbrugge, and Dwight are suggesting doubts as to man's affinity to the apes, the author is justified in emphasising once more, not only their general points of identity of structure, and especially the striking similarity in the arrangement of the hair, but also the positive evidence of a "blood-relationship" which the biological precipitin tests of blood afford.

There is a striking resemblance between the distribution and limits of the absolutely hairless skin areas in man and the anthropoid apes. However, the skin on the back of the ungual phalanges of both fingers and toes and on the outer part of the back of the foot in the human fœtus is quite free from the hair rudiments which are found in the chimpanzee in these situations. The distribution of the temporary hair (lanugo) of the human fœtus presents the closest resemblance to that of the permanent hair of the American apes, both Cebidæ and Hapalidæ; whereas the distribution of the hair which develops in the human being at the time of sexual maturity recalls that of the overgrown hair-tufts of the old-world apes. In a series of other features the human hair is disposed like that of various apes, in contradistinction to the arrangement found in other mammals, not excluding even the lemurs.

The work treats in considerable detail of the nature and significance of lanugo; the racial and sexual variability of the permanent hair, which develops in early childhood, and the "terminal" hair, which develops at puberty or during the period of maturity; the texture of the various kinds of hair and its mode of insertion in the skin, its coloration, its anomalies of distribution and of excess or defect, the changes it undergoes in old age, and the parasites that may populate it at various times of life.

The large number of illustrations, many of them excellently executed, is probably the reason for the large, unwieldy quarto form of these volumes and their considerable price. If the text had been printed in type of the size usually adopted in scientific works, and many of the wholly unnecessary and offensively-coloured illustrations of the nude human figure had been omitted, the book could have been produced in the form of a small and cheap octavo volume. In such a form the mass of valuable and often suggestive information which it contains would have been made available for a much larger body of serious students, to many of whom the present volumes will be inaccessible by reason of their cost.

G. ELLIOT SMITH.

THE HABITABILITY OF MARS.

Mars as the Abode of Life. By Percival Lowell. Pp. xx+288. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 10*s*. 6*d*. net.

WHEN a worker in science devotes a considerable portion of his life to a definite piece of research work, and enriches his science with a series of valuable publications embodying the details of such an inquiry, he renders a good service to mankind at large by expounding the main results of his investigation in general and popular form.

It is not often that the investigator is able to accomplish both of these, but in Prof. Lowell we have a man who is capable of bringing to a successful issue the one form as well as the other.

The title of the book under review is sufficient to inform the reader as to the lines on which Prof. Lowell has treated the interesting subject-matter concerning the planet which he has made his own. While his chief energies have been devoted to learning as much as possible about Mars when favourably situated, he has by no means ignored the opportunities afforded him of minutely studying the physical features of the other planetary members of the solar system. Such a general survey has thus enabled him to make an interesting comparison of the conditions on Mars with those seen on the other planets, and thus form an idea of the different stages of evolution in a planet's life as represented by members of our system.

It will be remembered that in the author's work entitled "Mars and its Canals," which was published in the year 1906, he was led to formulate the opinion that Mars was inhabited by beings of some sort or other, which he considered as certain as it was uncertain what those beings may be.

This view was in opposition to that formulated by Dr. Alfred Russel Wallace, who, in his book entitled "Man's Place in the Universe," published in 1903, claimed that there were enormous probabilities in favour of the earth being the only inhabited planet of the solar system, and, further, that the probabilities are almost as great against any other sun possessing inhabited planets.

Since both the above books were published, a very important fact has been observed which must undoubtedly alter some of the conclusions drawn. While Dr. Wallace held that Mars had not sufficient mass to retain water-vapour, and that the polar snows were caused by carbonic acid or some other heavy gas, Prof. Lowell was almost convinced that the dark rifts round the caps when they were in the process of melting were caused by water from the melted ice.

Recent spectroscopic evidence produced by Mr. V. M. Slipher has, however, shown that there is undoubted evidence of water-vapour in the atmosphere of Mars.

Granting, therefore, the presence of water-vapour in the Martian atmosphere, the observed changes on the planet can be more easily and naturally explained than the assumption of other matter the behaviour and effects of which are not so familiarly known. Thus the seasonal change of colour of the different portions of the planet Mars is readily associated with the melting at the two poles, thus giving rise to the seasonal variability of the canals as exhibited by Lowell's *cartouches*.

In the book before us the arguments used are in the main to show that Mars can be an inhabited planet, and the canals and oases, according to Prof. Lowell, are proofs that life of no mean order prevails there.

Thus in his final paragraphs he writes:—

"Part and parcel of this information is the order of intelligence involved in the beings thus disclosed. Peculiarly impressive is the thought that life on another world should thus have made its presence known by its exercise of mind. That intelligence should thus mutely communicate its existence to us across the far stretches of space, itself remaining hid, appeals to all that is highest and most far-reaching in man himself. More satisfactory than strange this; for in no other way could the habitation of the planet have been revealed. It simply shows again the supremacy of mind. Men live after they are dead by what they have written while they were alive, and the inhabitants of a planet tell of themselves across space as do individuals athwart time, by the same imprinting of their mind."

In the very brief interval of time in the evolutionary history of a planet, when the conditions are such that life in some form or another can exist, that interval, in the case of Mars, is approaching an end. The one great aim and object of the whole of the intelligent minds on Mars is concentrated on making the utmost use of the slowly diminishing water supply, and, as Prof. Lowell finally remarks, "the drying up of the planet is certain to proceed until its surface can support no life at all."

Our earth, fortunately, is not in such an advanced stage of its own life-history that like measures are necessary, but undoubtedly the time will come when all nations will have to work together to one common end, namely, to survive at all.

In the volume before us, which may be looked upon as a delightful essay on the birth and development of worlds, Prof. Lowell has presented us with a vein of thought which will appeal to a very wide circle of readers. Technicalities are avoided as much as possible, and when more detailed information is required the notes brought together in the second part of the volume can be referred to.

AN ATLAS OF THE EMPIRE.

The British Empire (and Japan). Its Features, Resources, Commerce, Industries, and Scenery together with the Physical and Economic Conditions of the World. By W. Bisiker. 213 maps and 272 illustrations. (London: The Geographical Publishing Company, 1909.) Price 1*l.* 1*s.* net.

THE author offers this volume "as a contribution to 'Education and the Empire,'" and since his contribution has taken the shape of an atlas, presumably he had in view geographical education. Now while the British Empire, as such, might well enter into college or university curriculum as an historical subject, it cannot be treated in a geographical course. The Empire is not a geographical unity; from a geographer's point of view it is a heterogeneous collection of the whole or parts of widely different natural regions. We must treat of fragments, large or small, of tropical West Africa, of an isolated scrap of South America, and a similar arbitrary selection from other continents. The majority of the colonies and dependencies of the Empire cannot be geographically treated apart from the regions to which they belong. To attempt to carry the criterion of political ownership into geography is, to say the least, unscientific. The author admits the necessity of considering the economic productions of the entire world as a basis for the study of British trade. In that he is right, but surely the only true understanding of the Empire and the right conception of its place in the world must be reached through a study of the geography of the entire globe.

However, if this atlas falls short of educational requirements it will certainly prove of great service as a work of reference, especially for commercial purposes. Each of the large regions within the British Empire has two maps devoted to it, a photo-relief map and an ordinary political one. The former are finely executed and very instructive, but we doubt if they have as great a value as good contour maps. However, the physical names which they bear have been wisely chosen, and—a feature of geographical value—the railways are shown in relation to the surface relief. Submarine relief is well portrayed in these maps. In addition there are pressure, temperature, and rainfall maps, and various small economic charts for each region, all crowded with information graphically or statistically displayed. Each colony is illustrated by several small views, but these have often more artistic than scientific value. A number of general physical and economic charts of the world, most of which are too crowded and small to be instructive, complete the atlas, except for two pages devoted to Japan. We do not understand why that country alone of extra-British lands should have been included. The author would surely have been better advised to include the United States of America as a country the commercial interests of which lie nearest to those of Britain.

The statistical information, if rather condensed and summary, seems to be thoroughly up-to-date, and, so far as we have tested it, accurate. But a little expansion in this direction might not have been out of place. The bare statement, for instance, regarding Ireland's total trade, that it was in 1907 17,767,657*l.*, might be misleading without a qualifying note that this refers only to trade with lands beyond the British Isles. In reality Ireland's total trade was (1906) more than six times that figure. The index to commercial products is too meagre to be of much use, and should have been considerably expanded.

One or two minor errors should be pointed out. The South Orkney and South Shetland Islands, despite recent assertions to the contrary, are not British, but Argentine possessions. South Georgia is used as a whaling station, and exploited for its sea-elephants and penguins rather than "as a field for mining" (p. 56), though gold and coal have been reported. King penguins do not breed on the Antarctic continent (p. 55). On plate 44, Fig. 18, the house shown is not, as stated, Napoleon's dwelling at St. Helena, but quite another building. The statement that the Nile floods are caused chiefly by the Blue Nile (p. 53) does not convey the whole truth, for the Sobat and the Atbara largely contribute. Nor is it quite accurate to assert that pearls are formed "round grains of sand or other hard substances," since they are generally formed round encysted larvæ of parasitic worms; and we are at a loss to understand who the Buddhists are who figure so largely in the south-western United States on plate 15. However, these are small points, and care and thought have evidently been expended on the work. But a less restricted outlook would undoubtedly have enhanced the value of this atlas. A cheaper edition at 16*s.* seems only to differ in the binding.

INDUSTRIAL ELECTRICITY.

Électricité Industrielle. By C. Lebois. Deuxième Partie, Deuxième Édition. Pp. 437. (Paris: Ch. Delagrave, n.d.) Price 4 francs.

THE author is Inspector-General of Technical Instruction in France, and on the title-page we read that his work has been honoured by a subscription by the Ministers of Commerce and Technical Instruction. In these circumstances the reader may expect a book of exceptional merit, but in this expectation he will be disappointed. The book is no better and no worse than scores of others with which the market nowadays is flooded. The subtitle is "Second Part; Complementary Study of Continuous and Alternating Currents and Their Applications."

This subtitle describes sufficiently the contents. We find the usual explanation of the generation of an E.M.F. in the wires of an armature moving in the interpolar space, various armature windings, some examples of brush gear, different forms of magnet frame, the calculation of the magnetisation curve, formulæ for the E.M.F. and torque of a machine, the latter called a new formula, although it is certainly not new to English readers, some hints and examples on the design of continuous-current machines, and then a similar treatment of alternating-current machinery, including synchronous and non-synchronous motors, for which the author has coined the name "alternomoteurs."

Further, there are chapters on transformers, measuring instruments, meters, and other accessories. The industrial application of the science is represented by examples of machinery made by French firms, some descriptions of transmission plant and wireless telegraphy. This short account of the contents will show that the book covers, within its compass of some 430 small octavo pages, a wide field, and that for this reason alone anything like exhaustive treatment cannot be expected. Its usefulness is also marred by the defect very frequently found in Continental books of having no index.

In one respect the book is, however, an improvement on other French works on the same subject, and that is the use of mechanical illustrations of electrical phenomena. French men of science have always been adverse to graphic treatment or mechanical analogies. They are content to represent the subject in a purely analytical manner, and although it must be confessed that in elegance of mathematical treatment the French school is supreme, this kind of treatment does not lead so easily to an understanding of the subject as the use of graphic methods and mechanical analogies, which is a characteristic of the English school. Even so highly-trained a mathematician as Maxwell did not disdain the use of some very simple mechanical contrivance in order to make clear an intricate electrical phenomenon, and since Maxwell's time all English writers and most German have followed this lead.

Now we find that the author of the book under review has also gone over to the school of Faraday and Maxwell, and uses mechanical analogies to express electrical processes. As a good example of his methods may be taken the vectorial addition of currents illustrated by the apparatus of Prof. Gaillard, which was primarily designed to illustrate an alternating current of so slow a periodicity that it can be shown by the harmonic movement of a spot of light to a whole class of students (p. 185). Another model to represent three-phase currents and their properties is shown on p. 311. The mechanical representation of the principle of the inductor alternator, although, strictly speaking, not a model, but merely an incomplete machine, should prove useful to beginners.

The book is, in fact, written for beginners, if we may judge by the omission of many matters of more intricate nature. Thus, after explaining the process of commutation in a general way, the author dismisses the subject of sparking in a few lines by saying that in modern machines there is hardly any necessity to shift the brushes when the load changes. Nothing is said about commutation by brush resistance or interpoles, or Deri winding, or Parsons' compensating coils. Again, the short paragraph on inductive drop in a transformer is quite inadequate; we are told that the drop is from 1 to $1\frac{1}{2}$ per cent. in each coil, but not a word is said about the influence of the details of the design on the drop. In the matter of cooling a transformer, the author is equally superficial; he merely says that 20 sq. cm. cooling surface per watt lost will produce an admissible temperature rise. Such general statements are perfectly valueless, and, in fact, worse than that, for they are untrue.

The author seems to have a great aversion to the use of mathematical formulæ even when they are very simple and convenient. He seems to start from the supposition that his reader is so much of a beginner that he cannot even grasp the meaning of a very simple analytical expression, and to overcome this imaginary difficulty he uses numerical examples by preference. Most readers will consider this point of view to be wrong in principle. A man who is quite ignorant of even the simplest mathematics had better not attempt to study electrical matters, and if he has the modicum of mathematical knowledge required for the study of such elementary books as that under review, his task is not made easier, but more tedious, if matters that could be presented in three lines of mathematics are worked out in two pages of numerical examples. A striking instance of the cumbersomeness of this method is the deduction of the virtual value of an alternating current given on pp. 174 to 178. Here more than four pages of algebra and arithmetic are used to prove that the virtual current is equal to the crest value divided by the square root of 2. All this could have been shown by a few lines of very simple calculus, or, better still, by Blakesley's graphic method. GISBERT KAPP.

A GERMAN TEXT-BOOK OF ZOOLOGY.

Lehrbuch der Zoologie für Studierende. By Dr. J. E. V. Boas. Fünfte vermehrte und verbesserte Auflage. Pp. x+668; 603 figs. (Jena: Gustav Fischer, 1908.) Price 12 marks.

THE fact that Prof. Boas's well-known text-book has now reached its fifth edition speaks volumes for the importance attached to the study of zoology in Germany. The book, although it contains 668 large and closely-printed pages, is an elementary one, and is designed especially, as we are told in the preface, for students of medicine, veterinary science, and forestry.

German ideas as to the preliminary education of medical students must be very different from those which are held by the medical profession in this country. Perhaps the German students work harder, or it may be that they cover a wider field in a more superficial manner. Dr. Boas's text-book makes us suspect that it is a little of both, and although we think that the subject might well receive more attention from English medical students than it now does, yet we should hardly care to place the present volume in their hands. Excellent and interesting as it is in many respects, it appears to us to suffer greatly from over-condensation, from the attempt to cover far too much ground. We miss the detailed anatomical description of types to which English students have become accustomed, and although this can easily be, and we fear frequently is, overdone, it can hardly be altogether dispensed with in an elementary text-book. It is true we find a short description of the Amœba by way of general introduction to the study of structure and function, but this is the only special type which is at all adequately dealt with. Probably it is intended that the detailed study of types should be undertaken in the laboratory with the aid of a special practical text-book, but we have not noticed any reference by the author to the importance of such practical work.

The book illustrates very clearly the great difficulties which attend the teaching of zoology at the present day, and which are due, in the first place, to the enormous extent and variety of the animal kingdom, and in the second place to the many different points of view from which the subject may be approached. No elementary book can deal adequately with the entire field. In the present work, for example, the problem of heredity, which is of vital importance to medical students, is dealt with in a single page, while five pages are devoted to a general account of the Coleoptera. We should have thought that the medical student would have found the former altogether insufficient and the latter superfluous, and that a forestry student would require to know far more about beetles than can be compressed into five pages. Probably the latter studies entomology later on as a special subject, but if so it seems hardly necessary to attempt to deal with it systematically in his preliminary course.

We have already realised in our own country that systematic zoology, as such, is of very little use to medical students, and there can be no doubt that the insistence, in former years, upon an unnecessary degree of intimacy with the animal kingdom has done much to discredit the subject in the eyes of the medical profession, and has brought about a reaction which threatens to remove both zoology and botany from the medical curriculum. This, of course, would be a disastrous error. Medical studies must have a scientific foundation. The human body cannot be rationally interpreted except as the last link in a long chain of animal forms stretching back to the Protozoa. If the study of anatomy and embryology is to be inspiring it must be comparative. Scientific physiology must be founded on some knowledge of the lower animals, and the problems of heredity cannot be solved from the merely medical point of view. The zoology which is offered to medical students needs to be rigidly selected with such ends in view, and in this way only can the matter to be studied be kept within reasonable limits. In the book before us we cannot help feeling that the distinguished author has been unable to do justice either to himself or to his subject, but at the same time it is evident that his work has met with much appreciation in Germany. The numerous and excellent illustrations form a striking feature of the book.

A. D.

SOME NEW CHEMICAL BOOKS.

(1) *An Organic Chemistry for Schools and Technical Institutes.* By A. E. Dunstan. Pp. viii+160. (London: Methuen and Co., n.d.) Price 2s. 6d.

(2) *An Intermediate Course of Laboratory Work in Chemistry.* By E. K. Hanson and J. W. Dodgson. Pp. viii+124. (London: Longmans, Green and Co., 1908.) Price 3s. 6d.

(3) *Laboratory Notes on Industrial Water Analysis. A Survey Course for Engineers.* By Ellen H. Richards. Pp. iii+49. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 2s. net.

(1) MR. DUNSTAN'S organic chemistry is intended for the use of the higher forms of schools and as a first-year course in technical institutions. Although the author disclaims writing to a syllabus, he thinks his book may be useful as a preparation for certain examinations, and especially for evening students connected with chemical industry. There are so many elementary text-books of organic chemistry at present available that one naturally looks for some special feature which may distinguish one from another. In the present case the fusion of the aliphatic and aromatic series is a somewhat new departure. As systems of classification of organic compounds are mainly matters of convenience, it is questionable whether any real advantage is offered by the new arrangement. The parent hydrocarbons of the two series, as well as the majority of their derivatives, present such marked differences in properties that their separation seems to us almost a natural one. The new system has, however, no serious significance, and does not detract from the sound merits of the book, which is clearly written, and illustrated by numerous experiments and plain outline drawings of apparatus.

We would direct the author's attention to a few inaccuracies. The definition of organic chemistry as "the chemistry of compound radicals" (p. 17) belongs rather to the past than to the present; it is not quite correct to say that Russian petroleum contains no paraffins (p 79); the explanation of specific rotation is misleading (p. 98); the formula for copper acetylide is incorrect (p. 109), and there is something wrong about the two formulæ for sodium ethyl malonate numbered (1) and (2) on p. 117, which seem to be identical. The two space formulæ for *d*- and *l*-tartaric acids are not enantiomorphous but identical, and represent the *meso*-form, whilst the one on the following page, which is intended for the *meso*-acid, is in reality one of the active forms (p. 124). The differences are most easily recognised by means of models. Acetoxime is twice spelt wrongly on p. 148.

(2) Messrs. Hanson and Dodgson's intermediate course is intended for students preparing for the intermediate science examination of the London University. It consists of series of simple preparations of inorganic and organic compounds, which are followed by exercises in volumetric and gravimetric analysis and qualitative analysis. There is little that calls for criticism. The preparations are well selected, and cover a variety of operations and reactions, and the analytical exercises are thoroughly representative and instructive.

If it were not "assumed throughout that the student is not working by himself, but can obtain the advice and assistance of a teacher at all times," one might feel disposed to suggest the addition of equations to explain the different preparations, and of some reference to the use of the balance and the graduation of the volumetric apparatus.

We would also suggest that the yield in each preparation should be roughly estimated.

It is scarcely correct to describe acetone as a pale *yellow* liquid (p. 29), or the acid from olive oil as a *solid* (p. 30).

Photography applied to glass apparatus is rarely satisfactory. Simple outline or shaded drawings are much more convincing, and the teacher, it is to be feared, will be called in to explain many of the illustrations.

(3) The laboratory notes on water analysis are intended for the use of engineers, who, it is presumed, have already received a sound training in practical and theoretical chemistry. For there are no equations or explanations of the reactions involved in the various processes, which are described in the briefest manner, so briefly, indeed, that we should doubt if some of the operations could be successfully carried out. Thus, the reader is told (p. 19) to "neutralise with 1 c.c. of the reagent and compare the standards," without other reference.

It seems unnecessary and merely confusing to introduce indiscriminately both centigrade and Fahrenheit scales, and an over-elaboration to count the drops of a reagent the strength of which is not given (p. 20).

It may also be pointed out that the method described as Dr. Thresh's (p. 21) is usually known as Forchhammer's or Tidy's process. J. B. C.

OUR BOOK SHELF.

Mental Pathology in its Relation to Normal Psychology. A Course of Lectures delivered in the University of Leipzig. By Dr. Gustav Störring. Translated by Thomas Loveday. Pp. x+298. (London: Swan Sonnenschein and Co., Ltd., 1907.) Price 10s. 6*d.*

The bearing of the study of abnormal mental processes upon general psychological doctrine has long been understood. In some cases invaluable light may be thrown upon the normal nature of a complicated psychosis by the abnormal heightening or lowering in degree of one of its constituents; in other cases a pathological phenomenon may supply the "negative instance" that checks the harmful progress of a plausible but erroneous theory. Thus the leading pathological cases are familiar to English readers from their appearance in one or other of these capacities in the pages of several treatises on general psychology.

Nevertheless, Prof. Loveday is undoubtedly right in thinking that a systematic collection of such cases by a psychologist competent to select them judiciously, to describe them accurately but without unnecessary clinical detail, and to illuminate them by a cautious commentary, would be a useful addition to the student's library. Further, we believe him to be right in thinking that Dr. Störring's lectures prove that he possesses these qualifications in at least as high a degree as any other writer on the subject.

The besetting sin of the morbid psychologist is to erect elaborate and novel systems of interpretation upon a too narrow basis of fact. Dr. Störring avoids this fault, and exhibits a conservatism and restraint which will favourably impress even those who, like his translator, do not find themselves able to accept all his conclusions.

No one who is acquainted with the present unsettled state of psychological opinion upon fundamentals will be surprised to find himself frequently unable to agree with the author's view, or at least compelled to translate his interpretations into what he deems a more satisfactory psychological idiom. But in any case it remains true that on fundamental questions of psychological theory—such as the nature of perception and of the consciousness of self—and on questions of great importance in the practical science of pedagogy—such as the teaching of reading and writing, and the "training of the will"—Dr. Störring's cases (though they need supplementing and correction by more modern instances) throw a light the strength of which is due largely to the way in which the several rays have been disposed and concentrated.

It is doubtful whether the translator did well to decline the task of finding English equivalents for such Teutonisms as "disease-picture," which occurs rather frequently in his pages. In a second edition he should certainly Anglicise the index letters of his diagrams, which are, as they stand, provokingly difficult to use.

The Evolution of the Atmosphere as a Proof of Design in Creation. By John Phin. Pp. 191. (New York: The Industrial Publication Company, 1908.)

According to its subtitle, this work is "a simple and rigorously scientific reply to modern materialistic atheism," and, after perusing it, we find no reason to dispute the first portion of the description. But when we see "rigorously scientific," we feel inclined to question the accuracy of the descriptive phrase.

The purpose and tenor of the volume may be gathered from the following extract (p. 184):—"Any one who will carefully read the works of Haeckel, Tyndall, Huxley and men of that stamp cannot fail to see that their intense hatred of ecclesiasticism has swayed their logic, embittered their language and even led them to distort their facts when they came to write about anything relating to the religious faith taught in the churches."

The greater part of the book is taken up by definitions, and by the demonstration of simple scientific experiments illustrating the physical and chemical properties of the atmosphere, the idea being to show that, had not an intelligent creator adjusted the proportions of terrestrial elements to the very finest conceivable degree, the atmosphere could not have been suitable for man's existence. That such creative design must have superintended the composition of the primitive nebula of the solar system, at least, and also its proper partition, is not stated by Mr. Phin, although to be "rigorously scientific" this aspect would, presumably, have to be considered.

The probable sequence of the evolution of the atmosphere is reasonably stated on lines similar to those indicated in Lockyer's "Inorganic Evolution." But the "proof" of design apparently consists of Mr. Phin's statement that, because man exists, therefore an intelligent designer mixed the eighty or so terrestrial—speaking more logically "cosmical"—elements in such proportions that, after all their combinations and dissociations, their expansions and condensations, there remained just enough nitrogen, oxygen, &c., uncombined, to provide an atmosphere exactly suited to the requirements of the preconceived organic life.

That such life might have developed with, say, even a little less oxygen, or even a little of the uncondensed sulphuric acid he mentions, and yet not have been radically different in form, is not considered by Mr. Phin; yet we know that one species, of one age and of one development, is able to exist under very different conditions of atmospheric pressure and composition.

The author concedes, for the moment, that previous "evidences" have been materially weakened by the theory of organic evolution, and gives that as his reason for considering "inorganic" phenomena, wherein Haeckel's "sexual cell-love" is, presumably, inoperative.

The readers to whom the book will appeal will no doubt feel reassured by the author's statement that, whilst betting or gambling for gain is immoral, "the throwing of dice . . . or the tossing of coins for the purpose of determining the scientific principles involved in the theory of probability" is innocuous.

W. E. Rolston.

Essays and Addresses. By the late J. H. Bridges. With an introduction by Frederic Harrison. Pp. xxi +307. (London: Chapman and Hall, Ltd., 1907.) Price 12*s*. 6*d*. net.

THE essays included in this volume (unobtrusively edited by Prof. L. T. Hobhouse) form an admirable memorial of one of the noblest spirits that have been touched to fine issues by the "religion of humanity." It is, naturally enough, chiefly as a splendid evangelist of the Positivist movement that Dr. Bridges is considered in the introduction—itself an interesting and illuminative essay—which Mr. Frederic Harrison has contributed to the book. But there is no reader, however unsympathetic with the Comtist propaganda, who could rise from the perusal of these essays without having acquired deep admiration for the earnestness and spiritual charm, the learning, worn lightly as a flower, and presented with extraordinary vividness and freshness, the wonderful industry, fecundity, and versatility of the man whose literary achievements were the fruit of the leisure hours of a busy physician and hard-worked Government inspector.

The scientific reader who first made Dr. Bridges' acquaintance as the learned and indefatigable editor of Roger Bacon will accept almost as a matter of course the masterly summary of his long study of the great Franciscan, delivered as a university extension lecture in 1903. He will find in the oration on "Harvey and his Successors" merely another delightful example of the combination of critical, historical, and expository powers that illuminated so effectively the "Opus Majus." He will be prepared also for the familiar knowledge of the mediæval world shown in the two essays on Dante. But in these latter essays, particularly in the one entitled "Love the Principle," he will have revelation of spiritual powers perhaps unsuspected and of the noblest type. Moreover, his progress through the book will constantly deepen the impression that, even more admirable than the ability, the industry, and the taste that made Dr. Bridges so interesting and instructive a critic of topics ranging from Thales to Calderon and Diderot, was the self-sacrificing enthusiasm ever burning at the core of his indefatigable life.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Upper Air Temperatures.

WITH reference to Dr. Chree's letter published in NATURE of April 1, may I state that the conditions I postulated *were* violated in *every one* of the cases quoted in his former letter? The ascents were all made *after* sunrise and *before* sunset. They cannot, therefore, be fairly used as evidence to suggest that my conclusions were inaccurate in the direction of underestimating the influence of radiation. At the same time, it may be worth while to consider these cases.

Dr. Chree specified three occasions on which the differences between the temperatures recorded by two instruments of different types exceeded 2° C., the maximum differences being 2°·1, 2°·5, 2°·9 C. The first, as he stated, was probably due to a scale or zero error, one thermometer being continually below the other. The third, on which he lays most stress, occurred in an ascent at Uccle on February 7, 1907. The readings of both instruments agreed during the ascent, the greatest difference being 0°·8 C. (or 1°·1 C. at the highest point). During the descent larger differences occurred. Now, at the time of observation, the sky was covered by a veil of cirro-stratus, and it appears extremely probable that the instruments, in descending from cold to warmer, perhaps saturated, air, would be affected by condensation of ice-vapour. The difference in exposure and type, combined with the bad conductivity of hoar-frost, may quite reasonably account for the differences between the temperatures of the two instruments which arose when they left the isothermal region. In addition to this, at the time of maximum difference the downward velocity was about 10 m.p.s., and there would be some lag in the instruments. This descent was, in fact, exceptional.

In the second case, an ascent at Strassburg on the same day, the readings indicate a slight lag in one instrument until the lowest temperature is reached. The sudden passage to a relatively warm upper layer was accompanied by a sudden jump of 1°·2 C. in the difference between the readings of the two instruments. The type of instrument which shows the lower temperature is the same as that which showed the higher temperature in the Uccle descent. This is just what we should expect if the instruments passed from a saturated layer, in which they became covered with hoar-frost, to a drier region. There is no record of the upper clouds at Strassburg at the time of the ascent, but it occurred simultaneously with the Uccle ascent, so that the explanation is a possible one.

In an earlier letter Dr. Chree suggested the possibility of errors of ±10° F. in the instrumental records. In order to show as fairly and clearly as possible the errors that may arise, I have taken, for Munich, all the cases from January, 1907, to March, 1908, in which the readings from two types of instrument were obtained, and the following table gives the height of the ascent, the extreme differences that occurred, and the mean of the absolute values of the differences at all the points for which they are published. The types of instrument were the same as those considered by Dr. Chree.

Height in kilometres	Extreme values of $T_1 - T_2$ (degrees C.)		Mean value of $\lvert T_1 - T_2 \rvert$
10·5	1·2°	−1·6°	0·7
10·5	0·5	−1·5	0·5
9·8	0·6	−1·3	0·5
14·8	0·6	−1·6	0·3
11·0	0·2	−0·6	0·2
12·4	2·4	−0·2	0·5
13·5	0·5	−0·2	0·2
12·7	1·8	−0·7	0·5
13·0	1·0	−0·2	0·3
17·0	3·5	−0·9	1·1
13·0	3·0	−0·6	0·9
12·9	1·3	−1·2	0·5
14·2	1·1	−1·1	0·5
13·4	1·5	−1·3	0·5
14·8	1·4	−2·8	0·8
16·0	1·7	−2·9	0·8

In interpreting these results, it ought to be borne in mind that they are chiefly from *ascents*, and include errors owing to lag, which could be largely eliminated in dealing with the observations. The records I have seen usually show that the thermometer, which is higher in the ascent, is lower during the descent, and that the lag occurs almost entirely in the worse instrument, so that the differences are representative of the absolute errors arising from this cause. Considering the very many sources of error to be guarded against, especially the difficulty of testing the instruments at very low temperatures under the conditions to which they are to be exposed, I can only regard these results as a tribute to the care and ingenuity displayed by those engaged in the experimental exploration of the upper air.

Dr. Chree does undoubted service in directing attention to the need for great care in testing and comparing instruments, but I think he is inclined to be a little unjust to those who are tackling the difficulties of upper-air investigation and nomenclature. These difficulties are exemplified by the examples he quoted and by a term which he himself accepts, apparently without demur, when he describes a phenomenon as an "inversion of temperature."

Personally, I am quite prepared to discard the term "isothermal" when another is suggested which is short, equally expressive, more accurate, and more characteristic. The greatest variation of temperature in a vertical direction in the region under discussion is about 20° C. in 14 kilometres. Usually it is much less. In the lower part of the atmosphere the variation is generally 60° C. to 70° C. in 10 km. The upper region is therefore *comparatively* isothermal. The rapid increase of temperature between 12 km. and 13 km. in the Uccle ascent of July 25, 1907, is an example of a phenomenon which occurs in the lower layer of the isothermal region in about one-third of the ascents.

E. Gold.

Vienna, April 7.

The Greenwich Winter of 1908-9.

If the art of long-range forecasting is ever acquired, it will probably be through a careful study of past experience (of which we have now nearly seventy years' excellent *data* for Greenwich), including, among other things, what are known as "sequences," cycles (if any), and the relation of weather to solar, and possibly lunar, changes.

I propose to offer a few remarks on the state of available knowledge regarding winter, at the end of last autumn, and year, and its bearing on what followed.

By the end of November we had had only three frost days. After such autumns as the last, with all three months dry, December (as was pointed out in a table) has nearly always been mild (twelve cases out of thirteen). Thus it was pretty clear that the second half of 1908 would have less than the average of frost days (18). The actual number is 8.

The same table seemed to point to at least two of the three winter months being mild; and that is what happened, though, of course, with the cold of February the winter (proper) was slightly severe as to mean temperature and number of frost days (the latter 36, which is +3).

When the second half of a year has less than the average of frost days (18), the total, from September to May, is generally also under average (54). There are only three exceptions (1857–8, 1891–2, 1894–5) in a total of thirty-one cases. Thus it would be reasonable to expect that the total for the first half of 1909 would not be more than 46 (*i.e.* 54−8). There have been 42 up to the end of March, and it is possible the total may be a little in excess, conforming to the "exception" instead of the "rule" (a contingency which has often to be regarded). The number up to April 20 is 46.

If we indicate by a plus or minus sign the character (as regards frost days) of each winter (December–February) ending in a sun-spot *maximum* year, and the four winters following, we have the following table:—

Max. year	Max.	1	2	3	4
1848	+	−	+	−	−
1860	+	+	−	−	+
1870	+	+	−	−	+
1883	−	−	−	+	+
1893	+	−	+	−	−
1905	−	−	+	−	

We might here note (without pressing the point too much) that each of the first five groups has at least two *plus* values, and as the four winters 1905–8 show only one, a *plus* in the vacant place seemed the more likely. Further, one might show that the average for the first four vertical columns is a *minus* value; for the fifth, a *plus*. The winter, as stated, had an excess of three frost days.

Another point of view. We might fairly expect the next sun-spot *minimum* in 1912 (the series before is 1843, 1856, 1867, 1878, 1889, 1901). Then this year would be the third before. Consider how many frost days there were in the first half of the third year before previous *minima*. We find:—

	F.D.	Relation to average
1840	?	?
1853	42	+ 6
1864	40	+ 4
1875	42	+ 6
1886	55	+19
1898	21	−15
	Av. 40	+ 4

This points to a probable excess. The number to March 31 is 42.

After a very dry autumn the winter tends to be dry. Thus of the ten driest autumns, nine were so followed. The winter (December–February) was a very dry one.

I submit, then, that, on the threshold of last winter, there was reason to expect (1) December to be mild, and frost days in the second half of 1908 under average (18); (2) at least two mild months in winter (December–February); (3) frost days in first half of 1909 not more than 46, but (4) over average (36); (5) frost days in winter, over average (33); (6) a dry winter.

While most of the above facts were, I think, known to me at the outset, I quite agree that it is one thing to make a retrospective comparison like this, and another thing to predict successfully. Of many pieces of evidence, some may seem in conflict, and one has to try and judge which is the more weighty and trustworthy. I may further admit that the cold this year has a little exceeded what I looked for.

It may be useful, nevertheless, to direct attention to these comparisons, emphasising the fact that there *is* a large body of evidence (as I believe) in relation to the character of a coming season. It seems to have been too readily assumed, hitherto, that we have absolutely no light on the subject, and that any one venturing an opinion on an approaching season is, by that fact, declared a dreamer or a charlatan, his "hits" and his "misses" being alike mere chance.

That the winter season of 1908–9 would at least not be a very severe one (say, more than sixty frost days in September–May) I consider to have been provable by a strong consensus of facts.

Alex. B. MacDowall.

Fluorescence of Lignum Nephriticum.

With reference to Mr. Benham's letter in Nature of April 8 (p. 159), the following statements may be of interest.

The wood known as *Lignum Nephriticum* reached Spain probably about or before the middle of the sixteenth century. Monardes (1574) and Fr. Hernandez (about the same time) were familiar with the fact that a watery infusion of the wood in a short time assumes a blue colour, but they do not mention the peculiar dichroism of the infusion. This was described for the first time by Athanasius Kircher in his "Ars Magna Lucis et Umbræ" (1646), and, apparently independently of him, by Joh. Bauhin in his "Historia Plantarum Universalis" (1650).

The origin of the wood has so far remained obscure. Linnæus—and already Plukenet and Dale before him—referred it to *Moringa pterygosperma*, the horse-radish tree of India, but without reason, as was pointed out long ago. Researches, however, made at Kew within the last few weeks have convinced me that *Lignum Nephriticum* is the wood of *Eysenhardtia amorphoides*, H.B.K., a small Mexican tree or shrub of the order Leguminosæ. The blue inflorescence exhibited by an infusion of the wood of this tree is very brilliant indeed.

O. Stapf.

Royal Botanic Gardens, Kew, April 16.

Morphology of the Enteropneusta.

In a paper "On the Morphology of the Excretory Organs of Metazoa: a Critical Review," recently published in the Proceedings of the American Philosophical Society (vol. xlvii., 1908), the author, Dr. T. H. Montgomery, states on p. 577, with reference to the Enteropneusta, that in Spengelia I described rudimentary pores along the whole trunk in 1899. What I did describe in this connection was a single pair of structures which I thought might represent a single pair of truncal canals and pores.

Dr. Montgomery says that he had not seen the original description, and consequently was unable to add further details. The work ("Zoological Results") can be obtained at an easy cost from the Cambridge University Press. Perhaps, however, the original description is not deemed worthy of perusal, although it would be charitable to assume that, like the proverbial egg, it must be good in parts.

Arthur Willey.

Colombo, Ceylon, March 22.

GENERAL RESULTS OF THE METEOROLOGICAL CRUISES OF THE "OTARIA" ON THE ATLANTIC IN 1905, 1906, *AND* 1907.

WE have already reported preliminary results of the expedition which we organised in 1905 for the study of the trade-wind and the anti-trade by means of free balloons the trajectories of which were determined by triangulation (NATURE, vol. lxxiii., pp. 54–6, 449–50).

Since then two expeditions have been sent out on the Atlantic during the summers of 1906 and 1907, and Fig. 1 shows the regions which have been studied. As may be seen by the dates entered on the route of the *Otaria* (Fig. 1), many of the important points were visited in different years and at different times during the same year. This gives a much greater value to our conclusions, because the accidental phenomena are thereby, to a certain extent, eliminated.

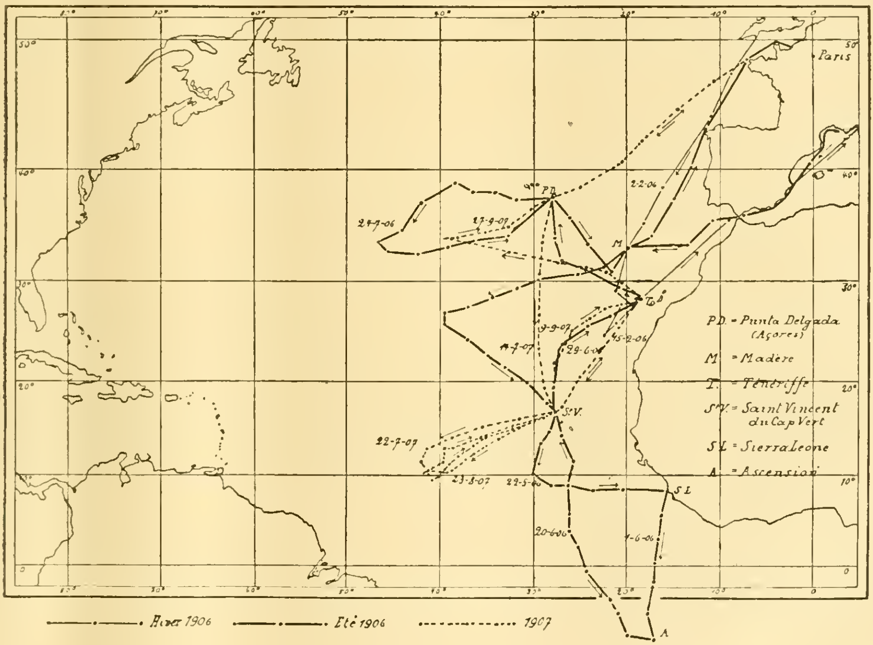


FIG. 1.—Map of the Cruise of the *Otaria*.

In consequence of the investigations made by Prof. Hergesell on board the Prince of Monaco's yacht *Princesse Alice*, in the region between the Canaries and the Azores, this distinguished meteorologist was impressed by the existence of the north-west winds which he observed at a variable height above the surface winds, represented generally by the north-east trade. These north-west winds, which had not been observed before because the methods of aërial soundings have only been employed for a few years, do not themselves present marked peculiarities, since, as Dr. Hann has remarked, if one turns to the chart of isobars at different heights, which was published by M. Teisserenc de Bort twenty years ago, it is seen that at about 4000 metres there exists a barometric gradient extending from the Gulf of Mexico towards the north-east, a gradient which should in most cases, at these heights, produce currents from the west or north-west. In his communication to the Meteorological Conference at St. Petersburg, Prof. Hergesell questioned the existence of the ordinary south-west anti-trade, believing that these north-west winds were themselves a much deflected return branch of the equatorial current.

As we endeavoured to demonstrate by our first expedition of 1906, the anti-trade exists generally above the trade, and, as will be seen by the following results of the two later expeditions, the existence of the north-west winds is not incompatible with the presence of the anti-trade, and this fact should be emphasised. Of course, since the meteorological phenomena do not follow the regular zones that theory requires, but group themselves around barometric maxima having more or less ellipsoidal contours, it cannot be expected that the normal superposition of winds above the same place will be encountered every day. There are days, for example, when the north-east winds, ordinarily confined to a few hundred metres, extend up to five or six kilometres, or even more; in other cases a north-west current, superposed on the trade, encroaches more and more on the high atmosphere up to such a height that the balloons do not show any anti-trade. But the normal condition is easily deduced from the documents gathered by our three expeditions, and it occurs so frequently that each expedition, considered individually, leads to the same conclusion. In general, the zone where the anti-trade is most regular appears to be situated to the eastward of the meridian passing through the centre of greatest pressure. To the southward of the maximum, and when it is very pronounced, northerly winds are frequent up to so great a height as eleven kilometres, which was the limit of observation here.

From the beginning of the year 1906 we were able to show by ascensions of pilot balloons, made over the open ocean to the south-west of the Canaries, that the winds with a southerly component, which we had already observed in 1905, also occurred far away from land, and even appeared to be more marked than near the islands.

During the months of May, June, July and August, 1906, the *Otaria* made another cruise which extended to Ascension Island (latitude 7° 55′ S.), and on this expedition a number of *ballons-sondes* were launched. These results, combined with those from kites flown at the same time, enabled the types of vertical temperature distribution to be determined for the regions traversed.

The lower stratum, having a drift from north-east, shows a rapid decrease of temperature (0°·9 to 1°·8 C. per 100 metres) in the first 500 or 600 metres, and an especially rapid decrease north of latitude 25°. Usually, above the zone of rapid decrease there is an inversion of temperature in which the wind velocity diminishes. Above the trade there is generally a north-west current (Fig. 3); then higher up, at about 2500 metres, near the Tropic of Cancer, and at 3000 or 3500 metres north of the tropic, there occurs a wind with a southerly component, except in the cases already mentioned. The direction of these winds possessing a southerly component, however, changes with the latitude, as might be expected from the effect of terrestrial rotation. They are south-east near 15° N. and west-south-west near 25° N., no doubt gradually changing from one to the other of these directions after passing by the south.

These same characteristics are found in the south-east trade, above which there are in general calm strata, sometimes of great thickness, then winds with a northerly component mixed with interlaced currents from the south-west, corresponding to the north-west winds of the northern hemisphere (Fig. 3). This region, however, has only been studied to about latitude 8° S.

At the limit of the two trades the winds are easterly at all heights, up to at least 14 kilometres, with a component which is sometimes north and sometimes south, but in general very weak, depending upon the exact spot where the rise of air takes place. North of the Tropic of Cancer the distribution of the winds becomes much more irregular, and it frequently happens that there is no anti-trade (Fig. 4). However, the regular *régime* of the trades appears to persist to about latitude 35° N. for places situated to the east of longitude 37° W. Farther west, winds from

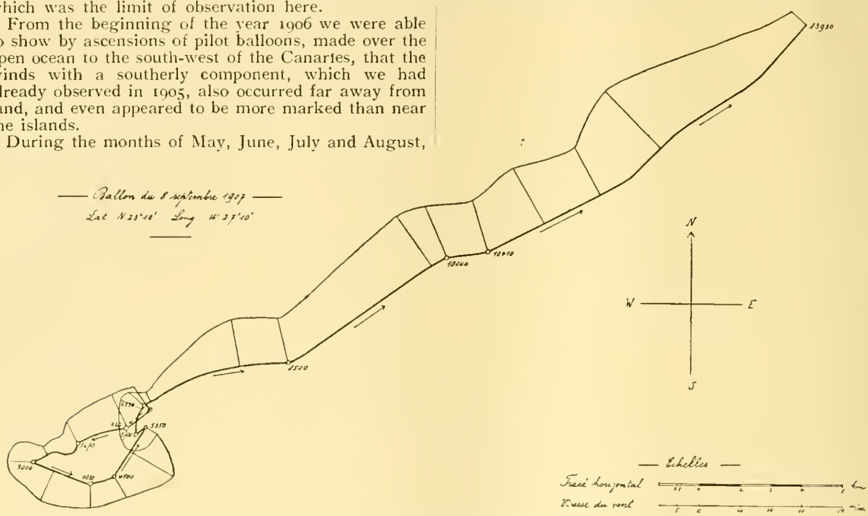


FIG. 2.—Motion of air in the region of the trade winds, showing a layer of N.W. wind and anti-trades.

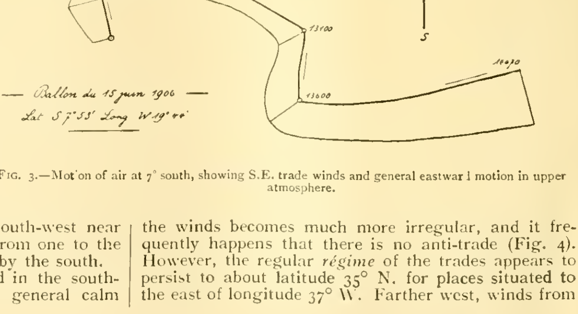


FIG. 3.—Mot'on of air at 7° south, showing S.E. trade winds and general eastwar l motion in upper atmosphere.

south to south-west prevail, which are explained by the distribution of the isobars.

Another campaign from July to October, 1907, gave the same general results, as well for the direction of the atmospheric currents as for the vertical distribution of temperature (Figs. 2 and 4). This voyage was not continued further south than 10° N., but the vessel remained twice during twelve days near this parallel, this latitude having been selected on account of the regularity of the trade wind. Again the easterly current predominated at all heights, and also the layer of inverted temperature near 1000 metres.

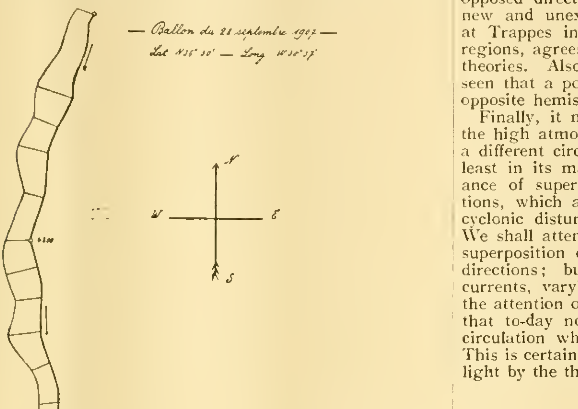


FIG. 4.—Motion of air in the atmosphere in the region of the Azores.

Note.—In all the figures the numbers give the altitude and the breadth of the lines the velocity of the wind.

The *ballon-sonde* ascensions made in 1907 were somewhat higher than before, and the isothermal layer was reached at 14 kilometres in latitude 25° 18′ N. North of 25° the isothermal layer was often met with at altitudes varying from 12 to 14 kilometres, while to the south of this parallel it was not reached, although the balloons many times exceeded 15 kilometres. Therefore, it appears that the altitude at which the temperature ceases to decrease is much greater near the equator than in moderate latitudes. This distribution of temperature is also confirmed for the regions of the Azores and Canaries, as far as about 25° N., by the ascensions of *ballons-sondes* made by Prof. Hergesell.

Our conclusions concerning the direction of the upper currents correspond in substance with former ideas about the anti-trades, apart from the situations which produce currents of very different and almost opposed directions lying one above the other. This new and unexpected fact, which was also observed at Trappes in the barometric maxima of our own regions, agrees tolerably well with certain of Maury's theories. Also near the equator it can be distinctly seen that a portion of the anti-trade comes from the opposite hemisphere.

Finally, it may be said that, if the exploration of the high atmosphere over the Atlantic does not show a different circulation from that already supposed, at least in its main features, it emphasises the importance of superposed strata flowing in various directions, which appear to persist in the regions where cyclonic disturbances of large diameter rarely form. We shall attempt later to give an explanation of the superposition of two or three strata having different directions; but the stratification of numerous thin currents, varying in their motions, is a fact worthy the attention of meteorologists, for we must recognise that to-day no theory explains this special mode of circulation which extends over a very large region. This is certainly one of the important facts brought to light by the three cruises of the *Otaria*.

L. TEISSERENC DE BORT.
A. LAWRENCE ROTCH.

AVIATION, MATHEMATICAL AND OTHERWISE.[1]

THE second volume of Mr. Lanchester's large work deals mainly with the following points:—The forms of the paths described by bodies in free flight; the conditions of longitudinal, lateral, and directional stability; the theory and use of scale-models; theories of soaring flight; and a large number of experimental verifications.

The theoretical discussions are based, to a large extent, on the consideration of what the author calls phugoid curves. According to the "Glossary," "phugoid theory" means "the theory dealing with the longitudinal stability and the form of the flight path," though in a footnote the author raises some doubt as to the appropriateness of the Greek derivative which he has himself coined. The simplest form of phugoid curve, to the study of which the author devotes considerable attention, might form the subject of problems that would delight the heart of the old-fashioned tripos examiner. Like the latter's particle on his perfectly smooth surface, the gliding body is supposed to have its mass concentrated at a single point and to travel without loss of energy, and the supporting surface is supposed to be small and to be always tangential to the direction of motion. In other words, the problem reduces to that of a particle acted on by gravity and by a supporting force (due to the air) which is always normal to the

[1] (1) "Aërodonetics." Constituting the Second Volume of a complete Work on Aërial Flight. By F. W. Lanchester. Pp. xvi+433. (London: A. Constable and Co., Ltd, 1908.) Price 1l. 1s. net.
(2) "Artificial and Natural Flight." By Sir Hiram S. Maxim. Pp. xv+166. (London: Whittaker and Co., 1908.) Price 5s. net.

direction of motion and proportional to the square of the velocity.

In view of the fact that classes on calculus for engineers form an integral part of every modern technical course of instruction, it is to be regretted that Mr. Lanchester has not made some attempt to bring his equations more into conformity with ordinary well-recognised notation. When he writes down the equation of his curve as

$$\cos \Theta = \frac{H}{3H_n} + \frac{C}{\sqrt{H}},$$

and the expression for the radius of curvature as

$$r = \frac{dL}{d\Theta},$$

his readers will take some time to find out what these equations mean; whereas any student who has attended the classes above referred to would understand at a glance the same equations if written as

$$\frac{dx}{ds} = \frac{y}{3y_0} + \frac{c}{\sqrt{y}} \text{ and } \rho = \frac{ds}{d\phi}.$$

When Mr. Lanchester applies his phugoid theory to investigate the longitudinal stability of aërofoils, he at once comes into conflict with the theory which the present writer, in conjunction with Mr. Williams, worked out some few years ago. There has been some difficulty in making out how Mr. Lanchester arrives at his results, and Mr. Harper has examined the matter independently. It was not intended at first to deal with what might be a controversial point in a review in NATURE, but the difference between the two methods is probably not so very difficult to explain.

According to our theory, the small oscillations about steady motion of an aëroplane, or indeed any body moving in a resisting medium in a vertical plane, depend on the roots of a biquadratic equation, and the conditions for stability are those given by Routh. This method enables account to be taken of every circumstance which may affect the stability, in particular, variations in the position of the centre of pressure for different angles.

Mr. Lanchester, on the other hand, considers only the case of a single aëroplane, the variations of the centre of pressure of which are not taken into account, stability being maintained by means of a tail. He starts with the assumption that his "phugoid" oscillations, when small, are simple harmonic in character, and that the effect of the moment of inertia of the machine, as well as of resistances, is to change the amplitude of these oscillations. In estimating the effect of these changes he assumes the equations of simple harmonic motion to hold good. For example, in considering the rotatory motion about the centre of gravity (§ 63) he writes

$$\tau_1 = \frac{2I\pi^2}{t_1^2} \times 2\Theta_1 = \frac{4\Theta_1 I\pi^2}{t_1^2},$$

where τ_1 is the maximum torque, Θ_1 the maximum angular displacement, t_1 the time of oscillation (calculated, it would seem, from the ideal "phugoid" motion), and I the moment of inertia.

This step is unjustifiable. The correct equation is

$$I\frac{d^2\theta}{dt^2} = \tau,$$

where τ is the torque at any instant. A similar consideration applies higher up, and when the necessary corrections have been made they are found to lead to the biquadratic equation of the Bryan-Williams theory.

It is as if, in working out the theory of the compound pendulum, it were attempted to treat one weight as a simple pendulum, and to assume that the motion of the other weight did not affect the period, or the relation between velocity and displacement, but merely produced variations of amplitude.

Mr. Harper has applied the Bryan-Williams method to the particular kind of tailed aëroplane considered by Mr. Lanchester, and he obtains a numerically different result, the discrepancy being accountable for by the assumptions contained in Mr. Lanchester's method.

There is thus a good bit of work of a theoretical character requiring to be done before the problem of stability can be regarded as completely solved. In the meantime, it must be remembered that airship designers have not, as a rule, undergone even the elementary training in practical mathematics referred to in this review, and that most extraordinary views commonly prevail in this country regarding the subject of stability. It is not improbable that Mr. Lanchester's conditions may be sufficiently near the mark for practical purposes, and his experimental verifications seem to support this view. Moreover, they may err on the side of safety. It seems also certain that unstable machines have been safely guided through the air by skilled manipulators, and the stability of the Wright machine has been seriously questioned. Indeed, there are good reasons for believing it to be unstable. Mr. Lanchester's method applied to the Lilienthal machine shows it to be unstable, although, in view of its broad curved supporting surfaces, a complete investigation would require account to be taken of several neglected factors for which no experimental data exist.

A great deal of rubbish has often been written on the "soaring bird," and much that has been stated in print has been incompatible with the doctrine that perpetual motion is impossible. Mr. Lanchester's observations and experiments are deserving of the most careful consideration, and the same applies to his chapter on "Experimental Aërodonetics." The book represents the result of a serious effort to place the theory of flight on a scientific basis, and should do much to convince would-be aviators that "airship design" can no longer be regarded, as it has been in the past, as a mere exercise for the imaginative faculty, but as a subject requiring hard thought, endless experiments, and great care in drawing conclusions from them.

Sir Hiram Maxim's book is distinctly disappointing. An account of his early experiments, if somewhat out of date, would be at least of historic interest; but when the author indulges in a tirade against mathematicians, the question which naturally suggests itself is, Where on earth does he find his mathematicians? He tells us that

"During the last few years a considerable number of text-books have been published. These have, for the most part, been prepared by professional mathematicians who have led themselves to believe that all problems connected with mundane life are susceptible of solution by the use of mathematical formulæ, provided, of course, that the number of characters employed are numerous enough."

Now Prof. Chatley, who certainly has got a pretty clear grasp of the present state of the flight problem, recently wrote:—

"A few great mathematicians (including Lords Kelvin and Rayleigh) have devoted some attention to the matter, but the author is not aware that any mathematician worthy of the name has considered it worth while to make an exhaustive study of the question. . . ."

When Sir Hiram says that "Up to twenty years ago Newton's erroneous law as relates to atmospheric resistance was implicitly relied upon, and it was not the mathematician who detected its error, in fact we have plenty of mathematicians to-day who can prove by formulæ that Newton's law is absolutely correct and unassailable. . . ." his information does not agree with the facts of the case. What about Kirchhoff's theory of discontinuous fluid motion, to mention nothing else?

Again, it is rather amusing to see mathematicians accused of demonstrating "by formulæ, unsupported by facts, that there is a considerable amount of skin-friction to be considered," when the usual complaint is that they will assume all their bodies to be perfectly smooth, and will not take account of frictional resistances in solving their problems. But some clue as to where Sir Hiram finds his mathematicians is afforded by his reference (preface, p. x) to a recent controversy in *Engineering*. Surely he cannot suppose that the authors of difficult mathematical researches would, as a rule, publish their best work in journals devoted to the interests of practical engineers, even if the editors would consent to print them! If he would consult the pages of journals and transactions devoted to researches in mathematics and mathematical physics, he would soon discover the paucity of papers to which Prof. Chatley refers.

On pp. 104 to 108 he publishes figures of stream-lines taken (so he says) from "mathematical" treatises, and all he is able to say is that "just how or why" the air moves in these particular ways is not evident. Now, in the first place, the diagrams show complex systems of eddies, the equations of motion of which no mathematician would ever attempt to integrate, and in the second place the question is not how the air is *likely* to move, but how it actually does move?

As an exponent of experimental *versus* mathematical methods, why did not Sir Hiram put the matter to a decisive and conclusive test by determining experimentally the form of the stream-lines produced in the neighbourhood of the various surfaces shown in these illustrations? Experimental, and in particular photographic, methods of plotting stream-lines are not difficult, and they can be conducted at a very trifling expense. Some of those who are, or have been, conducting such experiments are not altogether unmathematical in their methods. Surely Sir Hiram Maxim has missed a grand opportunity of scoring off his "mathematicians."

It was in 1894 that the author's gigantic experimental machine ran to and fro between rails. To all that has been done since that time only about five pages, including illustrations, are devoted in a chapter on "Some Recent Machines," and an equal number in a chapter headed "Balloons"; and yet the fifteen years that have just elapsed form the most eventful period in the whole history of artificial flight. It is the experimenters who have expended time and money, and have even sacrificed their lives, rather than the mathematicians, who have cause for disappointment at the scanty recognition they have received.

An address on "Recent Progress in Aëronautics," delivered before the engineering section of the American Association at Baltimore by Major George O. Squier, is published in *Science* for February 19. It is in the nature of a general summary, and deals both with balloons and aëroplanes, but the treatment of resistances on "arched surfaces" reveals an important gap in the experimental information dealt with in the address. It is tacitly assumed that the only effect of arching the surface is to increase the coefficient of resistance, the angle of flight being taken "to be the inclination of the chord of the surface to the line of translation." This would be all right if we were sure that the resultant reaction was always perpendicular to the chord, but it is pretty certain that such is not the case. If the aërocurve forms a circular arc, the resultant must (in the absence of skin-friction) pass through the centre of curvature, and if the centre of pressure is in front of the centre of the arc, the effective angle of flight will be less than the inclination of the chord, that is, the ratio of drift to lift will be less than the tangent of the inclination of the chord. Experimental information on this point is very scanty as a rule, a notable exception being Mr. Turnbull's investigations of plane, concave, convex, and doubly curved surfaces. Again, exception may be taken to the statement that "the helicopter type of machine may be considered as the limit of the aëroplane when by constantly increasing the speed the area of the supporting surfaces is continuously reduced until it practically disappears."

In his suggestions for "the stabilisation of aëroplanes" in *La Revue des Idées* (Paris, February 15), M. Étienne Maigre deals with lateral stability, and assumes that the lateral balance is to be maintained, not automatically, but by the voluntary or involuntary effort of the aviator. He suggests the use of two triangular surfaces attached to the main aëroplane and controlled by hand. He assumes Otto G. Luyties' law, according to which the normal resistance varies as $2 \sin a - \sin^2 a$, and finds a maximum lift for an angle of 37°.

Captain Renard has been giving a series of conferences before the Société d'Encouragement pour l'Industrie national, of which the first has appeared in the *Bulletin* (Paris, January). Captain Renard distinguishes six different methods of experimenting on air-resistance, including the use of experiments in water, with suitable allowances for difference of density. The need of further experiments in this direction is strongly emphasised.

It is to be noticed that the art of designing gigantic airships fitted with saloons, cabins, and mess-rooms has not yet faded away into past history, despite the recent advances in aëroplanes and dirigibles. About the beginning of February the *Standard* devoted more than half a column to an American project very suggestive of the *Minerva* of Robertson or the gigantic apparatus for which M. Petin raised 1000*l.* in the early days of ballooning, but for which the gas supply proved inadequate.

G. H. Bryan.

DEW-PONDS.

A GROWING interest in the subject of dew-ponds has been exhibited in recent years, but it has yet to be proved whether there is actually such a thing as a true dew-pond. Dew-and-mist ponds there undoubtedly are, but dew and mist, similar in essence as they may be, are yet distinct and separate meteorological phenomena. The term "dew-pond" has arisen from the careless habit of assuming that every form of condensation of aqueous vapour which is not seen as rain or snow must be called dew.

The Journal of the Society of Arts (March 5) contains a paper on the subject by Mr. Geo. Hubbard, and he has therein endeavoured to show how artificial deposition of dew may be brought about in a pond. He maintains that by laying down a bed of straw beneath puddled clay, the water may be chilled sufficiently to cause the atmosphere to give out aqueous vapour as dew. In his earlier remarks on the subject, it was the chilling of the puddled clay to which he attributed deposit of dew. Of course, if a pond were fairly full there would be but little puddled clay exposed, so now he attributes the additional supply to the chilling of the water, and this, of course, presupposes that the pond is fairly full, otherwise there would be no water-surface at all to speak of. Perhaps it is intended that when empty the puddled clay commences the operation, and when the water has arrived this carries on the process. What evidence is there that this is so? The chief evidence is found in that ice is obtained in India by placing pans of water in shallow beds filled with rice-straw.

This is excellent so far as it goes, and Dr. Wells records that he performed the same experiment in England nearly a hundred years ago. Thus there is a presumption that if straw be laid down under a pond, it may act in such a way as to cut off the heat of the earth below. The difficulty lies in carrying out a similar process on a large scale, and at the same time in keeping the straw dry. Should it become moist, and it must do so if in contact with puddled clay, it will cease to be an efficient non-conductor of heat, and it must be borne in mind that whereas the straw under the ice-pans in India can be, and is, frequently changed, this cannot be done under a pond. Mr. Hubbard says:—"In numerous dew-ponds in this country the dew-point is reached without difficulty." Nothing is given in support of this statement, and we may well ask on what evidence it is based. It presumably means that the water itself reaches a temperature which is below the dew-point. A number of observations made by the writer have never yet revealed the fact. The water of a pond parts with its heat extremely slowly. To be of value toward the replenishment of a pond, the dew must be received in the height of summer, when there is but little rainfall, and when, as is admitted, the ponds at lower levels are drying up. The pond is heated during the day, and evidence is wanting as yet that it falls below dew-point at night. Of course, dew is being received on the grassy banks around, that is to say, on vegetation, but the radiating powers of water and grass are apart as the poles, and on radiation dew-fall, as we know it, depends.

As Mr. Hubbard states, the altitude of the ponds may result in some amount of condensation, owing to the lowering of temperature resulting from the expansion of the air. This would, however, be but a small factor, whilst the condensation would show itself as mist. There may be something, too, but not much, in the osmotic action of dew-pond water, containing as it does a small proportion of sodium chloride. But there must be some greater factor at work if we are to credit the few records which have been made of the acquisition of, for instance, "$3\frac{1}{2}$ inches of water after five nights of heavy dew."

Mr. Hubbard rightly judges the importance of the dew-pond principle, if fully established, in countries where there is no natural water-supply other than dew. He is also quite correct in dwelling upon the importance of vegetation in increasing the rainfall of a district. But when we hear of the rising of the water in a pond by an inch or more in a night, we desire to know if there are any overhanging trees, and whether there are grasses rooted in the bottom of the pond, with several inches of their growth exposed to the atmosphere. The dew deposited on these would be a large item, and would go to feed the pond. Still, there are undoubtedly some ponds, of large size, with no vegetation appearing above the surface, no drainage except from their own shelving bank, the only visible means of recruiting of which consists of rain and driving mists. Given a period of drought, yet these ponds seem to suffer but little. I am not at all satisfied that straw is really a necessity of the case. I have collected information from several different quarters as to the manner of construction of dew-ponds, but straw is not used in all cases, and when used it is frequently placed above the clay merely to prevent cattle from trampling through the bottom and so allowing the water to escape. If dew-point is reached in the air above a pond, there must be some other factor than the alleged chilling of the clay or the water to bring it about. There is room for more experiment. E. A. M.

NOTES.

At the last meeting of the Royal Society the following were elected foreign members of the society:—Prof. Santiago Ramón y Cajal, Madrid; Prof. Émile Picard, Paris; Prof. Hugo Kronecker, Berne; and Prof. George E. Hale, Mount Wilson.

Lord and Lady Rayleigh, who have been travelling abroad for several months, have returned to Terling Place, Witham, Essex.

A Central News message from New York states that Prof. F. L. Tufts, professor of physics at Columbia University, was killed on April 15 while testing some electric feed wires.

The annual dinner of the Institution of Mining and Metallurgy will be held at the Hotel Cecil on Friday, April 30. The president, Mr. Edgar Taylor, will preside.

The death is reported, at Louisville, Kentucky, of Dr. Letchworth Smith, at the age of thirty-seven. For several years he had been specially engaged in the study of milk, first at Cornell Medical School and afterwards at the research laboratory of the New York Board of Health. He was the founder of the Babies' Milk Fund Association.

America has lost one of her veteran naturalists by the death of Dr. W. H. Edwards, who was born in 1822, and made a voyage up the Amazon in 1846 to collect objects of natural history. In addition to a volume describing this expedition, he published three series of books on the butterflies of North America. He also contributed to scientific journals a large number of entomological articles.

By the death of Prof. F. E. Hulme, which was announced in the last number of Nature, botany has lost an assiduous votary. Although his professional career lay outside the subject, as he was for many years professor of drawing on the engineering side at King's College, London, he found time to prepare several popular illustrated works on flowers. The best known is "Familiar Wild Flowers," published originally in five series, then extended to eight, and a ninth was revised in proof by the author before his death. "Familiar Garden Flowers," produced in conjunction with Shirley Hibberd, was a contemporaneous publication, and another pleasurable volume, "Familiar Swiss Flowers," appeared last year. The charm of his illustrations lies in the combination of artistic feeling with accuracy of form and colour, while the text discloses an intimate knowledge of plants and flower lore.

A short essay by Mr. Edward Greenly in the Rationalist Press Association Annual suggests that the ancient Greeks, if they were with us to-day, would be much more likely to favour the teaching of natural science than compulsory Greek in schools. Mr. Greenly points out that the geological observations of Pythagoras were as correct, and his conclusions from them as sound, as those of the founders of modern geology. Archimedes, Aristotle, and Eratosthenes of Alexandria also followed the plain and profitable paths which deviated later into the mazes of *a priori* metaphysics, and thus prevented the growth of a scientific Hellenic world. Had the scientific method of inquiry and experiment been pursued, Greek science would have been comparable with that of the nineteenth century, and the whole course of history would have been changed.

Mr. R. Hay Fenton has presented to the Natural History Museum of Aberdeen University his fine collection of British birds' eggs—his labour of love for twenty years. The entire collection consists of about 7000 eggs, and includes good series of all the breeding species. There are some interesting rarities, such as the eggs of Ross's gull, the nesting place of which was discovered by Mr. Buturlin in the delta of the Kolyma River in 1905. There is also a fine series of cuckoo's eggs, about fifty altogether, and the foster-parents' clutches. The last addition to the collection was the egg of the great auk purchased a short time ago in London. In handing over his collection to the University, the generous donor makes the interesting statement that his gift has been largely prompted by his recollection of happy visits which he paid to the museum in his boyhood. The bulk of the collection is now well displayed in carefully protected drawers in the University museum at Marischal College, and may be consulted by all serious students.

In reference to the recently recorded discovery of a skeleton of a mammoth on the beach at Selsey, Sussex (March 25, p. 104), Mr. W. J. Lewis Abbott writes to express the opinion that nearly complete skeletons both of this extinct elephant and of *Elephas antiquus* are commoner in English Pleistocene deposits than is usually supposed. He thinks that the fragmentary nature of many of the specimens recovered is due to unskilled collecting. To the skeletons recorded from Ilford and Ealing, Mr. Abbott adds one from Endsleigh Street, near Euston Station, described by Dr. Henry Hicks in 1892, and one from West Thurrock, Essex, discovered by himself in 1890. Mr. E. Heron-Allen informs us that the whole of the bones recovered at Selsey have been collected by him, and will in due course be deposited in the Natural History Museum, South Kensington. The presence among the remains of the right and left patellæ and a metatarsal bone, all three flawless, will enable experts to judge accurately of the size of the animal when living. Mr. Heron-Allen adds:—"A superficial microscopical examination of the mud in which the skeleton was found has been made by Mr. Clement Reid, F.R.S., and by myself, and proves the deposit to have been fresh-water. The seeds hitherto identified are those of the *Potentilla comarum* (cinquefoil), Myriophyllum (water milfoil), *Eleocharis palustris* (spike rush), *Ranunculus aquatilis* (water crowsfoot), Zannichellia (horned pond weed), Carex (sedge, two species), Potamogeton (pond weed), Stellaria (stitchwort), and *Hippuris vulgaris* (mares' tail)."

In the report for 1908 of the museums and art-galleries under the control of the Corporation of Glasgow, it is mentioned that the total number of visitors to these institutions again touched a million and a quarter, and this without any special new attraction. A number of new specimens have been added to the natural-history collections.

A method of mounting rotifers and protista in Canada balsam is described by the Rev. Eustace Tozer in the Journal of the Royal Microscopical Society (February). Various fixatives, namely, osmic, picric, and glacial acetic acid, absolute alcohol, and formalin, are used, the choice depending on the species to be prepared. An important feature is the performance of the processes of hardening, staining, and dehydrating on a glass slip under a cover-glass, which is kept from crushing the objects by a thread of white cotton placed under one side. The fluids are drawn off by placing blotting-paper outside the cotton thread, the subsequent fluids being applied at the opposite side of the cover. Euglenæ and diatoms are amenable to suitable modifications of the treatment.

In the *Museums Journal* for March Mrs. Roesler (in a paper read at the Ipswich Museums' Conference of 1908) gives an account of the work done, chiefly by herself, in the matter of instruction by American museums. To teachers desirous of giving lectures to their classes on special natural-history subjects, the American Museum of Natural History offers the use of a class-room or lecture-hall, and a lantern with a large stock of slides from which to select. For classes desirous of visiting the exhibition-hall, the museum also provides the gratuitous services of an instructor, who meets the classes by appointment and explains the collections. At the Boston Museum a "docent" performs the same services for classes and visitors for a small fee. The author then proceeds to describe the arrangements for instruction made by herself at the New York Museum. These hung fire for a time, but eventually became much appreciated. Among the arrangements are two courses—in spring and autumn—of informal lectures for children, and the museum also provides several hundred cabinets of natural-history objects for loan to the public schools of New York and its neighbourhood.

Afforestation and timber-tree growing in Great Britain and Ireland forms the subject of a paper read by Dr. J. Nisbet before the Society of Arts, and published in its Journal (March 26). It is mainly a criticism of the report of the Royal Commission issued this year.

An article is contributed by Dr. T. S. Hall to the Melbourne *Argus* (February 20) on the national park which has been formed by the Government of Victoria on Wilson's Promontory, explaining the objects for which the land is being reserved. It is intended to preserve the indigenous plants growing on this area, and introduce such native animals as the grey kangaroo, emu, and lyre-bird. Certain parts of the promontory compare with the famous arboreal and fern scenery around Healesville.

Bulletins on plants poisonous to stock, ramie cultivation, and pure maize seed have been received from the Transvaal Department of Agriculture, and the same topics are discussed by Mr. J. Burtt-Davy in his annual report for 1907–8. Maize cultivation in the colony has received a great impetus owing to the growth of an export trade, and farmers are pressing for a supply of pure seed of good quality. The bulletin points out how good seed may be obtained by selection or by breeding in accordance with Mendelian principles. Three plants are noted as being especially poisonous to stock, *Homeria pallida*, known as yellow tulp, which grows with lucerne, but dies down before the lucerne is ripe, *Chailletia cymosa*, and *Urginea Burkei*.

A new journal, *Mycologia*, edited by Mr. W. A. Murrill, in continuation of the *Journal of Mycology*, was initiated in January. It is announced that each number will contain a coloured plate of fungi in natural colours; the plate in this number illustrates five species of different genera, including *Boletus scaber* and *Hypholoma perplexum*. The editor contributes a first list of American

Boletineæ of North America, and favours the establishment of numerous small genera; besides adopting Tylopilus and Rustkovia of Karsten, he creates four new genera, one of which, Suillellus, is founded on the species *Boletus luridus*. Mr. J. B. Rorer communicates a note on a bacterial disease of the peach which is pretty certainly the same as *Bacterium Pruni*, reported by Dr. E. F. Smith as the cause of leaf spots on plum and peach.

There is considerable opportunity for critical observations regarding the classification of the Polypodiaceæ. In this connection an article by Dr. E. B. Copeland in the botanical series of the *Philippine Journal of Science* (vol. iii., No. 5) respecting the limitation of the genus Athyrium merits special attention. The opinion is advanced that Athyrium, Diplazium, and Anisogonium do not form distinct natural genera, and that certain species of Diplazium show closer affinities with certain species of Athyrium than with other species of Diplazium. Therefore it is recommended to unite the species under the one genus Athyrium, and the author has collated with a key the large number of Philippine species that would come under the genus. In the following number of the journal Dr. Copeland makes a similar suggestion with regard to Cyathea, Alsophila, and Hemitelia, and applies his views in naming a few Philippine species under the generic name of Cyathea.

Prof. Giglioli, of Pisa, has issued as a reprint a paper published in the *Bollettino della Società degli Agricoltori Italiani* in which he discusses some of the newer phases of manurial action. In particular he has collected the results of a number of experiments on the manurial value of manganese dioxide, which has frequently given an increase in crop, although it is not an essential plant food. Indirect manurial actions of this kind are of interest in connection with the idea now being developed in certain quarters that soils contain substances toxic to plants, and a discussion of the phenomena from this point of view is given in the paper.

Bulletin No. 131 of the Purdue University Agricultural Experiment Station contains a report on the working of the recent Feeding-Stuffs Act of Indiana, which, like ours, compels the merchant to guarantee the percentages of oil, protein, and the maximum amount of fibre, and imposes penalties in case the feeding-stuff does not come up to guarantee. There is some difference in detail, and, on the whole, the Indiana Act is more stringent, but it is said to have been entirely effective, and to have improved considerably the standard of goods supplied to the farmer.

The report from the Transvaal Government Laboratories for the year 1907–8 shows a decrease in the total number of samples examined, which, however, is more than accounted for by the falling off in the number of plague specimens. A large number of waters, milks, flours, meals, and other food-stuffs were examined, and attention is directed to the bad state of some of the tinned meats supplied. A number of poison cases were investigated, but it is pointed out that little or no progress can be looked for in dealing with native poisoning cases until a complete examination has been made of the plants indigenous to South Africa and the poisons they contain.

Mr. F. V. Emerson contributes a paper, entitled "A Geographic Interpretation of New York City," to the Bulletin of the American Geographical Society (Nos. 10 and 12, vol. xl.; No. 1, vol. xli.). An elaborate inquiry into the geographical position of New York, and examination of statistics concerning its position in relation to other towns on the Atlantic coast of the United States, leads the author to the conclusions that the commercial growth of New York is due, primarily, to its easy route to the interior, but that there is some evidence that the "momentum" which it has enjoyed from this cause is decreasing. Business men in New York have realised this danger, hence the enlargement of the Erie Canal.

In the March number of the Bulletin of the Imperial Academy of Sciences at St. Petersburg, Prince Galitzin discusses the records of the Calabrian earthquake obtained at Pulkowa. This observatory is specially devoted to a comparative study of the behaviour of various types of instruments, not to that of the movement of the ground; some interesting results seem to have been obtained, among which may be counted the value of electromagnetic damping. This is the only form which gives a constant coefficient of damping for all amplitudes of swing, and its efficiency in eliminating the idiosyncrasies of individual instruments is strikingly exemplified by the reproduction of a double record of two similar Zollner pendula, each recording independently on the same sheet of paper, in which the two curves follow each other with hardly a perceptible divergence in course. It is noticed that all the records indicated an initial movement towards the origin; Prince Galitzin explains this by assuming that the first displacement was outwards, but that the piers, acting as heavy pendula of short period, were tilted backwards by their own inertia, thus producing an apparent inward movement on the instruments which they supported.

In the February number of the *National Geographic Magazine* Captain F. M. Munger, of the U.S. Revenue Cutter Service, gives an account of "the most wonderful island in the world," that near Bogloslof, in the Aleutian Islands, Alaska. In 1886–7 a new island, named "Fire Island," made its appearance. In 1905–6 a new peak rose between this and the adjoining "Castle Rock." Next year a third elevation, called "McCulloch Island," showed itself in the same area. This seems to have exploded in September, 1907, a heavy fall of ashes having covered the entire region for a distance of sixty miles. At the survey in 1907 the formation of the remaining portions of these various volcanic peaks was found to consist of disintegrated rock, basalt, felspar, scoria, tufa, pumice, obsidian, trachyte, and other igneous rocks, with volcanic mud, all more or less discoloured with a deposit of sulphur. The series of excellent photographs obtained by Captain Munger gives an excellent idea of the successive stages of this remarkable exhibition of volcanic energy.

The British School at Rome recently issued an appeal for help towards excavations in the western Mediterranean, accompanied by a report, by Dr. Duncan Mackenzie, on the mysterious Nuraghi of Sardinia and their west-European relations. At Sena he found the so-called "Giant's Tomb," closely connected with the Nuraghe-castle, and remarks:—"On the other hand that the Nuraghe-villagers should turn out to have buried in constructed chamber-tombs that themselves were imitations of the Nuraghe-hut as well as in rock-shelters and rock-cut chamber-tombs would in itself not be a singular phenomenon, but one that has a wide illustration in the Mediterranean Basin and elsewhere in Europe. At the same time an ethnological puzzle of a curious order may well underlie the fact that the people of the Nuraghe-castles should arrogate to themselves for their exclusive use a type of tomb which owes its origin to the primitive dolmen at the same time that they inhabit houses of the same round type as the Nuraghe-huts of the simple villagers." He goes on to illustrate the connection of these remains with the migratory movement through Spain which civilised Europe in the early prehistoric period, France forming the chief highway from north to south. The same tomb-types characteristic of pre-Gallic France recur in the British Islands in the case of New Grange, and the Mediterranean types exhibit special analogies with the horned cairns of Caithness. Excavations in Sardinia and Malta are thus likely to throw much light on the ethnology and prehistoric past of western Europe, and it may be hoped that this appeal will result in liberal aid to a most important investigation, which will continue in the competent hands of Dr. Mackenzie.

The *U.S. Monthly Weather Review* for November, 1908, contains a suggestion, by Prof. A. G. McAdie, for the reform of meteorological methods, by the gradual adoption of metric and centigrade measures in the records and work of the Weather Bureau. For atmospheric pressure a distinctly new proposition is advanced; the author thinks that if pressure changes were charted in percentages of a standard atmosphere, the result would be more satisfactory to both meteorologists and the public. "Instead of 29·92 inches or 760 mm. we should have the value 1000, meaning thereby the pressure of the atmosphere at sea-level reduced to standard temperature and gravity. Then on any given weather map, in place of 30·3 inches we should have 1012. . . . The great advantage of this is that pressure gradients can be read at a glance, and the average man can readily understand the significance of pressure variation." Prof. McAdie considers this method as much superior to the metric system as that is to the one now in use. The editor of the *Monthly Weather Review* points out that the publication of the paper does not imply the approval of the chief or other officials of the Weather Bureau, but he invites discussion thereon.

The Weather Bureau of the Philippine Islands has published part i. of its annual report for 1906; this volume occupies 153 quarto pages, and contains the hourly meteorological observations made during the year at the central observatory at Manila. Each of the tables shows also the hourly, daily, and monthly means; the extreme daily values of the various elements, together with the times of their occurrence, are given in a separate table. All the observations are expressed in the metric system, according to the practice adopted at the time of the reorganisation of the Weather Bureau by the United States Government. This detailed publication of observations and means, which began with 1885, is of great value for the purpose of scientific inquiry, and complies with an international understanding that each country should publish such data for one or more of its principal stations. From the general summary we note that the normal annual duration of sunshine (1890–1906) is 2266 hours; rainfall (1865–1906), approximately 76 inches, on 139 days; shade temperature (1880–1906), 80°·4 F. A statement printed in the English edition of the report of the International Meteorological Committee (Paris, 1907) gives the absolute extremes of temperature (1885–1907) as 100° F. and 59° F. The observations at outlying stations of this important organisation form separate parts of the annual report.

Drawings and photographs of a 40-feet gas-driven launch are given in the *Engineer* for April 9. This launch has been built for cruising purposes by Maclaren Bros., of Dumbarton, and is fitted with a 30 horse-power four-cylinder Crossley gas engine and suction gas-producers using anthracite. The gas is cleansed and cooled in a wet scrubber charged with coke; the ascending gas meets a spray of sea-water supplied at the top, and then passes downwards through a dry scrubber also charged with coke. The maximum speed of the engine is about 800 revolutions per minute, and with a compression of 120 lb. per square inch combustion is so complete that there is an entire absence of smoke and smell both in the engine-room and at the funnel. The engine when cold is started on petrol, and runs with this fuel until the producer has settled down to supply the necessary quality of gas. At the trial runs of the launch, under unfavourable weather conditions, a speed of 9 knots was attained, the cost of running being about $2\frac{1}{2}d.$ per hour.

Attention is directed in a leading article in *Engineering* for April 9 to the extent and special character of the plant necessary in warship construction, and to the fact that much of this plant is kept idle during prolonged periods owing to the method of the Admiralty in placing orders. Protective decks, armour, guns, and gun mountings require special plant involving very heavy capital charges without any possibility of return except in naval work. At present, armour for ten or twelve battleships per annum can be produced in this country, but in the past three years armour for eight ships only has been ordered. The time required from casting the ingot until completion of the plate is seventy-seven days, and, of this time, thirty-five days' work may be done before any dimension other than the thickness has been specified. It is therefore urged that armour could be ordered early in the preliminary design of a ship. A 12-inch gun takes ten months to construct, and eighteen months are required for the completion of the latest type of barbette mounting for two 12-inch guns. The *Dreadnought* gun mountings were ordered six months before the ship, and took nine months longer to construct than the ship itself. This plan of ordering gun mountings long before the detailed design of the ship is completed might usefully have been adopted with the ships at present contemplated. Woolwich is not adapted for modern gun mountings, and, in the absence of some guarantee of steady work, it is unreasonable to expect private firms to increase their plant to meet a rush. We have sufficient armour and ordnance plant at present to meet all needs if they are utilised with judgment.

Both the *Electrician* and the *Electrical Review* in their issues of April 9 direct attention to two new systems of electric wiring which seem destined to do much in the near future to popularise the electric light amongst those to whom the cost of an installation has hitherto been an obstacle. The new systems are the "Stannos" and the "Kuhlos," and both use a conductor encased in a thin brass or copper tube about a fifth of an inch in diameter. The tube can readily be bent by hand, and is attached to the wall by means of a small clip nailed to the wall and bent over the tube. The cost of wiring is thereby greatly reduced, and the wires are of so small a diameter as to be inconspicuous.

In the *Physikalische Zeitschrift* for April 1 Dr. O. Krüger describes an addition he has made to the Atwood machine in order to show experimentally that the time of swing of a pendulum depends on the acceleration of its point of support. One of the falling weights of the machine carries the pendulum, and is guided in its fall by two vertical wires, so that the swing of the pendulum will not drag it out of its path. The bob of the pendulum carries a fine brush kept inked by means of a tube in the bob, and this brush writes on a vertical strip of paper during its fall. By regulating the two falling weights the pendulum may be made to ascend or descend with a given acceleration; in the former case the time of swing is decreased, in the latter increased, and the two times are determined from the strip records of the upward and downward motions. In the example given by the author the agreement between the observed and calculated ratio of the times of swing is within one part in one thousand.

The *Journal de Physique* for March contains a description of the apparatus for radio-active measurements by the electroscope method exhibited by Messrs. C. Cheneveau and A. Laborde at a recent meeting of the Société française de Physique. The electroscope is of the type introduced by the late Prof. P. Curie, the leaf of aluminium being supported by a plate rising from the base of the instrument, where it is insulated by passing through a plug of "ambroid." To its lower end a short or a long rod may be attached. Radio-active solids are placed in a shallow cylinder under the electroscope into which a short rod connected with the leaf projects. Gases are tested in a longer cylinder, into which a long rod projects. The aluminium leaf is observed through a microscope with a scale in the eye-piece, one division of which corresponds to 0·4 volt. The normal rate of leak of the instrument is 1 volt in twelve minutes, and the minimum for a measurement 1 volt a minute. The lowest rate of production of radium emanation measurable with the larger cylinder is 0·002 milligram per minute. The authors hope that the simplicity of the apparatus will lead to its extensive use.

Messrs. J. W. Gray and Son, the well-known lightning-conductor experts, of 91 Leadenhall Street, have sent us a pamphlet, from the pen of their senior partner, Mr. Alfred Hands, entitled "Lightning and the Churches." The author estimates that not more than 25 per cent. or 30 per cent. of the ecclesiastical buildings in this country are provided with lightning conductors. Statistics which he has collected show that about twenty-four such buildings are damaged every year by lightning, and that of these about three are fitted with conductors which have failed to afford protection. Failure, he considers, may be due to original faults of construction or arrangement, to decay of important parts, or to alterations made in some of the metallic portions of the building after the conductor had been fixed. It is urged that the system of protection should be designed by an expert to suit each particular case, and should be inspected and tested at least once in every three years. The book contains many interesting photographs illustrating the destructive effects of lightning, and concludes with a list of 244 cathedrals, churches, and chapels which have been damaged by lightning during the last ten years.

The principal features of the *Bulletin de la Classe des Sciences* (1908, No. 12) of the Royal Academy of Belgium are a paper by P. Bruylants on the derivatives of trimethylene and a paper by J. Fraipont on the okapi and its affinities with living and with extinct giraffes. The former paper, extending over eighty-four pages, contains a description of a wide range of compounds containing the group $\begin{matrix}CH_2\\ |\\ CH_2\end{matrix}\!\!>CHX$, the boiling points and densities of which are contrasted with those of the isomeric allyl compounds $CH_2=CH.CH_2X$, and of the isopropyl compounds $\begin{matrix}CH_3\\ CH_3\end{matrix}\!\!>CHX$; the trimethylene compounds usually have a higher boiling point and a higher density than the corresponding allyl and propyl compounds. The latter paper is illustrated by an excellent picture in colours of the *Okapia johnstoni*, a map showing its distribution in the Congo basin, and a series of six comparative photographs of the skull of the okapi and related species.

Attention has been directed in these columns to observations by Noyes which indicated that the mobility of the hydrogen ion in hydrochloric and in nitric acids continued to decrease at dilutions considerably greater than those at which other ions exhibit constant mobilities. A recent paper by Chittock in the Proceedings of the Cambridge Philosophical Society records a number of observations in which the same experimental result was obtained, namely, an increase in the migration value of hydrogen in hydrogen chloride from the normal value 0·167 to 0·275 in very dilute solutions. The explanation given is, however, of a much simpler character, the suggestion being made that the decreased mobility of the hydrogen ion is due to its association with traces of ammonia present as impurities in the water, whereby the hydrochloric acid is converted into ammonium chloride. A similar conclusion had already been reached by Whetham and Paine from observations of the conductivity and migration velocities of dilute solutions of sulphuric acid. It should not be difficult, *e.g.* by distilling from phosphoric acid, to prepare water practically free from ammonia and basic impurities, and it would be of interest to know whether such samples of water would give rise to abnormalities similar to those described above.

Messrs. Witherby and Co. have in preparation a work on the "Birds of Kent," by Dr. Norman F. Ticehurst, who has for many years been well known among ornithologists as a close observer of the avifauna of the county. The work will be published by subscription, and only a limited edition will be issued.

A special meeting of the council of the Iron and Steel Institute was held on Tuesday, April 20, under the presidency of Sir Hugh Bell, Bart., to consider the situation created by the resignation of the president-elect, Sir W. Thomas Lewis, Bart. A resolution of regret that Sir W. Thomas Lewis had found himself unavoidably precluded from assuming the office to which he had been elected was passed, and at the unanimous desire of those present Sir Hugh Bell consented to retain the presidency for a further term of twelve months. In that capacity he will, therefore, take the chair at the annual meeting and at the dinner on May 13 and 14 respectively.

OUR ASTRONOMICAL COLUMN.

Halley's Comet.—*Science Progress* for the current quarter (No. 12, April, p. 543) contains an interesting article by Mr. Crommelin, who reviews the past history of Halley's comet and discusses the probable time of the approaching perihelion passage. In the retrospect Mr. Crommelin directs attention to the fact that a fifteen-months' variation of the period caused Halley to hesitate before accepting the conclusions regarding the object's periodicity; it is now known that the planetary perturbations may cause a five-year variation, from seventy-four to seventy-nine years.

The identifications of returns are now carried back so far as 240 B.C., although there is no certain identification of Halley's with any observed comet until 12 B.C.; its appearance at that return is very fully described in the Chinese annals. Mr. Crommelin regards it as certain that the comet will be re-discovered as soon as the region of Orion, where it now is, becomes observable in the autumn of the present year. January or February, 1910, should find it visible in small telescopes, or even to the naked eye.

As showing the enormous difference between the aphelion and perihelion velocities, Mr. Crommelin points out that nearly half the period, from December, 1856, to April, 1889, was spent on the small arc of the path which lies beyond the orbit of Neptune. At perihelion the similar arc will be traversed in two years. On the assumption that perihelion will occur on April 16, 1910, the comet should appear at its brightest for a few days after May 17, its distance from the earth being then only about 12,000,000 miles.

PRESSURE IN THE SUN'S ATMOSPHERE.—*Apropos* of the discussion as to the pressure obtaining in sun-spots, the results published by MM. Fabry and Buisson in No. 11 of the *Comptes rendus* of the Paris Academy of Sciences are of special interest. Using their interference method, they have investigated a number of the displacements of solar lines which may be due to pressure. They find that all the lines do not behave alike; some are displaced in one direction by different amounts, whilst others are displaced in the opposite direction. Such displacements may not be attributed wholly to pressure, but are allied to the asymmetrical broadening of lines in the arc investigated by Dr. Duffield.

For the solar work MM. Fabry and Buisson selected fine lines such as are symmetrically broadened, and for twenty lines between λλ 4000 and 4500 they find a displacement corresponding to a pressure of four or five atmospheres above atmospheric pressure. Twelve lines between λλ 5100 and 5500 gave a similar result, and it therefore appears that a pressure of 5 or 6 atmospheres obtains where the iron absorption takes place in the sun's atmosphere.

THE SPECTRA OF NEBULÆ.—In these columns on March 11 (NATURE, No. 2053, p. 19) we briefly summarised some results, dealing with the spectra of nebulæ, recently published by Prof. Wolf. Some interesting comments on these results are now published by Dr. Eberhard in No. 4318 of the *Astronomische Nachrichten*.

First he directs attention to the enumeration of the nebular lines adopted by Prof. Wolf; this is not in accordance with the conventionally accepted enumeration, and seems likely to lead to confusion. Prof. Wolf found that the central star of the Ring nebula in Lyra is apparently less active, actinically, than the ring itself; Dr. Eberhard points out that this is a matter of the relative aperture of the instrument used, and the result was to be expected from the instrument employed by Prof. Wolf. He also reminds us that the unknown line at λ 345, suspected by Prof. Wolf in the spectrum of N.G.C. 2023, was certainly observed by Palmer in Nova Persei and in N.G.C. 6886.

According to Prof. Wolf's observations, Hγ was found to be double in N.G.C. 6210, but Dr. Eberhard suspects that, as the dispersion employed was small, this was not an actual doubling, but the incidence of two separate lines, λ 4341 and λ 4363; he also questions some of the identifications given.

THE ORBITS OF SPECTROSCOPIC BINARIES.—In recent numbers of the Publications of the Allegheny Observatory the orbits of several spectroscopic binaries are discussed. In No. 10 (vol. i.) Mr. R. H. Baker discusses the orbit of the spectroscopic components of α Virginis, and derives final elements, which give the period as 4·01416 days, the eccentricity as 0·10, and the apparent semi-major axis as 6,930,000 km.

In No. 11 the same observer discusses the results obtained for the spectroscopic components of *u* Herculis, whilst in No. 12 the orbit of α Coronæ Borealis is derived, by Mr. F. C. Jordan, from measures of 136 plates taken during 1907 and 1908 with the Mellon single-prism spectrograph attached to the 30-inch reflector. The final elements give the period as 17·36 days, the eccentricity as 0·387, and the apparent semi-major axis as 7,671,000 km.

THE CIRCULARITY OF PLANETARY ORBITS.—From Prof. T. J. J. See we have received an abstract from the *Astronomische Nachrichten* in which he discusses the origin of the planetary system, and the reason for the circularity of the orbits of the planets and satellites. Rejecting Laplace's hypothesis of a central rotating nucleus, casting off successive portions which became planets, Prof. See suggests that the planets are bodies which came from outside into such a nebulous mass as Laplace's original "solar nebula." The circularity of the orbits then becomes the natural consequence of the revolution of such bodies, around the central nucleus, through the resisting medium of the nebulous matter.

THE NATURAL HISTORY MUSEUM.

THE subjoined letter appeared in the *Times* of Monday, April 19.

It will be generally admitted that the Natural History Museum is one of the greatest scientific institutions in this country. It receives a grant of more than 60,000*l.* a year of public money, and is the national centre for the cultivation and organisation of the natural-history sciences. It is therefore a matter of concern, not only to naturalists, but to the public generally, that this great national institution should be administered in the best possible way. Unfortunately, in the opinion of all independent naturalists now living and of all the leading naturalists of the last forty-five years, the system of administration of the natural history departments of the British Museum is so defective that the accomplishment of the great objects for which the museum exists is seriously hampered. Rumours of this have already reached the public ear. It is not, however, our design, for the present, to refer to these rumours beyond stating that there is a strong *a priori* probability of their truth, for they indicate a state of affairs which could hardly be avoided under the present system of administration. The defects in this system to which we now desire to direct attention are as follows:—

(1) The government of the Natural History Museum is nominally, and in the eyes of the public, in the hands of the trustees of the British Museum, a large body of distinguished men, forty-nine in number, of high rank and great importance in the State. This number is so large that the trustees cannot act effectively as a single body. The result is that the executive is restricted to a small section of them, known as the standing committee, an entirely irresponsible body, subject to no control or criticism except of a purely formal kind, though spending annually large sums of public money.

(2) While the actual government of the museum is in the hands of the standing committee, the appointment of all officers and servants is in the hands of the principal trustees—the Archbishop of Canterbury, the Lord Chancellor, and the Speaker of the House of Commons. This arrangement, by which the control after appointment is in different hands from those which make the appointment, is highly unsatisfactory. For, should the principal trustees appoint a director not acceptable to the other trustees, as has happened, it is clear that a very difficult position must necessarily be created, alike for trustees and director. Moreover, it is, in our opinion, inimical to the proper conduct of the museum that the appointment to the subordinate offices should be made by the principal trustees. This point has already been touched upon in the fourth report of the Royal Commission of 1874. The commissioners state that:—

"It is held to be singularly inappropriate that the three important personages who are the principal Trustees, occupied as they are in the discharge of the highest functions in Church and State, should be burdened with the duty of making appointments to offices of every grade in the British Museum."

(3) The standing committee of the trustees control, not only the Natural History Museum at South Kensington, but also the Library and the Museum of Art and Archæology at Bloomsbury. This arrangement cannot be regarded as satisfactory, because with the rapid growth of archæology and natural science in the last fifty years the interests represented by the two museums have become so vast, complex, and divergent that it is beyond the power of a single body of men, even of the knowledge of affairs and distinction of the trustees, to fully understand the interests involved. The subdivision of the subjects was recognised when the natural science part of the museum was removed to South Kensington, and it is obvious that two institutions situated so far apart, and dealing with

such different material, cannot be adequately administered by a single governing body.

(4) These remarks apply equally to the remarkable regulation according to which the director of the Natural History Museum is subject to the direction of the principal librarian. This arrangement, by which the director of the largest and most complex natural science institution in the country is subordinate, not merely theoretically, but actually, to a literary man at Bloomsbury, with no scientific knowledge, is so extraordinary, and has had such baleful effects, that we must devote a few words to it. Quite apart from the welfare of the Natural History Museum, it seems unfair to expect of the principal librarian that he should be responsible for the institution in Cromwell Road in addition to his other heavy responsibilities; but it is when we look at the other side of the question that the faultiness of the arrangement becomes fully obvious. To choose as director at South Kensington a man distinguished for his technical knowledge, and then to fail to give him reasonable freedom in the employment of his training and experience, seems as bad a plan as it is possible to conceive. We think it is clear that at one time the trustees were of this opinion. Sir Wiliam Flower was in 1884 granted a large amount of independence, and this might have been greater had he not declined part of the responsibility offered him. When the late director was appointed this freedom was curtailed. It was, we think, unavoidable that in these circumstances difficulties should arise, and we feel very strongly that the recurrence of such difficulties ought to be made impossible; and this can only be done with certainty by making the Natural History Museum an independent unit.

The Prime Minister, in his reply to the deputation on this subject which waited upon him last July, said that the trustees were men of wide experience and equally cognisant of natural history and archæology. These statements are doubtless true, but the question is, are they competent to interfere in the management (as apart from the general supervision and financial control) of a great institution like the Natural History Museum, as complex and highly technical in its constitution as a modern laboratory or observatory? In our opinion, and in that of others who have looked into the question, they are not competent to do this. Yet they do interfere in details of management, not only on their own initiative, but also under the guidance, not of their own "director" especially appointed for his knowledge of museum work and of the larger needs of science, but of a librarian who makes no claim to knowledge under either of these heads. A proposal to place an eminent man of letters or an archæologist at the head of the National Observatory or of the National Physical Laboratory would justly excite the ridicule of the literary no less than of the scientific world, yet under the present system, based upon an Act of Parliament of the eighteenth century, the librarian at Bloomsbury is forced into just such a position with regard to the National Museum of Natural History.

These are some of the principal defects in the present system of administration of the museum. There are others to which, had we space, we should like to direct attention, but we have said enough to show that the present system of administration is defective in important particulars, which it is very desirable in the interests of science and education to remedy without delay.

In conclusion, we may point out that, in addressing this letter to you at the present moment, we cannot be accused of acting in haste. The defects to which we have directed attention have long been known to men of science, and many attempts have been made to remedy them. A short history of these attempts from 1864 to 1898, in which every distinguished man of science has participated, is appended to this letter. The present attempt originated in September, 1907, when the professors of zoology of the United Kingdom addressed a petition to the Prime Minister asking for an inquiry into the methods of administration which, as they subsequently explained by a detailed statement made in a deputation to the Prime Minister in July, 1908, had had such lamentable results.

It only remains to be added that this last effort has apparently been as devoid of result as have been its predecessors, and it has therefore become necessary to place before the public the main facts of the case. That public pays the cost of the Natural History Museum to the tune of 60,000*l.* a year. It does so presumably because it regards the museum as an absolutely efficient and well-organised scientific institution, having the full confidence of the scientific experts of the country. It is, therefore, necessary that the public should realise that, in the opinion of the professional naturalists, a continuance of that confidence is being gravely jeopardised by the continued refusal of those in authority to bring up to date its administrative methods. What we demand is an inquiry by a Royal Commission into the present administration of the Natural History Museum. The way would then be open for the establishment of a satisfactory scheme of reconstruction.

J. C. Ewart.
A. Sedgwick.
Sydney J. Hickson.
Gilbert C. Bourne.

April 17.

DAYLIGHT AND DARKNESS.

A MEETING in support of the Summer Season Time Bill, otherwise known as the Daylight Saving Bill, was held at the Guildhall on Tuesday, April 20, when the following resolution was adopted:—"That the passing of the Daylight Saving Bill would improve the physical, mental, moral, and financial welfare of the nation, and that it is deserving of the support of all classes of the community."

The chief speaker at the meeting was Sir Robert Ball, who referred to the effect of latitude upon duration of daylight, and described the zone system of time reckoning. It is difficult to understand, however, how his remarks can be considered to give support to the proposals of the Bill. The fact that different meridians are used in different parts of the world as standards of time-reckoning, or that a date-line exists about longitude 180°, provides no reason for a seasonal change of the standard meridian. The reference to the difference in the duration of daylight in different latitudes was also unfortunate; for when the difference of latitude is taken into consideration we find that the people in North Britain already enjoy about an extra hour of daylight in summer compared with those in the south, so that they do not need legislative action to obtain it.

As much misconception appears to exist as to the system of time-reckoning and the effect of latitude upon the length of day, it may be of interest to state a few elementary facts relating to them. The number of hours the sun is above the horizon of different latitudes within the limits of the British Isles is shown in the subjoined table for the ends of the months from April to August:—

	Latitude											
	50°		52°		54°		56°		58°		60°	
	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.
April 30... ...	14	37	14	49	15	2	15	16	15	33	15	51
May 30	16	0	16	18	16	40	17	5	17	34	18	8
June 30	16	18	16	40	17	4	17	32	18	5	18	45
July 30	15	18	15	34	15	50	16	10	16	32	16	58
Aug. 30... ...	13	35	13	42	13	50	13	58	14	8	14	19

In this table no account is taken of the lengths of dawn and twilight, which vary both with the season and the latitude. Twilight lasts until the sun is about 18° below the horizon, and where the apparent diurnal path does not descend to this point there is twilight all night. Thus defined, at the end of April places in our islands between latitudes 57° and 60° have twilight all night; during June the sun does not get 18° below the horizon of any place in our islands, and all places north of Edinburgh have twilight all night from about the end of April to the end of July. It is not suggested that work or recreation can be carried on without artificial light during the whole duration of twilight, but even if half this duration be taken it will be found that over a large part of our islands there is sufficient natural light for these purposes up to 10 p.m. or 11 p.m.

Suppose we consider eight hours' sleep as the normal amount to be taken out of the twenty-four hours of a day, and that a reasonable hour to retire is 11 p.m. The difference between this hour and the time at which the lamps of road vehicles have to be lighted will show the interval during which work or recreation cannot be carried on out of doors, assuming that the lighting-up time is always one hour after sunset. In Scotland there is sufficient light to work or play during a large part of the summer months for a much longer period than one hour after sunset, but for simplicity the rule for lighting-up time may be applied to the whole of our islands. The following table gives the interval between this time as thus defined and 11 p.m. Greenwich Time:—

	Latitude					
	50° h. m.	52° h. m.	54° h. m.	56° h. m.	58° h. m.	60° h. m.
April 30...	2 40	2 35	2 30	2 20	2 10	2 0
May 30 ...	2 0	1 50	1 40	1 30	1 10	0 55
June 30 ...	1 55	1 40	1 30	1 20	1 0	0 45
July 30 ...	2 25	2 20	2 10	2 0	1 50	1 40
Aug. 30 ...	3 10	3 10	3 5	3 0	2 55	2 50

An examination of this table shows that, taking the bed-time hour as 11 p.m., daylight can be used within two hours of this time during June in the lowest latitude of the British Isles, and within about one hour of 11 p.m. at any place north of Edinburgh. If we consider 9.30 p.m. a time at which people have worked long enough at business or pleasure out of doors to desire rest or recreation indoors before retiring at 11 p.m., it will be seen that the actual interval of darkness before 9.30 is small. For instance, taking latitude 52°, which is a little north of London, during May, there is one hour before 9.30 p.m. during which artificial light may be necessary; during June, there are less than twenty minutes; during July, about fifty minutes; and during August, about one and a half hours. If the latitude of Edinburgh (56°) be considered, then at 9.30 p.m. there is no darkness during May and June; in July people give up outdoor occupations needing daylight about half an hour before 9.30 p.m., and in August about one and a half hours before that time. In higher latitudes the people can play or work out of doors up to 9.30 p.m. or longer during the whole of May, June, and July. The only argument that can be derived from latitude is that North Britain should be excluded from the provisions of the Bill.

Now as to the zone or international system of time-reckoning. In the days when places were not within easy communication with one another, either by rail or telegraph, local time was commonly used. The necessity for a uniform standard became clearly evident when railway time-tables had to be printed. We have now become so used to this single system of time-reckoning that few of us remember that formerly it was common to see the announcement of railway companies, "London (Greenwich) Time observed at all stations." By the introduction of standard time, order was called out of chaos, though it meant that for places west of the Greenwich meridian time indicated by the sun is after the time indicated by clocks. A still further advance was made when the Greenwich meridian was adopted as the prime meridian for the international system of time-reckoning.

Thanks chiefly to the persistent advocacy of Sir Sandford Fleming, twenty-four standard meridians are now recognised, beginning with Greenwich, and counting toward the east. The time of each of these meridians is thus one hour behind that of the next meridian to the east of it, and one hour in advance of the next meridian to the west. Each meridian may be regarded as the mid-line of a zone 15° of longitude in width, so that the twenty-four meridians give the standard times on the international system for the whole world. It is usual for places within half an hour of the standard meridian to adopt the time of that meridian as its mean time, but in some cases the line midway between two consecutive meridians of the twenty-four hour system is taken as the standard meridian.

As Sir Robert Ball has given his support to the Daylight Saving Bill, it is of interest to notice what he says in his "Popular Guide to the Heavens" as to the value of uniformity and system in the reckoning of time. Describing standard time, he remarks:—"As soon as communication by railway and telegraph is established in a country, it is convenient to adopt throughout the country a uniform system of time. Very usually the time adopted has been at first the mean time of the capital. But as communication between different countries increases, great inconvenience arises when allowance has to be made for a difference of adopted time involving an odd number of minutes and seconds. A large number of countries and States have therefore adopted a standard system of time based upon that of Greenwich, and differing from it by an exact number of hours, with occasionally an odd half-hour."

The subjoined table, from "Whitaker's Almanack," shows the countries in which this system of standard time, with the prime meridian at Greenwich, has been adopted:—

Country.	Central Meridian.	Fast or Slow on Greenwich Time
Mid-Europe	15° E.	1h. fast.
East Europe, British S. Africa, Egypt	30° E.	2h. fast.
Mauritius and Dependencies	60° E.	4h. fast.
Chagos Archipelago	75° E.	5h. fast.
India	82½° E.	5½h. fast.
Calcutta	90° E.	6h. fast.
Burma	97½° E.	6½h. fast.
Hong Kong, Borneo, West Australia	120° E.	8h. fast.
Japan	135° E.	9h. fast.
South Australia	142½° E.	9½h. fast.
Victoria, New South Wales, Queensland, Tasmania	150° E.	10h. fast.
New Zealand	172½° E.	11½h. fast.
Iceland	15° W.	1h. slow.
America.		
Atlantic	60° W.	4h. slow.
Eastern	75° W.	5h. slow.
Central	90° W.	6h. slow.
Mountain	105° W.	7h. slow.
Pacific	120° W.	8h. slow.

Greenwich Time is used in Spain, Belgium, Holland, Gibraltar, and Faröe (Sheep Islands).

What the Daylight Saving Bill proposes, therefore, is that from the third Sunday in April to the third Sunday in September we shall use the mid-Europe meridian as our standard meridian, and the Greenwich meridian during the rest of the year. It is only necessary to state this fact to show how the proposals of the Bill would introduce confusion into what is now a simple and scientific system. If, as is suggested, some other countries in various latitudes may follow suit and change their standard meridians during various months, the result would be absolute chaos instead of scientific order.

There is only one other point to which we can refer now; it relates to the portion of the year during which the provisions of the Bill are to take effect. As Mr. L. C. W. Bonacina pointed out in NATURE of March 18, the division is unscientific, and follows no natural order.

The following table shows the days on which the sun's declination is approximately the same. In any given latitude the duration of sunlight upon each day in any pair is equal, that is to say the amount of daylight is the same.

Sun's Declination	Days of Equal Sunlight	
20° N.	May 21	July 24
15° ,,	May 1	Aug. 13
10° ,,	April 16	Aug. 28
5° ,,	April 3	Sept. 11
0° ,,	March 21	Sept. 23

The Bill proposes that the change of time shall be from the third Sunday in April to the third Sunday in September, but it is evident that whereas the latter date is about the autumnal equinox, the former is nearly a month after the spring equinox. The declination of the sun in the third week of April is about 12° N., and the corresponding declination after the summer solstice is about August 22. If, therefore, the duration of daylight is intended to determine the dates of change of time, these dates should be the third week in March and the third week in September, or the third week in April and the third week in August.

PRODUCER GAS FOR ENGINES.[1]

II.—TESTS AND EFFICIENCIES.

MR. DUGALD CLERK had careful tests made with a 30-B.H.P. plant and a 40-B.H.P. plant of the type shown in Fig. 2 of the article published last week, and found that the heat efficiency of the former gas was 83 per cent. and that of the latter as high as 90 per cent., both with hot starts.[2] In Table A, I give the results obtained with the last-named suction plant, and for comparison the results with a steam-jet pressure plant of the same power, and the average of results with seven other pressure plants of different sizes :—

TABLE A.

Comparison of Suction and Pressure Plants.

	Suction plant 40 B.H.P. (hot start)	Pressure plant 40 B.H.P. (hot start)	Pressure plants. Average of 7 plants (hot start)
Fuel used	Anthracite	Anthracite	Anthracite
Composition of gas (per cent. by volume)—			
Hydrogen	15·64	19·8	17·36
Methane	1·16	1·3	1·20
Carbon monoxide	20·13	23·8	25·55
Carbon dioxide	6·09	6·3	5·77
Oxygen	0·74	—	0·30
Nitrogen	56·24	48·8	49·82
Total combustible gases (per cent. by volume)	36·93	44 9	44·11
Calorific power (higher scale)—			
Calories per cubic metre	1204	1463	1432
B.Th.U. per cubic foot	135·3	164·4	161·0
Air required for combustion of unit volume	0·927	1·162	1·122
Yield of gas—			
Cubic metres per kilo. of fuel ...	5 80	5·04	5·01
Cubic feet per ton of fuel	208,000	181,000	180,000
Approximate power given by an engine which will give 100 H.P. with gas of Column 3	93	100	100

The practical outcome of many tests made with engines worked with suction plants is that with a full load, or nearly full load, the consumption when running is a little under 1 lb. of anthracite, or about $1\frac{1}{8}$ lb. of gas-coke per B.H.P.-hour. This is exclusive of the fuel burnt when starting and during the stand-by hours. The consumption of fuel and water in the small plants (about 20 B.H.P.), tested at Derby in 1906 on behalf of the Royal Agricultural Society was as follows :—

Anthracite
- Full load ... 1·1 lb. per B.H.B.-hour, including fuel for starting and banking during the night.
- Half load ... 1·6 lb. per B.H.P.-hour, including fuel for starting and banking during the night.
- Water ... 1 gallon per B.H.P.-hour at full load.
- $\frac{3}{4}$,, ,, half ,,

Coke
- Full load ... 1·3 lb. per B.H.P.-hour, including fuel for starting.
- Water ... 1·5 gallons per B.H.P.-hour at full load.

I had an interesting test made with a 250-B.H.P. engine and suction plant, working night and day for 123 hours without a stop. The engine worked a dynamo, and readings were taken every half-hour of the current generated. The general result was that the consumption of small anthracite, including all sources of waste, was only 1·23 lb. per kilowatt-hour. On the assumption that the efficiency of the dynamo was 90 per cent., this corresponds with 0·82 lb. per B.H.P.-hour.

Close attention is usually given to the consumption of fuel per H.P.-hour, sometimes to the thousandth of a pound, and it is not a little remarkable that a separate account is seldom taken of the consumption of fuel while the steam or gas plant is standing with a fire in it. The stand-by loss of a boiler is much greater than that of a gas producer, and the explanation is not far to seek; for a given H.P. the producer is much smaller, and has far less radiating surface than a boiler; it has no water in it to be heated, and it can be worked up to its maximum production in about fifteen minutes, after standing almost any length of time. With a boiler, except in the vertical or portable type, there is a large amount of external brick-

[1] Continued from p. 203.

[2] For full details of these trials see "Producer Gas," 2nd edition (Longmans).

work to be heated, and there is a considerable quantity of water, even in the tubular type. When the boiler is standing the water and the brickwork lose heat, and not only more time, but more fuel, is required to make up this loss than in the case of a gas producer. Doubtless the heat efficiency of a good boiler is high when it is working to nearly its full capacity, but the reverse is the case when it is standing. Table B gives some comparative results :—

TABLE B.

Consumption of Fuel in Stand-by Hours.

Steam power			Gas power	
Type of boiler	Max. H.P. of boiler	Coal consumed per standing hour	Max. H.P. of producer	Coal consumed per standing hour
		lbs.		lbs.
Various	100	14·0	250	5·1
Lancashire	450	37·5 [1]	250	3·9
Babcock and Wilcox.	210	67·0	100	2·1
,, ,,	210	67·0	250	4·5
,, ,,	500	180 0	225	3·8
,, ,,	500	112·0	375	1·8
Niclaussé	400	50 0		
Lancashire	400	44·7		
	Average ...	71·5	Average ...	3·5

On this basis, if a 200-B.H.P. steam plant works eight hours and is standing sixteen hours, and if it consumes 2·5 lb. per B.H.P.-hour, the stand-by loss will be more than 20 per cent. of the total fuel consumed in twenty-four hours. Under like conditions, if a gas plant of the same power consumes 1 lb. per B.H.P.-hour, the stand-by loss will be under 4 per cent. With a 500-B.H.P. plant the stand-by loss with steam will be about 15 per cent., and with gas under 2 per cent. If we take the percentage of the stand-by loss on the fuel consumed during the working hours, we have the following results :—

	200 B.H.P.	500 B.H.P.
Steam power	26·8 per cent.	17·9 per cent.
Gas power	3·8 ,,	2·0 ,,

The accompanying Figs. 3, 4, 5, and 6 show at a glance the relative heat efficiencies of a steam boiler and steam engine, and of a gas plant and gas engine of the same power; Figs. 3 and 4 are each for 250 B.H.P., and Figs. 5 and 6 are for 40 B.H.P. The blank space at the top of each column represents the number of heat units (100 calories or B.Th.U.) in the fuel consumed to produce the same amount of useful work. For the 250-B.H.P. steam plant I have taken 80 per cent. as the heat efficiency of the boiler, and for the 40 B.H.P. 75 per cent.; for the condensation in pipes, driving feed-pumps and other usual losses, I have taken 10 per cent. of the total heat for the larger plant and 5 per cent. for the smaller one. For the larger steam engine I have assumed a heat efficiency of 15 per cent., and for the smaller one 10 per cent. For the 250-B.H.P. gas power I have assumed that the gas plant is of the steam-jet pressure type, and that, including its small boiler, the heat efficiency is 80 per cent. For the 40-B.H.P. gas power I have assumed that the gas plant is of the suction type, and that its heat efficiency is 85 per cent. With gas plants there are no losses from condensation or other causes beyond those allowed for in the above percentages. For the gas engines I have assumed a heat efficiency of 28 per cent., and in all the diagrams I have taken the friction of the engine as 15 per cent. The figures given for the fuel consumed correspond approximately with the following consumptions of fuel of average quality :—

900 grams	(2 lb.)	per B.H.P.-hour	for	250	B.H.P.	steam power
450 ,,	(1 lb.)	,,	,,	,,	,,	gas power (pressure plant)
1350 ,,	(3 lb.)	,,	,,	40	,,	steam power
400 ,,	(0·9 lb.)	,,	,,	,,	,,	gas power (suction plant).

In Fig. 3, 1120 heat units are absorbed in the boiler, and of these 224 are taken as lost in ashes, radiation, flue

[1] Exclusive of raising the steam pressure from 90 lb. to 120 lb.

gases, &c.; the steam generated represents 896 units, and of these 112 are lost by condensation, &c. The steam supplied to the engine represents 784 units, and of these 667 are lost in the exhaust, so that only 117 are converted into indicated work, and from this 17 are deducted for friction. In Fig. 4 525 heat units are absorbed in the producer, and of these 105 are taken as lost in ashes, radiation, cooling of gas, &c. The gas supplied to the engine represents 420 units, and, as in Fig. 3, 117 units are converted into indicated work, and of these 17 are deducted for friction. In Fig. 5 1680 heat units are absorbed in the boiler, and of these 420 are lost in ashes, radiation, &c.; the steam generated represents 1260 units, and of these 84 are lost by condensation, &c. The steam supplied to the engine represents 1176 units, and of these no less than 1059 are lost in the exhaust. In Fig. 6 494 heat units are absorbed in the producer, and of these 74 are taken as lost in ashes, radiation, cooling of gas, &c. The gas supplied to the engine represents 420 units, and the remaining losses are similar to those in Fig. 4.

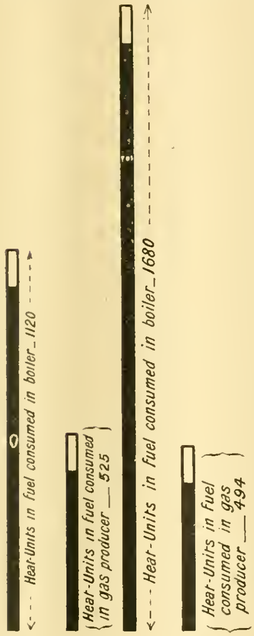


Fig 3. Fig 4. Fig 5. Fig 6.

FIG. 3.—250 B.H.B. steam.
FIG. 4—250 B.H.P. gas.
FIG. 5.—40 B.H.P. steam.
FIG. 6.—40 B H P. gas.

On these bases the general result is that for the 250-B.H.P. size, in order to obtain 100 heat units in useful work with steam power there must be 1120 heat units in the fuel consumed in the boiler; whereas with gas power there need only be 525 units in the fuel consumed. This shows a saving of 53 per cent. in the weight of fuel in favour of the gas plant. The result is still more striking in the case of the 40-B.H.P. size, as there must be 1680 units in the fuel consumed for steam power compared with 494 for gas power. This is a saving of 70 per cent. in favour of the gas plant. These figures do not include any allowance for stand-by losses, which would be considerably less for gas than for steam power.

After considering the two types of plant, I think our general conclusions may be as follows:—A suction plant has certain practical advantages—it costs less and occupies a smaller ground-space; but the gas made in it is not so strong as in the older form of pressure plant, and in the case of large engines this advantage may be important, as it affects the maximum power of the engine. The fuel consumption per H.P.-hour and the labour required are about the same in both types of plant, provided the steam required is raised without an independent boiler. The consumption of water is the same in both types. Where there are several engines to serve, a pressure plant is better, as all can be served with one main from the gasholder, with a branch to each engine. This simplifies the piping and reduces its cost considerably; it also facilitates the starting of the engines. It seems to me that each plant has its own province, and that in some cases the pressure type is better than the suction type; in others suction is better than pressure.

Looking at the matter broadly, one cannot but be struck with the enormous development in gas power which has taken place during the last ten, and especially during the last five, years. Small steam engines are being rapidly superseded, and in several cases the makers of steam engines are now making gas engines. At first only small gas engines were supposed to be within the range of practical politics, but those days are over, and there are many gas engines developing more than 1000 H.P. each which are working satisfactorily. Gas power has come to stay, and now has a recognised position among engineers.

J. EMERSON DOWSON.

TRANSATLANTIC WIRELESS TELEGRAPHY.[1]

ON previous occasions I have had the honour of describing before this institution some of the stages through which the application of electric waves to telegraphy through space has passed. This evening I propose to confine myself chiefly to describing the results and observations recorded during the numerous tests and experiments which my collaborators and I have been carrying out with the object of proving that wireless telegraphy across the Atlantic was possible, not merely as an experimental feat, but as a new and practical means for commercial communication (Journ. Inst. Elec. Eng., xxviii., 1899, p. 291).

In March, 1899, communication was established by means of my system of wireless telegraphy across the Channel between England and France (see Fig. 1), and the *Times*

of March 29 of that year published the first Press telegram ever transmitted to England from abroad by means of electric-wave telegraphy.

At that time a considerable discussion took place in the Press as to whether or not wireless telegraphy would be practicable for much longer distances than those then covered, and a general opinion prevailed that the curvature of the earth would be an insurmountable obstacle to long-distance transmissions, in the same way as it was, and is, an obstacle to signalling over considerable distances by means of optical signals such as flashlights, the heliograph, or the semaphore.

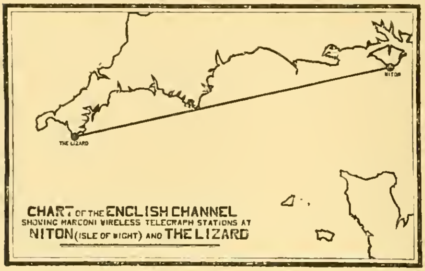
Other difficulties were anticipated as to the possibility of being able practically to employ and control a transmitter capable of radiating an amount of electrical energy large enough to actuate a receiver at really great distances, and,

1 From a discourse delivered at the Royal Institution on Friday, March 13, 1908, by Commendatore G. Marconi.

granting the possibility of this, whether such a powerful radiator would not interfere with the working of all other wireless stations which might be established on shore or ships within the sphere of influence of the long-distance sender.

What so often occurs in most pioneer work has repeated itself in the case of long-distance wireless telegraphy—the anticipated obstacles and difficulties were either imaginary or else easily surmountable; but in their place unexpected barriers manifested themselves, and my efforts and those of

FIG. 2



my collaborators have been mainly directed to the solution of problems presented by difficulties which were not anticipated when the tests over long distances were first initiated.

In January, 1901, wireless communication was established between St. Catherine's Point in the Isle of Wight and Lizard in Cornwall, over a distance of 186 miles. The height of these stations above the sea-level did not exceed 300 feet (100 metres), whereas to clear the curvature of the earth a height of more than a mile at each end would have been necessary.

The result of these tests went far to convince me that electric waves produced in the manner I had adopted were able to make their way round the curvature of the earth, and that therefore it was not likely that this factor would constitute a barrier to the transmission of waves over greater distances. At this time I had achieved a considerable measure of success, by means of syntonic or tuning devices, in preventing mutual interference between stations, and Prof. Fleming described, in a letter to the *Times*, dated October 4, 1900, the results obtained, and which he and others had witnessed (Journ. Soc. Arts, xlix., No. 2530, 1901). The principle on which the transmitters and receivers at St. Catherine's Point and the Lizard were worked is shown in Figs. 3 and 4.

FIG. 3

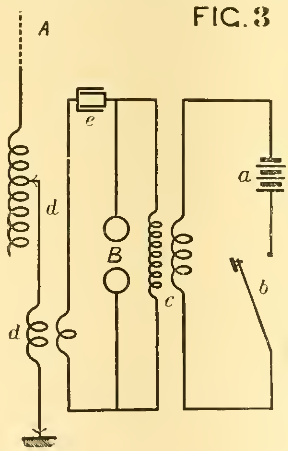
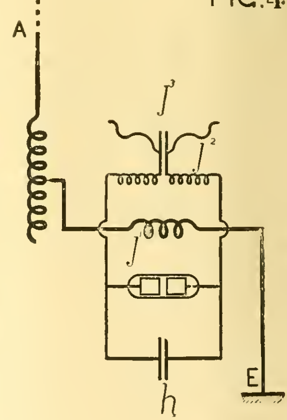


FIG. 4



At the transmitting end a condenser, usually taking the form of a battery of Leyden jars, had one terminal connected to one spark-ball of an induction coil or transformer and the other to the primary circuit of an oscillation transformer. The opposite terminal of this transformer circuit was joined to the second spark-ball. The condenser was charged to the potential necessary to produce a suitable spark by means of an induction coil. The secondary circuit of the oscillation transformer was inserted between the vertical conductor, or aërial wire, and earth, and an adjustable inductance coil included in the circuit.

The circuits, consisting of the oscillating circuit and radiating circuit, were more or less closely "coupled" by varying the distance between the primary and secondary of the oscillation transformer. By the adjustment of the inductance inserted between the elevated conductor and earth, and by the variation of the capacity of the primary circuit of the oscillation transformer, the two circuits of the transmitter could be brought into resonance, a condition which I first found was absolutely necessary in order to obtain efficient radiation.

The receiver consisted also of a vertical conductor or aërial connected to earth through the primary of an oscillation transformer, the secondary of which included a condenser and a coherer, or other suitable detector, it being necessary that the circuit containing the aërial and the circuit containing the detector should be in resonance with each other, and also in tune with the periodicity of the oscillations transmitted from the sending station.

The energy employed to signal over a distance of 186 miles could be brought as low as 150 watts, and even less if a higher or larger aërial had been used.

The facility with which distances of more than 100 miles could be covered prior to 1900, and the success of the methods for preventing mutual interferences (Journ. Soc. Arts, xlix., No. 2530, 1901), led me to advise that two large power stations be constructed, one in Cornwall and the other in North America, in order to test whether it was possible to transmit messages across the Atlantic Ocean.

I have often been asked why I did not first endeavour to establish commercial communication between places situated at a shorter distance. The answer is very simple. The cables which connect England to the Continent, and between most Continental nations, are Government-owned, and these Governments would not, and will not, allow the establishment of any system, wireless or otherwise, which might in any way tamper with the revenue derived from these cables.

As regards Transatlantic communication, however, the conditions were different. There was no law either here, in Canada, or in the United States to impede the working of wireless telegraphy across the Atlantic.

A further potent reason, moreover, an economical reason, prompted me to attempt communication with America. Notwithstanding the cost of high-power stations, I am convinced that it is more profitable to transmit messages at 6*d*. a word to America than at, say, ½*d*. a word across the Channel, and that the economical advantage of wireless over cables and land-lines increases instead of diminishing with the distance.

A site suitable for a long-distance station was chosen at Poldhu, in Cornwall, and here in 1900 work was commenced in earnest—work in which I was ably assisted by

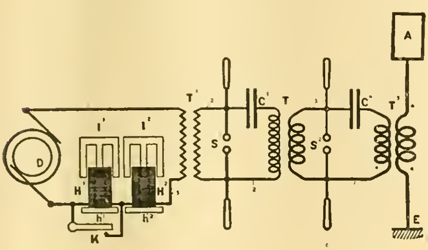
Prof. J. A. Fleming, of the University of London. The transmitter at Poldhu was similar in principle to the one I have already described, but it is obvious that the considerable distance over which it was proposed to transmit signals necessitated the employment of more powerful electromagnetic waves than those ever previously used. These were obtained by means of a generating plant consisting of an alternator capable of an output of about 25 kilowatts, which, through suitable transformers, charged a condenser having a glass dielectric of great strength.

Time does not permit me to describe in detail all the engineering difficulties which were encountered in controlling electrical oscillations of a power which at that time was certainly unprecedented, and as the tests were made possible by commercial organisation, the objects of which do not consist solely in the advancement of science, you will understand that a detailed description of the plant used at the Transatlantic stations cannot, for the present at least, be made public.

My early tests on wireless transmission by means of the elevated capacity method had convinced me that when endeavouring to extend the distance of communication it was of little utility merely to increase the power of the electrical energy applied to the transmitting circuits, but that it was also necessary to increase the area or height of the transmitting and receiving elevated conductors.

As it was economically impracticable to use vertical wires of very great height, the only alternative was to increase their size or capacity, which, in view of the facts I had first noticed in 1895, seemed likely to make possible

FIG. 5



the efficient utilisation of large amounts of electrical energy (Journ. Inst. Elec. Eng., xxviii., 1899, pp. 278–9).

The form of aërial which I first proposed to employ consisted of a conical arrangement of wires insulated at the top and gathered together at a lower point in the form of a funnel. This aërial was supported by a ring of twenty masts each 200 feet high, arranged in a circle 200 feet in diameter.

During the first tests an arrangement of circuits (Fig. 5) proposed by Dr. Fleming, and consisting of a modification of the system shown in Fig. 3, was employed. In this arrangement, in place of one high-frequency oscillation circuit, two are employed, and the constants of the two circuits are so arranged that very high-tension discharges can be obtained from one of the condensers—the one which is inductively connected with the aërial—without danger of damage to the circuits of the generator ("The Principles of Electric Wave Telegraphy," 1906, p. 506).

Simultaneously with the construction of the station at Poldhu, the erection of another one on substantially the same plan was undertaken at Cape Cod, in the United States of America.

The completion of the arrangements was delayed owing to a storm, which wrecked the masts and aërial at Poldhu on September 18, 1901, but by the end of November the aërial was sufficiently restored to enable me to complete the preliminary tests which I considered necessary prior to making the first experiment across the Atlantic.

Another accident to the masts at Cape Cod seemed likely to postpone the tests for several months more. I therefore decided that in the meantime I would use a purely temporary receiving installation in Newfoundland for the purpose of testing how far the arrangements in Cornwall had been conducted on right lines.

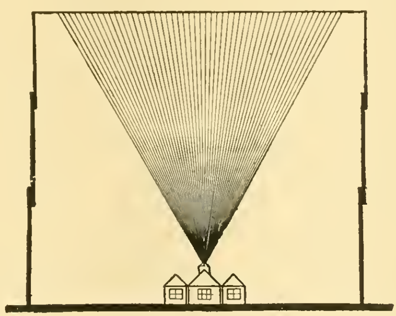
The transmitting elevated conductor employed at Poldhu during the experiments with Newfoundland consisted of fifty almost vertical copper wires supported at the top by a horizontal wire stretched between two masts 48 metres high and 60 metres apart. These wires converged together at the lower end in the shape of a large fan, and were connected to the transmitting instruments situated in a building (Fig. 6).

The transmitting condenser used with this aërial had a capacity of one-fiftieth of a microfarad, and was charged to a potential sufficient to produce a suitable spark discharge between spheres 3 inches in diameter, 1½ inches apart, the wave-length being 1200 feet. The actual power employed for the production of the waves was about 15 kilowatts.

I left for Newfoundland on November 27, 1901, with two assistants. As it was impossible at that time of the year to set up a permanent installation with poles, I decided to carry out the experiments by means of receivers connected to elevated wires supported by balloons or kites—a system which I had previously used when conducting tests across the Bristol Channel for the Post Office in 1897.[1]

It will be understood, however, that when it came to flying a kite on the coast of Newfoundland in the month of December this method was neither an easy nor a com-

FIG. 6



fortable one. When the kites were got up much difficulty was caused by the variations of the wind producing constant changes in the angle and altitude of the wire, thereby causing corresponding variations in its electrical capacity and period of electrical resonance. My assistants at Poldhu, in Cornwall, had received instructions to send on and after December 11, during certain hours every day, a succession of S's followed by a short message, the whole to be transmitted, at a certain pre-arranged speed, every ten minutes, alternating with five minutes' rest.

Owing to the constant variations in the capacity of the aërial wire in Newfoundland, it was soon discovered that an ordinary syntonic receiver was not suitable, although, at one time, a number of doubtful signals were recorded. I therefore tried various microphonic self-restoring coherers placed either directly in the aërial or included in the secondary circuit of an oscillation transformer, the signals being read on a telephone.

On December 12 the signals transmitted from Cornwall were clearly received, at the pre-arranged times, in many cases a succession of S's being heard distinctly, although probably in consequence of the weakness of the signals and the constant variations in the height of the receiving aërial no actual message could be deciphered. The following day we were able to confirm the result. The signals were actually read by myself and by my assistant, Mr. G. S. Kemp.

[1] "Signalling through Space without Wires," lecture by Sir William Preece, Royal Institution, June 4, 1897. Proc. R.I., xv., p. 467.

I have often been asked why I adhered to the practice of transmitting series of the letter S for these tests. The reason is that the switching arrangements at the sending station at Poldhu were not constructed at that time in such a manner as to withstand long periods of operation—especially if letters containing dashes were sent—without considerable wear and tear, and that if S's were sent an automatic sender could be employed. Moreover, the immediate object of these experiments was not to transmit actual messages across the ocean, but to ascertain the possibility of detecting the effects of electric waves at a distance of 2000 miles.

The result obtained, although achieved with imperfect apparatus, was sufficient to convince me and my co-workers that by means of permanent stations (that is, stations not dependent on kites or balloons for sustaining the elevated conductor) and by the employment of more power in the transmitters it would be possible to send messages across the Atlantic Ocean with the same facility with which they were being sent over much shorter distances.

About two months later, in February, 1902, further tests were carried out between Poldhu and a receiving station on board the American liner *Philadelphia*, *en route* from Southampton to New York. The sending apparatus at Poldhu was the same as that used for the Newfoundland experiments. The receiving aërial on the ship was fixed to the mainmast, the top of which was 60 metres above sea-level. As the elevated conductor was fixed, and not floating about with a kite, as in the case of the Newfoundland experiments, good results were obtained on a syntonic

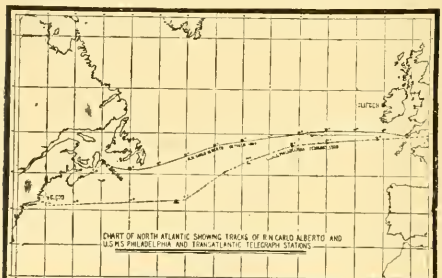


Fig. 7.

receiver, and the signals were all recorded on tape by the ordinary Morse recorder. On the *Philadelphia* readable messages were received from Poldhu up to a distance of 1551 miles, S's and other test letters as far as 2099 miles.

Although I never had the slightest doubt in my mind as to the genuineness of what was accomplished between Poldhu and Newfoundland, the results obtained on the *Philadelphia* amply prove that the station at Poldhu was capable at that time of transmitting signals to a distance of at least 2000 miles, which is the distance separating Cornwall from Newfoundland, and that if it was practicable to send a message over 2000 miles of sea from shore to ship, it should also be practicable to send it over the same space of ocean from shore to shore.

A result of some scientific interest which I first noticed during the tests on the s.s. *Philadelphia* was the very marked effect of sunlight on the propagation of electric waves over great distances.[1]

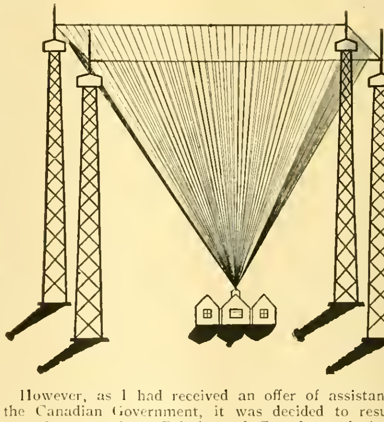
At the time of these tests I was of opinion that this effect might have been due to the loss of energy at the transmitter by daytime, caused by the dis-electrification of the highly charged transmitting elevated conductor operated by the influence of sunlight. I am now inclined to believe that the absorption of electric waves during daytime is due to the ionisation of the gaseous molecules of the air effected by ultra-violet light, and as the ultra-violet rays which emanate from the sun are largely absorbed in the upper atmosphere of the earth, it is probable that the portion of the earth's atmosphere which is facing the sun will contain more ions or electrons than that portion which is in darkness, and therefore, as Prof. J. J. Thomson (*Phil. Mag.*, August, 1902, Ser. 6, iv., p. 253) has shown, this illuminated and ionised air will absorb some of the energy of the electric waves.

The fact remains that clear sunlight and blue skies, though transparent to light, act as a kind of fog to powerful Hertzian waves. Hence the weather conditions prevailing in this country are usually suitable for long-distance wireless telegraphy.

Apparently the amplitude of the electrical oscillations and the lengths of waves radiated have much to do with the interesting phenomena, small amplitudes and long waves being subject to the effect of daylight to a less degree than large amplitudes and short waves. I never considered that this daylight effect would be an insuperable obstacle to Transatlantic telegraphy, as sufficient sending energy could be used during daytime to make up for the loss of range of the transmissions.

Turning again to Newfoundland, I ought to add that the experiments could not there be continued or extended in consequence of the hostile attitude of the Anglo-American Telegraph Company, which claimed all rights for telegraphy, whether wireless or otherwise, in Newfoundland.

FIG. 8



However, as I had received an offer of assistance from the Canadian Government, it was decided to resume the tests between Great Britain and Canada, and these tests were very greatly facilitated by the subsidy of 16,000*l.* granted by the Canadian Government to support my experiments. The construction of another long-distance station was, therefore, commenced at Glace Bay, in Nova Scotia, and very extensive tests and experiments were carried on with Poldhu during the latter part of 1902.

Contemporaneously with the construction of the station at Glace Bay, alterations and modifications were executed at Poldhu. Four wooden lattice towers, each 210 feet high, were erected at the corners of a square of 200-feet side. The towers carried insulated triatic stays, from which was suspended a conical arrangement of four hundred copper wires forming the aërial, put up in sections, so that more or less could be employed (Fig. 8). The buildings for the generating plant were placed in the middle of the space between the towers. Additional machinery was obtained, and alterations carried out in accordance with the experience obtained from previous tests.

Identical towers and aërial arrangements were at that time adopted at the stations at Glace Bay, and at the similar installation in course of erection at Cape Cod, Mass.

In most of the experiments carried on from Poldhu the capacity of the sending condenser was one-thirtieth of a microfarad, the spark-length $1\frac{3}{4}$ inches, and the wave-length 3600 feet. In these and subsequent tests the double con-

[1] Proc. Roy. Soc., lxx., p. 344, "A Note on the Effect of Daylight upon the Propagation of Electro-magnetic Impulses over Long Distances." Paper read June 12, 1902.

denser arrangement of Dr. Fleming was replaced by a single condenser, the arrangement being similar to that shown in Fig. 3.

During the time that constructional work was in progress at Glace Bay, I carried out some tests with Poldhu over considerable distances, and these tests were greatly facilitated by the interest taken in them by the Italian Government, which placed the cruiser *Carlo Alberto* at my disposal.

During these experiments the interesting fact was observed that, when using waves of more than 1000 metres in length, intervening land or mountains do not bring about any considerable reduction in the distance over which it is possible to communicate. Thus messages and Press despatches were received from Poldhu at the positions marked on the map (Fig. 9), which map is a copy of the one accompanying the official report of the experiments (*Revista Marittima*, Rome, October, 1902).

In December, 1902, messages were for the first time exchanged at night between the stations at Poldhu and Glace Bay, but it was found that communication was exceedingly difficult and untrustworthy from England to Canada, whilst it was good in the opposite direction. The reason for this is that the Glace Bay station was equipped with more powerful and more expensive machinery—a condition rendered possible by the subsidy granted by the Canadian Government; whilst as regards Poldhu, owing to

the uncertainty of what might or might not be the attitude of the British Government at that time towards the working of the station, my company was unwilling to expend large sums of money for the purpose of increasing its range of transmission.

As, however, messages could be sent then for the first time by wireless telegraphy from Canada to England, inaugural messages were dispatched to the Sovereigns of England and Italy, both of whom had previously given me much assistance and encouragement in my work, and who, by their gracious replies, attested their appreciation of the results which had been achieved. Other messages were also sent to England by the Government of Canada.

Further tests were shortly afterwards carried out with the long-distance station at Cape Cod, in the United States of America, and a message from President Roosevelt was transmitted from that station to His Majesty the King in London.

It is curious to note, in regard to the transmission of this message, that the energy employed at Cape Cod was barely 10 kilowatts, and it was not anticipated that this amount of energy would be sufficient to carry direct to Poldhu. The message was therefore transmitted from Cape Cod, instructions having been given to the operators at Glace Bay to be on the look-out, and to repeat wirelessly on to Poldhu any message received from Cape Cod, and my assistant, Mr. P. J. Woodward, at Poldhu, took in the message on one of my magnetic detectors.[1] The electromagnetic waves conveying this message travelled, therefore, 3000 miles through space over the Atlantic, which distance included about 500 miles of land, following an arc of 45 degrees on a great circle.

(*To be continued.*)

[1] Proc. Roy. Soc., lxx., p. 341, "Note on a Magnetic Detector of Electric Waves which can be employed as a Receiver for Space Telegraphy."

THE PHYSICS OF GOLF.

IN two articles recently published in the *Times* (March 16 and 23) Sir Ralph Payne-Gallwey has extended in an interesting way the earlier results in the physics of golf which the late Prof. Tait communicated to NATURE between the years 1887 and 1894. In Sir Ralph's experiments the golf balls were projected mechanically by means of a catapult, the ball being either thrown from a cup at the end of the rotating arm or hit off as it hung at the end of a gossamer thread by a blow from the arm. In either case the initial conditions of projection must differ from those which exist in the ordinary mode of propulsion, and it would have been interesting to have had some comparisons. As Tait conclusively showed, the great factor in long driving was the underspin communicated to the ball by the impact of the club in a line below the centre of gravity. Hence the value of the roughened ball, causing not only a better grip between the ball and the club, but also making more efficient the effect of the resistance of the air in producing the uplifting force. Sir Ralph Payne-Gallwey shows experimentally that the ball must not be too much roughened, and that, indeed, a distinctly less roughening than is usual is sufficient to ensure the maximum carry. It is obvious that with a very rough surface the resistance of the air will rapidly cut down the rotation, and thereby diminish the transverse force which lifts the ball against gravity.

Sir Ralph does well in directing attention to the necessity of a truly centred ball. The golfer can readily test the ball in this respect by floating it in water (Tait used to use mercury) and noting whether or not it comes quickly to the same position. If it comes quickly always to the same position it is badly centred, and must be rejected. As all bowlers know, the lack of true centring will give a bias which cannot but produce inaccurate putting. In the flight through the air the bad effects due to the centre of gravity being non-coincident with the centre of figure will probably come into evidence because of the shifting of the axis of rotation. Such a badly centred ball, when projected from the tee, will in general be sent off rotating about an axis which, though initially horizontal, is not a principal axis of inertia. Of necessity precessional motion will result, and the axis of spin will move away from its horizontal position. The phenomena which lead to the evils of slicing and pulling will at once declare themselves. Moreover, if the precessional motion be rapid enough, it is conceivable that the ball might swerve in one direction during one part of its course, but in the other direction during another part of the same trajectory. A sinuous flight is, indeed, occasionally observed, but is generally attributed to the direct action of the wind. Sir Ralph Payne-Gallwey does not himself touch upon the ultimate dynamics of the problem, but confines himself entirely to the direct teaching of experiment. His conclusions are of great practical value to all devotees of the game, and it would be well if the manufacturers of golf-balls would test every ball they put on the market by the simple methods described by him.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Bristol Town Council has decided to contribute in the proportion of one penny in the pound on the rate, or about 7000*l*. per annum, towards the support of the proposed university for Bristol and the West of England, for which more than 200,000*l*. has been subscribed, mainly by members of the Wills family.

THE estimate of the amount required in the year ending March 31, 1910, for grants in aid of the expenses of certain universities and colleges in Great Britain is 217,400*l*. The following are the sub-heads under which this vote will be accounted for by the Treasury. Grants in aid, universities and colleges:—(A) University of London, 8000*l*.; (B) Victoria University of Manchester, 2000*l*.; (C) University of Birmingham, 2000*l*.; (D) University of Wales, 4000*l*.; (E) University of Liverpool, 2000*l*.; (F) Leeds University, 2000*l*.; (G) Sheffield University, 2000*l.*; (H) Scottish universities, 42,000*l.*; (I) colleges, Great Britain, 100,000*l.*; (J) university colleges, Wales, 12,000*l.*; (K) Welsh university and colleges, additional grant, 15,000*l.*; increase, 15,000*l.* University College of North Wales (building fund), decrease, 20,000*l.* Provision is made as follows in other estimates for expenditure in connection with the University of London:—buildings, external maintenance and repairs, 3358*l.*; rates, 4500*l.*; non-effective, 1317*l.*; total, 9175*l.*

THE *Times* announces that "the German Aërial Navy League is organising a school for aëronauts which, it is said, will be opened at Friedrichshafen on October 1 of this year. The object of the school is to provide the necessary scientific and practical training for the crews of military and other airships. Only those who have been through an 'intermediate' school and, in addition, have worked for a year in engineering shops, will be admitted as pupils. The course will extend over three years, of which the first will be devoted to theoretical instruction, the second to work in a construction yard, and the third to ascents in airships and flying machines." This announcement will be read with the more interest as a somewhat similar project forms a part of the programme of the recently formed Aërial League of Great Britain, the inaugural meeting of which at the Mansion House was so highly successful. It is much to be hoped that the promoters of the English scheme will succeed in maintaining the same high standard of admission, and the same length of training, that are contemplated in the above notice. It would be highly undesirable that an institution founded for the training of aëronauts should have to waste its resources by providing classes in elementary calculus and mechanics such as can be found at any technical college.

THE National Union of Teachers held its annual conference of delegates at Morecambe from April 10 to 15, and the meeting was thoroughly successful and the discussions full of interest, notwithstanding the rather unusual circumstance that there was no new Education Bill to be considered. The president, Mr. C. W. Hole, delivered the inaugural address, in the course of which he stated that the elementary schools have made great progress during recent years. The ancient system of payment by results has passed away, leaving all concerned happier and better for its disappearance; the liberty and confidence reposed in the teachers have resulted in the children being, not only rationally instructed, but also more properly educated. It remains for the Government to provide financial assistance in order that the size of the classes may be reduced and the staff rendered efficient in number and quality. In this connection Mr. Hole warmly approved Mr. Runciman's recent staffing circular. Resolutions were carried unanimously (1) in favour of larger grants from the National Exchequer; (2) regretting attempts made by certain local authorities to repudiate settled contracts of teachers in their service. At the sectional meetings papers were read by Mr. C. H. Wyatt and Mr. Ernest Gray on the supply and training of teachers, by Mr. A. R. Pickles on leaving examinations and scholarship competitions, and by Mr. Charles Bird on the teaching of handwork. Mr. Pickles quoted with approval the report of the British Science Guild on the relations of primary and secondary education, particularly the recommendation that the reports of teachers should supersede largely the present system of estimating ability by examinations.

THE Colonial Conference in 1907 pronounced in favour of reciprocity between the Governments and examining bodies throughout the Empire. The council of the Surveyors' Institution has taken an important step forward by submitting a memorandum to the Colonial Secretary, which Lord Crewe has approved and dispatched to the officers administering the Governments of Canada, Newfoundland, Australia, New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, New Zealand, Cape of Good Hope, Natal, Transvaal, and Orange River Colony. The memorandum states that under existing conditions a surveyor has to pass examinations and comply with requirements, varying in different parts of the Empire, before he is allowed to practise. It is hoped, as a result of the present movement, to arrive at a uniform standard of qualification. A surveyor would then, having taken his diploma in England or one of the colonies, be eligible to practise in any part of the Empire, subject to an examination in the local land laws and conditions. In the event of an Imperial conference of surveyors being held, it will take place at the Surveyors' Institution, and the chief points, so far as they have been formulated, for discussion would probably be the desirability of establishing reciprocity throughout the Empire:—(*a*) that a candidate must have matriculated at some recognised university, or passed an equivalent examination; (*b*) that an examination in the theory of land surveying be then taken, the standard of this examination to be as high as that now in force in South Africa; (*c*) that the candidate be then required to pass an examination in practical surveying, and that he be ineligible to sit for this final examination until he has had at least two years' experience with a practising surveyor.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 10, 1908.—"The Specific Heat of Air and Carbon Dioxide at Atmospheric Pressure, by the Continuous Electrical Method, at 20° C. and at 100° C." By W. F. G. **Swann**. Communicated by Prof. H. L. Callendar, F.R.S.

The continuous electrical method possesses two main advantages over the method of mixtures; it enables the specific heats to be measured over small ranges of temperature, and further, the elimination of the heat loss does not depend upon the results of a set of experiments in which the conditions are different to those which hold in the main experiments. The mean of a large number of measurements of the specific heats, agreeing to about 1 part in 1000, gave the following results:—

Air	Carbon dioxide.
0·24173 cal. per gram degree at 20° C.	0·20202 cal. per gram degree at 20° C.
0·24301 ,, ,, 100° C.	0·22141 ,, ,, 100° C.

An accurate comparison with the values deduced on theoretical considerations from Joly's measurements at constant volume can be made in the case of air, and the agreement is shown to be nearer than to 1 part in 1000. The comparison can only be made in a rough manner for carbon dioxide, and the agreement is to 1 per cent.

The results obtained are about 2 per cent. higher than those obtained by former investigators. The experiments of Regnault are discussed as a typical example, and it is pointed out that an uncertainty amounting to 5 per cent. (tending to make the results too low) probably exists in those experiments, owing to the fact that the heat loss was determined by a set of observations in which the conditions were different to those which held in the main experiments.

March 25.—Sir Archibald Geikie, K.C.B., president, in the chair.—Liberation of helium from radio-active minerals by grinding: J. A. **Gray.** (1) Helium is liberated from thorianite, and a liberation of 28 per cent. has been effected; (2) the smaller the mineral is ground the more helium is liberated; (3) this liberation has a temporary limit when the mineral is reduced to a size of about 3μ; (4) it is impossible to say how the remaining 72 per cent. of helium is contained in the mineral, and to how much finer than 1 μ the mineral would have to be reduced to liberate the helium.—The expulsion of radio-active matter in the radium transformations: Sidney **Russ** and W. **Makower.** When the radium emanation is transformed into radium A, the process is accompanied by the emission of α particles with a velocity of $1{\cdot}70\times10^9$ centimetres per second. The portion of the atom from which the α particle has been emitted, which constitutes the radium A, must therefore recoil in a direction opposite to that in which the α particle is projected. If we further consider that the mass of the α particle is $4(H=1)$, and that of the active deposit of the order 100, it follows that at the moment of its formation this product must be travelling with a velocity of the order 10^7 centimetres per second. In ordinary circumstances, when the emanation is mixed with air at atmospheric pressure, the radium A particle will possess only sufficient energy to permit it to travel a fraction of a millimetre before being stopped by collision with air molecules. On the other hand, at very low pressures, these particles should travel considerable distances without being stopped by the rarefied air, and come to rest on the enclosure containing the emanation. The case is similar for the formation of radium B from radium A. To investigate these phenomena, discs were suspended, *in vacuo*, above surfaces rendered active by the various disintegration products of radium, and the activity obtained on the discs after exposure was measured in the normal manner by a quadrant electrometer. The principal results obtained in this paper may be summarised as follows:—(1) When radium emanation, in radio-active equilibrium with its products of disintegration, is condensed at the bottom of an evacuated tube immersed in liquid air, active deposit particles are radiated up the tube. This phenomenon is ascribed to the recoil of the residual atom when an α particle is emitted. (2) The law of absorption of this radiation, both in air and hydrogen, has been investigated. The radiation reaching a surface at a fixed distance from the condensed emanation is an exponential function of the gas pressure. (3) From the rate of decay of the activity collected on a surface exposed to the radiation from the emanation, it appears that both radium A and radium B reach the surface. (4) Radium B and radium C are both radiated through a vacuum from a surface previously rendered active by exposure to the emanation. Supposing that radium B emits only β particles, the radiation of radium C must be due to the recoil of the atoms when β particles are emitted.—*Sphaerostoma ovale*, n. gen., and *Crossotheca Grievii*, n. spec., an account of the structure and relations of the reproductive organs of *Heterangium Grievii*: Dr. Margaret **Benson.** *Sphaerostoma ovale* (*Conostoma ovale et intermedium*, Williamson) is the earliest Palæozoic ovule so far known structurally. It is a small ovule 3·5 mm. in length, and shows the same general type of organisation as the "Lagenostoma" series of ovules. The pollen-chamber, however, does not engage with the micropyle, but opens and closes with a very perfect mechanism, somewhat reminiscent of the peristome and epiphragm of Polytrichum. The paper also deals with the relation of this ovule to *Heterangium Grievii*, and with a new Crossotheca which is attributed to the same plant.

Physical Society, March 26.—Dr. C. Chree, F.R.S., president, in the chair.—The production of steady electrical oscillations in closed circuits, and a method of testing radio-telegraphic receivers: Dr. J. A. **Fleming** and G. B. **Dyke.** By the use of two such nearly closed oscillatory circuits, one being employed as a transmitting station and the other as a receiving station, these being placed at a distance of a few hundred yards from each other, what is practically equivalent to radio-telegraphic stations with open oscillators at very large distances can be constructed. Methods were described for producing in one of the closed circuits extremely constant damped oscillations by means of an induction coil or transformer, a spark-gap on which a steady jet of air is allowed to impinge, and a suitable mercury break. Means were described for ascertaining when the current in this transmitting circuit is constant. Instances were given of the ease with which detectors of various types, such as a magnetic detector, electrolytic detector, crystal detector, and ionised gas detector, could be compared for relative sensibility.—Effect of an air blast upon the spark discharge of a condenser charged by an induction coil or transformer: Dr. J. A. **Fleming** and H. W. **Richardson.** When an oscillatory discharge of a condenser takes place across the spark-gap in the usual manner by charging the condenser by an induction coil or transformer, the intermittent spark which takes place is a complex effect. It consists partly of a true condenser discharge and partly of an alternating-current arc due to current coming directly out of the induction coil or transformer. This arc discharge is a source of difficulty in making accurate quantitative measurements with electrical oscillations, and to produce a uniform oscillatory discharge this true arc discharge must be prevented or arrested. It was shown in the paper that this can be done by a regulated air blast produced in any convenient manner, thrown upon the spark-gap, provided that the spark-gap is small. The paper also described experiments made to investigate the effect of breaking up the spark-gap into smaller spark-gaps in series, both when the gaps were subjected to an air blast and also without the air blast.—The action between metals and acids and the conditions under which mercury causes evolution of hydrogen: Dr. S. W. J. **Smith.** The action between an acid and a metal, which results in the replacement of hydrogen, can be formulated without the aid of any hypothesis beyond the assumption that it is approximately reversible. The mode of formulation suggests a kinetic picture of the process by which equilibrium is in certain cases attained. This was described by the author, and it was pointed out that if a steady state is reached, after a certain quantity of hydrogen has been evolved, it will be defined by an equation of the form $ahM = bmH$. In this, a and b are constants at a given temperature, h and m are the concentrations of the hydrogen ions and of the metal ions respectively in solution, and H and M are specific constants of hydrogen and of the metal. The experiments described in the paper may be regarded as an attempt to justify the above equation when the metal is mercury.

Zoological Society, April 6.—Mr. F. Gillett, vice-president, in the chair.—Description of a new form of Ratel (Mellivora) from Sierra Leone, with notes upon the described African forms of this genus: R. I. **Pocock.**—An ichthyosporidian causing a fatal disease in sea-trout: Muriel **Robertson.**—A small series of fishes from Christmas Island, collected by Dr. C. W. Andrews: C. Tate **Regan.** Seven new species were described, comprising five blennies, a Pampeneus, and a Cirrhites. In connection with the last-named, it was pointed out that the Cirrhitidæ, as defined and limited by Dr. Günther, with the addition of Haplodactylus, form a very natural family.—Some new and little-known Hesperidæ from tropical West Africa: H. H. **Druce.** The paper contained remarks on, and descriptions of, some new forms of these butterflies lately obtained by Mr. G. L. Bates on the Ja River, Cameroons, and others from Nigeria. New species of the genera Abantis, Acleros, Gorgyra, Parnara, and Ceratrichia were described.

Paris.

Academy of Sciences, April 13.—M. Bouchard in the chair.—The diffraction of Hertzian waves: H. **Poincaré.**—A general solution of the spectroheliograph: H. **Deslandres.** The spectroheliograph described, which is installed at Meudon, consists of four different spectroheliographs arranged round one collimator and astronomical objective, and controlled by four synchronised electric motors. These spectrographs are arranged for different classes of work, some having two and others three slits. The apparatus has already given interesting results on the black filaments of the upper layers of the solar atmosphere, especially the images of K_3 and $H\alpha$.—The transformations of the associated O networks: C. **Guichard.**—The integration of certain functional inequalities: Arnaud **Denjoy.**—A problem of Fourier: Henri **Larosse.**—The action of a continuous current on symmetrical chains of electrolytes not having common ions: M. **Chanoz.** Study of the gases disengaged by the action of copper salts on steels: E. **Goutal.** Three steels were studied, containing respectively 0·29, 0·64, and 1·38 per cent. of carbon, the solution used for the attack being that of the double chloride of copper and potassium containing a few drops of hydrochloric acid to the litre. The carbon dioxide, carbon monoxide, and hydrocarbons evolved were determined separately. The loss of carbon thus determined amounted to 0·01 to 0·05 per cent., and this loss is reduced by about one-half if the carbon in the residue is estimated without drying.—The quantitative analysis of the occluded gases in the lava from the last eruptions of Mt. Pelée and Vesuvius: M. **Grossmann.** Estimations were made of the total quantity of gas per 100 grams, and figures given for the amounts of carbon dioxide, oxygen, nitrogen, hydrogen, carbon monoxide, and methane. The various products from Vesuvius show marked differences in the quantity and composition of the gases evolved.—

The distribution of ferments in plant members and tissues: C. **Gerber.**—The hypotensive function of choline in the organism: Jean **Gautrelet.** By means of the Florence reaction, choline has been recognised in various glands of the horse, sheep, pig, ox, and dog. The hypotensive action of the alcoholic extract is shown to be due to the choline present, since this action disappears if the choline is precipitated. The alcoholic extract of the glands exactly neutralises the hypertensive action of adrenalin.—The intra-dermo-reaction to tuberculin in the treatment of tuberculosis: Charles **Mantoux.** The intradermal reaction can be used to measure the sensibility of the subject, and to control the quantity of tuberculin necessary for injection. The local reactions serve as a guide for the conduct of the treatment, and render it much more certain.—The treatment of genito-urinary troubles by direct action on the nervous centres: Pierre **Bonnier.** Details are given of the beneficial effects of slight cauterisations of the nasal mucous membranes in various diseases, especially those connected with the genito-urinary functions.—Sero-anaphylaxis of the dog: Maurice **Arthus.** —Sero-anaphylaxis of the rabbit: Maurice **Arthus.** —Some new facts concerning the transgressivity and the tectonic observed in the mountains of Algeria and Tunis: J. **Roussel.**—The polar magnetic storms in 1882 and 1883: M. **Birkeland.**

DIARY OF SOCIETIES.

THURSDAY, April 22.

Royal Society, at 4.30.—Dynamic Osmotic Pressures: The Earl of Berkeley, F.R.S., and E. G. J. Hartley.—(1) The Theory of Ancestral Contributions in Heredity; (2) The Ancestral Gametic Correlations of a Mendelian Population Mating at Random: Prof. Karl Pearson, F.R.S.—The Intracranial Vascular System of Sphenodon: Prof. A. Dendy, F.R.S.—On the Graphical Determination of Fresnel's Integrals: J. H. Shaxby.

Mathematical Society, at 5.30.—The General Principles of the Theory of Integral Equations: F. Tavani.—The Equations of Electrodynamics and the Null Influence of the Earth's Motion on Optical and Electrical Phenomena: H. R. Hassé.—The Solution of a Certain Transcendental Equation: G. N. Watson.—The Physical Applications of Certain Conformal Transformations of a Space of Four Dimensions and the Representation of a Space Time Point by Means of a Sphere: H. Bateman.—Some Criteria for the Residues of Eighth and Other Powers: A. E. Western.—On the Discontinuities of a Function of One or More Real Variables: Dr. W. H. Young.

Institution of Mining and Metallurgy, at 8.—The Valuation of Mining Areas on the Rand: W. Fischer Wilkinson.—The "Wholesale" Idea in Gold Mining: W. R. Feldtmann.—The Computation of the Present Value of Developed and Undeveloped Mines: W. H. Goodchild.

Institution of Electrical Engineers, at 8.—The Electrical System of the London County Council Tramways: J. H. Rider.

FRIDAY, April 23.

Royal Institution, at 9.—Tantalum and its Industrial Applications: A. Siemens.

Physical Society, at 5.—On a Want of Symmetry shown by Secondary X-Rays: Prof. W. H. Bragg, F.R.S., and J. L. Glasson.—Transformations of X-Rays: C. A. Sadler.—Theory of the Alternate Current Generator: Prof. T. R. Lyle.

Institution of Civil Engineers, at 8.—The Development of Hydro-electric Power Schemes; with Special Reference to Works at Kinlochleven: J. M. S. Culbertson.

Institution of Mechanical Engineers, at 8.—Presidential Address: J. A. F. Aspinall.

SATURDAY, April 24.

Royal Institution, at 3.—The Earth Movements of the Italian Coast and their Effects: R. T. Günther.

MONDAY, April 26.

Royal Society of Arts, at 8.—Aërial Flight: F. W. Lanchester.

Institute of Actuaries, at 5.—Notes on Mortality and Life Assurance in India: A. T. Winter.

Institution of Civil Engineers, at 8.—Road Motors ("James Forrest" Lecture): Colonel H. C. L. Holden, F.R.S.

TUESDAY, April 27.

Royal Institution, at 3.—The Brain in Relation to Right-handedness and Speech: Prof. F. W. Mott, F.R.S.

Royal Statistical Society, at 5.

Zoological Society, at 8.30.

Faraday Society, at 8.—Experiments on the Current- and Energy-Efficiencies of the Finlay Alkali Chlorine Cell: Dr. F. G. Donnan, Dr. J. T. Barker, and B. P. Hill.—On the Coefficients of Absorption of Nitrogen and Oxygen in Distilled Water and Sea-water, and of Atmospheric Carbonic Acid in Sea-water: Dr. C. J. J. Fox.—On the Electromotive Force of Certain Platinum Compounds, with Special Reference to the Oxygen-Hydrogen Gas Cell: Dr. P. E. Spielmann.

Institution of Civil Engineers, at 8.—Annual General Meeting.

WEDNESDAY, April 28.

Geological Society, at 8.—The Boulders of the Cambridge Drift: their Distribution and Origin: R. H. Rastall and J. Romanes.—The Nephrite and Magnesian Rocks of the South Island of New Zealand: A. M. Finlayson.

Royal Society of Arts, at 8.—The Resources of the Peruvian Andes and the Amazon: C. R. Enoch.

British Astronomical Association, at 5.

THURSDAY, April 29.

Royal Society, at 4.30.—*Probable Papers*: A Phenomenon connected with the Discharge of Electricity from Pointed Conductors (with a Note by Prof. J. Zeleny): Prof. H. T. Barnes and A. N. Shaw.—On the Effect of Temperature on Ionization: J. A. Crowther.—The Wave-making Resistance of Ships; a Theoretical and Practical Analysis: T. H. Havelock.—The Ionisation in Various Gases by Secondary γ Rays: R. D. Kleeman.

Royal Society of Arts, at 4.30.—The Problem of Indian Labour Supply: S. H. Fremantle.

FRIDAY, April 30.

Royal Institution, at 9.—The Pitfalls of Biography: Dr. Edmund Gosse.

SATURDAY, May 1.

Royal Institution, at 3.—The Earth Movements of the Italian Coast and their Effects: R. T. Günther.

CONTENTS.

THURSDAY, APRIL 29, 1909.

CENTRAL-AMERICAN ORTHOPTERA.

Biologia Centrali-Americana. Insecta. Orthoptera, Vol. I., by Dr. Henri de Saussure, assisted by Dr. Leo Zehntner and A. Pictet. The Forficulidæ, by Count de Bormans (1893–1899). Vol. II., the Acridiidæ, by Prof. Lawrence Bruner [the Tettiginæ, by Albert P. Morse], and the Phasmidæ, by Robert Shelford (1900–1909). (London: Dulau and Co.)

THE Orthoptera have been sadly neglected by British entomologists, and the sound systems of classification of the component families, which we now possess, are due almost entirely to the researches of Continental naturalists. It is therefore not surprising, though perhaps a little galling to one's sense of patriotism, to find that the study of Central American Orthoptera in the Godman-Salvin collection was entrusted to French, Swiss, Austrian, and American entomologists. The result of their combined labours is a magnificent memoir on a most interesting order of insects from one of the most interesting regions of the world; it is, in fact, the only complete memoir on a tropical orthopterous fauna that has been published, and we venture to prophesy that this position will long remain unchallenged. The faunistic memoirs of Grandidier's "Histoire de Madagascar," which alone can compare with the "Biologia Centrali-Americana," appear to have come to a premature end; whilst naturalists like Dr. Godman and the late Mr. Salvin, with the energy, public spirit, and sufficient pecuniary resources to institute zoological surveys of other tropical lands, are unfortunately seldom found.

The first volume of the memoir under notice began to appear in 1893, and it was completed in 1899; it treats of the Forficulidæ, Blattidæ, Mantidæ, Gryllidæ, and Locustidæ. The Forficulidæ were worked out by de Bormans, and are referred to forty-one species, of which eight are new to science; the author merely enumerates the species with descriptions of the new forms, but adds nothing to what was previously known on the taxonomy of the group. De Saussure and Zehntner, on the other hand, in their work on the Blattidæ and Mantidæ, publish valuable keys to the genera and species, and, in order to make the keys as complete as possible, have included a number of extra-Central-American forms; consequently these treatises have been since their publication standard works of reference. The largest cockroach known, *Megaloblatta rufipes,* occurs in Central America, and is fully described and well illustrated in this memoir. The authors remark on its resemblance in details of structure to the genus Blabera of a totally different subfamily, and they appear to regard the resemblance as mimetic. This interpretation is obviously erroneous; mimicry implies the superficial resemblance of structurally different animals, but Megaloblatta is superficially very different from Blabera, especially in colouring, and the structural resemblances of the two forms must be due either to convergence in development or to genetic relationship; for our own part we are inclined to favour the latter view, and to believe that the systematic position of Megaloblatta has been wrongly determined.

Since Brunner von Wattenwyl once exclaimed enthusiastically that the system of classification of the Gryllidæ evolved by de Saussure was not the system of M. de Saussure, "mais bien celui du Créateur Lui-même," it is only fitting that to the Swiss naturalist should have been entrusted the study of the Central American species, and entomologists may be congratulated on now possessing a most illuminating monograph of a difficult but fascinating group of insects. De Saussure was a systematist who delighted in discovering the relation of structure to function, and his entomological writings are full of references to the bionomics of the insects he studied, and of ingenious suggestions as to the use of the structures that they present. When discussing, in the memoir now reviewed, the presence of four cerci in the genus Tridactylus, a character unique amongst the Orthoptera, he alludes to the amphibious habits of these little crickets, and suggests that the appendages serve to hold an air-bubble when the insects dive and swim under the surface of the water. The various modifications of elytral structure and venation to form stridulating organs in the Gryllidæ and Locustidæ are admirably explained and clearly figured; the fact is mentioned that many of the apterous Stenopelmatinæ are endowed with auditory organs on the front tibiæ, and that stridulation is produced, as in the Acridiidæ, by the friction of the hind femora, which are roughened on their inner aspect, against an apposed surface—in this case the sides of the abdomen.

The second volume, containing a monograph on the Acridiidæ by L. Bruner and A. Morse, and a list of Phasmidæ compiled by R. Shelford from the recent monograph on the family by Brunner von Wattenwyl and Redtenbacher, bears the dates 1900–1909. The considerable period of time elapsing between the commencement and the completion of this volume is partly to be accounted for by the difficulty of working out the large collections of the difficult family of Acridiidæ, and partly by the conditions imposed by the Austrian entomologists when they undertook the determination of the Godman-Salvin collection of Phasmidæ. They were unwilling to anticipate by preliminary memoirs their exhaustive monograph of the Phasmidæ of the world, and would only undertake to describe the new genera and species from Central America in the monograph itself; consequently it was impossible to publish anything on these insects in the "Biologia Centrali-Americana" until the monograph appeared in 1906–1908. The plates illustrating the Central American species were prepared some years ago, but since, in some cases, the views on nomenclature of Brunner von Wattenwyl and Redtenbacher were subsequently modified, the legends on the plates do not always correspond with the names of the species as published in their monograph; such discrepancies as exist have, however, been explained in the references to the plates. The memoir on the Acridiidæ is a valuable piece of work, and adds largely to our knowledge of them; some of the keys to the genera in the different subfamilies are, however, of most portentous length, occupying ten or twelve quarto

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pages; it would have been advisable to split up the subfamilies into sections, and so to subdivide the keys into more handy form. A word of special praise must be accorded to the general editing and indexing of these two volumes, a task that has been most efficiently and conscientiously carried out. R. S.

COAL MINING.

Practical Coal Mining. By Leading Experts in Mining and Engineering, under the Editorship of Prof. W. S. Boulton. Divisional Vol. VI. Pp. viii+177–449. (London: The Gresham Publishing Company, n.d.)

THIS volume forms the final instalment of the above-named book, and brings to a conclusion this somewhat heterogeneous collection of articles relating to coal mining. The fifth volume was noticed in Nature of October 1, 1908, and it concluded in the midst of an article by Mr. A. H. Cooke on mine surveying, the entire article consisting of five chapters; for reasons best known to themselves the publishers have here again given an example of their irritating practice of concluding a volume in the midst of a paragraph.

Mr. Cooke's contribution maintains throughout a high standard, and in the absence of any modern British text-book on the subject is more especially welcome. He quite rightly lays stress upon the importance of triangulation for the purpose of surveying the surface of mining royalties, and his description of the field work of triangulation is very good and complete; the only omissions that we have noted, and these are not very important, are those of the use of such modern alloys as "invar" for bands for base-line measurements, and some reference to the employment of satellite stations, when trigonometrical stations, otherwise highly suitable, are not accessible for setting up the theodolite. It would have been well to have devoted some space to the office work and calculations required, especially to the methods for calculating the coordinates of the triangulated points direct by the use of traverse tables alone.

It might also be pointed out that whereas a chapter has been devoted to the correlation of underground and surface surveys, there is no mention made of the important portion of the mine surveyor's duties that is comprised under the general head of "setting out," *e.g.* the laying out of surface and underground roadways, curves, &c.; yet the latter is almost a daily part of the surveyor's routine work, whilst the former, important though it certainly is, constitutes an exceptional operation that has only to be performed at long intervals.

The second article, by Mr. S. W. Price, deals with the preparation of coal for the market. It is a great pity that more space was not devoted to this subject, in view of its great and daily increasing importance, and of the fact that the literature on the subject is so scanty. This latter reflection justifies the expression of some surprise that the author has not made use of the best—almost the only—contribution to his subject in modern British literature, namely, the report of the committee of the Mining Institute of Scotland on coal cleaning, which he might have consulted with much advantage. The present article contains three chapters, the first on the handling and tipping of coal-tubs, the second on screening and picking coal, and the third on washing coal. The first two are entirely satisfactory, but the third is too short and sketchy, and is decidedly weak, especially in the theoretical portion. Thus the author seems to rely almost wholly on the principle of equal falling in order to explain the action of the jig or bash, without making it at all clear that in these appliances the *régime* of equal falling (when the particles are falling with practically uniform velocity) is never really reached; it is, moreover, not quite correct to say with Pernolet that a particle reaches this ultimate velocity in the first second of its fall, because the time required to reach this condition depends upon the size and density of the particle, and may be much more than a second or only a fraction of that time. The author quotes Maurice and Bring with equal approval, or, if anything, lays more stress on the conclusions of the former, although Bring reaches his as the result of a vast amount of experimental work, whilst those of Maurice are mainly deduced from mathematical reasoning, which is, moreover, vitiated by the fact that it is all based on the assumption that the resistance offered by the water (or viscosity, as Maurice wrongly calls it) varies always as the square of the velocity of motion of the particle, whereas this relation is only approximately correct when a certain velocity has been attained, and is therefore not true in the initial stages of falling.

Prof. W. Galloway contributes an excellent article on coke ovens, dealing exclusively, however, with retort and by-product ovens. He has gone almost exclusively to Germany for his data, and has succeeded in condensing a large amount of very valuable and not generally accessible information into his article.

The last article is on the economics of coal, by Messrs. H. S. Jevons and David Evans. This difficult subject is dealt with here far too briefly, and the writers do not seem to have the intimate technical knowledge that is required to discuss this subject thoroughly, though it is only right to say that in dealing with a subject like this, on which every writer has views of his own, wide differences of opinion are naturally to be expected. Thus to many it would seem that the authors' classification of the demand for coal is not satisfactory, and that a sharp line should be drawn between the demand for furnaces, factories, and the like, and the demand for transport purposes, by railways, and, above all, by steamships, the economic effects of these two requirements being quite different. The authors have included the requirements for manufacturing and for transport under one head, and thus obscure the results of certain conditions that are economically of distinct importance, as, for example, the effect that the annual closing of the Baltic Sea to navigation in winter has upon the price of coal. Further, it might be objected that the question of the life of a colliery and the necessity of the corresponding amortisation of the capital invested in the shafts and other permanent works has not received the consideration which this very important subject deserves. Henry Louis.

A COMPREHENSIVE WORK ON DIPHTHERIA.

The Bacteriology of Diphtheria. Edited by Dr. G. H. F. Nuttall, F.R.S., and Dr. G. S. Graham-Smith. Pp. xx+718. (Cambridge: University Press, 1908.) Price 25*s.* net.

THIS important work aims at a much more comprehensive account of the essential facts underlying the pathology of diphtheria than its title suggests. It is by far the most complete record of our present knowledge of this disease hitherto written in the English language. Not only is the bacteriology of diphtheria dealt with very fully, but chapters are included which cover the history of the disease, its epidemiology, its mortality, and an account of its toxins and antitoxins. Seeing that we have come to regard the antitoxin treatment as the only rational method of therapeusis in this disease, the reader has here before him practically all he may need to know about diphtheria, except certain clinical facts which he can easily find in any text-book of medicine. The inclusion of a short chapter embodying these facts, indeed, would have completed the whole subject from beginning to end.

Of all the infective diseases which trouble mankind, diphtheria stands foremost as the one concerning which our knowledge seems most complete. It may be mere vanity to say so, but this knowledge appears to contain few, if any, gaps of vital consequence to the human race. The nature of the causal micro-organism is known, the methods of detecting this in afflicted persons are matters of everyday practice, and, most important of all, the specific remedy is in universal use. It is quite doubtful if all this can be said of any other infective disease. Were there room for boasting in the sphere of medical science, this array of brilliant discoveries connected with diphtheria might be quoted with pride as conquests for humanity, won by much toil in the face of great difficulties. These discoveries, of the utmost practical value in the treatment of the disease, constitute one of the greatest arguments against the statement ofttimes made, that the results of animal experimentation prove this method of research to be devoid of useful results. Not only the discovery of the cause of the disease, but the very manufacture of the only remedy known to cure it, has depended almost solely upon animal experiments.

The book opens with a short series of biographical sketches of the men whose names figure most prominently in connection with these discoveries: Bretonneau, who first recognised the clinical picture presented by the disease; Loeffler, who discovered the specific microbe; Behring, who first enunciated the principles of toxin and antitoxin; and Roux, to whose studies we owe the preparation of anti-diphtherial serum. Excellent photographs accompany these sketches.

The subject-matter proper of the book is contributed by well-chosen authors. To Prof. Loeffler is given the task of writing the history of the disease, resulting in fifty pages of most fascinating reading. Dr. Newsholme treats of the epidemiology and Prof. Mallory of the pathology of diphtheria. The causal bacillus and its various congeners, with the modes of infection and methods of diagnosis, are dealt with by Dr. Graham-Smith. Matters of immunity, including the difficult subject of toxin and antitoxin, are discussed by Dr. Dean, and a most carefully written chapter on mortality comes from the pens of Drs. Park and Bolduan. The last-named writers also contribute a section upon serum sickness. A very full bibliography, including all the papers extant upon the subject, and a useful index, complete the work. Sixteen plates are inserted, and the photomicrographs in these are excellently reproduced.

Despite a most thorough acquaintance with the work, we have failed to find anything at which to carp. There is nothing to say except praise for the editors, who have produced a magnificent exposition of modern knowledge on this important disease—an exposition which must certainly take its place as the classical authority upon the subject. T. J. H.

ALLOYS.

Alloys and their Industrial Applications. By E. F. Law. Pp. xvi+269; with numerous illustrations and plates. (London: C. Griffin and Co., Ltd., 1909.) Price 12*s.* 6*d.* net.

IT is not easy to realise the unimportance or even insignificance of metals, as such, in the workaday world. Generally speaking, it is only when they are mixed together that they are converted from chemical curiosities into useful materials. The improvements in the properties of metals usually brought about by alloying them are a reduction in melting point so that they can be more easily melted and cast, and an increase in hardness, which confers greater strength and durability. The only general deterioration caused by alloying is a reduction in malleability and ductility, which can be put up with if it is not allowed to get out of hand. It is typical of the extent to which the essential and fundamental may be lost sight of amid the wealth of detail in modern study that the comparative lowness of the melting points of alloys is never once alluded to in the volume under review.

It must not be concluded, however, that Mr. Law's book is lacking in clearness of thought or in balance. It is the most important summary of the state of knowledge on the subject that has appeared for many years. More than this, it is a well-considered attempt to make the results of the recent scientific investigations on alloys available to manufacturers and engineers. How far the attempt will be successful cannot yet be said. It is not the author's fault that English manufacturers are wary birds, and that it is difficult to put the salt of research on their tails. It is not even his fault that much recent research has been somewhat beside the mark.

Besides, efforts have not been spared to apply investigations to the problems that most need solution. As soon as trustworthy pyrometers made their appearance, there was a rush to determine the melting points of alloys and then to ascertain the nature and extent of their pasty stages. The hardness of alloys was found to be due in many cases to the formation of intermetallic compounds, and straightway the conditions of formation of numbers of these were investigated. The toughness and ductility of alloys were seen to be connected with their structure, and the effects of annealing, quenching, and the like on the structure were accordingly subjected to careful scrutiny. It is natural for scientific observers to lose sight of the practical bearing of their work, and to wander, in the author's words, "in the intricacies of solid solutions, hyper-eutectics, solidus curves and phases," whither the manufacturer refuses to follow them. It has been Mr. Law's business to show that there is another side to research, and that something has been done besides the manufacture of a set of new labels.

On the whole the result of his labours is promising. The book is written in an easy conversational manner, which encourages the reader to continue seeing what the author has to say. About 100 pages are devoted to the general properties of alloys and the methods of investigating them, and the remainder to special descriptions of particular alloys. Only those employed in the industries are dealt with, and though at first sight this seems to leave many gaps, we are reconciled to the method as we realise how much space is saved for useful and practical remarks.

Both sections have been carefully prepared, and mistakes are far from numerous. Among those noticed is the statement on p. 219, and again on p. 221, that 5 per cent. of cadmium is added to standard silver in America as a deoxidant. This should, of course, be 5 per 1000. Then the definition of "isomorphous" in the glossary, "a term applied to crystals exhibiting similarity in form," leaves much to be desired. The "glossary of terms" generally is weak, alike in respect of omissions and of inexactness. The author is happier when dealing with photomicrography. Both the colour photographs reproduced in the frontispiece and the series of plates at the end of the book are really handsome illustrations of the structure of metals, and are far in advance of the smudgy photographs or diagrammatic drawings usually associated with such work.

T. K. R.

ASTRONOMICAL DETERMINATION OF POSITION FROM BALLOON.

Astronomische Ortsbestimmung im Ballon. By Prof. Adolf Marcuse. Pp. 67. (Berlin: Georg Reimer, 1909.)

THE great advances made in aërial transit, by which long-distance voyages are rendered possible by ordinary spherical balloons, while hundreds of miles may be travelled by dirigibles, and the prospect of long-distance voyages in the rapidly improving aëroplanes, suggest at once the important problem of the determination of the astronomical position of these craft at any moment.

During the daytime, while the earth is in view and not rendered invisible by cloud strata below, the experienced aëronaut can easily locate his position by means of the many excellent large-scale charts at his disposal. On clear nights, by means of the light of the moon, he is also able to follow his course, and, failing the moon, he can pick up his whereabouts by closely observing the lighted-up cities and towns as he approaches them.

With, however, no glimpse of the earth below him, the only two facts which he has in his possession are his height from the ground and the magnetic cardinal points.

In a spherical balloon this knowledge does not inform him whether he is travelling in a northerly, southerly, easterly, or westerly direction. In a dirigible he may head his craft in the direction of any of the points of the compass, but then his leeway will be an unknown, probably a very considerable, quantity, and he will soon find that his position in relation to the earth's surface is unknown.

For navigating purposes it is as important to know exactly where one is when travelling in the air as it is to a sailor when his ship is ploughing the ocean.

The volume before us is therefore very welcome, for Prof. Marcuse brings together, in a very concise and simple manner, methods which can and have been employed on actual voyages. It must be understood, in the first instance, that very rigid determination of position cannot at present be attempted. In the first place, the basket of a balloon is seldom steady, and is nearly always in a slow state of rotation. Again, the envelope above the observer cuts off a considerable portion of the sky that would be available under land or sea conditions, but against this he is in an elevated position and his horizon is clearer. Possibly better observations can be made from the platforms of dirigibles than from the baskets of spherical balloons.

The instruments necessary for the determination of the latitude and longitude, to which reference is made in this book, are the level-quadrant for the observation of altitude, a chronometer for recording Greenwich time, and a fluid compass with an alignment addition for azimuth observations. The first portion of the book, parts i. to iii., deals with the instruments, their use, and the general nature of the problems to be solved. Part iv. is devoted to the formulæ, forms for working them out quickly, and numerous worked-out examples; this portion is divided into two parts, treating of day and night observations. In part v. the use of the tables given at the end is explained in detail, and a description is also given of the charts which conclude the book. These maps include a chart of the northern hemisphere, showing the brighter stars which are best available for use, and following this are two magnetic maps, showing by isogonic lines the deviation of the compass from the true meridians for the year 1909 for (*a*) the whole of Germany and (*b*) for Europe.

This brief summary of the main features of this book shows that it is well adapted for the purpose it has in view. British aëronauts should therefore make themselves acquainted with some of the methods here expounded, for the subject will increase in importance as years go by.

W. J. S. Lockyer.

SOCIAL AND EXPERIMENTAL PSYCHOLOGY.

(1) *An Introduction to Social Psychology.* By William McDougall. Pp. xv+355. (London: Methuen and Co., n.d.) Price 5s. net.

(2) *Lectures on the Elementary Psychology of Feeling and Attention.* By Prof. E. B. Titchener. Pp. ix+404. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1908.) Price 6s. net.

(1) THE general nature and scope of Mr. McDougall's book is admirably expressed, in the words of his preface, as "an attempt to deal with a difficult branch of psychology in a way that shall make it intelligible and interesting to any cultivated reader, and that shall imply no previous familiarity with psychological treatises on his part; ... a book that may be of service to students of all the social sciences, by providing them with the minimum of psychological doctrine that is an indispensable part of the equipment for work in any of these sciences." After an introductory chapter pointing out the grave need in the sciences of ethics, economics, history, and politics for a more accurate and thoroughgoing psychological analysis than that employed at the present time, the author proceeds to give a description and classification of the emotional constituents of the mind, which he vindicates as of paramount importance for social life.

The principle of classification adopted is new, in that it involves an identification of emotion and instinct as the psychical and physical aspects, respectively, of the same process. On this assumption the list of primary emotions receives support and confirmation from the list of principal instincts of specific tendency with which they are individually correlated. These principal instincts and emotions are as follows:—the instinct of flight and the emotion of fear, the instinct of repulsion and the emotion of disgust, the instinct of curiosity and the emotion of wonder, the instinct of pugnacity and the emotion of anger, the instincts of self-abasement (or subjection) and of self-assertion (or self-display), and the emotions of subjection and elation (or negative and positive self-feeling), the parental instinct and the tender emotion. The more complex emotions are shown to admit of complete description as combinations of two or more of these primary emotions, either by themselves or within a "sentiment." Moreover, this conception of "sentiment," due originally to Mr. A. F. Shand, is given a physiological interpretation by the author. The difficult task of displaying the course of development of the moral sentiments is remarkably well done, and in a subsequent chapter on volition Mr. McDougall comes to closer quarters with the question of free-will than any other modern psychologist, giving, *inter alia*, a good psychological solution of Prof. James's difficulty of "action in the line of greatest resistance."

The last hundred pages of the book are devoted to the more strictly sociological question of the working of the primary mental tendencies in social life.

In bringing together emotion and instinct, Mr. McDougall has made an original contribution to psychological science of the highest value and importance, and even if he does not succeed in carrying his fellow-psychologists all the way with him in his identification of the two, he will have set the problem of their relation in a form which is itself at least half the solution. Before the theory can be accepted as it stands, reason must be given for the occasional occurrence of well-marked instinctive activities unaccompanied by any clearly defined emotion. Again, the absence of joy and sorrow from the list of primary emotions, although necessitated by the theory, is not easy to justify on purely psychological grounds; the account given of them in the text, viz., that they are qualifications of other emotions, is not quite convincing.

The book is full of close reasoning, but is written in so lucid a style that it makes very pleasant reading. Its importance is more than academic; there are political theorists at the present day who would do well to take some of its teachings to heart.

(2) Prof. Titchener's book is a publication of lectures delivered at Columbia University last spring. The lectures deal with the problems of feeling and attention from the experimental standpoint, and are profusely annotated with quotations from and references to all the most recent experimental work. This fact, together with a clearness of statement, should make the book very popular. The one and only weakness of the book is its slight bias towards sensationalism, which makes the author very unfair in his treatment of such a theory as that of Prof. H. R. Marshall, and perhaps explains his tendency to quote Prof. Külpe as final. The development of a theory of attention as sensory clearness is admirably done, and should go far towards converting psychologists (old style) to the experimental method.

William Brown.

OUR BOOK SHELF.

Die Termiten oder weissen Ameisen. Eine Biologische Studie. By K. Escherich. Pp. xii+198; coloured frontispiece, and 51 figures in the text. (Leipzig: D. W. Klinkhardt, 1909.) Price 6 marks.

Although the termites, or white ants as they are frequently called, belong to the order Neuroptera, and not to the Hymenoptera like the three other great classes of social insects, the ants, bees, and wasps, yet they closely resemble the ants in their habits and domestic arrangements, as well as in their economic importance, in the countries which they inhabit. As a rule they shun the light, and always work in darkness in their underground nests and galleries, and in most places in the tropics they are extremely destructive to all kinds of woodwork. The raised nests of some species are even more gigantic above ground than those of the ants, those of one Australian species being built in the form of a solid wall twenty feet high. In South Africa, as shown in an illustration on p. 158 of the book before us, the hollowed-out nests of termites are frequently used by natives and colonists as ovens.

Prof. Escherich has given us an extremely useful treatise on these insects, which he regards as far superior to the ants; though in his preface he discusses the difference between human reason and the collective and inherited "instinct" of social insects.

In his introductory chapter he discusses the zoological position of termites, and compares them with the ants. He follows Handlirsch in regarding the termites as forming a separate order, Isoptera, allied to the Blattidæ, and including three sub-families and about 350 species.

In later chapters the foundation of a colony, the structure of their nests, and their form and habits are dealt with. Like ants, they sometimes defoliate trees in order to form mushroom-beds. Next, their relations, hostile and otherwise, with bees, wasps, and especially ants, are discussed, and also the various animals (beetles, reptiles, &c.) which inhabit their nests, either as guests or intruders. In the sixth chapter their relations to man, and the good and harm which they work, are dealt with. The book concludes with a useful synopsis of families and genera, after Desneux, supplementary notes on the sexes, soldiers, recognition of friends and foes, &c., and a bibliography and index. Naturalists will be grateful to Prof. Escherich for having brought together in this handy form a useful compendium of widely scattered information relative to a very interesting and important, though somewhat neglected, group of insects.

W. F. K.

Oil Motors: their Development, Construction, and Management. By G. Lieckfeld. Pp. xv+272. (London: C. Griffin and Co., Ltd., 1908.) Price 15*s*. net.

This work is an authorised translation of a German handbook written for German engineers interested in engines using liquid fuel. Although, as is inevitable in a case of this kind, a large part of the work is taken up with catalogues of German machinery, there are about 130 pages of the book which give valuable and well-arranged general information on the subject. The first few chapters give a very readable history of the development of the liquid fuel trade, both of the mineral oils obtained from oil wells and the liquid fuels distilled from coal or from various shales. The chapters on petroleum spirit, on the paraffin oils, on benzol, and on alcohol also give valuable information in a condensed form.

The development of the modern internal combustion engines worked by petroleum spirit and by paraffin and the heavier oils is given partly in historical and partly in descriptive form, and the remainder of the book, with the exception of the last thirty pages, is a descriptive list of machinery almost entirely German, although a few engines of English construction are mentioned.

There are several important omissions in the book. The name of one of the leading workers on this subject, Dugald Clerk, is never mentioned, although he was undoubtedly one of the first in the field, and has taken a leading part in the development of the internal combustion motor using liquid fuels. Again, in giving the history of the adaptation of the petrol engine to the automobile movement, the author assumes that all the work previously done with steam engines may be ignored, whereas it is well known that as regards the heavier class of motor vehicles steam-driven vehicles still predominate.

There are several places where the work suffers from careless translation, notably in one of the notices on the De Dion Bouton engine, at the foot of p. 84, which is quite unintelligible as it stands.

Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew, 1908. Pp. iv+477+116; with appendices. (London: His Majesty's Stationery Office, 1908.) Price 4*s*. 6*d*.

The volume of the Kew Bulletin for 1908 well merits its title as a compendium of miscellaneous information. The systematic work emanating from the herbarium includes six decades of African plants, two of new orchids, and seven of new plants generally. The African plants appear to have come in small collections and from all parts of the continent. China supplies a considerable quota to the Decades Kewenses. A notable contribution to a knowledge of Transvaal trees and shrubs is provided by Mr. J. Burtt Davy, and no less valuable is the list of southern Nigerian trees furnishing timber, prepared by Mr. H. W. Thompson. Generic revisions are provided by the director for the gentianaceous genus Chironia, and by Mr. A. W. Hill for two genera of the Exaceæ. In connection with the rubber industry, information is supplied regarding the West African asclepiad *Raphionacme utilis*, that stores the latex in its tuberous root, *Bleekrodea tonkinensis* (Moraceæ), and the sources of Manicoba rubber. Other economic articles deal with patchouli and cascara sagrada. It is interesting to note the inclusion of articles by outside contributors, such as the account of the Southern Islands expedition by Captain Dorrien Smith, and the continuation of the policy of sending members of the staff to visit establishments of interest.

The Genitalia of the Group Noctuidae of the Lepidoptera of the British Islands. An Account of the Morphology of the Male Clasping Organs. By F. M. Pierce. Illustrated by F. M. Pierce and H. Butler. Pp. xii+88; 32 plates. (Liverpool: A. W. Duncan, 1909.) Price 7*s*. 6*d*. net.

In this unpretentious volume we have the results of twenty years' investigations by an ardent microscopist into a group of anatomical characters which have hitherto been less frequently, and also less successfully, employed in the Lepidoptera than in some other orders of insects, especially the Neuroptera and Trichoptera. Mr. Pierce's work is naturally too technical for detailed notice, but we may note that he gives careful directions for the preparation and examination of specimens, and a general description and nomenclature of the organs, one section only of which, the clasping organs of the males, is figured, and described in more or less detail, in a large number of species of British Noctuidæ. Mr. Pierce takes as his motto a quotation which expresses a truth which should encourage all honest workers, and should never be overlooked by critics, "He who never makes a mistake, never makes anything."

W. F. K.

Palaeolithic Vessels of Egypt, or the Earliest Handiwork of Man. By Robert de Rustafjaell. Pp. iii+22; 13 plates. (London: Macmillan and Co., Ltd., 1907.) Price 2*s*. 6*d*. net.

In this pamphlet of some twenty-two pages and thirteen plates, Mr. de Rustafjaell advances a new theory as to the origin of pottery. He directs attention to certain flint nodules with hollow cavities which he found in the Western Desert of Egypt, and suggests that they were used by primitive man as water-holders, that these hollow flint "nodules were copied during the Palæolithic age in limestone, from which again evolved other stone, and finally the clay vessels of the predynastic period" (p. 21). This is a theory which will have few, if any, adherents, and the author seems to be unaware that the lines on the earliest examples of pottery abundantly show its evolution from basket-work (by way of a burnt clay lining), and not from any form of rigid material. The forms of early stone vessels clearly show that they were copied from pottery types.

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 intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Australian Kinship.

In a note which appeared in Nature of April 1 *à propos* of my paper on terms for human relationships (British Academy), the writer suggested that our knowledge of Australian society was still very incomplete. Even as to Arunta rules and customs, he said, our informants differed greatly in their reports. There is now reason to suppose, however, that our informants, Messrs. Spencer and Gillen, and, later, the Rev. Mr. Strehlow, are not really at odds. The impression that they disagreed was caused by some letters of Mr. Strehlow in *Globus* and elsewhere; but now that he has published two parts of his "Die Arunta und Loritja-Stämme" (Frankfurt: Baer and Co., 1907, 1908), it becomes clear that he has merely studied branches of the Arunta "nation" not within the range of the work of Messrs. Spencer and Gillen, and that his natives differ, not only in customs and beliefs, but more or less in language, from those of the English explorers.

The differences are matters of detail; the broad outlines of custom and myth are identical. I ventured to express this opinion in *Man*, and was confirmed in my view by finding that it is held by Mr. N. W. Thomas ("Folk-Lore," March 30, 1909). He writes that Mr. Strehlow's second volume "confirms the belief that local differences of considerable magnitude exist, not only in belief, but also in social organisation."

In all probability both Messrs. Spencer and Gillen and Mr. Strehlow are right as regards the natives whom they have studied. Mr. Strehlow's full knowledge of the languages or dialects makes his book "masterly," as Mr. Thomas says, but the book does not invalidate the results of the English inquirers. An English translation would save trouble to readers in this country who are not too familiar with German.

A. Lang.

Forms, Markings, and Attitudes in Animal and Plant Life.

The object of this letter is to suggest what I may call a collateral theory of mimicry, and not in any sense a complete theory. It is based upon facts or groups of facts, many of which are very well known, but all of which have passed under my own observation.

Notwithstanding the great variety of form in leaves, there is general agreement as to the primary character of a simple ovate leaf, and the bi-facial form of the leaf is in obvious correlation with the great functions of transpiration and assimilation. The bi-facial leaf-like form of the leaf-insect (Phyllium) is not in correlation with any such essential metabolic functions, but it is correlated with the mode of life of the insect. The expression "mode of life" is sufficiently vague; it represents the combination of physiological reactions which make up the outward life of the animal. What these reactions are cannot always be stated in precise language, and until they can be so stated our knowledge has not advanced very much in regard to a particular case.

The cryptozoic habit of so many animals is the expression of reactions which may be conveniently classified together under the term cryptotaxis. Thus the concealment afforded by protective resemblance is one example of this general tendency; living under logs, or bark, or below the surface of the ground is another. Prof. Loeb, as I understand him, has attempted to throw discredit on this tendency in so far as he reduces it to a manifestation of stereotropism ("The Dynamics of Living Matter," 1906, p. 157); but stereotropism may, and obviously does, coexist with cryptotaxis, as may be verified any day in the behaviour of snakes, land-leeches, and land-planarians.

The leaf-butterfly (Kallima) also admirably lives up to its name, but in a different sense; for, whereas Phyllium has a dorsoventrally flattened body, Kallima has a normal body, and resembles a leaf only when at rest with closed wings. The pupa of another butterfly, *Troides darsius*, resembles a crumpled yellow leaf; but it is not only amongst insects that we find leaf resemblances. It occurs also amongst fishes. Besides the extraordinary case of Phyllopteryx, the young sea-bat (*Platax vespertilio*) resembles a simple yellow leaf, the dorsal, ventral, and anal fins assisting to form the contour line, while the caudal fin is glass-clear (*Spolia Zeylanica*, ii., 1905, p. 51). Drifting yellow leaves which have fallen from mangroves and other maritime trees are common enough in the sea and backwaters.

Animals which resemble the same thing resemble one another; but whereas the resemblance of a leaf-fish (Platax) to a leaf is a real resemblance, advantageous to the fish, its resemblance to a leaf-butterfly is accidental, and of no value to either. The important fact is their common possession of a fundamental form, namely, that of a leaf.

Of other forms which are widely distributed amongst different families, orders, and even classes, I may mention the ant-form and the tadpole-form, without going into further particulars.

With equal brevity allusion may be made to familiar markings, widely distributed without reference to mutual resemblances, but conforming to common physiological reactions. Such, for example, are longitudinal stripes or bands, transverse bars or rings, bright spots on a dark ground, dark spots on a pale ground, &c. In all such cases I suggest that the primary fact is the conformity to a fundamental pattern, which is itself the expression of a pigment-reaction, the causes of which have not yet been reduced to a definition. Any advantage which this conformity to a common standard may confer is a secondary factor which may conduce to the preservation of the species by natural selection.

Lastly, with regard to attitudes there is much to be said, but I must be brief. One of the most telling examples of general conformity of attitude is the bi-pedal posture of all birds, some reptiles, and many mammals.

The little palm-squirrels (Funambulus) and tree-lizards (Calotes) are often seen associated together on the same tree, and it is therefore the more noticeable that they have in common a singular habit of remaining in one spot with the fore-body somewhat raised, and then jerking the fore-body up and down several times in rapid succession whilst clinging to the trunk or branch of a tree. I do not know what the precise significance of this bobbing movement may be, but they both practise it.

The only other attitude which I desire to mention is the vertical attitude assumed by some fishes. Some years ago I described and published an ideal picture of the vertical swimming attitude of *Amphisile strigata* (Zoological Results, part vi., 1902, p. 719). More recently the late Mr. W. Saville Kent told me that he had seen the same thing, and had kept the fish in an aquarium, whereas I had only seen it from a boat, swimming in a small shoal in the sea. I was glad of the confirmation of the vertical attitude; but upon showing my figure to Mr. Saville Kent, he pointed out to me that the head is not directed upwards, as there represented, but downwards, as if to feed from the bottom. What I saw were swimming in mid-water, and as the body has a pronounced amphioxine form, it was impossible to be certain which end was uppermost. This uncommon vertical attitude, with head directed downwards, is not without parallel amongst fishes, having been observed by Dr. Abbott in the case of the "mud sunfish" (*Acantharchus pomotis*) in 1884.

Arthur Willey.

Colombo, Ceylon, April 4.

The Simple Equivalent of an Alternating Circuit of Parallel Wires.

In Nature of January 30, 1908, some results were quoted by me with reference to the effective inductance of two long parallel wires when the change of current distribution due to frequency is taken into account. These were extended later (*Phil. Mag.*, February, 1909) to meet the case in which the wires are very close together. Pending more detailed publication, the following developments and extensions may be of interest from the practical point of view, as they do not require the construction of special tables, but may be used as they stand. The system of formulæ determines the simple equivalent of the two wires, copper or iron, when their capacity is sufficiently small to be left out of account. One wire is the return of the other, and they are equal in all respects.

Let (a, μ, σ) be the radius, permeability, and resistivity of a wire in C.G.S. units, f the frequency of alternation, and c the distance between the axes of the wires.

Writing

$$\lambda = 4\pi a(\mu f/\sigma)^{\frac{1}{2}}, \quad \rho = \log_e(\tfrac{2}{3}\pi f a . 10^{-10}).$$

Then

(*a*) For copper wires, provided $\lambda > 11$, so that the frequency is high, if (L, R) be the inductance and resistance per unit length of the pair,

$$L = 4\left(1 - \frac{a^2}{\rho c^2}\right)\log_e\frac{c}{a} + \frac{4}{\lambda}\left(1 - \frac{2}{\lambda}\right) - \frac{4a^2}{\lambda c^2\rho^2}\left(\rho - \overline{4\rho + 3}\log_e\frac{c}{a}\right)$$

$$\frac{R}{8\pi f} = \frac{1}{\lambda}\left(1 + \frac{1}{\lambda}\right) - \frac{a^2}{\lambda c^2\rho^2}\left(\rho - \overline{2\rho - 1}\log_e\frac{c}{a}\right) + \frac{a^2}{\lambda^2 c^2\rho^3}\left\{\rho^2 - \overline{2 - 3\rho + 2\rho^2}\log_e\frac{c}{a}\right\}$$

where λ^{-3}, a^4/c^4, and $a^2/\lambda^3 c^2\rho$ have been neglected.

(*b*) For iron wires, ignoring also $\mu\lambda^{-3}$ and μ^{-3},

$$L = 4\left(\log_e\frac{c}{a} - \frac{a^2}{c^2}\right) + \frac{4}{\lambda}\left(1 - \frac{2}{\lambda}\right) - \frac{2a^2}{\mu c^2}\left(\lambda - 1\right)\left(\rho - 2 + \log_e\frac{c}{a}\right)$$

$$\frac{R}{4\pi f} = \frac{2\mu}{\lambda}\left(1 + \frac{1}{\lambda} + \frac{3}{4\lambda^2}\right) - \frac{a^2\lambda}{\mu c^2}\left(2 - \rho - \log_e\frac{c}{a}\right) + \frac{a^2\lambda^2}{c^2\mu^2}\left(4\rho - 2 - \rho^2 - \rho\log_e\frac{c}{a}\right)$$

(*c*) For copper wires with low frequency,

$$L = 4\log_e\frac{c}{a} + \frac{2\beta}{\alpha z} + \frac{4a^2}{c^2 D}\left(1 - 2\beta\rho z - \frac{y}{z}\right) - \frac{8a^2}{c^2 D}\left(2\alpha\rho z^2 - 2\alpha\rho\gamma z - \beta z + 2\beta\gamma\right)\log_e\frac{c}{a}$$

$$\frac{R}{8\pi f} = \frac{\gamma}{\alpha z} - \frac{2a^2}{zc^2 D}\left(\beta - 2\alpha\rho z + 2\gamma\rho z^2\right) + \frac{4a^2}{c^2 D}\log\frac{c}{a}\left(\gamma^2 - \beta^2 \quad \gamma z + 2\alpha\beta\rho z\right)$$

where

$$D = 1 - 4\beta\rho z + 4\alpha\rho^2 z^2, \quad 2z\sqrt{2} = \lambda,$$

$$\alpha z^{-2} = 1 - \frac{5}{12}z^4 + \frac{143}{720}z^8 . \ 2\beta z^{-3} = 1 - \frac{11}{24}z^4 + \frac{473}{2160}z^8$$

$$\gamma z^{-1} = 1 - \frac{1}{3}z^4 + \frac{19}{120}z^8$$

and z^{12}, a^4/c^4 have been ignored.

(*d*) For iron wires under the same conditions, neglecting also μ^{-2} and a^2z^8/c^2,

$$L = 4\log_e\frac{c}{a} - 4\frac{a^2}{c^2} + 1 - \frac{z^4}{24} + \frac{13z^8}{4320} - \frac{4a^2z^4}{\mu c^2}\left(\rho + \log_e\frac{c}{a}\right) + \frac{8a^2}{\mu c^2}\left(1 + \frac{1}{6}z^4\right)$$

$$\frac{R}{4\pi f} = \frac{\mu}{z^2}\left(1 \quad \frac{1}{12}z^4 - \frac{1}{180}z^8\right) - \frac{4a^2z^2}{\mu c^2}\left(1 \quad \frac{z^4}{24}\right) + \frac{4a^2z^2}{\mu c^2}\left(\rho + \log_e\frac{c}{a}\right)\left(1 - \frac{1}{3}z^4\right)$$

The results above appear to be capable of including all important practical cases in which the condition of small capacity is not violated. This condition restricts the length of the wires.

For a four-figure accuracy, the capacity must in general satisfy the two conditions

$$C \ngtr (3fl^2)^{-1}10^{-3}$$
$$C \ngtr (6Lf^2l^2)^{-1}10^{-4}$$

where C is the capacity per unit length and l is the length of either wire. For a capacity of a microfarad per kilometre $C = 10^{-20}$. J. W. Nicholson.

Trinity College, Cambridge, April 21.

Gigantocypris and the "Challenger."

The writer of the note on "Some Marine and Freshwater Organisms" (Nature, April 8) quotes from Herr Lüders (*Zeitschr. wiss. Zool.*, xcii., [1], p. 103, 1909) the statement that the giant Ostracod Gigantocypris was first obtained by the *Challenger* Expedition. It may perhaps be worth while to point out that this statement has no foundation in fact. It was first made in 1895 by Dr. G. W. Müller (Bull. Mus. Comp. Zool. Harvard, xxvii., p. 165), who quotes a passage from the "Challenger-Briefe" of R. v. Willemoes Suhm (*Zeitschr. wiss. Zool.*, xxiv., p. 13, 1874), where it is stated that the *Challenger* dredged between Prince Edward Island and the Crozets a fragmentary specimen of a gigantic Ostracod. Dr. Müller suggests that this may have been a Gigantocypris, and he continues:—"Leider fehlen nähere Angaben über das Thier, und in den Challengerostracoden ist es nicht erwähnt." Herr Lüders, in his recent paper, accepts the identification, and echoes the lament. As a matter of fact, the specimen described by Willemoes Suhm is still safely preserved in the British Museum, but it is not an Ostracod at all! Long before Müller conjectured that it might be a Gigantocypris, Prof. G. O. Sars had described and figured it as one of the two co-types of the remarkable phyllocarid crustacean *Nebaliopsis typica* (Rep. Phyllocarida *Challenger*, p. 22, 1887). Prof. Sars says:—"It is apparently this form that was mentioned by the late Dr. v. Willemoes Suhm in a letter to Prof. v. Siebold as a gigantic Ostracode. This strange mistake may be readily explained by the incompleteness of the first specimen obtained, of which only the carapace and a small fragment of the body was brought up in the dredge." The statement might have been made still more emphatic. The description and the dimensions given by Willemoes Suhm, as well as the locality, put it beyond doubt that he was speaking of the identical specimen which is figured on Plate III., Fig. 5, of Prof. Sars's report.

W. T. Calman.

British Museum (Natural History), Cromwell Road, S.W., April 15.

Persistent Trail of a Meteor on March 14.

I recently sent the Cape Astronomer Royal an account of an unusual meteor which I saw, and he has suggested that I forward an account to you.

On the evening of March 14 I was walking along the sea-shore looking south-west; the sun had set, and the sky was still bright with sunlight. A few clouds were slowly drifting from the south-east, when suddenly, about 7.45 p.m., I saw what looked like a large rocket dart from behind a cloud, rush across the sky from west to east, and disappear over the Table Mountain range in the direction of False Bay. The track of the meteor was shown by a brilliant, apparently glowing, streak of silvery light, which remained stationary in the sky like a long ribbon of fire for fully ten minutes. The "tail" then gradually assumed a wavy form, and slowly faded out of sight. The peculiarity consisted in the persistence of the "tail" or track of the meteor, as I suppose it was. On looking into Sir Robert Ball's book, "The Story of the Heavens," I find an account strangely akin to mine, and I should like to know the reason for the persistence of the luminous track, which must have been very bright to have shown so plainly against the sun-lit sky. Our southern skies are wonderfully brilliant, owing, doubtless, to the clearness of our air; and I have often seen meteors flash across the sky, but never before have I seen such a magnificent display as that described above. Edward J. Steer.

Box 42, Cape Town, March 22.

Lignum Nephriticum.

I must thank Mr. Benham for directing attention (April 8) to the early observations of Boyle quoted by Faraday. I have erred in good company; Stokes himself was apparently unaware of Boyle's experiment, and the "Optics" of Basset, Glazebrook, Preston, Tait, and Winkelmann all seem to regard Brewster and Herschel as the first discoverers of fluorescence.

Dr. Stapf's letter in Nature of April 22 confirms the conclusions of a recent correspondence in the *Gardeners' Chronicle*; letters of March 20 and April 3 give reasons for assigning *Lignum Nephriticum* to a Mexican tree known as Coatli or Tlapalcypatli. John H. Shaxby.

University College of South Wales and Monmouthshire, Cardiff, April 23.

THE NANDI.[1]

Mr. A. C. Hollis, who holds an important post in British East Africa, is favourably known to ethnologists as the author of a valuable book on the language and folk-lore of the Masai, and now ethnologists are indebted to him for a companion work on the Nandi, concerning whom much less was previously known than about their belligerent neighbours. One-half of the new book is taken up with a vocabulary and grammar of the Nandi language. This is a sister language to that of the Masai, and just as there is probably a strain of Galla or Somali blood in the Nandi, Masai, &c., so also there is nothing improbable in the idea that Somali influence may be traceable in their language. They certainly owe to it some of their numerals, and it may be that the use of the articles and the order of words are due to the same cause. But Sir Charles Eliot, who discusses this problem, states that in details he sees no proof of near kinship.

The general account of the Nandi given by Mr. Hollis is written with great care, and is illustrated by a number of clear figures in the text and a wealth of beautiful plates. The Nandi appear to be a mixture of Nilotic Negro and Bantu, with some pygmy element and a Galla strain. Originally they came from further north, and Mr. Hollis is of opinion that they have not occupied their present position on the plateau east of the Victoria Nyanza for more than a few generations. Their country was closed to Arab and Swahili traders, for the Nandi, who were hardy mountaineers and skilful fighters, refused to allow strangers to cross the threshold of their country without special permission. Punitive expeditions against them were made in 1895, 1900, 1903, and 1905. Now they are moved into a reserve, and it is hoped that a difficult native problem has been finally settled.

In the Nandi we have an example of an originally hunting people who became pastoral, and, according to Sir Charles Eliot, have within the last few generations betaken themselves to agriculture, though in a somewhat desultory fashion. Like the Masai, they regarded raiding as the most important business of life, and their social institutions are very similar. They are divided geographically into fifteen districts or divisions, and parishes or subdivisions, and genealogically into clans and families. Each clan has one or more totem or sacred animal, but totemism is on the wane, as marrying into the same clan is permitted, and though it is now considered wrong for a man to kill his sacred animal, to whom an apology is expected, in former times the killing of a sacred animal by the clansman was strictly forbidden. A man of the elephant clan shot an elephant because it had good tusks. When the animal was dead he went up to it and said, "So sorry, old fellow, I thought you were a rhino." He traded the tusks with the Swahili, gave the elders a present, and no notice was taken of his action. The supreme deity is Asista, the sun. He is the creator and giver of all good things; prayers are addressed and offerings made to him. There is also a kindly and a malevolent thunder god. The spirits of departed ancestors and adult relatives are held responsible for sickness and death, and are appealed to and propitiated whenever necessary. There is also a devil who prowls around seeking whom he may devour. The principal medicine man is the supreme chief of the whole race, with a hereditary position, but it seems that the office was borrowed from the Masai; he never prays to Asista, but only to the spirits of his ancestors.

A circumcision festival is held every seven and a half years, when most youths between the ages of, say, ten and twenty undergo the operation, which transforms them from boys into warriors. For about six months they remain isolated from women and children, and wear women's clothes, and for about half this time they also wear a remarkable head-dress (Fig. 1). Before their circumcision festival the girls dress in men's attire, and after it they wear long garments which reach from the neck to the feet,

Fig. 1.—Boy wearing the Nyorkit Garb and the Kimaranguchet Head-dress. From "The Nandi."

and their heads are enveloped in a complete hood which has only two holes for the eyes. It is customary for the Nandi to distribute their stock amongst their wives during their lifetime, each one being given a certain number to look after, tend, and milk. The sons of each wife inherit the property thus placed in their mother's charge. The boys usually are also given cattle from their earliest youth upwards. The eldest son of the principal wife inherits the lion's share of his father's property. There is a classificatory system of kinship, and the maternal uncle plays an important part in the existence of every Nandi. An understanding exists between a boy and his maternal uncle which is not met with between other relatives, and the maternal uncle is appealed to for intervention when a boy is in disgrace. The most

[1] "The Nandi: their Language and Folk-lore." By A. C. Hollis. With Introduction by Sir Charles Eliot. Pp. xl+328. (Oxford: Clarendon Press, 1909.) Price 16s. net.

terrible thing that can happen to a Nandi is to displease his maternal uncle. Thus it is evident that the Nandi have not long passed from the stage when mother-right obtained.

Mr. Hollis gives an account, illustrated with good figures, of most of the objects made, worn, or used by the Nandi, and a number of folk-tales and riddles are given in the original language and in translation. It will thus be seen that Mr. Hollis has made a noteworthy contribution to our knowledge of the ethnology of British East Africa. A. C. H.

FIG. 2.—A wife and daughter of Ar-ap-Koilepe, the chief medicine man of the Lumbwa. From "The Nandi."

THE MICROSCOPE IN ENGINEERING.

DURING the past ten years the young science of metallography has made rapid strides, and in consequence of this development the microscope is steadily assuming an increasingly important position in the testing-laboratories of those who have to deal with metals, either as manufacturers or users. This position has, however, been accorded to it with some reluctance, partly, perhaps, because at the outset too much was claimed for the instrument. Another cause is to be found in the fact that, as is necessarily the case in all young sciences, theoretical development has outstripped practical application, and practical men are too apt to regard anything "theoretical" as practically useless. But even if we leave aside all questions of the promising future applications of these theoretical discoveries, a mass of purely practical results is now available in which the microscope has clearly demonstrated its immediate value.

Perhaps the most fruitful field for the application of the microscope in the present state of our knowledge of metals is the study of the nature and causes of breakages or other failures occurring in practice. That the thorough clearing up of such cases, wherever possible, is eminently desirable, both in the interests of the parties immediately concerned, and also for the sake of the general advancement of our knowledge, is so obvious that it need not be further insisted upon. It is just where our accepted knowledge and our usual practice go wrong that the field for fresh discoveries lies before us. The methods that are available for the *post-mortem* examination of breakages must depend very much upon the nature of each particular case; experiments that are possible with the broken end of a 12-inch shaft are not applicable to a small brass condenser tube. In every case, however, the first, and perhaps the most vital, step is the examination of the micro-structure of the material close to the actual fracture itself, and also of the mass of the material lying away from the fracture. The first of these sections will often show whether there is any special local weakness in the metal at the point of actual fracture, or whether the fracture itself displays any particular characteristic, for it is well known that the path which a fracture takes among the micro-constituents of a metal depends on both the nature of the metal and the manner in which the fracture was produced. In a given material, for instance, the section of a tensile or bending fracture is quite different from one produced by shock or by repeated alternations of stress. The difficulty about these observations lies, however, in preparing an actual section through the fracture, as this is usually either corroded or worn by subsequent friction; when it is clean and fresh, however, the actual fracture may be embedded in a thick deposit of electrolytic copper, and a satisfactory section may be cut through the compound mass thus formed. An example of a section of this kind is shown in Fig. 1.

Apart from the examination of the fracture itself, the general micro-structure of the material will, as a rule, reveal whether it has been subjected to any undue treatment during manufacture or use. Thus excessive heating, whether by exposure to an unduly high temperature or to a more moderate temperature for an unduly long time, leaves its trace in the form of a coarse, angular structure which is readily recognised in such materials as steel, brass, or bronze. Insufficient rolling or forging, or working at either too high or too low a temperature, can also be readily diagnosed. In many cases a useful guide can be obtained by comparing the micro-structure of the object which has failed with that of a similar object which has given good service; but this is only necessary where the material in question is one which has not been thoroughly studied, so that the effects of various forms of treatment on the micro-structure are not so definitely known as could be desired. Fortunately, the list of such materials is rapidly diminishing, but, owing to the wide range and complexity of industrial alloys, cases of this kind will continue to occur occasionally.

Although the microscopic evidence is, as a rule, quite conclusive, it is eminently desirable to supplement it wherever possible by the data of a careful chemical analysis and complete mechanical tests, dynamic as well as "static." Even where these additional data are not needed to confirm the conclusions drawn from the microscopic examination, they are valuable as throwing a light upon the indications of the various forms of test relied upon by engineers in drafting their specifications.

FIG. 1.—Section through a fracture of mild steel, after embedding in an electro-deposit of copper. The path of the fracture among the constituents of the steel can be clearly traced. Magnification, 100 diameters.

This consideration raises the question how far it would be possible or desirable to include an examination of the micro-structure in the regular tests carried out on engineering materials. Some time ago metal manufacturers, and more particularly steel makers, would have met such a proposal with every means of opposition in their power, but greater familiarity with questions of micro-structure has, it may be supposed, diminished this feeling. If it were simply a question of imposing an additional test, or of placing an additional difficulty in the way of the manufacturer who has to comply with specifications, a hostile attitude would, of course, be readily understood, but the effect of the inclusion of microscopic examination in regular testing would not be at all likely to increase the stringency of the specifications in question. Thus, as regards chemical compositions, specifications are so drafted that, even with unfavourable structure, the material may be strong enough to meet the mechanical requirements of the engineer. Were it possible to rely upon obtaining a favourable structure in the material as used, the necessity for stringency in regard to composition would be materially reduced.

Further, the use of the microscope in this connection should enable the engineer to rely more securely upon both the uniformity of his materials and on their conformity with the test specimens. The reason is that, by the microscopic examination of a number of very small pieces chosen from a variety of different pieces or parts of the material, it would be at once ascertained whether the material was uniform, and whether the test-pieces chosen for mechanical testing or for chemical analysis fairly represented the bulk of the material. This again is an application of the microscope in engineering practice which could not be regarded as operating against the interests of the makers of the material; the rejection of metal on the results of tests carried out on samples which happen to be below the average of the batch would be prevented quite as often as the acceptance of a batch on results obtained from an unduly favourable sample.

In the case of large pieces of metal also, the application of the microscope would prevent the occurrence of failures which sometimes arise as a consequence of want of uniformity in the materials forming different parts of the same forging. Such differences may arise either from segregation, *i.e.* from a non-uniform distribution of the constituents or the impurities in the metal as originally produced, or it may be the result of insufficient or of wrongly applied working. Thus, if rods of ductile metal, such as brass, are drawn down cold too rapidly, or if the reduction at each pass through the dies is incorrectly adjusted, the result is the production of a surface layer of material which has been much more heavily deformed than the core of the rod, and this results in a condition of serious internal stress which may even produce subsequent spontaneous fracture.

In large forgings also, an external layer of fine-grained material is sometimes found superposed on a coarse-grained core as the result of inadequate working. This also is liable to lead to failure in use, while the indications of test-pieces cut from the fine-grained layer are entirely falsified by the real behaviour of the piece as a whole. An example of the diversity of structure to be met with in different parts of the same piece of metal is shown in Fig. 2, the two halves representing, to the same magnification, the structure as seen in the outer and central layers of a large forging. This example is, of course, abnormal, but the intelligent use of the microscope in ordinary testing practice would prevent such a piece from passing into use.

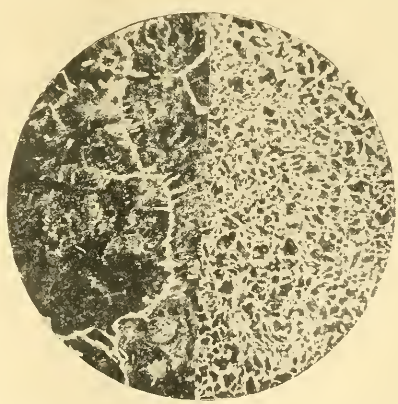


FIG. 2.—Sections from two parts of the same large forging; the right-hand half of the figure represents the fine structure of the external layers, while the left-hand half represents the coarse structure of the interior. The magnification of both is 50 diameters. The dark and light areas in both portions represent pearlite and ferrite respectively.

Examples of other uses of the microscope in connection with the materials of engineering could be given in great numbers. Perhaps one of these which is already most appreciated in practice is the use of the instrument to control the annealing processes in connection with copper and its alloys. The whole history of the constitution and structure of the more important alloys of copper with one added element at a time has been worked out and embodied in what appear at first sight to be highly theoretical "equilibrium diagrams." These diagrams, however, enable us to understand the precise effect produced upon the constitution and structure of any of these alloys by thermal treatment. The structures resulting from exposure to certain temperatures, followed by either slow or rapid cooling, have been determined, as well as the particular properties of the alloys which correspond to these structures. An understanding of these diagrams therefore enables the manufacturer or user to treat his alloys at the proper temperatures, and to control the results with ease and certainty by examining a few specimens of the metal under the microscope and noting the type and the size or scale of the structure.

At the present moment the control of these processes is only satisfactorily available for those groups of alloys the constitution of which has been fully investigated, but this is so far the case only for binary alloys—*i.e.* those consisting of two metals only. The majority of industrial alloys are much more complex, and for these the theoretical guidance is not yet available, principally because the complete study of these complex systems is a matter of much greater difficulty than that of the simpler binary series. The fullest benefit of the microscope will therefore only become available for workers who deal with these complex alloys when the purely scientific investigations have covered this difficult ground; but meanwhile it is quite possible in practice to obtain empirical data as regards the best micro-structure and the treatment required to obtain it. Such data, although not of equal value with the more complete knowledge, form a useful temporary substitute.

These few indications of the present practical utility of the microscope in connection with engineering materials, while very far from covering the whole range of the subject, may perhaps be enough to show that, even with existing knowledge, the instrument is capable of rendering—and is, in fact, rendering—the greatest service to engineering and metallurgical practice. These fruits are already derived from little more than twenty years of metallographic investigation. For the future of this young science, therefore, the highest hopes appear to be well founded.

WALTER ROSENHAIN.

THE YIELDING OF THE EARTH TO DISTURBING FORCES.[1]

THE problem of determining how much the earth as a whole actually yields to the tidal disturbing forces of the sun and moon was definitely brought before scientific men by Lord Kelvin. He pointed out that, from observations of the tides of long period, it ought to be possible to obtain some definite information, and he urged the establishment of gravitational observatories fitted with instruments for detecting the lunar disturbance of gravity. However rigid the body of the earth may be, it necessarily yields a little to the deforming action of the sun and moon. This action produces two kinds of effect. In the first place, it alters the shape of the earth. If the earth were a perfect sphere, it would be drawn out by the attraction of the moon, for instance, into a prolate ellipsoid of revolution. The actual earth, of a shape that is nearly spherical but presents certain inequalities, acquires under the action of the moon a slight additional inequality of figure, of the same type as that which answers to elongation in the direction of the long axis of the ellipsoid and flattening round the parts remote from that axis. As the moon moves relatively to the earth, the long axis of the ellipsoid moves about in the earth, so that a corporeal tide is raised in the earth. Besides raising a corporeal tide, the action of the moon alters the attraction of the earth. If the change of external shape only is taken into account, the alteration of the attraction consists of the added attraction, due to the protuberances at the ends of the long axis of the ellipsoid, coupled with the loss of attraction, due to the flattening round the parts remote from these ends. But, since the material of which the earth is made up is not homogeneous, a similar effect is produced by the elongation and flattening of the surfaces of equal density, and, since the material is not absolutely incompressible, the density must be in some parts increased and in others diminished, owing to the attraction of the moon being different in different parts. The alteration of the earth's attraction by the action of the moon is therefore of a somewhat complex character. The effects produced by the action of the sun are similar to those produced by the action of the moon.

Many attempts have been made to measure the changes of level that are due to the tidal disturbing forces of the sun and moon. In the majority of such attempts, instruments of the horizontal pendulum type have been used. The displacement of a horizontal pendulum that would be produced by the attraction of the moon, or the sun, if the earth were absolutely rigid, is known, for the attractions of the moon and sun are known. In the actual case, owing to the yielding of the earth, all we can hope to determine by observations of the tides or of the displacement of horizontal pendulums is a relative change of level, and to measure this is far from easy. The effect to be measured is extremely minute, and it is liable to be obscured, or even disguised altogether, by the effects of air currents and of changes of temperature. Recently Dr. O. Hecker, of Potsdam, has succeeded in overcoming the experimental difficulties. By setting up two horizontal pendulums in an underground chamber, and observing their behaviour during a protracted period, he was able to show that the effect of the moon, in particular, is perfectly definite, that in phase it follows very closely the motion of the moon, and that in amount it is almost exactly two-thirds of what it would be if the earth were absolutely rigid.

Hecker's result confirms decisively the results which had been found with much less perfect experimental means by previous observers. It leaves no shadow of doubt of the actuality of a corporeal tide produced by the moon. It accords also with those results, deduced from observations of fortnightly tides, which were used by Lord Kelvin in his famous estimate of the rigidity of the earth. This estimate was obtained by working out mathematically the change of shape that would be produced by the attraction of an external body, such as the moon, in a solid elastic globe, of the same size and mass as the earth, if the material of which it is made were homogeneous and absolutely incompressible. When these simplifying assumptions are made, the change of attraction is calculable in terms of the change of shape, and the measurement of the relative change of level leads easily to the determination of the absolute change of

[1] Based on a paper by Prof. A. E. H. Love, F.R.S., read before the Royal Society on January 14.

level. If with these simplifying assumptions there is combined the observed fact that the relative change of level is two-thirds of what it would be if the earth were absolutely rigid, it is found, as Lord Kelvin did in effect find, that the calculated rise and fall of the surface is one-third of what it would be if the earth were made of homogeneous incompressible fluid, and the calculated change of its attraction due to the sun, or moon, is one-half of the tide-generating force of the sun, or moon. The rigidity which the material, supposed homogeneous and incompressible, would need to have in order that the two numbers may have the calculated values, $\frac{1}{3}$ and $\frac{1}{2}$, is about the same as the rigidity of steel. Both the numbers $\frac{1}{3}$ and $\frac{1}{2}$, which are thus calculated are inferred, partly from a result of observation, and partly from the subsidiary hypotheses of homogeneity and incompressibility. If these hypotheses are discarded, all that can be inferred from observations of fortnightly tides and horizontal pendulums is a single equation connecting two numbers. The number which in the special case is $\frac{1}{3}$ is in general conveniently written as $\frac{2}{5}h$, and the number which in the special case is $\frac{1}{2}$ may be called k. The observations in question concur in leading to the equation $h-k=\frac{1}{3}$. (In the special case $\frac{5}{6}-\frac{1}{2}=\frac{1}{3}$.)

It was first suggested by Prof. Simon Newcomb that the length of the earth's free period of nutation, usually called the "Chandler period," may be an independent index of the yielding of the earth to small forces. It has long been known that if the earth were absolutely rigid this period would be about 306 days. A free nutation of the earth would be manifested by periodic changes of latitude of places on its surface. Small variations of latitude have long been known to exist, but all efforts of astronomers to detect a period of 306 days in these variations failed. It was announced by Dr. S. C. Chandler, in 1891, that the variations are roughly periodic, but that the period is really 427 days instead of 306. Newcomb pointed out that the lengthening of the period must be due to a yielding of the earth. At any instant the earth is rotating about an axis which does not quite coincide with a principal axis. A solid globe would be deformed by rotation into an oblate spheroid in the same way as a fluid one, but not so much. The inequality of the so-called "centrifugal force," due to the deviation of the instantaneous axis from a principal axis, produces a slight deformation of the surface, accompanied by a slight alteration of the attraction, and these effects can be specified by means of the same two numbers h and k as are required to express the effects of tidal disturbing forces. Mr. S. S. Hough, H.M.'s Astronomer at the Cape of Good Hope, calculated, in 1896, the lengthening of the period in the case of a solid elastic globe of homogeneous incompressible material. The problem has recently been discussed in a more general way by Prof. G. Herglotz, who was able to dispense with the hypothesis of homogeneity. A review of the theory, as presented by Herglotz, shows that it is possible to dispense with the hypothesis of incompressibility also, and that the lengthening of the period depends upon the number k, and not upon the number h. The number k is found to be expressible in terms of the two periods (306 and 427 days), the ellipticity and mean radius of the surface, the angular velocity of rotation, and the mean value of gravity at the surface. This number is therefore known. Its value is found to be about $\frac{4}{15}$. The result that $k=\frac{4}{15}$ means that the alteration in the attraction of the earth on account of the distortion produced in it by the sun or moon is actually about four-fifteenths of the tide-generating force of the sun or moon. This result does not depend upon any hypothesis as to the homogeneity or incompressibility of the material. The only assumptions that are used in obtaining it are the assumption that an equilibrium theory is applicable to the forces in question, and the assumption, commonly made in the theory of the figure of the earth since the time of Laplace, viz. that the surfaces of equal density within the earth are maintained in ellipsoidal shapes by the rotation. The result does not depend upon the special hypothetical law of density which Laplace introduced. Any law of density which satisfies the ordinary laws of hydrostatics will suffice.[1]

When the result expressed by the equation $k=\frac{4}{15}$ is combined with the result of observations of the tides and horizontal pendulums ($h-k=\frac{1}{3}$), it is found that $h=\frac{3}{5}$. This result means that the surface of the earth actually yields to the tidal deforming influence of the sun and moon by six-twenty-fifths of the amount by which it would yield if the earth were made of homogeneous incompressible fluid. The number $\frac{6}{25}$ takes the place of Lord Kelvin's number $\frac{1}{3}$.

The result that the earth actually yields a good deal less than Lord Kelvin supposed it to do suggests that it is decidedly more rigid than he estimated it to be. There are, however, many difficulties in the way of a more precise estimate, the chief being the heterogeneity of the material. If this fact is disregarded, and the simplifying assumption of homogeneity is made, it appears to be impossible to satisfy both the equations $h=\frac{3}{5}$ and $k=\frac{4}{15}$. An additional difficulty arises from the compressibility of the material, but, although this cannot be met directly, it is not very serious, because the general effect of compressibility must almost certainly be that any estimate of rigidity based on the simplifying assumption of incompressibility is under the mark. A possible method of procedure is to assume the earth to consist of a central nucleus of incompressible material of one density and rigidity, enclosed in a shell of incompressible material of a smaller density and a different rigidity, in the manner advocated by Prof. E. Wiechert, who regards the earth as made up of an iron core enclosed in a rocky shell. This method was developed by Dr. W. Schweydar, who found that, with the densities proposed by Wiechert, the rigidity of the core would have to be nearly three times that of steel, and the rigidity of the shell about one-eighth of that of steel. The possibility of a comparatively small rigidity in the enclosing shell suggests that there may be within it, or between it and the core, a layer of molten rock, devoid of rigidity, such as has sometimes been invoked in connection with the explanation of seismic and volcanic phenomena. This hypothesis is found, when tested mathematically, to require much too great rigidities both of the core and of the outer part of the shell. It appears, however, to be quite possible that the earth may consist of a very dense and very rigid core enclosed in, and connected by solid matter with, a lighter shell or crust, the greater part of which is solid and of a rigidity comparable with that of granite (about one-third of that of steel), the shell being honeycombed with hollow spaces containing molten matter. But it seems to be impossible that the molten matter should form a continuous layer separating the outer portions of the earth's body from the inner portions.

[1] Since the paper was written and sent in to the Royal Society, Prof. Larmor has shown that the result is independent of the supposed ellipsoidal shape of the surfaces of equal density. It is therefore established, quite generally, for any constitution of the earth which would admit of the application of an equilibrium theory to forces of the type in question. It is practically certain that the actual constitution is such that a theory of this kind can be applied.

THE NATURAL HISTORY MUSEUM.

"An independent government of the Natural History Museum is one of the most pressing scientific needs of the times."—*Michael Foster in* 1906.

THE government of the Natural History Museum, to which forcible attention was directed in a letter to the Press on April 19, published in last week's NATURE, stands in urgent need of reform. This has long been recognised by men of science, and, as the writers show in the historical appendix to their letter, the attention of the Government and of the trustees has been directed to it on several occasions in the last forty-three years. Almost every man of science of importance during that period has taken part in one attempt or another to obtain a reform of some of the more serious of the administrative defects. We notice the names of W. B. Carpenter, Charles Darwin, M. Foster, Francis Galton, Hooker, Huxley, Kelvin, Lubbock, Newton, Ramsay, Sclater, Sharpey, Henry Smith, Spottiswoode, Stokes, Turner, Wallace, and all the present professors of zoology and natural history in the universities and principal colleges of the United Kingdom. Further, two Royal Commissions have reported in the same sense, that of 1850 appointed to inquire into the conduct of the museum, and that of 1870 on "Scientific Education and the Advancement of Science."

It would thus appear that for some forty-three years the whole body of scientific opinion has been the same, and has from time to time urged, speaking generally, the same measures of reform, but nothing has been done, and recently the existing arrangements have given rise to grave dissatisfaction. At the outset we desire to point out that, if we understand the letter aright, the signatories, in directing attention to this dissatisfaction, impute no shortcomings to the present working staff of the museum, but they make it clear that the present administrative methods, if persisted in, must lead to failures in the general working of the museum. At present the museum stands at the head of the natural history museums of the world, but, as the *Times* remarks, "if the present system continues it will not only be overtaken, but rapidly put in the background."

The question is a complicated one, and in our opinion cannot be properly dealt with until a full inquiry into the working of the present method of government of the museum has been made. We agree with the deputation to the Prime Minister of last July and with the present writers to the Press in thinking that a Royal Commission is demanded, partly because that is the only means by which the information required can be obtained, and partly because of the dignity and importance of the matter to be inquired into. But if a Commission is appointed we hope that the high social position and importance of the existing board of trustees will not be used to render nugatory its conclusions, as seems to have been the case with the two Royal Commissions which have already dealt with the problem. The first point that comes up for settlement is the nature and functions of the controlling body. If the trustees are retained, as we think it desirable that they should be, and in this we are again in agreement with the deputation of last July, it will clearly be necessary that their number should be reduced, and that those of them who are responsible for the Natural History Museum should be separate from those who are responsible for Bloomsbury. The magnitude and diversities of the interests involved render this reform necessary.

We are further of opinion that the trustees should be, as is largely the case at present, men of the world skilled in affairs, able to attend regularly, and anxious to do their best for the museum, and that the scientific element, whether professional or other, should not be represented as such. This may seem a hard saying, but the reason for it becomes apparent when we consider the function of the trustees. Their powers should be defined and limited. They should not attempt to interfere in the management, because they have neither the time nor the knowledge to do so effectively. Nor should orders be given in their name, but in that of the director. It may be, and has been, replied to this that they should be reinforced and made a competent body from the "expert" point of view; but a little reflection will show that this cannot be done effectively, because it is practically impossible to find men with the requisite knowledge who can without payment give the time necessary for the proper performance of such work. If it is attempted it can only result in the establishment of an inefficient committee of management irregular in attendance (see Panizzi's evidence before the Royal Commission of 1850 on this point), and will almost certainly result in dissatisfaction among those schools of naturalists who are not represented in the management. We think it clear that the management of the museum should be carried on by the director, acting in cooperation with the senior members of his staff, and that the trustees should exercise general supervision and financial control, and act as a final court of appeal. If the trustees require expert advice other than that given by their director, it should come from a board of visitors such as exists in the case of Greenwich Observatory, and was recommended in the fourth report of the Commission on "Scientific Education and of the Advancement of Science" in 1874.

The next fundamental point which comes up for consideration is the relation between the two museums. This has been fully dealt with in the letter referred to, and we are in complete agreement with what is there said. The present arrangement, by which the director of the Natural History Museum is the official subordinate of the principal librarian at Bloomsbury, is, of course, historically intelligible, but from all other points of view is not only unintelligible but absurd. If our suggestion as to the division of the trustees into two bodies is carried out, this anomaly will naturally disappear. It is perhaps unnecessary to labour the point, but we should like to ask the Astronomer Royal or the director of the National Physical Laboratory how they would like to have to submit to the direction of a man of letters or of an antiquarian, however eminent.

A third point of great importance relates to the method of appointment of the officers and servants of the museum. The present method, by which the principal trustees appoint, the subsequent control being in the hands of the general body of trustees, stands condemned, not only by the Commission of 1874 to which we have already referred, but also by the recent lamentable occurrences as a result of which the museum has lost the services of one of the most distinguished naturalists of Europe. In our opinion it is necessary, in the interest of justice and historical accuracy, as well as of the museum, that these occurrences should be inquired into. The Prime Minister, in his reply to the deputation last July, said that he was "still unable to grasp in what way the museum failed to perform its functions." The deputation had carefully, and in our opinion rightly, avoided referring to this point and others similar to it. We admire them for their restraint, but had they done so they would have had no difficulty in convincing the Prime Minister of the radical defectiveness of the present method of government.

However, it is unnecessary for us to deal further with the anomalies of the present system. Enough has been said to show that we are in full general agreement with the views expressed in the letter to the Press of April 19, and by the deputation of last July (see Nature, July 30 and August 6, 1908). We do not pin our faith to any particular treatment of the problem. That can only be done after a full inquiry by a Royal Commission, which we sincerely hope will be granted. The suggestions we have offered have been made more with the view of bringing out the most important of the points at issue than with that of laying down the law as to their treatment.

In saying what we have said we are deeply impressed with the great importance of the Natural History Museum to science and to education. Not only is it a most important means of scientific organisation and of research into problems which have an intimate bearing on human welfare and happiness, but, to quote the words of Sir Michael Foster in his admirable article on the museum in the *Quarterly Review* for 1906, p. 496:—

"It has other uses as well. The museum belongs to the people; it is supported by the people's money; and it is only right that some benefit to the people more direct than that yielded by abstract science should come from it. And great direct benefit can, with some little administrative care, be got from it for the people. In this dull life of ours, above all in this dull city of ours, with its murky surroundings, it is no small thing that an easy stroll, without fee, should bring the dweller in slum alley and unlovely street face to face with the countless beauties of the animal creation; and much of the animal world is beautiful even in death. It is perhaps even a greater thing that, as is clearly shown by what has been done in the past few years, the collections may be so arranged and displayed as to bring to even the careless stroller lessons not only of beauty, but also of wisdom, opening his eyes to some of the great truths of the world of life."

What nobler aims, for which to work and to sink all minor differences, than these, *the welfare of man and the happiness of the people?* Let these be our watchwords, and the evils born of misrule and ignorance shall not prevail.

NOTES.

Prof. R. Meldola, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

Lieut. E. H. Shackleton will describe his recent Antarctic achievements at a meeting of the Royal Geographical Society to be held in the Albert Hall on June 24.

In reply to a question asked by Sir Philip Magnus in the House of Commons on Monday with respect to the administration of the natural history collections of the British Museum, the Prime Minister said he is in communication with the trustees of the British Museum upon the subjects.

On Tuesday next, May 4, Prof. Svante Arrhenius will begin a course of two lectures at the Royal Institution on "Cosmogonical Questions." These are the Tyndall lectures. The Friday evening discourse on May 7 will be delivered by Major Ronald Ross, on "The Campaign against Malaria," and on May 14 by Prof. George E. Hale, on "Solar Vortices and Magnetic Fields."

Lord Avebury will take the chair at the annual conversazione of the Selborne Society, which will be held on May 7 at the offices of the Civil Service Commission (Old London University). Two lectures will be given, the first on "How Birds Fly," by Mr. F. W. Headley, and the second on "How Men Fly," by Mr. T. W. K. Clarke. Mr. James Buckland, the original promoter of the Plumage Bill, will exhibit a number of lantern-slides illustrating the birds that are in danger of extermination in various parts of the world. There will also be a display of microscopes and natural-history exhibits.

The Home Secretary has appointed a departmental committee to investigate and report on the best means of standardising with greater accuracy than at present the apparatus and materials employed in the Abel heat test for explosives, and to examine and report on any supplementary test or tests that may be submitted. The committee is constituted as follows:—Major Aston Cooper-Key, Sir Frederic L. Nathan, Captain A. P. H. Desborough, Mr. F. W. Jones, Captain M. B. Lloyd, Mr. C. O. Lundholm, and Major J. H. Mansell, R.A. The secretary of the committee is Major H. Coningham, R.A., to whom correspondence may be addressed at the Home Office.

The Lisbon correspondent of the *Times* reports that a severe earthquake occurred in Portugal on April 23 about 5 p.m. Reports from up the Tagus show that serious damage has been done in the neighbourhood of Salvaterra, Benavente, and Samora, midway between Lisbon and Santarem. The shocks, which in Benavente extended over three hours, lasted at Lisbon from three to fifteen seconds. A Reuter message from Madrid states that earthquake shocks were registered there on April 23, and also at the towns of Valladolid, Huelva, Val de Peñas, Jerez, Villamanrique, Malaga, and other neighbouring places. The movement registered at the Ebro Observatory lasted 5h. 49m.

The committee for the forthcoming International Aëronautical Exhibition at Frankfort-on-Main is making great efforts to ensure the success and attractiveness of the undertaking. By the middle of April the amount of the guarantee fund, 50,000*l.*, was over-subscribed, and the sum of 6500*l.* had already been promised for prize competitions. Prizes of 500*l.* each are offered (1) by Count Zeppelin for the smallest dirigible balloon which shall make at least five journeys of not less than half an hour's duration, returning to the starting point without intermediate landing, and carrying at least two men; (2) by Dr. Gans Fabrice to anyone who has made the greatest number of flights of more than five minutes' duration; (3) by Baron Krupp von Bohlen-Halbach, the conditions to be arranged by the committee. An ornithological exhibition for the representation of natural flight is being prepared by the Senckenberg Philosophical Society, with the assistance of Prof. Schillings.

An investigating party sent out by the Government at Manila has obtained further particulars of the death of Dr. William Jones, reported in our issue of April 15. It appears that, in returning to the head-waters of the River Cagayan in order to obtain boats, he unwittingly crossed a "dead line" that had been established by a hostile tribe. He was met by a party of warriors, who offered him a dish of fish as a token of defiance, in accordance with tribal custom. Not suspecting that he was thereby accepting their challenge, he ate the fish, and was immediately attacked. He managed to fight off his assailants with his revolver until he could reach a boat, in which he escaped, but he died five hours later from his wounds. His body was rescued by friendly natives. The investigating party has recovered the valuable ethnological collection made by Dr. Jones during his two years' stay in the hills, and it will be sent to the Field Columbian Museum in Chicago.

The Berlin correspondent of the *Westminster Gazette* gives in the issue of April 22 a *résumé* of an article published by Prof. O. Lehmann in the *Berliner Tageblatt*, in which is described the principal conclusions arrived at as the result of his long series of investigations of the properties of liquid crystals and the observations upon which they are based. The subject has already been discussed in Nature for January 7, and attention was directed to the part that liquid crystals appear to play in the growth of living organisms. Prof. Lehmann is so fully alive to the far-reaching importance of his discoveries that he endeavours to arouse popular as well as scientific interest in them. To the general public without knowledge of the phenomenon of double refraction and of the crystalline symmetry which it portends, the fact that a substance possessing the mobility of a liquid should at the same time display polarisation effects which were supposed to be peculiar to rigid structures would seem of little importance, but, when it appears that these curious liquids may in some way be connected with the origin of life, the question ceases to be merely academic.

Captain Henry Toynbee, whose death was recorded in the *Times* of April 22, was born on October 22, 1819. He entered the mercantile marine at the age of fourteen, and followed the sea until 1866. In the following year he accepted the appointment of superintendent of the marine branch of the Meteorological Office. It was in this capacity that most of his scientific work was done, though he had published a number of papers on meteorological, astronomical, or geographical subjects before his retirement from active service. The office had been founded in 1854 for the express purpose of dealing with marine meteorology, and at the time when Toynbee joined it, sufficient data had accumulated to enable a commencement to be made with the publication of average values for the various elements. Among the best-known publications with which his name is associated is a very detailed discussion of the meteorological data for "Square 3" (lat. 0° to 10° N., long. 20° to 30° W.), issued in 1874. This area, lying in the region where the two trade winds meet, is one of special meteorological interest, and the discussion is probably the most detailed that has been attempted hitherto for any oceanic area of equal size. Two years later a somewhat similar, but less detailed, survey of the area between lat. 20° N. and 10° S., and long. 10° W. and 40° W., was issued. This work marked an epoch in the application of meteorology to practical life, for it gives in concise form much information necessary for determining the routes to be followed by sailing ships crossing the equator if they wish to take full advantage of the most favourable winds and to avoid, so far as possible, the equatorial belt of calms. Toynbee retired from the Meteorological Office in 1888, on attaining his seventieth year.

The death of Dr. Simeon Snell, president of the British Medical Association, during his tenure of this important office, and at the early age of fifty-seven, has created a painful impression. Widely known for many years as an assiduous contributor to societies and journals of ophthalmology, his observations have been recognised as of quite exceptional value and importance. A man of wide sympathies, he wielded a great influence in the intellectual life of the city of Sheffield, wherein his ophthalmic practice was conducted, and established many friendships with men of science who visited Sheffield to deliver lectures under the auspices of its Literary and Philosophical Society. His endeavours, both as quondam president and long as secretary of this society, served to maintain the usefulness and reputation of one of those active local associations such as formed the origin of the British Association for the Advancement of Science. In Sheffield he was also recognised as one of the most indefatigable workers in the development of the city university. Outside his own locality, thoroughly practical man as he was, he was well known for contributions to practice and to knowledge arising from work conducted within it. This great centre for the manufacture and manipulation of steel afforded unlimited opportunities for the treatment of eye injuries produced by splinters of metal, and Dr. Snell was the first to elaborate the use of the electromagnet for their removal. Placed in the centre of a large colliery district, his attention was early directed to those peculiarly embarrassing rotations of the eyeball which characterise the disease known as "miners' nystagmus." Whatever may be the cause of this disease, Dr. Snell's monograph on the subject, and the carefully observed conditions described by him as modifying the frequency of its occurrence, will remain as the basis of suggestions and as testimony to the true scientific spirit of medical practice.

An excerpt from the *Harvard Graduates' Magazine*, December, 1908, gives particulars of the expedition which the Harvard Observatory is sending to the elevated plateau of South Africa in charge of Prof. S. I. Bailey. The primary object is the determination of the character of the climate, with the view of finding an ideal site for an astronomical observatory. The first requisite for an astronomical station is a clear sky, free from cloud, haze, smoke, and dust. Since no locality is entirely free from clouds, it is very desirable that those clouds which do occur should be distributed fairly evenly throughout the year, rather than condensed into one decidedly "cloudy season," a condition which prevails in many countries. An ideal station would have freedom from strong winds, a small annual, and especially a small diurnal, range of temperature, low humidity, a reasonable altitude, accessibility, together with the necessaries and some of the comforts of modern life. For the present purpose, also, a station not much less than 30° south of the equator is desired, in order that the entire southern sky may be studied to the best advantage. Such meteorological reports as have been published, together with the accounts of various observers, indicate that excellent conditions for astronomical work exist on the tableland of South Africa. The altitude, which varies from 4000 feet to 6000 feet, is sufficient for the purpose. The records which have been published, however, give only a portion of the data which are needed. The problem can be settled only by a careful study, lasting through one year at least. The present expedition will endeavour to carry out this investigation. In addition to the study of climate, various astronomical investigations will be undertaken. A 10-inch visual telescope, provided with a Rumford photometer, will be used for the measurement of the magnitudes of a large number of stars, among which are sequences of standard stars in selected areas, sequences of comparison stars for southern variables, and so on. A pair of small photographic lenses will also be provided, carried on a single mounting. These are of different focal lengths, and of wide angle. They will be used in certain pieces of routine work, but especially to photograph the faint extensions of the Milky Way and other nebulous regions of the southern sky.

A leading New England paper, the *Springfield Republican*, recently devoted an editorial article to the subject of the popularising of scientific knowledge, as suggested by a speech of Mr. Balfour's a few weeks ago. According to the American writer, the supply is not equal to the demand. "Magazine editors who try to offer their readers first-rate work are in despair for lack of qualified writers. Newspaper editors who glean instructive notes for their columns find a deluge of the hasty, the superficial, the inaccurate, but seldom come upon really competent and well-written work." As to men of science themselves, their habits of intense and concentrated application make them impatient of popular writing. "They are experts, and when they write they write for experts. They think habitually in technical terms, and when it comes to explaining matters to an outsider they do not know where to begin." The *Springfield Republican* offers a practical suggestion to meet the difficulty. There should be established in some university a post-graduate "department of scientific interpretation," open to young men with a literary gift and an interest in science, but too versatile and active minded to make good specialists—men who had already passed through scientific and mechanical courses in their undergraduate years. "The head of their department, if only his services were available, would be Prof. Thomas H. Huxley." The purposes to be especially kept in view in their training would be "the acquirement of method, a clear comprehension of scientific principles, a broad survey of current scientific work, comprehension of the scientific type of mind, the ability to understand men who cannot explain themselves, the technique of simplifying, elucidating, illuminating by simile and analogy." The *Republican* is confident that a training of this kind would be an excellent preparation for all kinds of writers for the Press. "They would be ground between scientific accuracy and the demand for intelligibility as between the upper and the nether millstone, and if they did not emerge a finished product it would not be the fault of the process."

Mr. E. Thurston's paper on "Native Man in Southern India," delivered before the Royal Society of Arts on March 25, is a popular and anecdotal *résumé* of a subject already dealt with by him in his "Ethnographic Notes from South India," and the Bulletins of the Madras Museum, of which he is curator. He points out that while the population of the Tamil country and Malabar is dolichocephalic, that of the more northern districts is mesaticephalic or sub-brachycephalic. He declines to enter into a discussion of the causes which may have led to this variance of race type, and he thus tacitly rejects the theory of Sir H. Risley, that the short-headed people of the southern Deccan represent a Scythian immigration from northern India. Mr. Thurston gives interesting details of some curious customs—the dilation of the ear lobes among Shánan women; the rule which forbids women to drape the breast; the use of leaf garments; and the gradual rise in status of the primitive jungle man, who nowadays makes a caste mark on his forehead with ashes or anilin dyes, and uses lucifer matches in lieu of the old method of obtaining fire by friction. It is shown that it is a popular misconception to suppose any of the non-Aryan tribes to be woolly-haired, and the puzzling appearance of the cross-bow as a weapon among the Ulladans of Travancore is proved to be the result of Portuguese influence.

We have received cuttings of several articles from the *Melbourne Argus*, in which Mr. J. W. Barrett describes the experiences of a party of tourists interested in natural history who made a new year's trip to some of the small islands in Bass Strait. One of the features of the excursion was a visit to the seal-rocks at Westernport, where the seals which formerly frequented several of the islands alone survive. It has been suggested that the numbers of these animals should be reduced, on account of supposed future injury to the fisheries, but, apart from the fact that they do not usually eat fish, the writer points out that their numbers have probably not altered appreciably for centuries, and that the "balance of nature" is almost certain to be maintained in the future. The trip also included an inspection of the wonderful breeding-colony of gannets on Cat Island, where some 4000 of these birds were nesting at the time of the visit.

The heredity of the colour of hair in man is discussed at considerable length by Gertrude and Charles Davenport in the April number of the *American Naturalist*. As regards the nature of the colouring, the authors consider that there are probably two main types of pigment in human hair, one a reddish-yellow, which finds its highest development in bright red, and the other a sepia-brown, the intensity of which ranges from light yellow to dark brown and black. As the result of a combined study of both eye-colour and hair-colour, the writers finally arrive at the conclusion "that two parents with clear blue eyes and yellow or flaxen straight hair can have children only of the same type, no matter what the grandparental characteristics were; that dark-eyed and haired, curly-haired parents may have children like themselves, but also of the less developed condition. In the latter case what the proportions of each type will be is, for a fairly large family, predictable by a study of the immediate ancestry."

We have received from the Bureau of Entomology of the United States Department of Agriculture a paper by Mr. J. J. Davis containing biological studies of three species of Aphididæ, the corn-root aphis (*Aphis maidiradicis*, Forbes), the corn-leaf aphis (*Aphis maidis*, Fitch), and the sorghum aphis (*Sipha* [*chaitophorus*] *flava*, Forbes). The life-cycle of the aphis is very curious, no fewer than five forms being recorded for the corn-root aphis, viz. winged viviparous females, wingless viviparous females, oviparous females, males, and eggs. From the eggs some ten to twenty-two generations of viviparous females follow, but the last generation of the season consists of oviparous wingless females and males, which pair, and the females produce eggs. Evidence is adduced to show that external conditions of temperature, &c., determine whether a particular generation is to be viviparous or oviparous; it is considered that aphides could reproduce parthenogenetically for an indefinite period if the environment was favourable. The biological problems involved are of great importance. Bulletin No. 66, by F. H. Chittenden and H. M. Russell, deals with the semi-tropical army worm (*Prodenia eridania*, Cram.), a hairless caterpillar doing much damage to market-garden crops. Arsenical sprays were found to be effective against it.

Mr. C. Baker, of 244 High Holborn, London, W.C., has issued his quarterly classified list of second-hand scientific instruments for sale or hire. He offers a very large stock of microscopes and microscopic apparatus which, as in the case of all instruments catalogued, have been inspected and where necessary repaired. The list also contains a varied selection of surveying instruments and other apparatus classified under eight sections.

The report of the commission for the flora of Germany regarding new localities for plants recorded during the years 1902 to 1905 has been published as a supplement to last year's volume of the *Berichte der deutschen botanischen Gesellschaft* (vol. xxvi., A). It is a continuation of the reports issued as part of the supplements to the twentieth and earlier volumes of the *Berichte*, but is confined to phanerogams. The arduous task of compilation has been undertaken by Prof. K. W. von Dalla Torre. As in previous reports, the systematic list of records is arranged according to the floras of Koch and Garcke, and is preceded by a bibliography of publications consulted.

The notes contributed by Mr. J. E. C. Turner to the *Indian Forester* (February) on the germination of myrabolan seedlings, *Terminalia chebula*, are of interest, as the conditions must be somewhat similar in the case of not a few drupaceous fruits yielded by trees. Some myrabolan fruits are plump and round, others are strongly ridged; the latter are preferred commercially, but the former are recommended for propagation. The ridges are due to the shrinking of the mesocarp, which causes also the tighter and more solid encasement of the seed. The fruits are sometimes penetrated by a fungus which reduces the mesocarp to powder; in this case, or when for other reasons the mesocarp does not shrink, the fruits remain round, and at germination the embryo has little difficulty in emerging.

An important contribution to the classification of the Geoglossaceæ, a family of ascomycetous fungi, has been furnished by Dr. E. J. Durand, who has published in the *Annales Mycologici* (vol. vi., No. 5) a systematic account of North American species. It is based on the examination of many type-specimens and duplicates in American and European herbaria, and is fully illustrated with outline drawings and photomicrographs. Two groups are distinguished, the Geoglosseæ, mostly clavate, like a simple type of Clavaria, and the Cudonieæ, mostly pileate. Under Geoglosseæ seven genera are identified, including Microglossum and Corynetes for the hyaline-spored species, and a genus, Glœoglossum, for species of a viscid, gelatinous consistency. The Cudonieæ are arranged under the four genera Leotia, Vibrissea, Apostemidium, and Cudonia. Confirmation is given to the researches of Dittrich that the young hymenium of many species is covered by a veil, comparable to the "volva" of the agarics; it is best seen in *Cudonia lutea* and *Spathularia velutipes*.

The report of the East Kent Scientific and Natural History Society for the year ending September, 1908, contains the presidential address delivered by Mr. S. Harvey at the commemoration of the jubilee of the society. Among the notes there is reference to the discovery of *Salvia verticillata* near Dover, where, according to the Rev. J. Taylor, it appeared to be well established; this plant is not listed in Hooker's "Student's Flora" or in the "London Catalogue," but is given in Dun's "Alien Flora of Britain." Another interesting find, made by Mr. W. R. Jeffery on Westwell Down, was an apparent hybrid between *Verbascum Lychnitis* and *Verbascum Thapsus*. The hybrids were much taller than the species, produced inflorescences similar to *Lychnitis*, but bore yellow flowers like *Thapsus*.

Dr. L. Ritter von Sawicki publishes a discussion of the vexed problem of the Rhine-Rhone water-parting in the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde. The main conclusions at which he arrives are four in number:—(1) the present Rhine-Rhone water-parting was formed during the Quaternary period, and destroyed the unity of the former system which flowed to the Rhine; (2) it was formed by a displacement of the old divide caused by lowering of the Geneva basin. This lowering (3) can be correlated with the levels of inter-Glacial times; (4) the "Bühl" period is an important epoch in the glacial time, and on the Lake of Geneva it can be divided into at least three phases, of which the second is the most important.

The International Council for the Exploration of the Sea has issued a supplementary part of the "Bulletin Trimestriel" for 1906–7, containing a *résumé* of the observations made and the results obtained in the areas under investigation. The region is divided into eight sections:—the Gulf of Bothnia, the Baltic (including the Gulf of Finland, the waters between Rügen and Scania, and the Baltic proper), the Belts and the Kattegat, the Skagerak, North Sea and English Channel, the Irish Sea, the Atlantic, the Norwegian Sea, and the Arctic Sea, and in each case a short description is given of the general distribution of temperature and salinity. Twenty-three plates giving mean values from August, 1902, to May, 1906, accompany the memoir, which is invaluable as marking a stage in the discussion of the vast quantity of material acquired by the council. It is obviously impossible to give, in the space at our disposal, even a short abstract of the results stated; suffice it to say that in each subdivision marked progress has been made in the elucidation of the difficult problems of surface and under-surface circulation.

The Bulletin of the Imperial Society of Naturalists of Moscow (vol. xxi., No. 4) contains a detailed and valuable discussion, by Dr. E. Leyst, of the meteorological observations made in 1907 at the observatory in connection with the university of that place. Observations are made thrice daily, and these are used as standards for checking the hourly tabulations from the self-recording instruments, of which the observatory possesses a very complete set. The year 1907 was about 2°·2 F. below the normal; the mean was 36°·9; January 4°·6, July 65°·5. The extreme readings were 85°·3 and −27°·2; the absolute extremes during the last fifteen years were 96°·3 and −34°·6. Only 198 days in the year 1907 were quite free from frost. The rainfall, &c., amounted to 20·87 inches, the number of days being 209; the amount was normal, but the average number of days of precipitation is 171. The hours of bright sunshine numbered nearly 1300—about the average for the north-east of England. Although the results are not published in this summary, the observatory records earthquake phenomena, observations of atmospheric electricity, and terrestrial magnetism. The investigation of the upper air has been temporarily suspended for want of funds.

When carbon, metals, or metallic oxides are heated in a vacuum they give out negative electrons, and expressions for the number of electrons emitted in a second, the electric charge they carry, and the energy with which they leave the surface from which they are emitted, have been given by Profs. O. W. Richardson and H. A. Wilson. Part iv. of the *Verhandlungen der deutschen physikalischen Gesellschaft* contains an abstract, and part iii. of vol. xxviii. of the *Annalen der Physik* a complete account, of the measurement of the energy of these electrons recently made by Drs. A. Wehnelt and F. Jentzsch, of the University of Berlin. They measure the energy necessary to keep the temperature of a platinum wire covered with calcium oxide constant, first when electrons are, secondly when they are not, emitted by the surface. They find the agreement between theory and experiment altogether unsatisfactory, and conclude that the present theory is not a correct representation of the phenomena of emission of electrons from glowing bodies.

The March number of *Terrestrial Magnetism and Atmospheric Electricity* contains an abstract by the author, Dr. L. A. Bauer, of the report recently issued by the United States Coast and Geodetic Survey, dealing with the results of the magnetic survey work in the country up to 1906. This report is the most complete summary published up to the present, and supersedes previous reports. The stations used in the survey are on the average thirty-one miles apart, and the charts cover a considerable area of the surrounding ocean. All values relate to 1905 January 1, and are corrected for diurnal variation. The secular changes in the United States appear to be much more complicated than has been supposed hitherto, and if cyclic must have subperiods as well as a principal period. Dr. Bauer is already examining the data with the view of determining what part of the magnetic field is referable to a potential, and hopes to base other investigations on the material the report supplies.

The *Journal of Physical Chemistry* has during recent months been occupied largely by a series of papers by Prof. Bancroft on the electrochemistry of light. In the fourth and fifth papers of the series the "problem of solarisation" is discussed at length, the two papers covering ninety pages of the January and seventy pages of the March issue. Bulky quotations are given from the original literature, and the monograph therefore does for one branch of modern scientific work the same service that Ostwald has performed by reprinting various classics of exact research. The February number will be read with interest, as it contains Kahlenberg's reply to the criticisms of Cohen and Commelin of his work on the osmotic pressure of solutions in pyridine with a rubber membrane. It will be remembered that Kahlenberg obtained pressures for inferior to those deduced by means of the gas-equation; Cohen and Commelin, with an improved apparatus, also failed to reach the calculated pressures, but attributed their failure to experimental imperfections. In the present communication the validity of the original experiments is maintained, but no new evidence of importance is brought forward.

One of the principal machines to which the requirements of a modern boiler-house have given birth is the automatic recorder of carbon dioxide. Such recorders are devised to take samples of the flue gases at intervals of, say, two or four minutes, analyse them for the percentages of CO_2, and record the results on a chart driven by a clock. A continuous record is thus obtained throughout the whole period at which the boilers are at work, and is of value in showing whether proper conditions for maintaining complete combustion have been preserved. As the record is visible at all times, stokers rapidly learn to preserve economical conditions. Some tests on the Simmance-Abady combustion recorder have been made recently by Mr. Rosenhain at the National Physical Laboratory, and are commented on in *Engineering* for April 16. Samples giving 4·99 per cent. of CO_2 by the Sodeau hand analysis apparatus were recorded by the automatic instrument as 4·91 per cent., the draught being 0·75 inch of water. This result corresponds to an avoidable loss in fuel of 32 per cent. Another sample, showing 9·09 per cent. by hand test, was automatically recorded as 8·98 per cent., the avoidable loss of fuel in this case being 10 per cent. Another sample, showing 15·88 per cent. by hand test, was recorded as 15·39 per cent.; this percentage represents the highest possible under economical working with bituminous coal. Taking the mean of all the tests, the recorder was less than half of 1 per cent. low. As the charts are graduated to read to 1 per cent. only under ordinary conditions, the results of the trials must be regarded as extremely satisfactory for this recorder.

A paper on problems connected with the construction of the *New York Times* building was read by Mr. C. T. Purdy before the Institution of Civil Engineers on April 20. The Underground Railway passes through the basement of the building, and the paper describes the special features of the steel construction due to the existence and operation of the railway. The height of the building from the pavement to the twenty-third storey is 329 feet, and above this is an observatory and lantern, the roof of which is 30 feet higher; the basement storeys extend 48 feet below the level of the sidewalk. The total dead weight of the building is 33,611,000 lb. (15,000 tons). The problem of vibration arising out of the Underground Railway needed special treatment. In addition to making the structure of the subway independent of the building, it was arranged to found the supporting columns of the former on cushions of sand, and thus still further to insulate the building. The results at first were quite satisfactory, and no vibration was felt from passing trains; but later distinct vibration was detected, and at last this became very pronounced. Seismograph observations were taken, and a thorough examination of the two structures was made. The trouble disappeared when the railway company re-laid the tracks through the building, all perceptible vibration then ceasing. The author considers, nevertheless, that the insulation of the two structures and the provision of the sand-cushions for the subway columns have a material effect in producing this result. Under many conditions such insulation of structural members would be the most effective and economical method of preventing vibration. It is stated that it was certainly efficient in the new building, which has four railway tracks through it, and often three or four trains in the building at the same time, some stopping and others passing through at high speeds.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in May:—

May 1. 12h. Jupiter stationary.
5. 9h. 43m. Satellite III. occulted by Jupiter, reappearance 13h. 12m.
5. Red spot visible on Jupiter's disc between 8h. and 9h.
7. Red spot visible on Jupiter between 10h. and 11h.
13. 3h. Mars at quadrature to the Sun.
16. 3h. 33m. Satellite III. transits Jupiter's disc, egress 7h. 3m.
19. 11h. 34m. Venus in conjunction with the Moon (Venus 1° 6′ N.).
20. 4h. Mercury at greatest elongation E. of the Sun (22° 22′).
23. 7h. 28m. Satellite III. transits Jupiter, egress 10h. 57m.
26. 11h. 5m. Jupiter in conjunction with the Moon (Jupiter 4° 13′ S.).
26. 23h. Jupiter at quadrature to the Sun.
30. 11h. 27m. Satellite III. transits Jupiter, egress 14h. 56m.

The Meteoric Shower of Halley's Comet.—Mr. W. F. Denning writes:—

"The stream of meteors radiating from near η Aquarii in the mornings between May 1 and 6 should be looked for with special attention this year, as the shower is supposed to owe its parentage to Halley's comet. The latter is approaching the sun rapidly, and will probably be discovered next September.

"Should the meteors prove to be unusually abundant this year and in 1910, the fact may be accepted as conclusive evidence that they are directly associated with Halley's comet. Experience has proved that meteors may swarm in front of a parent comet as well as behind it. Prof. Newton pointed out that the Andromedid meteors precede Biela's comet to a distance of 300 millions of miles along the orbit.

"At Greenwich the radiant of the Aquarids does not rise until about 1.30 a.m., so that observations will be useless before that time, and there is only a short interval left for effective watching, for daylight has so far advanced at 3 a.m. that only really conspicuous meteors can be observed. This year the moon will be full, and her strong light will obliterate the fainter meteors, but the Aquarids are generally pretty bright, with long flights of 40 or 50 degrees, so that should the shower abundantly return this year it may be expected to present a striking aspect, notwithstanding the presence of our satellite."

Comet Morehouse, 1908*c*.—This comet was observed by Prof. F. Ristenpart at Santiago de Chile on March 28 and 30, and the observations show that, on these dates, the ephemeris published by Herr Ebell in No. 4296 of the *Astronomische Nachrichten* required corrections of +2m. 2s., −1·0′, and +1m. 43s., −2·2′, respectively (*Astronomische Nachrichten*, No. 4318).

The "Original" Canals of the Martian Doubles.—Usually the twin lines forming the double canals on Mars are equally intense, but on occasions one line appears to be more conspicuous than its fellow. The reduction of Prof. Lowell's 1907 observations shows that, with one or two exceptions, it is always the same canal of any pair that becomes weakened, sometimes to extinction.

A table given in Bulletin No. 37 of the Lowell Observatory shows that, of twenty-two double canals observed during the opposition of 1907, eighteen definitely presented the phenomenon of unequal intensities. Of these, sixteen always showed the one line of the pair, the "original" canal as Prof. Lowell names it, stronger than the other; the period of observation covered the epoch of minimum visibility of the doubles.

The two exceptional canals were the Gihon and the Is, and in both cases there is a possible explanation of their apparently anomalous behaviour. For the former this depends upon the fact that when the eastern line was the stronger the canal was still being fed from the north polar cap, whilst when the western line preponderated the canal was sharing in the general southern darkening of the canals of the southern hemisphere. A similar explanation holds in the case of Is. Comparisons with Schiaparelli's observations confirm the phenomenon.

Chromospheric Calcium Lines in Furnace Spectra.—In No. 32 of Contributions from the Mount Wilson Solar Observatory Dr. A. S. King discusses the behaviour of the calcium lines H, K, and λ 4227 in the spectrum obtained by heating calcium to various temperatures, and under varying conditions of density, in the electric furnace.

His experiments at the Pasadena laboratory show that whilst the line 4227 appears at a low temperature, and is not sensitive to increases of temperature, it is enormously strengthened by increasing the amount of calcium vapour present. On the other hand, H and K do not appear until the temperature approaches 2500° C., and are very sensitive to temperature variation, whilst but little affected by increasing the quantity of calcium vapour.

Dr. King points out that although these results do not throw much light on the study of sun-spot spectra, they are in strict accordance with eclipse observations of the chromosphere. H and K appear alone in the higher regions of prominences, but 4227 does not appear until the chromospheric vapours reach a considerable density.

Mount Wilson Solar Observatory Report.—Prof. Hale's report of the work done at the Mount Wilson Observatory during 1908 is too compendious to notice in detail, and many of the results mentioned have already been abstracted in these columns, but there are one or two points which may be mentioned. Prof. Hale states that the electric-furnace experiments have confirmed the conclusion that the temperature of the vapours of Fe, Ti, &c., in sun-spots is lower than that in the "reversing layer" outside spots.

Mr. Abbot, of the Smithsonian Institution, is still engaged in the studies of the solar constant, and arrangements have been made by the institution to construct a permanent station on Mount Wilson, where such studies will be regularly maintained. The total number of spectroheliograms taken with the 5-feet spectroheliograph amounted to 5196 on September 30, 1908.

An investigation dealing with the absorption and scattering of light in the solar atmosphere has just been completed by Prof. E. F. Nichols, of Columbia University, and the observations are in course of reduction.

A spectrocomparator has been added to the laboratory equipment, and is being used for the comparison of the intensities of spectrum lines. The definite reduction of the photographic sun-spot spectra is being carried out, and some idea of the magnitude of the task is afforded by the statement that between λ 5000 and λ 5500 there are more than 1500 lines for which wave-lengths and laboratory identifications have to be determined.

THE ELECTRIFICATION OF RAILWAYS.

The presidential address delivered by Mr. John A. F. Aspinall in the lecture hall of the Institution of Mechanical Engineers on Friday, April 23, proved to be a most agreeable surprise to those members who were fortunate enough to be present. Addresses on such occasions are apt to take a historical or academical form, and many experiences of this character served to emphasise the interest taken by the audience in Mr. Aspinall's clear account of the electrification and experiences gained in the working of the Liverpool and Southport branch of the Lancashire and Yorkshire Railway, of which the author is the distinguished head, since its inception in October, 1902.

It is too often stated that a general electrification of our railways would be of very great advantage. In certain instances this work can be undertaken with great commercial success, but each case has to be considered with great care, not only on account of the costly character of the work, but also because the conditions upon which success or failure depend vary in almost every place or district. To warrant the electric equipment of a main line of railway, dealing in present circumstances with long steam-hauled trains at high speed for long distances without a stop, some great commercial advantage must be shown. Business men can easily arrange their journeys at present between Liverpool or Manchester and London so as to have five hours in town. Even supposing a speed of 120 miles per hour to be attained by electric traction, the gain to the traveller would be small, while the increased cost to the railway would be enormous. Again, such fast trains would practically prohibit the use of the same tracks for the running of slower local trains, and would necessitate separate tracks for these. The earning capacity of the express tracks would thus be diminished.

On the other hand, in the case of many suburban lines from our great cities, electrification will at once double the train-carrying capacity of the tracks, while in others it will allow a greater time space between trains, which may be utilised for the passage of steam-worked express trains coming in from the more distant parts of the line. In a district where a railway has had its tracks paralleled by tramways, the creation of an electric railway service will have the immediate effect of bringing back large numbers of passengers who have used the trams in the early stages of their construction, but who find that they cannot tolerate the great waste of time which results from the very slow speed and the many stops due to the crowded streets through which the trams have to run. Some of the advantages of electrification for local services are:—

(*a*) High schedule journey speed.
(*b*) Much more frequent service when required.
(*c*) Increased acceleration and deceleration.

(d) Greater possible mileage per train per day, increasing the earning capacity of any given quantity of rolling stock, and increasing the loading and unloading capacity of existing platforms.

The Southport branch of the Lancashire and Yorkshire Railway has proved to be a commercial success under electric working. It consists of a coast line of $18\frac{1}{2}$ miles, having fifteen stations. The total length of electrified line in the district amounts to four miles of four tracks and twenty-five miles of double tracks, making a total of seventy miles of single track, including sidings. It has been found possible to run all the passenger traffic on the double track on the section having four tracks, leaving the other double track free for goods traffic, thus enabling several stations on the goods track to be closed. The line is considered to provide the fastest service of this character in existence. Stopping trains run $18\frac{1}{2}$ miles, stop fourteen times, and do the journey in thirty-seven minutes. Express trains run the same distance in twenty-five minutes.

During the transition stage from steam to electrical working there came a period when it was necessary to run steam trains in between the electrical trains at the same speed in order to keep them out of the way of the latter. An opportunity was thus afforded of comparing the coal consumption of the locomotives and the power house, and it was found that the six-wheeled coupled tank engines which did the work in 1904 consumed 80 lb. of coal per train mile with express trains, and 100 lb. with stopping trains. The consumption of coal at the power station in 1908 works out at 49 lb. per train mile for the electrical trains.

The time necessary for the conversion from steam haulage to electric traction is of importance. In the case of the line under discussion, the order for commencing the work of electrification was given on October 22, 1902, and the work was finished and the steam trains entirely withdrawn on May 13, 1904.

After considering the questions of the wear in third and fourth rails, Mr. Aspinall dealt with the important matter of the excessive wear of track rails in electrical working. In his opinion, the special rails introduced by Sandberg were not the real cure. The real fault is one of construction. The more or less modern motor truck has all the defects of the older-fashioned locomotives on account of the low position of the centre of gravity. The modern steam locomotive with a high centre of gravity is a very easy riding machine. A motor-car, with its four axles, has a total weight of 12 tons, which is not carried by the springs. Raising the centre of gravity so as to enable this weight to be spring-borne would introduce additional mechanism, and would also block up the passages from car to car. The great advantages of direct drive would be lost, and as the present gears run extremely well it may be a more commercial method to wear out the cheap rail instead of expensive mechanism.

The cars on the Southport line are 60 feet long, and have large side doors at each end. These doors are opened or closed by the public themselves, who, by a bye-law sanctioned by the Board of Trade, are required to enter the car by the rear door and leave by the front door. This system requires a smaller platform staff, but as the larger number of electric trains requires more guards, the total number of men employed remains the same. During the rush hours the cars are emptied in fifty seconds at terminal stations, while intermediate stops consume fifteen seconds only.

Mr. Aspinall favours overhead conductors wherever possible. In the particular case of the high-tension line connecting Aintree with Seaforth, the cost per mile of the overhead equipment was 1300*l.*, while the cost per mile of the cable line was 2030*l.*

It was decided in 1905 to install battery plants; the general idea was to provide for running the whole railway for one hour in the event of any serious accident at the central generating station. The battery substations are placed at points intermediate to the rotary substations, and have had the effects of reducing the momentary peaks in the load from a maximum of 7000 kw. to 4500 kw., and the hourly peak during the rush hours from 3800 kw. to 3100 kw., enabling the load to be carried during the winter with 4500 kw. of plant, and during the summer with 3750 kw. of plant.

The total over-all efficiency was found in July, 1906, to be 81 per cent. from the alternating current bus bars to the circuit breakers on the trains. The coal burned at the power house per unit of direct current delivered to the third rail, including all conversion losses, amounted to 3·28 lb. for the twelve months ending December 15, 1908.

In 1907 the Aintree line was electrified, and has led to the recovery of much of the traffic which had been taken away by the Municipal Tramways, which run parallel to the railway. On Grand National Day the race traffic on this section amounts to 13,000 people in about $2\frac{3}{4}$ hours.

Mr. Aspinall estimates that any railway company having facilities for putting its own plant down in the country, with opportunities of getting cheap coal and water, should be able to produce current at the generating stations at a "works cost" of 0·25 penny per B.T.U. A high-speed service could then be worked at a cost of 9·5*d.* per train mile. No amount for depreciation, other than battery depreciation, is included in this, or for interest on outlay. The figure does not include the maintenance of running track and stations, costs of platform staff, or other items common to both steam and electric lines. The great economy to be hoped for in the future for electrical railways, where no water power is available, is in the production of electricity in very large quantities; the total current-producing charges amount to the large proportion of 4·52*d.* out of the above-mentioned 9·5*d.* Other possible economies are in the direction of such improved design in the motors as will lead to less repairs and a very careful consideration of the whole design of the motor truck. Items which may be put down as giving no trouble whatever are controllers, commutators, steel spur-gearing, and the third rail.

Mr. Aspinall looks forward to the opportunity which he hopes to afford members of the institution during the summer meeting at Liverpool of seeing the Liverpool and Southport line at work. The proceedings terminated with a hearty vote of thanks to the president for his interesting and valuable address, moved by Sir Wm. White, K.C.B., and supported by Mr. W. H. Maw.

There are ten appendices, with curves and photographs, giving minute information regarding the working of this line of railway.

SOME RECENT PALÆONTOLOGICAL PAPERS.

THE description of the fossil flora of Tegelen-sur-Meuse, near Venloo, in Holland, by Clement Reid, F.R.S., and Eleanor M. Reid (*Verhandel. d. kon. Akad. van Wetenschappen te Amsterdam*, September, 1907), is remarkable as showing how skilfully devised methods of observation will reap a rich harvest from "a box of clay easily carried by a man." The specimens of seeds washed or floated out of this Pliocene clay were temporarily preserved in formalin or salicylic acid; they were then washed in water, and each was placed, still wet, on a film of paraffin wax on a glass slide. The plate was immediately warmed from below, and the paraffin rose to take the place of the water evaporated from the seed. The surface could be cleaned with benzine, and the seed was now so tough that it could be easily handled. The Tegelen flora indicates a stage just earlier than that of the Cromer Forest bed.

An illustrated paper on historic fossil cycads, by G. R. Wieland (*American Journal of Science*, vol. xxv., 1908, p. 93), directs attention to new points in some of the great cycad stems and casts in the museums of Europe. The type *Cycadeoidea etrusca* in Bologna is a silicified stem that was used as a sharpening stone in an Etruscan city some 4000 years ago, and it is claimed as "the most anciently collected of all geological specimens."

From Japan come two papers on fossil plants (Journal of the College of Science, Tokyo, vol. xxiii., 1908, articles 8 and 9). In the former, M. Yokoyama describes spoils of war, in the form of Upper Carboniferous plants collected during the recent campaign in Manchuria. In the latter, H. Yabe, whose work on Fusulina has been previously noticed in NATURE, shows how the occurrence of *Giganto-*

pteris nicotiaenifolia in the Mungyong beds of Korea marks these strata as of Triassic age.

In the Proceedings of the United States National Museum, vol. xxxiv. (1908), p. 281, G. H. Girty describes an interesting series of sponges from the Carboniferous of Kansas, for which he is obliged to erect three new genera, Heterocœlia, Mæandrostia, and Cœlocladia. The specimens are now calcareous, and the first two were probably calcispongiæ, while Cœlocladia was a lithistid.

Mr. Girty goes on (p. 293) to describe several new Carboniferous brachiopods. The brachiopods of the Cambrian are added to by C. D. Walcott (Smithsonian Miscellaneous Collections, vol. liii., No. 1810, October, 1908). In a subsequent paper (*ibid.*, No. 1811) the same author gives a useful classification and terminology of the Cambrian Brachiopoda, in which attention is given to the structure of the shell and to the terms applied to its numerous details. A plate illustrates the microscopic structure.

Prof. A. P. Pavlow devotes a finely illustrated folio memoir to the relationships of the lamellibranch Aucella, with a review of all known species. An appendix deals with the Aucellinæ from the Russian Cretaceous strata (*Nouv. Mém. Soc. imp. des Nat. de Moscou*, tome xvii., 1907, p. 1).

Dr. L. Waagen, as an addition and a tribute to Bittner's work on the lamellibranchs of the Alpine Trias, has described "Die Lamellibranchiaten der Pachycardientuffe der Seiser Alm" (*Abhandl. d. k.k. geol. Reichsanstalt*, Bd. xviii., 1907, Heft 2, folio, price 30 kronen). Material gathered by Bittner before his death has been utilised and compared with a series of specimens in the collections of the University of Vienna. The memoir is no mere record of species, but contains philosophic criticisms of the position of several genera, such as Neumayr's Heminajas (p. 140), Sowerby's Myoconcha, and King's Pleurophorus (p. 154).

"Die Acanthicus-Schichten im Randgebirge der Wiener Bucht," by Franz Toula (*Abhandl. d. k.k. geol. Reichsanstalt*, Bd. xvi., Heft 2, 1907), forms yet another handsome folio, and is mainly devoted to ammonites. The author in 1905 found to his surprise, south-west of Vienna, a highly fossiliferous exposure of Upper Jurassic limestone. Quarrying operations allowed of the collection of a large amount of good material, including a new species, *Phylloceras giganteum*, measuring 44 cm. in diameter. Eight new species of Perisphinctes alone come from this limited locality. The author modestly explains that he has dealt with these fossils personally, since they came direct into his hands, and he felt a sort of devotion to them which it might have been hard to arouse in another worker. Nineteen exceptionally fine photographic plates place the features of the actual specimens before the critics whose comment is invited by the author.

An important stratigraphical and zonal paper, by N. T. Karakasch, on the Lower Cretaceous of the Crimea, appears in the *Travaux de la Société impériale des Naturalistes de St. Pétersbourg*, vol. xxxii., 1907. Numerous new species of cephalopods, among other fossils, are described and figured. Hoplites, it is noted, disappears in the Crimea before the Aptian epoch, though it occurs in higher series in other parts of Russia and in the Caucasus. The paper is accompanied by an abstract in French.

Dr. Kitchin's memoir on the invertebrate fauna and palæontological relations of the Uitenhage series (Ann. South African Museum, vol. vii., part ii., 1908) is also mainly concerned with molluscs. Bivalves are here prominent, but the ammonites furnish new species of Holcostephanus, which are shown among the beautiful figures drawn by Mr. T. A. Brock. The author strongly confirms the opinion, which has been gradually spreading, that these interesting beds in Cape Colony are of Lower Cretaceous and not of Jurassic age.

In "New Cretaceous and Tertiary Fossils from the Santa Cruz Mountains, California," by R. Arnold, of the U.S. Geological Survey (Proc. U.S. National Museum, vol. xxxiv., 1908, p. 345), a number of new molluscan species are figured from strata ranging from the Cretaceous to the Pliocene. Dr. Otto Wilckens issues a paper of faunistic importance on "Die Lamellibranchiaten, Gastropoden, &c., der oberen Kreide Sudpatagoniens" (*Ber. d. naturforsch. Gesell. zu Freiburg-im-Breisgau*, Bd. xv., 1907, p. 97). The material collected by Prof. Hauthal and sent to Prof. Steinmann was not in a good state of preservation, owing to earth-pressures and weathering processes, but a great deal that is new among molluscan species has come to light. Dr. Paulcke follows (p. 167) with an account of the cephalopods from the same strata, including several new species of Hoplites. On p. 83 Dr. Wilckens, in a sketch of the geology of south Patagonia, places these fossiliferous beds as Upper Senonian.

Almost simultaneously, the seventh volume of the Anales *del Museo Nacional* appeared in Buenos Aires, consisting of H. von Ihering's memoir of 600 pages on "Les Mollusques fossiles du Tertiaire et du Crétacé supérieur de l'Argentine." Dr. von Ihering places himself in accord with Dr. Florentino Ameghino and against Dr. Wilckens on the question of the "Pan-Patagonian" system, which he consequently regards as Eocene. With some justice, he claims that the Tertiary beds of South America are to be judged by their own inter-relations, and not by the sequence in North America or Europe. He believes that a continental barrier, required also on zoological grounds, united southern Brazil and Africa in Eocene times. The characters of the Eocene fauna of Argentina are thus Antarctic and Indo-European rather than North American. The author, in determining his systems, relies on the principles of Lyell and Deshayes, laying great stress on the proportion of the molluscan species that are to be found in existing seas (pp. 95, 113, and 419). The Pan-Patagonian system is thus regarded as Eocene, the Entrerian as Miocene, and the gap between these as filled by the Magellanian or Oligocene. Ameghino, however, has placed the Entrerian as Oligocene. The pebble-beds that extend along the Patagonian coastlands from Tierra del Fuego to the Rio Negro are now known to contain molluscan bands, and Darwin's belief that they were marine is thus confirmed (p. 391). This "Araucanian" formation is classed as Pliocene. Von Ihering thinks that the lower part of the much-discussed Pampas system may be Pliocene, while the higher marine beds proclaim the upper part as Pleistocene. In southern Brazil and on the Buenos Aires coast there are still younger Pleistocene deposits, representing a considerable incursion of the sea (p. 431). The section of the memoir (p. 482) which traces the history of the successive marine faunas raises many questions that affect palæontology, zoological distribution, and general geology. On p. 545, for instance, examples are given of the influence of oceanic climate in sending the littoral species of temperate zones into deeper waters near the tropics, and in allowing of a "bipolar" distribution of other forms, since they can live at great depths over all the oceanic area intervening between the poles. The criticism of so extensive a memoir must be left to specialists, but it is clear that its conclusions will interest geologists of very different lines of study.

In the Proceedings of the Cotteswold Naturalists' Field Club, vol. xvi. (1908), p. 143, Mr. E. Talbot Paris describes echinoids from the Lias of Worcestershire, and, with Mr. L. Richardson (p. 151), writes on the stratigraphical and geographical distribution of the Inferior-Oolite echinoids of the west of England. The latter paper, while relying in part on Wright's work, makes useful additions to it, new species being introduced and figured.

Mr. A. W. Slocom describes several new crinoids, belonging to genera already known, from the Niagara Limestone of Chicago (Field Columbian Museum, Geol. Series, vol. ii., 1907, p. 273). Two new species of the aberrant genus Zophocrinus are included. Mr. R. Arnold, whose molluscan work is above referred to, describes a new species of the ophiurid Amphiura from the Upper Miocene of California (Proc. U.S. National Museum, vol. xxxiv., 1908, p. 403).

Mr. C. D. Walcott, having completed his work on brachiopods, promptly enters on an investigation of Cambrian trilobites (Smithsonian Miscell. Collections, vol. liii., 1908, p. 13). The present instalment describes the new genera Burlingia, Albertella, and Oryctocara. The first-named, from the Middle Cambrian, is placed with Moberg's Schmalenseeia in a special family, the Burlingidæ.

The Geological Survey of Great Britain issued in October, 1908, a welcome quarto memoir on "The Higher Crustacea of the Carboniferous Rocks of Scotland," by B. N. Peach, F.R.S. (price 4s.). Four new genera, one being appropriately styled Tealliocaris, and twenty-three new species, are described. The forms are all transferred from the macrurous decapods to the schizopods, following an opinion early formed by the author, and confirmed by Sars's report in the *Challenger* series in 1885. Palæocaris is interestingly placed in G. M. Thomson's Anaspidæ (p. 53), a family erected in 1894 to include a less specialised fresh-water form still living isolated in lakes among the mountains of Tasmania. The illustrations to the memoir show the excellent preservation of much of the material, and it is pleasant to learn that the work was undertaken by Dr. Peach on his retirement from the Survey directly he was free from pressing official duties.

Passing to vertebrates, Messrs. F. R. von Huene and R. S. Lull are engaged in a re-consideration of the affinities of Hallopus, a reptile described by Marsh from Wyoming, and now known to be of Upper Triassic age (Am. Journ. Science, vol. xxv., 1908, p. 113).

Mr. G. E. Pilgrim gives us a new genus of Suidæ, Telmatodon, from Lower Miocene beds in Baluchistan (Records Geol. Surv. India, vol. xxxvi., 1907, p. 45). Mr. F. B. Loomis shows how the rhinoceros Diceratherium was comparatively common in the Lower Miocene of North America in beds where few vertebrates were known until some three years ago ("Rhinocerotidæ of the Lower Miocene," Am. Journ. Sci., vol. xxvi., 1908, p. 51). Two species of Acerotherium, a genus abundant in the American Oligocene, lived on amid a rich variety of Diceratheria. By the close of the Miocene, the latter forms had also run their course.

Herr Wilhelm Freudenberg introduces the Pleistocene *Rhinoceros Mercki*, var. *Hundsheimensis*, Toula, in his account of the fauna of the Hundsheim cave in Lower Austria (*Jahrb. d. k.k. geol. Reichsanstalt*, Bd. lviii., 1908, p. 220). The animals of this cave, including Machairodus, which may have preyed on rhinoceroses and elephants, are held to have lived in the district at first under cold conditions, and then during a warm interglacial interval. The striped hyæna occurs (p. 212), a species that goes back far into the Pliocene. The absence of the horse and man also gives the deposit an early aspect.

G. A. J. C.

PAPERS ON MOLLUSCS AND INSECTS.

THE molluscs of the family Pyramidellidæ inhabiting the coasts of New England and the adjacent region form the subject of an illustrated monograph, by Mr. P. Bartsch, published in the Proceedings of the Boston Society of Natural History, vol. xxxiv., parts lxvii.–cxiii. Attention is chiefly concentrated on the characters of the shell, although mention is made of some of the soft parts in diagnosing the genera. The new genus Couthonella is proposed for the species hitherto known as *Pyramis striatula*.

To the proceedings of the Academy of Natural Sciences of Philadelphia for December, 1908, Prof. H. A. Pilsbry contributes the twelfth instalment of his account of the clausilias of the Japanese Empire, in which a number of new species and subspecies of various sections, or subgenera, of Clausilia are described and figured. Especial interest attaches to certain species belonging to the section Euphædusa, such as *Clausilia echo*, on account of their exhibiting stages in a degeneration-series leading on to the section Reinia. In the same issue Prof. Pilsbry and Mr. Y. Hirase describe a number of new land-molluscs from the Japanese Empire, including forms from the main island of Japan, the Benin Island, the Ryukyu (Liu-Kiu) Islands, and Formosa. Particular interest attaches to the clausilias and operculated shells from the small volcanic isles of the Tokara group.

The pteropods and heteropods of the Irish coasts form the subject of a paper, by Miss A. L. Massy, published as No. 2 of Irish Fisheries Scientific Investigations for 1907 (1909). The list includes seventeen species of pteropods, among which is a new species of Clio (*C. gracilis*) and seven other species not previously recorded from British waters. Heteropods, on the other hand, are represented, according to present information, in Irish waters only by a few occurrences of *Carinaria lamarcki*.

The habits of the British carnivorous slugs of the genus Testacella form the subject of an illustrated note by the editor in the April number of the *Selborne Magazine*. Special interest attaches to the figure of one of these slugs seizing a worm with its protruded "radula."

Turning to insects, we have first to notice the first three "leaflets" on injurious insects issued by the Indian Forest Department. Of these, No. 1 is devoted to the sal bark-boring beetle (*Sphaerotrypes siwalikiensis*); No. 2 treats of the moth known as the teak-defoliator (*Hyblaea puera*); and No. 3 describes the teak-leaf skeletoniser (*Pyrausta machaeralis*), which, in its adult condition, is also a moth. As two at least of these insects have been noticed in NATURE in connection with other publications of the Forest Department, it will suffice to add that the three leaflets have been drawn up by Mr. E. P. Stebbing. In vol. ii., No. 7, of the entomological series of the Memoirs of the Department of Agriculture in India, Mr. Maxwell-Lefroy discusses the scale-insects, or Coccidæ, of the country, the life-history of three species being illustrated by coloured plates. None of the Indian species of the group inflicts much harm on crops.

Brazilian grasshoppers of the subfamilies Pyrgomorphinæ and Locustinæ (or Acridinæ) form the subject of No. 1661 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 109–163). Fifty-three species are discussed in this paper, among which the author, Mr. J. A. G. Rehn, describes seventeen as new, four new genera being also named and defined. The greater portion of the collection came from Matto Grosso and Rio de Janeiro, and the remainder from the neighbourhood of Pernambuco and Bahia. In the February issue of the Proceedings of the Academy of Sciences of Philadelphia, Messrs. Rehn and Hebard continue their survey of the Orthoptera of the south-western United States, dealing in this instance with those of New Mexico and Texas.

On a previous occasion reference was made in our columns to a paper in the Proceedings of the Philadelphia Academy of Sciences, by Dr. F. Creighton Wellman and Mr. W. Horn, on the tiger-beetles of Angola. In the same serial for December, 1908, the first-named author gives an account of Angolan oil-beetles (Meloidæ), in which special attention is directed to interesting features connected with the habits of these insects. Throughout the driest district of Angola various species of these beetles may be seen in thousands on a roseaceous plant of the genus Tribulus, which occurs in enormous masses, and forms almost the sole food-supply of the adult Meloidæ of the district. This plant produces large masses of yellow flowers, upon which the beetles cluster. It is remarked as a curious fact that the young of these oil-beetles should feed on the eggs, and later on the larvæ, of orthopterous and other insects, while the adults have such an intimate relation to certain plants, the appearance of the full-grown Meloidæ being synchronous with the flowering of the Tribulus, which lasts only for a few weeks.

An important contribution to morphology is formed by a paper on the so-called sclerites of insects, by Dr. G. C. Crampton, published in the Proceedings of the Academy of Sciences of Philadelphia for January. According to the author, there exists a most confusing want of uniformity in regard to the homology of these small chitinous elements and the names applied to them, this being, apparently, in great degree due to the fact that each investigator has been content to confine his studies to one or two groups of insects. Many important points have been brought to light by such investigations on the different orders, but they stand, for the most part, as isolated facts. The object of the investigations undertaken by the author has been to bring these isolated facts into harmony, and to construct a nomenclature for these structures which shall be applicable to the Hexapoda as a whole. With this object in view, Dr. Crampton first reviews the various theories of his predecessors on this subject, and then furnishes a revised and general system of nomenclature. A further communication on the subject is promised.

Publications by the Entomological Bureau of the U.S.

Department of Agriculture include a Bulletin on the peach-tree bark-beetle (*Phlaeotribus liminaris*), by Mr. H. F. Wilson, a paper on the orange-thrips (*Euthrips citri*), named for the first time, by Mr. D. Moulton, and a leaflet on fleas.

Starting with the fact that no sensible difference between the variability of the sexes in the human species can be found, if accurate measures be taken to determine that variability, it is of considerable interest to ascertain whether there is differentiated variability in the castes of the social insects. In a memoir published in *Biometrika*, vol. v., it was shown that the worker-wasp was more variable than the drone, and the drone than the queen. In vol. vi., part iv., of the same serial, Dr. Ernest Warren investigates the variability of the six castes of South African white-ants, or termites. The author finds that the sexual are less variable than the asexual castes, and considers that the difference of variability between the inhabitants of different nests cannot be accounted for by heredity, but must be due to post-embryonic environmental influences. It is also held that the relative variability of the whole population as compared with that of a single nest cannot be attributed to heredity, but must be due to the influence of environment on a plastic organism. Dr. Warren finds a high correlation between the mean sizes of the different castes in the same nest, and little correlation between the variability of different castes in the same nest, thus indicating that a similar environment does not affect the different castes in the same way.

In the April number of the *Zoologist* Mr. A. H. Swinton continues his account of the vocal and instrumental music of insects.

TRANSATLANTIC WIRELESS TELEGRAPHY.[1]

II.

IN the spring of 1903 the transmission of news messages from America to the London *Times* was attempted, in order to demonstrate that messages could be sent from America by means of the new method, and for a time these messages were correctly received and published in that newspaper.

By reference to the files of the *Times* I find that 267 words of news, transmitted across the Atlantic by wireless, were published in the London *Times* during the latter part of March and the early part of April of that year. A breakdown in the insulation of the apparatus at Glace Bay made it necessary, however, to suspend the service, and, unfortunately, further accidents made the transmission of messages uncertain and untrustworthy. In consequence of this it was decided not to attempt, for the time being, the transmission of any more public messages until such time as a trustworthy service could be maintained in both directions under all ordinary conditions.

As I found that many improvements evolved during the course of the numerous tests and experiments could not be readily applied to the plants at Poldhu and Cape Breton, it was decided to erect a completely new long-distance station in Ireland, and to transport the one at Glace Bay to a different site in the vicinity, where sufficient land was available for experimenting with aërials of much larger dimensions than had been hitherto employed.

Experiments were, however, continued with Poldhu, and in October, 1903, it became possible to supply the Cunard steamship *Lucania*, during her entire crossing from New York to Liverpool, with news transmitted direct from the shore.

In November of the same year tests similar to those carried out with the Italian cruiser took place on behalf of the British Admiralty between Poldhu and H.M.S. *Duncan*.

Communication with Poldhu was maintained during the entire cruise of this battleship from Portsmouth to Gibraltar, and further communication was established between Poldhu and the Admiralty station situated on the Rock of Gibraltar. It should be noted that the distance between Cornwall and Gibraltar is 1000 miles—500 over land and 500 over water.

[1] From a discourse delivered at the Royal Institution on Friday, March 13, 1908, by Commendatore G. Marconi. Continued from p. 237.

The aërial at Poldhu was shortly afterwards extended by the addition of wires sloping downwards, umbrella-fashion, as shown in Fig. 10. This increased the capacity of the aërial, and some further tests were carried out with a station at Fraserburgh, in the north of Scotland. From these tests considerable advantage appeared to be derived, at least for communication over land, by the adoption of much longer waves than had been hitherto employed, and with a wave-length of 14,000 feet it was found possible to telegraph over a distance of 550 miles with an expenditure of energy of about 1 kilowatt.

The operation of the long-distance stations in England and America made it possible to transmit messages to ships, whatever their position, between Europe and North

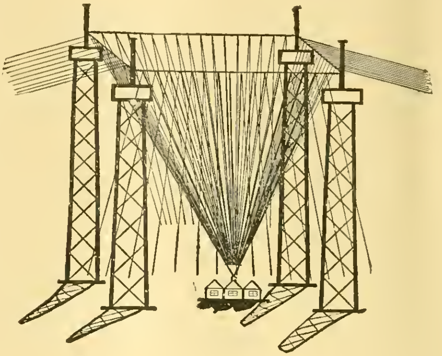


FIG. 10.

America; and to the Cunard Company belongs the credit of having greatly encouraged the long-distance tests, a circumstance which enabled them to commence, in June, 1904, the regular publication on their principal vessels of a daily newspaper, containing telegraphic messages of the latest news from Europe and America.

This daily newspaper has now been adopted by nearly all the large liners plying to New York and the Mediterranean, and it obviously owes its entire existence to long-distance wireless telegraphy. Therefore the tranquility and isolation from the outside world, which it is still possible to enjoy on board of some ships, is rapidly becoming a thing of the past; but, however much travellers may sigh over the innovations which have lately been brought about,

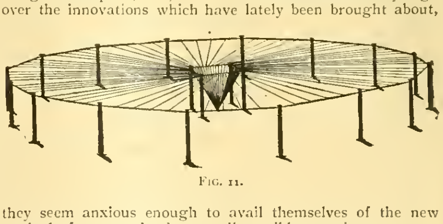


FIG. 11.

they seem anxious enough to avail themselves of the new method of communication on all possible occasions.

Early in 1905 the construction of the new station at Glace Bay was sufficiently advanced to allow of preliminary tests being carried out. The aërial was very large, and consisted of a vertical portion in the middle 220 feet long supported by four towers and attached to horizontal wires, 200 in number, each 1000 feet long, extending radially all round, and supported at a height of 180 feet from the ground by an inner circle of eight and an outer circle of sixteen masts (Fig. 11). The natural period of oscillation of this aërial gave a wave-length of 12,000 feet. The capacity employed was 1·8 microfarads, and the spark-length $\frac{3}{4}$-inch.

Signals and messages from this station were received at

Poldhu by day as well as by night, but no commercial use of the station was made at that time, in consequence of the fact that, although the signals came through by day as well as by night, they were exceedingly weak and faint, and also because the corresponding station on the same plan had not yet been erected in Ireland.

A further step in advance was the adoption at the Transatlantic stations of the directional aërial shown in Fig. 12.[1] The ordinary wireless telegraph aërials, which I have already described, send out electric radiation equally in all directions. This is, however, in many cases a disadvantage. Many suggestions respecting methods for limiting the direction of radiation have been made by various workers, notably by Messrs. Artom, Braun, and Bellini Tosi.

In some of my earliest experiments, in 1896, I used copper mirrors, by the aid of which it was possible to project a beam of electric radiation in a certain direction, but I soon found that this method would only work over short distances.

About three years ago I again took up the subject, and was able to determine that by means of horizontal aërials, disposed in a particular manner, it was possible to confine the effects of electric waves mainly to certain directions as desired. True, the limitation of transmission to one direction is not very sharply defined, but it is nevertheless very useful. The practical result of this method has been, so far, that messages can be sent over considerable distances in the desired directions, while they travel only over a comparatively short distance in other directions, and that, with aërials of moderate height, greater efficiency in a given direction can be obtained than can be obtained all round by means of the ordinary aërials.

When this type of aërial was adopted at Glace Bay a considerable strengthening of the received signals at Poldhu

Fig. 12.

was noticed. It was therefore decided to adopt the directional aërial at all long-distance stations.

A further improvement introduced at Clifden and Glace Bay consisted in the adoption of air condensers, composed of insulated metallic plates suspended in air at ordinary pressure. In this manner it is possible to prevent the dissipation of energy due to losses caused by the dielectric hysteresis in the glass dielectric of the condensers previously employed, and a very appreciable economy in working, resulting from the absence of breakages of the dielectric, is effected. These air condensers, which have been in use since May, 1907, have been entirely satisfactory. After very considerable delay and expense, the new station at Clifden was got ready for tests by the end of May, 1907, and experiments were then commenced with Glace Bay.

The wave-length used during these tests was 12,000 feet, the capacity employed 1·6 microfarads, and the potential to which the condenser was charged 80,000 volts.

Good signals were obtained at Cape Breton from the very commencement of the tests, but some difficulty was encountered in consequence of the effects of atmospheric electricity due to the prevalence of thunderstorms in the eastern part of Canada during the first few days of the tests.

Simultaneously with these tests others were carried out from Poldhu to Glace Bay with a new system of transmitting apparatus, by means of which continuous or semi-continuous oscillations could be produced.

Proportionately to the energy employed the signals from Poldhu were so much better than those from Clifden that I decided at once to adopt this new method of transmission at Glace Bay and Clifden. The apparatus which I have been using for producing continuous or closely adjacent trains of electric oscillations is as follows[2]:—A metal disc A (Fig. 13), insulated from the earth, is caused to rotate at a very high speed by means of a high-speed electric motor or steam turbine. Adjacent to this disc, which I shall call the middle disc, are placed two other discs, C_1, C_2, which may be called polar discs, and which also can be rotated at a high rate of speed. These polar discs should have their peripheries very close to the surface or edges of the middle disc.

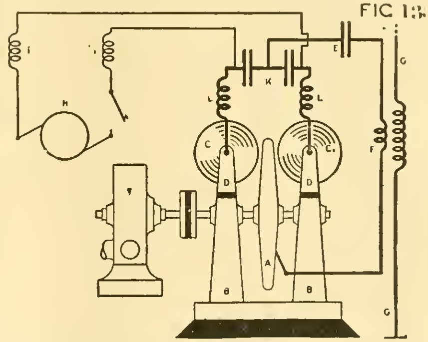
If a small amount of energy is used, stationary knobs or points may be used in place of the side discs.

The two polar discs are connected respectively through suitable brushes to the outer ends or terminals of two condensers K, joined in series, and these condensers are also connected through suitable inductive resistances to the terminals of a generator, which should be a high-tension continuous-current dynamo.

On the high-speed or middle disc a suitable brush or rubbing contact is provided, and connected between this contact and the middle point of the two condensers is inserted an oscillating circuit consisting of a condenser E in series with the inductance, which last is connected inductively or conductively to the aërial.

If the necessary conditions are fulfilled, and a sufficient E.M.F. is employed, a discharge will pass between the outer discs and the middle disc, which discharge is neither an oscillatory spark nor an ordinary arc, and powerful

FIG 13.



oscillations will be created in the signalling condenser E and oscillatory circuit F.

I have found that in order to obtain good effects a peripheral speed of more than 100 metres per second is desirable; therefore particular precautions have to be taken in the construction of the discs. Electrical oscillations of a frequency as high as 200,000 per second can be obtained.

The apparatus works probably in the following manner:—Let us imagine that the source of electricity is gradually charging the double condenser and increasing the potential at the discs, say C_1 positively and C_2 negatively; at a certain instant the potential will cause the charge to jump across one of the gaps, say between C_2 and A. This will charge the condenser E, which will then commence to oscillate, and the charge in swinging back will jump from A to C_1, which is charged to the opposite potential. The charge of E will again reverse, picking up energy at each reversal from the condensers K. The same process will go on indefinitely, the losses which occur in the oscillating circuit EF being made good by the energy supplied from the generator H. If the disc is not rotated, or rotated slowly, an ordinary arc is at once established across the small gaps, and no oscillations take place. The efficient cooling of the discharge by the rapidly revolving disc seems to be one of the conditions necessary for the production of the phenomena.

By means of this apparatus tests were carried out, but it was found, as was to be expected, that the oscillations were too continuous and of too high a frequency to affect a receiver, such as the magnetic detector, unless an interrupter was inserted in one of the circuits of the receiver.

[1] "On Methods whereby the Radiation of Electric Waves may be mainly Confined," &c. Proc. Roy. Soc., G. Marconi, A. lxxii., 1906.
[2] Patent Application No. 20,119, September 9, 1907.

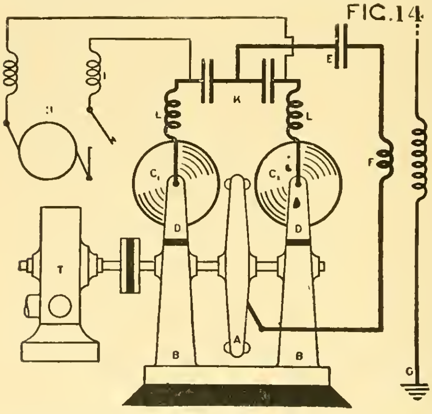
A syntonic coherer receiver would, however, work, in consequence, no doubt, of the considerable rise of potential which occurred at its terminals through the cumulative effect of resonance.

The best results over long distances have, however, been obtained by a disc as shown in Fig. 14, in which the active surface is not smooth, but consists of a number of knobs or pegs, at the end of which the discharges take place at regular intervals. In this case, of course, the oscillations are not continuous, but consist of a regular succession of trains of undamped or slightly damped waves.

In that manner it is possible to cause the groups of oscillations radiated to reproduce a musical note in the receiver, distinguishable in a telephone, and thereby it is easier to differentiate between the signals emanating from the transmitting station and noises caused by atmospheric electrical disturbances. By this method very efficient resonance can, moreover, be obtained in appropriately designed receivers.

A few tests with apparatus based on the principle described were carried out between Glace Bay and Clifden, and on October 17 of the year 1907 a limited service for Press messages was commenced between Great Britain and America. Difficulties were experienced, however, over the question of rates with the telegraph companies working the land-lines between Glace Bay and the principal towns of Canada and the United States, and at present the strange

FIG. 14.



anomaly exists that the rates for Press messages on the American land-lines are much cheaper for messages going from England to New York than in the reverse direction. On February 3, 1908, this service was extended to ordinary messages between London and Montreal.

The stations at Clifden and Glace Bay are not complete, and the necessary duplication of the running machinery has not yet been executed, but nevertheless communication across the Atlantic has never been interrupted for more than a few hours since the commencement of commercial working on October 17, 1907.

There have, however, been several serious interruptions at Clifden, due to the untrustworthiness of the land-lines connecting Clifden to the ordinary telegraph system. On one occasion one of these interruptions lasted from 5.20 p.m. to 10.30 a.m., a duration of seventeen hours, and on another occasion the land telegraph wires were struck by lightning and disabled for twelve hours. There have also been recorded numerous other interruptions of shorter duration, which resulted in delays to private and Press messages. Further delays have also been caused through interruptions on the land-lines connected with the Canadian station.

During the first months, on account of imperfections in the auxiliary apparatus connected principally with the operating keys and switches, only a fraction of the available transmitting power was used. In consequence of this the speed of transmission was slow, and short interruptions somewhat frequent. Many of these difficulties have now been overcome, and in a few more months, when it should be possible to utilise the full power available, a very much greater speed and efficiency is likely to be attained.

Messages can now be transmitted across the Atlantic by day as well as by night, but there still exist certain periods, fortunately of short duration, when transmission across the Atlantic is difficult and at times ineffective, unless an amount of energy greater than that used during what I might call normal conditions is employed.

Thus, in the morning and evening when, due to the difference in longitude, daylight or darkness extends only part of the way across the Atlantic, the received signals are weak and sometimes cease altogether.

It would almost appear as if illuminated space possessed for electric waves a different refractive index from dark space, and that in consequence the electric waves may be refracted and reflected in passing from one medium to the other. It is therefore probable that these difficulties would not be experienced in telegraphing over equal distances from north to south, or *vice versâ*, as in this case the passage from daylight to darkness would occur almost simultaneously in the whole of the medium between the two points.

In the same manner a storm area in the path of the signals often brings about a considerable weakening of the received waves, whilst if stormy conditions prevail all the way across the Atlantic no interference is noticeable. Electric-wave shadows, like sound shadows, may be formed by the interference of reflected waves with the direct waves, whereby signals may be much less effective or imperceptible in the area of such electric-wave shadow.

In the same manner as there exist periods when signals across the Atlantic are unusually weak, there exist other conditions, especially at night, which make the signals abnormally strong. Thus on many occasions ships, and stations equipped with apparatus of a normal range of 200 miles, have been able to communicate over distances of more than 1000 miles. This occurred recently when a ship in the English Channel was able to correspond with another in the Mediterranean. But the important factor about wireless telegraphy is that a service established for a certain distance shall be able to maintain trustworthy communication over that distance.

Long-distance stations are now in course of erection in many parts of the world, the most powerful of all being that of the Italian Government at Coltano, and I have not the slighest doubt but that telegraphy through space will soon be in the position of affording communication between distant countries at cheaper rates than can be obtained by any other means.

As to the practicability of wireless telegraphy working over long distances, such as that separating England from America, there is no longer need for any doubt. Although the stations have been worked for only a few hours daily, 119,945 words of Press and commercial messages had been transmitted across the ocean by this means up to the end of February, 1908, since the service was opened.

The best judges of a service are those who have made use of it, and amongst newspapers, the chief users have been the *New York Times* and the London *Times*, which have already publicly expressed their opinion of this new method of communication.

Whether the new telegraphy will or will not injure or displace the cables is still a matter of conjecture, but in my opinion it rests a good deal on what the cables can do in the way of cheaper rates. It is not, as some appear to imagine, either the business or the wish of those concerned in the development of wireless telegraphy to injure the cable industry. They are endeavouring at present to demonstrate that the new method is not only valuable for shipping, but that it should be also regarded as a new and cheaper method of communicating with far distant countries. Whatever may be the view as to its shortcomings and defects, there can be no doubt but that wireless telegraphy across the Atlantic has come to stay, and will not only stay, but continue to advance.

In seven years the useful range of wireless telegraphy has increased from 200 miles to 2500 miles. In view of that fact, he will be a bold prophet who will venture to affirm what may not be done in seven years more.

I shall not presume to say that at the present moment the wireless telegraph service between London and New York is as efficient and as rapid as that supplied by the cables. For nearly fifty years the Transatlantic cable organisation has been in existence, and there are now sixteen cables working across the North Atlantic, so that in the case of a breakdown of one cable the traffic is sent by one of the others. Moreover, long experience has served to bring their land-line connections to a high state of perfection. Nevertheless, I am convinced that if there were only one cable and the present wireless service, interruptions would be more frequent and much more serious in the case of the cable than in that of the wireless service.

We have only to look towards those parts of the globe such as India, South Africa, and so forth, where transoceanic communication is dependent upon only one or two cables, and the force of my remarks will be more readily appreciated. The cases of delay in regard, not only to commercial messages, but also to Government despatches, are only too frequent, as no doubt you have observed from time to time in the daily Press.

Among many people there seems to be a rooted conviction that wireless telegraphy is not suitable for the handling of code or cipher messages. Whatever gave rise to this idea I do not know, but I wish to emphasise that it is purely fictitious. Code messages can be sent just as well by wireless as by ordinary methods of telegraphy.

I need hardly say that most of the wireless messages passing between warships are now expressed in code, as are likewise the majority of the commercial messages handled by the Clifden and Cape Breton stations.

I do not wish to claim that wireless telegraphy is infallible, and although errors do sometimes occur, it is absolutely certain that, having regard to the London and Montreal service, most of the mistakes can be traced to the land-line telegraph transmission between London and Clifden, and between Glace Bay and Montreal.

I find, however, that probably the greatest ignorance prevails in regard to what is termed "tapping," or intercepting wireless messages. No telegraph system is secret. The contents of every telegram are known to every operator who handles it. It is incorrect to suppose that anyone can at will pick up wireless messages. On the other hand, it is easy for anyone knowing the Morse code to step into many telegraph offices and read off the messages by the click of the instruments.

Further, it is practicable, but illegal in this country, to make arrangements so that messages which pass over a telegraph line can be read by persons who are not operating the line at all. It is also expensive to erect a tall pole or tower and fix up all the instruments which are necessary before wireless messages can be taken in, and, moreover, such proceeding is contrary to the law of the land.

It should be remembered, too, that any ordinary telegraph or telephone wire can be tapped, and the conversation going through it overheard, or its operation interfered with. Results published by Sir William Preece show that it is possible to pick up at a distance, on another circuit, the conversation which may be passing through a telephone or telegraph wire.

At Poldhu, on a telephone connected to a long horizontal wire, the messages passing through a Government telegraph line a quarter of a mile away can be distinctly read. In a paper on his method of magnetic space telegraphy, Sir Oliver Lodge mentions an occasion on which he was able to interfere, from a distance, with the working of the ordinary telephones in the city of Liverpool.

Many instances can be enumerated showing that electric light and tramway power-stations have interfered with cables and land-lines. Nevertheless, there are penalties attached to the tapping of a telegraph wire, and it ought to be as well known that, since the passing of the Wireless Telegraphy Act, there are penalties involved if any wireless stations are erected or worked without the consent of the Postmaster-General. In conclusion, I may say that I am very confident that it is only a question of time, and that not a very long time, before wireless telegraphy over great distances, possibly round the world, will become an indispensable aid to commerce and civilisation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Applications to occupy the University's table in the zoological station at Naples should be addressed to Prof. Langley on or before Thursday, May 20.

Mr. C. L. Boulenger has been appointed assistant to the superintendent of the museum of zoology from March 15 to September 30.

Mr. G. I. Taylor has been appointed assistant demonstrator of experimental physics for five years from January 1, 1909.

The Anthony Wilkin studentship in ethnology and archæology will be available at the end of 1909. Applicants should send their names, qualifications, and a statement of the research which they wish to undertake to the Vice-Chancellor before November 1.

Oxford.—A new departure was taken in Oxford some time ago by the establishment of a department of forestry. A site for the necessary building was provided by St. John's College on a plot of ground adjoining their own gardens, and the work of the department was placed under the direction of Prof. W. Schlich, F.R.S., formerly of Coopers Hill. Coincidently with this movement, the chair of rural economy, founded by John Sibthorpe, who in 1747 succeeded Dillenius as professor of botany, was re-endowed and put on a new footing by the liberality of the same college. A building for the use of the present occupant of the Sibthorpian chair, Prof. W. Somerville, was also provided by St. John's College, this, together with the new quarters of the forestry department, forming a handsome block nearly opposite the University museum. The combined structure was opened on April 20 by the Vice-Chancellor, the president of Magdalen, in the presence of a large company, which included Sir Thomas Elliott, Sir Charles Crosthwaite, Mr. Rider Haggard, and many resident members of the University. The president of St. John's, who is now in his ninetieth year, was unfortunately prevented from being present by slight indisposition. In his speech at the opening ceremony the Vice-Chancellor dwelt on the traditions associated with the names of Sibthorpe and Dillenius, and referred in appreciative terms to the services rendered by St. John's College to the scientific studies of the University.

Under the Irish Universities Act, 1908, a professor of botany will be appointed shortly for the Queen's University of Belfast. Other appointments will include readerships or lectureships in physics, organic chemistry, bio-chemistry, and geology and mineralogy.

In furtherance of the movement for the establishment of a National Aëronautical College, we learn from the daily papers that the Aërial League has appointed a sub-committee consisting of Dr. Hele Shaw, F.R.S., Mr. Arthur du Cros, M.P., Lord Montagu of Beaulieu, Sir Buchanan Scott, and Mr. Stephen Marples. We are glad to see that the promoters are keenly alive to the importance of placing the movement on a strictly scientific basis, and that the mathematical side of the problem is to receive its due share of attention. This is the more important as the practical experimental side is pretty certain to be efficiently represented. That a serious effort is being made to wake up our country in the present connection may be gathered from the following remarks of Mr. Marples as reported in the *Standard* :—"Our object," he said, "is to prevent Great Britain from being beaten in aëronautics by foreign countries in the same way as we have been in commercial enterprise. France and Germany have had their technical and commercial colleges, which have produced such good results, and now they have their aëronautical colleges in full swing. Unless we have one we shall fall behind in aëronautics too. Aëronautics is a most scientific subject, and goes more deeply into higher mathematics than any other subject connected with engineering. Hence the great necessity for putting the college on a sane, sound, and businesslike footing to meet the needs of the moment. It is no use teaching even the practice of flying unless we have something of the theory. We hope that the Government will help us. We are also appealing to the public for money."

On July 12, 1908, King Edward VII. and Queen Alexandra visited Sheffield and opened the new University buildings. On the day of the King's visit Mr. Wm. Edgar Allen gave 10,000*l.* to the University on the sole condition that it should be used for the erection of a building for the University library. On Monday, April 26, to the great satisfaction of the University authorities and of the people of Sheffield and district, the Prince and Princess of Wales opened the Edgar Allen Library. At a special Congregation honorary degrees of Litt.D. were conferred on His Royal Highness and on Mr. Wm. Edgar Allen, the donor of the library. During the ceremony the Chancellor, the Duke of Norfolk, announced that Mr. Allen had that morning given donations of 5000*l.* to the Royal Infirmary and 5000*l.* to the Royal Hospital, on condition that a ward or wing in each should be called after the Prince and Princess respectively, a condition their Royal Highnesses were pleased to accept. The educational value of these fresh gifts was aptly referred to by the Chancellor, who pronounced them "a very thoughtful work in connection with this University, because it is undoubtedly a fact that the medical students of this University derive great advantages from what they can learn and see at the great hospitals of this city." The Prince, in the course of an interesting speech, said:—"The great development of the university movement is a remarkable feature in the march of education during the latter part of the nineteenth century. Our important industrial centres recognise that there are problems to be solved differing widely from those dealt with in the more ancient universities. Sheffield was quick to see the necessity of adapting herself to the industrial needs of the people, and to realise that scientific and technical knowledge is indispensable to success in the strenuous commercial struggle among the nations of the west. Thanks to the liberality of Mr. Mark Firth, the college which bore his name was founded in 1879, and incorporated twenty-six years later with those other institutions which constitute the University of Sheffield, including among them schools of engineering and metallurgy which are famous throughout the land. . . ."

The Lord Mayor will preside at a meeting, to be held at the Mansion House as we go to press, in support of the National League for Physical Education and Improvement. The speakers will include the Bishop of Ripon, the Duke of Argyll (probably), Lord Halsbury, Lord Ashbourne, Sir Henry Craik, M.P., and others. The following report, prepared by a strong and representative committee organised by the league, will be presented and discussed:—(1) That physical education should be compulsory in all schools, subject to the conditions of sections (2) and (3). (2) That medical inspection and report should be compulsory as a preliminary to pedagogical gymnastics and at intervals thereafter; the report to make special reference to the conditions of eyes, ears, teeth, lungs, and heart, and to be drawn up on an authorised form to be supplied to the medical officer. A special report should also be made on the return of a pupil after severe illness. That a local education authority does not adequately carry out its duties in regard to medical inspection unless provision is made for this. (3) That there should be regular pedagogical gymnastics at the schools, the number of lessons, the duration of each, and the nature of the exercises to be adapted to the age and physical condition of the child, the time so allotted not to curtail the play hours, games being an important part of physical education. The committee consider that, when possible, this instruction should be carried out daily, though they recognise that for the present this may be impossible, and that three days a week should be the minimum. They consider that, as far as possible, exercises not demanding apparatus should be carried out in the open air. (4) That in all secondary and intermediate schools specially trained gymnastic specialists should be appointed; in elementary schools, where the physical education is necessarily carried out by ordinary school teachers, such teachers should possess a qualification in physical training. (5) The studies of gymnastic specialists should be carried out on the general lines of the Swedish system, with such modifications as are necessitated by the different conditions of school life in this country; recognition to be made of various grades of qualifications, and corresponding differences in the course of study required. (6) The studies of the gymnastic specialist should embrace anatomy, physiology, hygiene, mechanics, and pedagogics. (7) For the present, certificates of efficiency as teachers will have to be granted or approved by a central body, whether or not in the future these powers can be delegated to universities or other local bodies. (8) The committee have considered the question of a central institute, and are of opinion that, although such an institute is highly desirable, they are not in a position at present to give definite recommendations in regard to its formation.

SOCIETIES AND ACADEMIES.

London.

Royal Society, April 22.—Sir Archibald Geikie, K.C.B., president, in the chair.—"Dynamic" osmotic pressures: the **Earl of Berkeley** and E. G. J. **Hartley**.—(1) The theory of ancestral contributions in heredity; (2) the ancestral gametic correlations of a Mendelian population mating at random: Prof. Karl **Pearson.** The purpose of these two papers is to place in a somewhat clearer light the relationship of the biometric to the Mendelian standpoint. The law of ancestral heredity, as stated by the present writer in a paper published many years ago in the Proc. Roy. Soc., involved the following three points:—(*a*) the linearity of the regression of offspring on any ancestor; (*b*) the diminution of the ancestral correlations in a geometrical progression; and (*c*) the determination of the probable character of the offspring, when the mating was at random, by the multiple regression formula. It was shown, in a memoir of 1896, that when the ancestral correlations were of the type ρ, ρ^2, ρ^3 . . . then the character of the offspring depended only on the characters of the two parents, and ancestry need not be considered. In a memoir in vol. cciii. of the Phil. Trans. it was shown later that (*a*) and (*b*) held for a generalised Mendelian population, for the *somatic* characters, but that the somatic correlations were not of the type ρ, ρ^2, ρ^3 . . . and accordingly that ancestry, in the biometrician's sense, did matter even in a population following the simplest Mendelian formula, providing the mating was at random. A recent paper in the Proc. Roy. Soc. might be interpreted as meaning that the law of ancestral heredity did not apply to a Mendelian population. In the first of the above papers the writer indicates how, in a population originally consisting of p dominants, s recessives, and q hybrids, mating at random, the percentage of the number of dominants in the offspring increases with the number of dominants in the grandparentage, and this is true in the case of any grade of ancestors, whatever be p, q, and s. In the second paper the writer turns from the somatic to the gametic correlations, which were not discussed in the earlier memoirs, and shows that the gametic correlations form a series of the character ρ, ρ^2, ρ^3 . . .; in other words, a knowledge of the gametic character of the parents makes a knowledge of the gametic character of the ancestry unnecessary. Apart from symbols, this must be a truism, because the offspring arises solely from the gametes of the parents; but a point of some interest is that the Mendelian *gametic* correlations, whatever be the mixture of protogenic, allogenic, and heterogenic elements in the freely mating population, take the same values, *i.e.* 0·5, 0·25, 0·125, &c., diminishing one-half with each ancestral grade. These *gametic* correlations are much nearer to the values obtained by biometric investigations for the *somatic* correlations, the theoretical Mendelian somatic correlations being considerably too small. It would thus appear that the Mendelian gametic correlations accurately obey the fundamental conceptions of the law of ancestral heredity, and the only real outstanding antinomy lies in the principle of absolute dominance. The correlations found biometrically suggest that there is a closer relation between the gametic and somatic constitution—at least for certain characters in the species investigated—than is represented by the first Mendelian principle of absolute dominance.—The intracranial vascular system of Sphenodon: Prof. A. **Dendy.** This memoir contains a detailed description, with illustrations, of the intracranial blood vessels of the Tuatara, of which no account has hitherto been published. The description is believed to be more complete than any hitherto given for any reptile, and a considerable number of vessels are described which have not hitherto been noted in Lacertilia. This comparative completeness of detail is largely due to the employment of a special method of investigation. By this method the entire contents of the cranial cavity are fixed and hardened *in situ*, and are then in excellent condition either for dissection or for histological purposes. The brain does not occupy nearly the whole of the cranial cavity, there being a very large subdural space (especially above the brain) across which many of the blood vessels run, together with delicate strands of connective tissue which connect the dura mater with the pia. The eyeballs are removed, and an incision is made on each side in the cartilaginous wall which separates the cranial cavity from the orbit. Acetic bichromate of potash (made up according to the formula given by Bolles Lee) is injected into the cranial cavity through these incisions, and the entire animal, after opening the body cavity, is suspended in a large volume of the same fluid for about five days, ano then graded up to 70 per cent. alcohol. When the cranial cavity is now opened up the cerebral vessels are seen with extraordinary distinctness, although they have not been artificially injected. Further details were made out by means of serial sections, both transverse and longitudinal, and both of the adult and of advanced embryos (Stage S). In most respects the arrangement of the intracranial blood vessels agrees with that found in the Lacertilia, so far as these have been investigated, but there is an important difference in the fact that the posterior cephalic vein leaves the cranial cavity through the foramen jugulare, and not through the foramen magnum, while a slightly more primitive condition is shown in the less complete union of the right and left halves of the basilar artery. Sphenodon makes some approach to the condition of the Chelonia in this latter respect, but differs conspicuously from this group in the fact that the circle of Willis is not completed anteriorly, as well as in the fact that no branch of the posterior cephalic vein leaves the cranial cavity through the foramen magnum. A very characteristic feature of Sphenodon is the development of large transverse sinuses resembling those of the crocodile, but these communicate with the extracranial vascular system in quite a different manner from that described by Rathke in the latter animal.—The graphical determination of Fresnel's integrals: J. H. **Shaxby.** Fresnel's integrals $\int_0^x \cos \frac{1}{2}\pi x^2$ and $\int_0^x \sin \frac{1}{2}\pi x^2$ can readily be evaluated by applying Simpson's rule to the calculated values of $\cos \frac{1}{2}\pi x^2$ and $\sin \frac{1}{2}\pi x^2$ for a sufficient number of values of x. In the cosine case, the curve $y = \cos \frac{1}{2}\pi x^2$ gives a series of loops, cutting the x-axis at $x = 1$, $\sqrt{3}$, $\sqrt{5}$, &c. The areas of these loops, after the first few, are shown to be proportional to the lengths of the bases upon which they stand; a loop extending from x_1 to x_2 has an area $k(x_2 - x_1)$, where $k = \frac{2}{\pi} = 0{\cdot}6366$. Thus integration to fairly large values of x as upper limit may be simply performed by adding together (*a*) the area for the first few loops (with due attention to + or − sign) obtained by Simpson's rule; (*b*) $k\Sigma d$, where Σd is the quantity obtained by summing (again paying attention to sign) the base lines of the complete loops of higher order than those in (*a*); and (*c*) the area of the part of a loop bounded by the upper limit, viz. from $x_1 = \sqrt{2n-1}$ to the upper limit of integration x_2, where x_1^2 is the greatest odd whole number less than x_2^2. The area (*c*) is given by the expression $\frac{2}{\pi(x_1 + x_2)}(\sin \frac{1}{2}\pi x_2^2 \pm 1)$. Similar methods can be used for the sine integral. Values of the integrals calculated as above are tabulated, and agree with Gilbert's values to within 1 part in 1000.

Linnean Society, April 1.—Dr. D. H. Scott, F.R.S., president, in the chair.—Amphipoda Hyperiidea of the *Sealark* Expedition to the Indian Ocean: A. O. **Walker.** The Amphipoda Hyperiidea of the *Sealark* Expedition consist of thirty-five species in twenty-eight genera, none new to science. *Scina borealis*, G. O. Sars, has not previously been found in tropical seas. Most of the specimens were taken in open tow-nets, so the actual depth at which they occurred is uncertain, but an ovigerous female of *Platyscelus armatus* (Claus) was taken "off sounding-lead" at 209 fathoms, which shows that this species deposits its ova on the bottom.—Marine Mollusca of the *Sealark* Expedition: Dr. J. Cosmo **Melvill.** The marine Mollusca obtained during the Stanley Gardiner Expedition of 1905–6 are especially interesting from the standpoint of geographical distribution. Accompanying the catalogue of nearly five hundred species are given tables of comparison with the molluscan faunas of nine or ten selected "areæ" of the Great Indo-Pacific region, one curious result of this investigation being that, whereas many are identical with species found in Polynesia or even Japan, the reverse obtains when comparison is made with the more contiguous fauna of the Persian Gulf and North Arabian Sea. This last has been made the subject of special study during the past fourteen years, and a total of nearly seventeen hundred species chronicled, of which something like five hundred proved new to science. Only one of these new forms (*Peristernia corallina*, Melv.) has been found to occur in the Stanley Gardiner collections made in the more southern portions of the same ocean, and comparatively few of the better-known forms are identical. Indeed, the affinities of this collection are, as might be expected, Mauritian.—Land and fresh-water Mollusca of the Seychelles Archipelago: E. R. **Sykes.** The author gives an account of the land and fresh-water shells collected by Mr. Stanley Gardiner in the Seychelles Islands. Nearly all the known forms are included in the collection, and three species belonging to Ennea (2) and Priodiscus (1) are described as new. A table showing the inter-insular distribution is given, and a list of all known forms. The origin of the fauna is uncertain, but the islands have evidently been for some considerable period separated from the mainland.—A blind prawn from the Sea of Galilee, constituting a new genus and species, *Typhlocaris galilea*: Dr. W. T. **Calman.**

PARIS.

Academy of Sciences, April 19.—M. Bouchard in the chair.—Examination of the upper layers of calcium and hydrogen in the solar atmosphere, and of the same black filaments in the two layers: H. **Deslandres** and L. **d'Azambuja.** The large spectroheliograph at Meudon permits of the examination of the K_3 and K_2 lines, quite pure and free from other light. The black filaments of K_3 have been compared with the image of Hα. It is concluded that in all previous work the lines obtained for hydrogen represent a mixture of different layers. To obtain the upper layer only, it is necessary to isolate the centre of the black line.—The slowness of the spontaneous transformation of the variety unstable at low temperatures of certain dimorphous bodies: D. **Gernez.** An experimental study of the equilibrium of yellow and red mercuric iodide and the corresponding varieties of thallous iodide.—The "sense of direction" in bees: Gaston **Bonnier.** The fact that bees, up to a distance of 3 kilometres, fly in a direct line for the hive, has been explained as due either to the sense of sight or of smell. The author's experiments clearly demonstrate that neither sight nor smell serve for this purpose, and that bees possess a "sense of direction." This sense is not located in the antennæ.—The map of south Imerina: the methods of work employed: E. **Colin.** This map is on the scale of 1/100,000, with contour lines of 50 metres.—Remarks relating to the communication of M. Deslandres: G. E. **Hale.** In the photographs of Hα it has been found that the relative intensity of the black and brilliant flocculi is determined by the position of the slit relative to the line Hα. If the slit only allows the light from the central portion of the line to fall on the plate, the brilliant flocculi are very intense in the image. If, on the contrary, the image is formed exclusively from the light of the edge of the line, the black flocculi are well seen, but the brilliant flocculi are faint or even invisible. The results are not favourable to the theory of anomalous refraction as the cause of the hydrogen flocculi.—Letter from Dr. J. B. **Charcot** describing the voyage of the *Pourquoi-pas?*

(Antarctic expedition).—The determination of the solar parallax from observations of the planet Eros made in several observatories in 1900–1: Arthur R. **Hinks.** The photographic observations lead to $w=8{\cdot}807'' \pm 0{\cdot}0027''$; the principal micrometric observations give $8{\cdot}803'' \pm 0{\cdot}0039''$. The reduction of the eye observations by the method of passages is not yet completed. The mean value $8{\cdot}806''$ is not consistent with a greater constant of aberration than $20{\cdot}47''$.—The distribution in space of large proper motions: H. H. **Turner.**—Infinitely small deformation of ruled surfaces: J. **Haag.**—Differential systems of isomorphs: E. **Vessiot.**—The analytical function equal to the maximum modulus of an integral function: Arnaud **Denjoy.**—The electrical properties of copper-aluminium alloys: H. **Pécheux.** Alloys containing 3, 5, 6, 7·5, 10, and 94 per cent. of aluminium were examined. The electromotive forces of thermocouples consisting of alloy/copper were measured for temperatures up to 820° C., and the resistances of the same alloys measured for temperatures up to 350° C.—Some consequences of the use of a selective receiver in the measurement of radiant energy: Ch. **Féry.**—The physico-chemical properties of the colloidal particles known as *micelles*: G. **Malfitano.** The author maintains that the experimental data of J. Duclaux are not in contradiction with his own experiments.—The function of contact electrification in the permeability of membranes to electrolytes: Pierre **Girard.**—The determination of added water in decomposed milks: André **Kling** and Paul **Roy.** The total nitrogen corresponding to the albumenoids of the milk is not affected by the fermentative processes, and hence is suggested as more suitable for the detection of added water than the estimation of the non-fatty solids.—The suspension of life in certain seeds: Paul **Becquerel.** Seeds of lucerne, mustard, and wheat were kept at the temperature of liquid air for three weeks, and then further cooled to −253° C. (boiling hydrogen) for seventy-seven hours. All the lucerne and mustard seeds germinated normally, and four out of five of the wheat grains. The seeds had been well dried and placed in a vacuum before cooling.—Remarks on the preceding communication: Armand **Gautier.**—The lowering of the diaphragm: A. **Thooris.**—The diastases of milk: F. **Bordas** and F. **Touplain.** The oxydase reaction given by unboiled milk in presence of hydrogen peroxide and paraphenylene-diamine appear to be due, not to an oxydase, but to the casein, or compound of casein and lime.—The comparative harmlessness of carbonic acid in incubation: M. **Lourdel.**—The inequalities of electric potential at several points of the organism: J. **Audrain** and R. **Demerliac.**—Passive congestion of the liver and arterial hypertension: E. **Doumer** and G. **Lemoine.**—The hydroids of the Lamouroux collection: Armand **Billard.**—A storm at sea: M. **Halluitte.**

DIARY OF SOCIETIES.

THURSDAY, April 29.

Royal Society, at 4.30.—Note on the Results of Cooling certain Hydrated Platin-cyanides in Liquid Air: Prof. J. Emerson Reynolds, F.R.S.—A Phenomenon connected with the Discharge of Electricity from Pointed Conductors (with a Note by Prof. J. Zeleny): Prof. H. T. Barnes and A. N. Shaw.—On the Effect of Temperature on Ionisation: J. A. Crowther.—The Wave-making Resistance of Ships; a Theoretical and Practical Analysis: Dr. T. H. Havelock.—The Ionisation in Various Gases by Secondary γ Rays: R. D. Kleeman.

Royal Society of Arts, at 4.30.—The Problem of Indian Labour Supply: S. H. Fremantle.

FRIDAY, April 30.

Royal Institution, at 9.—The Pitfalls of Biography: Dr. Edmund Gosse.

Society of Dyers and Colourists, at 8.—Recent Developments of the The ry of the Colloidal State, and their Bearing on the Dyeing and Cleaning of Textile Fibres: Dr. E. Feilman.

SATURDAY, May 1.

Royal Institution, at 3.—The Earth Movements of the Italian Coast and their Effects: R. T. Günther.

MONDAY, May 3.

Society of Chemical Industry, at 8.—Vulcanisation Tests in Plantation Rubbers: Clayton Beadle and Dr. H. P. Stevens.—The Indian Magnesite Industry: H. H. Dains.—A New Steam Meter: A. Girtler.—A New Refractometer: J. Lewkowitsch.

Royal Society of Arts, at 8.—Aërial Flight: F. W. Lanchester.

TUESDAY, May 4.

Royal Institution, at 3.—Cosmogonical Questions: Prof. Svante Arrhenius.

Royal Anthropological Institute, at 8.15.—(1) A Note on a Stone on the Rock of Cashel: (2) Some Irish Stone Circles: A. L. Lewis.

WEDNESDAY, May 5.

Entomological Society, at 8.

Society of Public Analysts, at 8.—The Analysis of Air: W. J. A. Butterfield.—The Estimation of Iron by Permanganate in Presence of Hydrochloric Acid: G. Cecil Jones and J. H. Jeffery.—The Composition of Butter from a Cheshire Herd of Cows: A. Smetham.—A Rapid Method for the Estimation and Separation of Milk Sugar and Cane Sugar in Sweetened Condensed Milk: I. S. Jamieson.

THURSDAY, May 6.

Royal Society, at 4.—Election of Fellows.—At 4.30.—*Probable Papers*: Reciprocal Innervation of Antagonistic Muscles. Note XIV. On Double Reciprocal Innervation: Prof. C. S. Sherrington, F.R.S.—Note on a Curious Property of Neon: Prof. J. Norman Collie, F.R.S.—The Properties of Colloidal Systems. I. The Osmotic Pressure of Congo-red and of Some Other Dyes: Dr. W. M. Bayliss, F.R.S.—The Origin and Destiny of Cholesterol in the Animal Organism. Part V. On the Inhibitory Action of the Sera of Rabbits fed on Diets containing Varying Amounts of Cholesterol on the Hæmolysis of Blood by Saponin: Miss Mary T. Fraser and J. A. Gardner.

Linnean Society, at 8.—On some Zoantheæ from Queensland and the New Hebrides: Mrs. Leonora J. Wilsmore.—The Œcological Relations of the Tiger-Beetles: Dr. V. E. Shelford.

Röntgen Society, at 8.15.—An Illustrated Description of the Historical Collection of Tubes recently deposited at the Albert and Victoria Museum: Dr. G. H. Rodman.—On X-rays Produced at a Magnetically Deflected Kathode Focus: J. H. Gardiner.

Institution of Electrical Engineers, at 8.—The Theory an Application of Motor Converters: H. S. Hallo.

FRIDAY, May 7.

Royal Institution, at 9.—The Campaign against Malaria: Majo Ronald Ross, C.B., F.R.S.

CONTENTS.

THURSDAY, MAY 6, 1909.

VERTEBRATE DEVELOPMENT.

The Development of the Chick. An Introduction to Embryology. By F. R. Lillie. Pp. xi+472. (New York: H. Holt and Co.; London: G. Bell and Sons.) Price 16*s.* net.

THE first feeling of an embryologist on examining this beautiful volume is of disappointment and regret that it treats solely of the development of so familiar an animal as the chick. The like style of work, dealing with some less-known form, might have been a very valuable original monograph. The chick has, indeed, played a very large and undeserved part in the history of embryology from the time of Harvey, Caspar Friedrich Wolff, and earlier, through all the years during which Pander and Carl Ernst von Baer devoted themselves to its study, down to to-day. The incubator of the embryological laboratory is a silent witness of the importance often still attached to the development of the common fowl in the teaching of embryology. In addition to the employment of this animal in the laboratory, many embryologists have found the incubated egg of the hen useful, at times invaluable, in their researches. None the less, like the type-system of the zoological laboratory, the chick has seen better days in embryological work and teaching. Convenience has become the sole reason for its continued employment. For most, if not all, of the subjects of a course of embryology it is not difficult at all to find far more suitable material for instruction.

No embryologist would think of attempting to demonstrate the wonderful story of the germ-cells, the phenomena of the maturation of germ-cells, fertilisation, egg-cleavage, or even of the formation of the so-called germinal layers with material supplied by the development of the chick. In almost every field of embryological research, where fundamental questions have been solved or brought nearer solution, material from other animals has been employed. "The book is meant for beginners in embryology," we are told in the preface, and the long list of literature at its close is intended doubtless as a further guide to him. It embraces, however, only those memoirs in which the developmental features of the highly specialised bird find a place. The beginner, therefore, having worked through the book and some or all of the literature, will have gained a very erroneous idea of what modern embryology really is. Most of the important parts of its literature on all sorts of questions will not have been brought to his notice. For example, the classic memoirs of Boveri and F. Meves on oögenesis and spermatogenesis, those of Mark, Whitman, and E. B. Wilson on egg-cleavage, or of E. van Beneden, Hubrecht, and Duval on the trophoblast and placenta, can of necessity find no place or mention in a work designed as this has been. After a close study of the work, the student may not unnaturally put a question we have often heard, "What *is* trophoblast? Is it a name invented for something existing only in the imagination of some 'versatile' embryologist?" What a revelation would it not, then, be to him to read Hubrecht's classic monograph on the trophoblast and placentation of the hedgehog (1889), to be followed by the study of the works of Duval, E. van Beneden, and J. P. Hill!

Were one, indeed, to search for the cause of the existence and persistence of so much that is erroneous in embryology, the convenient chick would probably be found to be the chief culprit. Of what value is it to the student to learn that the thymus arises from the walls of the third and fourth branchial pouches, if at the same time he remain ignorant that such a restricted origin be not by any means universal, and that there be fishes in which each and every branchial pouch may furnish its thymus element? The nature of the thymus could never be solved from its development in the chick. The mode of development of important structures from well-defined placodes or plates of cells, each placode probably having a first origin in a single cell, cannot be demonstrated from the embryology of the chick.

This animal has always been, and it still is, the bulwark of the doctrine of epigenesis, and this because the true developmental phenomena are often here obscure. The placodes of piscine development lead us in the direction of the large single cells or *teloblasts* of the earthworm, and the two things have significant bearings on the question of the mode of the development, whether by epigenesis, as Wolff and most other embryologists have thought, or by evolution with pre-determination, *not pre-formation*, as some embryologists are beginning to suspect.

What the beginner requires, we imagine, is not so much facts as principles, those underlying the development. Unless it be the formation of the germinal layers, and concerning the truth of the germ-layer theory sceptics are not wanting, it is difficult to say what embryological principle can be illustrated from the developmental pictures presented by this animal. Direct development *or* alternation of generations, epigenesis *or* evolution, somatic origin of germ-cells *or* germinal continuity from generation to generation, these and many other fundamental questions receive no certain replies from the study of the development of the chick, and no discussion in the pages of the book before us. What is a larva and what an embryo? are natural questions for a beginner to ask, but he will find no answer in the work before us. He will not even read that, as many embryologists think, the larva becomes the embryo; still less as, wonderful to say, happened recently in a well-known work, the embryo in its turn could become a larva. From the account of the rudimentary pronephros of the chick he will be able to form no conception of what a functional pronephros, such as that of the frog or newt, really is. In short, it may be doubted whether from a study of the development of the chick the beginner can hope to obtain any real insight into the facts and tendencies of modern embryology.

The book is clearly written, and evidently much labour has been expended upon its production, while the illustrations are excellent. Lillie's "Development of the Chick" is, indeed, one of the handsomest books available for embryological study, and it will be indispensable in every laboratory, though we should not care to regard it as a text-book of embryology for the student in quest of the scientific principles underlying animal development. B.

MODERN EXPLOSIVES.

The Manufacture of Explosives. Twenty Years' Progress. Four Cantor Lectures delivered at the Royal Society of Arts in November and December, 1908, by Oscar Guttmann. Pp. viii+84. (London: Whittaker and Co., 1909.) Price 3*s*. net.

It is now fourteen years since Prof. V. B. Lewes gave a series of Cantor lectures at the Royal Society of Arts on "Modern Explosives." The period which has elapsed has been so fruitful in research and manufacturing improvements that the series of lectures delivered by Mr. Guttmann, which form the subject of the present volume, is very welcome.

Mr. Guttmann's treatise on "The Manufacture of Modern Explosives" was published in 1895, and the present small volume is a useful addendum to the larger work. As is pointed out in the preface, it is impossible in so small a compass to give more than a general outline of the many improvements and researches during the past twenty years, but this outline is certainly valuable, especially as the author gives full references to all important patents and papers.

In spite of all advances, it is of interest to note that black powder was employed in mines and quarries to the extent of 7000 tons in 1907. In addition, nearly 3500 tons of "safety" explosives were also used. The world's annual production of celluloid is put at the enormous total of 24,000 tons, whilst artificial silk reached the astonishing total of 5000 tons.

Nitro-cotton in some form or other is, without doubt, the most important explosive compound at present made, not only because it forms the basis of all smokeless propellant explosives, but also of celluloid and artificial silk. No possible pains must be spared to ensure stability of the nitro-cotton, and the causes which may give rise to instability or promote further decomposition are well treated by the author, but many will differ from him as to the extent of deterioration arising from the preliminary treatment of the cotton and the effect of alkaline stabilisers. It will be admitted that nitro-cotton has its defects, but such statements as "picric acid is a treacherous substance," "a more inconvenient material still is nitro-cotton," "we have an almost uncontrollable substance in nitro-cotton," are open to criticism. Later the author himself says that the stability of nitro-cotton below 20° C. is assured.

So far as our Navy is concerned, exception must be taken to the statement that "it was and still is the practice in men-of-war to arrange the ammunition stores and powder magazines in close proximity to boilers and engines, frequently without any ventilation." This has never been our practice; there have been unavoidable instances where such an arrangement has been forced upon designers by other considerations, but in such cases the magazines have been thoroughly heat-insulated. Moreover, magazines have always been specially ventilated independently of the general ventilation of the ship. It is fully recognised by those responsible for the designs that the lower the temperature the better preserved will be the powder, and for that reason refrigerating machinery has been introduced, but the author's fear as to possible breakdown at a critical moment has not been left unprovided for by men who can evolve such an engine of destruction as a modern battleship.

One turns hopefully to the question, "What will be the powder of the future?" only to find that "the future belongs to a stable nitro-compound of the aromatic series." Possibly; but is there even remote promise of the production of any such body which will meet the varied requirements of a smokeless propellant as distinct from a simple explosive substance? J. S. S. B.

CHEMICAL ANALYSIS FOR STEEL-WORKS' LABORATORIES.

Rapid Methods for the Chemical Analysis of Special Steels, Steel-making Alloys, and Graphite. By C. M. Johnson. Pp. vi+221. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 12*s*. 6*d*. net.

The author of this book gives a detailed account of his methods for the determination of chromium, vanadium, copper, titanium, nickel, molybdenum, and tungsten in steel and steel-making alloys, besides those for the ordinarily occurring elements, viz. carbon, silicon, sulphur, phosphorus, and manganese. No reference is made to tantalum and uranium.

Most of the methods described are to be found in the standard English works on the subject, but there are several new features which deserve to procure a place for the book in all steel-works' laboratories. Of these features, the exact determination of phosphorus in ferro-vanadium, and the application of potassium ferricyanide to the separation of small amounts of copper and nickel from large amounts of iron are specially worthy of note.

Many of the methods described, however, are by no means "rapid," and much unnecessary time is spent in fusions, washing precipitates, &c. The analysis of tungsten powder is very tedious, although the author supplements his methods by a well-known rapid method of English origin, erroneously stated by him to give low results. Again, the author fuses impure tungstic oxide residues with about four times the necessary amount of sodium carbonate and for at least four times longer than necessary, whilst two hours are required for lead molybdate to settle, whereas it may be safely filtered off immediately after its formation. Many other similar points might be cited which are of little importance beyond the fact that the author aims, as the title-page suggests, at rapidity of execution.

The determination of carbon is dealt with very well indeed, and it is shown that the most trustworthy method is that of burning the drillings mixed with red lead in a stream of oxygen. This direct combustion process has been in constant use in most of the Sheffield works' laboratories for several years. Red lead is at present, however, being largely discarded in favour of pure manganese dioxide, which is in nearly every case quite as effective, and more than doubles the life of a porcelain boat.

The concluding chapters of the book include one on the examination of graphite and graphite crucibles, and one on the annealing of steel. In the former, the existence of silicon carbide in used plumbago crucibles is considered, and an account given of the determination of its amount. The chapter on the annealing of steel, to which attention is specially directed in the preface, contains the extraordinary statement that "rapid cooling of perfectly annealed steel has no effect whatever on its hardness." The author considers steel to be perfectly annealed when it has been kept at 700–720° C. for from ten to twelve hours, and states that it may then be cooled slowly or quickly—in fact, it may be plunged whilst at this temperature into cold water—without becoming hard. This statement cannot be accepted.

The book is very well printed, is singularly free from typographical errors, and is provided with an excellent index.

The author may be interested, by the way, to learn that the use of silver iodide indicators in the cyanide titration of copper solutions was suggested twelve years ago in the *Chemical News*. F. I.

HYPNOSIS AND SUGGESTION.

Die Hypnose und die Suggestion, ihre Wesen, ihre Wirkungsweise und ihre Bedeutung und Stellung unter den Heilmitteln. By Dr. W. Hilger. Pp. 185. (Jena: Gustav Fischer, 1909.)

THIS is a most interesting, scientific and readable book. After a somewhat detailed historical introduction, the author demonstrates in a clearer way than we have hitherto read, that there is at least a very close resemblance between normal and hypnotic sleep; indeed, one is left with the impression that there is practically no difference between them. *Inter alia* it is pointed out that there is an element of subconscious thought even in normal sleep, and that this is only partial (Teilschlaf); and, among other examples, the oft-cited mother is instanced who sleeps soundly through the noise of traffic or a thunderstorm, but wakes at the feeblest cry of her new-born child.

In discussing the nature of suggestion, Dr. Hilger directs attention to what he calls mental (seelische) reflexes, such as the flow of saliva at the thought of food, contraction of the pupils on thinking of a bright light, erection of the nipples and flow of milk when a lactating mother thinks of suckling her child, and so on. He also points out that memory-images are stronger in normal sleep than during waking hours, just as they are in hypnotic sleep. Some methods of hypnosis are described, and it is rightly said that a feeling of goodwill between the patient and the physician is essential to successful hypnotism.

In a chapter on suggestion and will, the author insists on the importance of the movement-idea in the performance of a voluntary action and on the cooperation of expectancy of and practice in the particular action. Instinct, motive, and interest are in turn duly considered.

The next chapter is devoted to a discussion of the influence of the will, suggestion, and similar psychical factors on disorders of perception; and many interesting cases bearing on the subject are reported, of which the following is a typical example. A man was afflicted with a tickling in his throat shortly after kissing his sweetheart, and he became convinced that it was due to a hair in his throat. His doctor examined the throat and found nothing more than a slight pharyngitis, which was treated in the usual way. Before the next visit, when the patient was no better and still convinced of the presence of the foreign body, the medical man had provided himself with a hair, which he surreptitiously introduced into but ostentatiously withdrew from the throat. The tickling was instantaneously and permanently cured.

In the last chapter, dealing with reflex disorders and their treatment, the author first points out that attention to a stimulus strengthens the reflex which it excites, and he makes special reference to Haab's cortical pupillary reflex. Many examples are then given of the cure by hypnotism, &c., of such reflex disorders as sea-sickness, the vomiting of pregnancy, hiccough, nervous diarrhœa, nocturnal enuresis, morbid blushing, palpitation, hay fever, nervous cough, asthma, &c. It will be a surprise to most people that the periods of menstruation may be modified by suggestion.

The volume concludes with an account of some cases of chorea and other functional disorders of the nervous system successfully treated by hypnotism. There is a good index, and we can cordially recommend the work to those interested in the subject.

THE STRUCTURE OF THE SCALLOP.

Pecten. By W. J. Dakin. Being No. 17 of the Memoirs issued by the Liverpool Marine Biology Committee. Pp. viii+136; 9 plates. (London: Williams and Norgate, 1909.) Price 4*s*. 6*d*.

THE scallop, clam or queen as it is called in different parts of our coasts is an animal of considerable interest. To the pilgrims of the Middle Ages who sought the famous shrine of St. James of Compostella, the shell was both a badge and a bowl, and from this old association it has become incorporated in many coats of arms, as, for instance, in that of the city of Reading. More utilitarian is the interest associated with the scallop as an article of food, and in this respect the rare delicacy of its flavour should bring "queens" into greater favour than they now enjoy. To the more curious inquirer the scallop offers many attractive features, both in its structure and habits. The gem-like green eyes that sparkle under the fringe of tentacles have long been known to present a peculiar and highly-organised structure. Pecten is perhaps the most highly coloured of all molluscous animals. The strength and activity of the movements by which it evades its chief enemy, the starfish, form a remarkable contrast to the lethargy of most bivalves. It is therefore with particular pleasure that we welcome a monograph on the large British species, *Pecten maximus*.

To the considerable body of existing facts on this animal which have been drawn upon by the author, he has added confirmatory and in some cases new evidence from his own dissections and observations. The result is an admirable piece of work, which will be of great assistance to all who wish to gain acquaintance with this especially interesting and accessible type of shellfish.

The structure of Pecten is so largely modified in association with its active life that Mr. Dakin has been well advised in giving an introductory sketch of its habits and of their change during life. When the free-swimming larva first settles down, the only mode of progression is that of crawling by means of the mobile foot. A little later, the "byssus" spins its threads and forms an anchorage by the help of the foot. In some species this mode of attachment is permanent, but in most it is rarely employed when adult life is reached. By that time, or even before, the mantle, and shell secreted by it, have assumed the peculiar form that enables both forward and backward leaping movements to be executed.

Among the specially good features of this work may be mentioned the biochemistry of the digestive gland and the account of the eye structure. Mr. Dakin has the advantage of knowing the structure of other lamellibranchs, and his book gains much from the comparative method. He has studied Pecten at different places, and knows the variation which it exhibits. As a result we have a most careful, workmanlike, and fully illustrated account. The author and publisher are to be congratulated on the appearance of this valuable addition to biological literature. The only disappointing section is that on development, our knowledge of which is very deficient. We hope the author will be able to add to it in a subsequent paper.

A STUDY OF THE AUSTRIAN SEA-BOARD.

The Shores of the Adriatic. The Austrian Side. By F. Hamilton Jackson. Pp. xv+420; with numerous woodcuts, photographs, plans, and maps. (London: John Murray, 1908.) Price 21*s*. net.

THOSE who have had the pleasure of reading Mr. Jackson's previous volume on the Italian Adriatic towns will be very pleased to find that the author has extended his researches to the "other shore, you know, upon the other side." The tour outlined in this volume commences at Aquileia, somewhat west of Trieste, and extends down to the Bocche di Cattaro, thus covering Istria and Dalmatia. Geographically speaking, the two shores of the Adriatic differ widely, the Italian side being an almost unbroken flat coast-line, while here a nearly continuous chain of islands extends from Pola down to Ragusa, and a number of arms of the sea furnish excellent harbours well shut in by mountains. The vegetation of the district is described as distinctly Mediterranean, while the only fault of the climate appears to be the prevalence of a cold north wind.

The people of these districts are of a very different race from the Italians over the water, and a fair account is given of their history, customs, proverbs, and superstitions. At the present time the Croat majority is abolishing the use of Italian in schools, and the author advises those who wish to acquire a knowledge of Dalmatia without learning Croat to do so before Italian is forgotten. In this attempt to perpetuate multiplicity of languages, the Dalmatians are very like the British, and we noticed another resemblance of a small kind in one or two of their superstitions.

The descriptions lead us to believe that the interest of the tour is not so exclusively confined to rummaging over old churches, as on the Italian side, but that the architectural features, as well as the relics in the treasuries of the churches, are none the less worthy of attention, and a study of the reciprocal influences of the two shores, and of the extent to which the architectural similarity is due to Eastern influence, forms a suitable concluding chapter.

The fact that the author met no English on his second tour would have been considered remarkable thirty years ago, when middle-class English formed the main bulk of European travellers. At the present time the absence of English visitors is equally noticeable, even in many of the best-known tourist and health resorts. It is now no longer necessary to go to Dalmatia to get away from one's compatriots; on the other hand, there is perhaps less inducement for those who travel to keep to the beaten tracks, and they may evidently have a very enjoyable tour in these Adriatic provinces.

The illustrations are partly from photographs, but mainly from line drawings, which well show up the beautiful carving and ornamentation in the churches. A number of plans are also given, and if the author had not obtained a special permit from the Austrian Government his artistic and photographic studies would probably have got him into great trouble. We commented on the absence of a map in the Italian volume. Here there is a map, and it is most useful.

OUR BOOK SHELF.

Les Planètes et leur Origine. By Ch. André. Pp. 285. (Paris: Gauthier-Villars, 1909.) Price 8 francs.

LIKE Gaul, M. André's book is divided into three parts. The first part is devoted to planets, the second to satellites, and the third to the formation of the planetary system

The book is well written and well illustrated. It deals very thoroughly with an important branch of astronomy. It will serve the purpose both of a popular treatise and of a book of reference.

The comparison of orbital motion with theory seems to have been beyond the plan of the author. In other respects it is hardly possible to notice the omission of any matter relevant to the title of the book.

The author decides in favour of a rotation period for both Mercury and Venus approximating to that of the earth. He gives an excellent *résumé* of Prof. Poynting's investigations of temperature. He obtains for Mercury 193° C., for Venus 66° C., and for the earth, by the same method, 16° C. This last result inspires some confidence in the two former. M. André decides against the canals of Mars. It is one of the many evidences of the up-to-date character of the book that reference is made to the experiments by Mr. Maunder and Mr. Evans on this question with the help of the boys of the Royal Hospital School at Greenwich.

The chapter on minor planets is excellent. M. Mascart has, however, recently covered the same ground. The present volume contains a reference to 1906 TG. The chapters on Uranus and Neptune consist for the most part of what is now ancient history. The author considers that planets inside Mercury or outside Neptune would have been already discovered if they existed.

In the second part the author gives a historical account of various announcements of a satellite of Venus. His chapter on the satellites of Mars, and the first half of the following chapter, is necessarily somewhat hackneyed. The latter chapter concludes with Mr. Melotte's discovery of Jupiter's eighth satellite and Mr. Crommelin's announcement that the orbit was retrograde (*fait absolument inattendu*). Mr. Crommelin's original period of three years and a half, based on the supposition of a circular orbit, enables one to date the writing of this paragraph to within a month or two.

The interest of the next chapter centres on Phœbe and the still unconfirmed tenth satellite. The last chapter of the second part refers to the masses of the planets and their satellites.

The third part, on the formation of the planetary system, describes Laplace's nebular hypothesis and its subsequent extensions and modifications by Roche, Darwin, Faye, and Stratton. On p. 239, in four short paragraphs, we have a statement of the case against Laplace's hypothesis. In these paragraphs the retrograde motion of Jupiter's eighth satellite is again mentioned.

The Care of Natural Monuments, with Special Reference to Great Britain and Germany. By Prof. H. Conwentz. Pp. xi+185; illustrated. (Cambridge: University Press, 1909.) Price 2*s*. 6*d*. net.

THE title of this little work scarcely gives a sufficient clue to the nature of its contents, as there are comparatively few persons who would regard wild mammals or wild birds as "natural monuments." As he tells us in the introduction, the author has himself felt this difficulty, but has nevertheless used the term as a translation of the German "Naturdenkmal"; though we fear this rendering may result in checking the sale of an excellent and praiseworthy volume. Prof. Conwentz writes as one having authority, since he is the Prussian Government commissioner for the care of natural monuments. On this subject he delivered an address at the Leicester meeting of the British Association in 1907; and it is that lecture which forms the groundwork of the book now before us. The book is divided into two sections—"Nature Threatened" and "Nature Protected"—the former particularising the various natural objects and types of scenery which require protection, and the latter what has been and is being done in this direction in different countries, but more especially in the United Kingdom and Germany. On the whole, the author appears to consider that we are doing our duty as regards the protection of the indigenous fauna fairly well, and bestows unstinted commendation on the action of local authorities in establishing reservations in various parts of the country. He is, however, of opinion that more attention might be devoted to securing small areas as reserves of this nature; and as regards other "natural monuments" suggests that private landowners might be induced to do more in the way of conservation than is at present the case. It is also suggested that the central committee for the study and survey of British vegetation might include in its programme the protection of characteristic associations of plants, as well as of single rare species. By directing attention to what has been done and what remains to be done, the appearance of the volume will doubtless serve to awaken renewed interest in the subject. R. L.

The Mineral Kingdom. By Prof. R. Brauns. Translated, with additions, by L. J. Spencer. With 91 plates (73 of which are coloured). (Stuttgart: Fritz Lehmann; London: Williams and Norgate, 1908.) Parts i. to v., price 2*s*. net each.

WHILE popular introductions to botany and zoology are numerous and find a ready sale, little has been done to familiarise the general public with the appearance and characters of the commoner minerals. The chief obstacle has been found in the difficulty of depicting the colour and lustre of minerals so accurately that they may be recognised without the employment of the ordinary methods of determination.

To judge by the five parts which have already appeared an unusually successful attempt has been made in the present work to solve the problem of the representation of minerals by colour printing. The reproductions of topaz, tourmaline, and phosgenite are excellent, and even minerals with metallic lustre are in most cases very effectively rendered. The plates measure $9\frac{1}{4}$ inches by $6\frac{1}{2}$ inches, and, as a rule, contain numerous coloured figures.

The book can be recommended to all who wish to take up the study of mineralogy, and have not the opportunity of referring to a collection containing as many examples as those illustrated in these plates.

The text is clear and readable, and comprises a simple introduction to the principles and methods of the science, as well as a detailed account of the different mineral species. J. W. E.

Man in the Light of Evolution. By Dr. J. M. Tyler. Pp. xiv+231. (London: Appleton and Co., 1909.) Price 6*s*. net.

THIS is the sort of book about which there is no need to say anything harsh. It is calculated to produce a vague edification in the mind of the unscientific reader. Prof. Tyler's attitude towards disputed problems of evolutionary science is so conciliatory and non-committal that one fails, for instance, to discover what view he holds about the inheritance of acquired characteristics, or whether he has any view of his own. He alludes in a distant way, but always politely, to Mr. Darwin, Mr. Haeckel, and so on. (But why is poor Mr. A. J. Balfour "Balfour"?) So far as he has any point to make, it would seem to be this, that the springs of progress lie not so much in the environment as in our own "higher powers," and that these "higher powers" consist especially in our moral and religious tendencies. All this may be quite true; but it cannot be said that our author helps in the slightest degree towards a clear understanding either of what those are or of how they have come about. A perfectly worthless bibliography is appended, in which the name of J. M. Tyler appears more than once, but that of E. B. Tylor not at all.

An Explanation of the Adjustment of Ships' Compasses. By Commander L. W. P. Chetwynd, R.N. Pp. 24. (London: J. D. Potter, 1909.) Price 2s.

THIS useful little book, the sections of which are accompanied by diagrams, is an endeavour on the part of the author to convey to the reader in as concise a manner as possible the various causes of deviation, and the methods of overcoming them, without the use of mathematical formulæ.

In most treatises dealing with this subject it is, unfortunately, the case that they are too theoretical and contain too many symbols to suit the average seaman; therefore great praise is due to Commander Chetwynd for the able manner in which he has brought out a practical book for practical people. H. C. L.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

An Inquiry concerning Scientific and Medical Journals.

CAN any of your readers kindly inform me where copies of the following journals can be found in England, if possible in London?

(*a*) *Lo Spallanzani.* This is a journal of the medical and natural sciences published at Modena in the 'seventies and 'eighties.

(*b*) *Mittheilungen d. Wiener embryol. Institut.* Published in the 'eighties, and perhaps still.

(*c*) *Gazette médicale d'Algérie.* Published at Algiers in the 'fifties.

(*d*) *Ann. Soc. méd. d'Émulation de la Flandre occid.* Roulers, 1849. There are other references to a *Soc. méd. d'Émulation*, without place or name. I should be very glad to have these *Soc. méd. d'Émulation* cleared up, as there must, I think, have been several such societies.

(*e*) *Baltimore Sun*, 1876. The stock of this journal was burnt. Is there a file of it anywhere in England?

(*f*) *Archiv de méd. nav.* Published at Paris in the 'seventies.

(*g*) *Archiv f. Psych. u. Nervenkrankheiten,* for the 'eighties.

(*h*) *Sociedad medica Argentina*, 1901.

(*i*) *International Med. Magazine.* Philadelphia, 1892.

(*j*) *Zeitschrift f. Tiermedicin,* 1897. (Sought at Royal Veterinary College.)

(*k*) *Soc. med. Württemberg*, 1905.

These have been sought for at the likely places, but it is possible that they exist and have been overlooked. It is a pity that some of the larger libraries in London duplicate certain of the *rarer* scientific and medical journals, whereas by a division of material they might provide a more comprehensive collection. Further, there ought to be at least one library in London with a complete set of university dissertations and degree theses. No library at present appears to make a speciality of such material. I have always found German university librarians most willing to lend copies, but the delay is vexatious, and a cursory examination of five minutes' duration would often have settled the point required. KARL PEARSON.

Biometric Laboratory, University College, London.

Radio-activity in Relation to Morozoff's Theory of the Constitution of Atoms.

THE fact that the α particles of radium, as shown lately by Prof. Rutherford and Geiger,[1] carry two elementary charges of positive electricity, $2 \times 4{\cdot}65 \times 10^{-10}$ E.S.U. per atom of helium, appears quite unexpected, and requires consideration. Since the atom of helium carries more than a single charge, which would present the simplest and most natural contingency, there arises the question, Why does it carry just two charges and not one or more? an answer to which has been proposed by N. L. Müller in the "Jahrbuch der Radioaktivität" (v., 702, 1908), but it seems to me that the following explanation, based upon the Morozoff theory of the constitution of atoms,[1] will not be devoid of interest.

According to Morozoff, all the chemical elements are formed by manifold combinations of three primordial elements, viz. archonium (nebulium) (Z), with a combining weight 4; protohelium (x), with a combining weight 2; and protohydrogen (h), with a combining weight 1. Of these, protohelium, as shown by the value of its combining weight, presents half an atom of ordinary helium, the re-combination of two of which yields again a helium atom.

Archonium (Z), with its eight affinities, plays the part of carbon in organic compounds, the archonium elements, more or less saturated with protohelium (x) and protohydrogen (h), building the main atomic chain. The chains of various chemical elements are built of one to eleven such links, which, combined after certain rules, allow us to reconstitute the whole periodic system of elements.

As in the notation of organic chemistry, the atom of radium is represented in Morozoff's system by the following symbol:—

$$x - \mathrm{Z}(x_2h) - [\mathrm{Z}(xh)_6]_9 - (x_2h)\mathrm{Z} - x.$$

Radio-activity is due to closing of the chain, accompanied by splitting off of two helium half-atoms (x),

$$\underbrace{\mathrm{Z}(x_2h) - [\mathrm{Z}(xh)_6]_9 - (x_2h)\mathrm{Z}} + 2x.$$

which yield the material carriers of electricity of the α particles.

Since both extreme helium half-atoms (x) are expelled under similar conditions, and since they carry electricity, each of them cannot carry less than one elementary charge of $4{\cdot}65 \times 10^{-10}$ E.S.U., hence a whole atom of helium must carry at least two elementary electric charges, or $9{\cdot}3 \times 10^{-10}$ E.S.U.

As not only radium, but also thorium and uranium, are represented by similar symbols, and their radio-activity is always accompanied by the expulsion of two helium half-atoms, it is evident that in all known radio-active changes an atom of expelled helium must carry at least two elementary charges. If we call, further, as has been done by Maxwell, an elementary charge an atom of electricity, we can consider the combination of two of them as a molecule of electricity, and state the following general law:—in all radio-active changes the smallest quantity of electricity associated with an atom of matter is not an atom ($4{\cdot}65 \times 10^{-10}$), but a molecule of electricity ($9{\cdot}3 \times 10^{-10}$). B. DE SZYSZKOWSKI.

Kieff, Zolotoworotska 6, Russia, April 16.

[1] Proc. Roy. Soc., lxxxi., 162 (1908), and *Physikalische Zeitschrift*, x., 42 (1909). Also NATURE, November 5, 1908.

[1] *Physical Review* (Russian), ix., 73, 121 (1908).

The Gravitative Strain upon the Moon.

IN his discourse on "The Æther of Space" at the Royal Institution, February 21, 1908 (abstracted in NATURE, vol. lxxix., p. 323), Sir Oliver J. Lodge states that "the force with which the moon is held in its orbit would be great enough to tear asunder a steel rod four hundred miles thick, with a tenacity of thirty tons per square inch," and he further states that Maxwell calculated the gravitational stress near the earth to be 3000 times that which the strongest steel could stand, and near the sun it should be 2500 times as strong as that.

For convenience we may call the diameters of the earth and of the moon 8000 and 2160 miles respectively, and the moon's distance from the earth 240,000 miles. At the surface of the earth the moon would fall 16·1 feet, or 1/328 mile, in one second. The velocity necessary to counteract this fall is, therefore, equal to $\sqrt{8000 \times 1/328}$, or about five miles per second, at which velocity the centrifugal force of the moon, revolving at a distance of

4000 miles from the earth's centre, would just balance the earth's attraction of gravity. So that, if this attraction were absent, and the two bodies were connected by a rod, or material bond, instead, there would be continual strain on such bond equal to the moon's weight at the earth's surface.

Now, the volume of the earth is $8000^3 \times 0{\cdot}5236$ cubic miles, or about 4×10^{23} cubic feet, which, multiplied by $5\frac{1}{2}$ and $62\frac{1}{2}$, gives 1375×10^{22} lb., or 6875×10^{18} tons (the value given by Cavendish's experiment is $6{\cdot}14 \times 10^{21}$ tons, the difference being due to the larger value of the earth's diameter here used), the moon's weight at the earth's surface being, therefore, $6875 \div 80$, or 86×10^{18} tons, which would be the strain on the material bond connecting the two bodies as above in the absence of gravity. As this strain varies directly as the mass of the revolving body and the square of its velocity, and inversely as its distance or radius of revolution, then at the moon's actual distance of 240,000 miles, and velocity of 0·64 mile per second, the strain would be diminished by the factors $4000\ 240000 \times (0{\cdot}64/5)^2$ or $1/3600$; that is, to $86 \times 10^{18}/3600$, or 24×10^{15} tons. Thus if some Titan should, like a stone in a sling, whirl the moon at its present velocity and distance around his finger, the strain upon the string would be 24×10^{15} tons, which, if the string be of the same thickness as the moon itself, gives about 1·6 tons per square inch, necessitating a steel rod about 400 miles in thickness of thirty tons per square inch tenacity, just as Sir O. Lodge states.

But have we not neglected a very important factor in this computation? As the moon moved away from the earth's surface to its present distance, we allowed for its change of velocity and distance as affecting its centrifugal force; but should we not also allow for the diminution of gravity at the increased distance? The tension of the stone in the sling upon its restraining cord would be less at the greater distance owing to the decreased velocity and to the effect of the increased distance upon the centrifugal force; but as the stone moved outwards it would also come into a weaker field of gravitative force, which would further reduce the strain inversely as the square of the distance (just as if its mass had been diminished), or by the factor $1/3600$, thus reducing the total strain of 24×10^{15} tons obtained above for the moon at its present distance and velocity to $24 \times 10^{15}/3600$, or $6\frac{2}{3} \times 10^{12}$ tons for its actual present value, requiring a steel rod only about $6\frac{1}{2}$ miles thick and of the same tenacity as before.

EVAN MCLENNAN.

Corvallis, Oregon, U.S.A.

The Inheritance of Acquired Character.

I HAVE received the following from my brother, Dr. A. W. Smyth, late superintendent of the United States Mint at New Orleans. He has experimented with bees and written papers on them, which have been published in several bee-journals throughout the world.

He says, The commonly accepted view, stated by Dr. Francis Darwin in his presidential address, that the queen bee is entirely isolated, so as to bar the ordinary course of inheritance, is not so. According to Dr. Smyth, some of the workers occasionally lay eggs, and these eggs always produce drones, which, coming to fertilise the queen, opens the path for the ordinary course of inheritance. Upon this principle he bases an explanation of the following facts. In Morocco the honey-bee has foes in the form of certain beetles. To guard their stores the bees have come to build pillars of wax at the entrance to the hive, which prevents the entrance of the beetle. This becomes a habit, and a habit that could only have arisen as an acquired character, and it could only have reached workers through the queen being fertilised by drone-offspring of the workers. When a Morocco queen is brought to this country, where these beetles do not exist, the progeny of the queen continue to build pillars of wax; in the course of time this acquired habit becomes attenuated.

WM. WOODS SMYTH.

Maidstone, April 17.

THE IMPERIAL SIDE OF THE FUEL QUESTION.

THE returns issued by the Board of Trade on February 24, dealing with the output of coal in the United Kingdom during 1907, should go far to convince the most callous that our fuel supply is at the present moment every whit as important an Imperial question as keeping up our first line of defence to the two-Power standard or forming an efficient citizen army, and that unless due prominence and consideration is given to it, it is impossible for our Navy and Army, no matter how good, to save the nation for more than a limited period.

Our kingdom has but two capital assets, labour and coal, and without the latter labour would count for but little in face of competition with nations possessing the means of economic power production; so that the real measure of England's power and prosperity is to be found in her store of unwon coal and her ability to husband the resources with which nature has endowed her in order that she shall retain the same relative position towards other nations that she does at present.

Not only has America the largest store of coal in the world, but until lately the amount that has been mined has been comparatively small, and out of all proportion to the magnitude of her coalfields. The close of the last century, however, saw her an easy first as regards the output of coal, and she now raises at least a third more than the United Kingdom.

It is, however, with the position of nations nearer home in respect to this question that we are at the present time more deeply interested, and in order to gain an idea of the relative life of their fuel supplies as compared with our own, it is necessary to contrast their rate of output with the available quantities of coal still unused.

The Royal Commission on Coal Supplies, which sat from 1901 to 1905, collected all the evidence possible as to the amount of coal still existing in this country, which at the rate of output then obtaining would last something like six hundred years, but they also gave warning that "vast as are the available resources, it must be borne in mind that a large percentage of them are of inferior quality, or are contained in deeper and thinner seams which cannot be worked at the present cost"; whilst the rate of consumption is increasing so rapidly that the output of 236,000,000 tons of coal in 1905 had risen in 1907 to 267,831,000 tons.

Such factors as these mean an inevitable and increasing rise in the price of coal, and it must be clear that it will be the time when coal has risen to such a price as seriously to hamper our power of competing with other European countries that will govern the period of our commercial supremacy, and not the date of the complete exhaustion of our coalfields.

Taking such figures as are available for the coal resources of the more important coal-producing European countries and the returns of the coal raised in 1905 and 1907, we may tabulate them as follows:—

	Total existing coal, in millions of tons	Coal raised 1905	Coal raised 1907
United Kingdom ...	140,000 ...	236,130,000 ...	267,831,000
Germany	150,000 ...	119,349,000 ...	140,835,000
France	17,000 ...	34,780,000 ...	35,586,000
Belgium	16,000 ...	21,500,000 ...	23,324,000

So that for all practical purposes the quantity of coal still existing in Germany may be taken as being the same as ours, the extra 10,000 million tons which that nation possesses being made up for by the superior quality of our steam and gas coals.

When, however, we turn to the output we find that we are raising nearly double the quantity that is being brought to the surface in Germany, so that if the ratio between the two outputs remains fairly steady, it must follow that Germany will still be a flourishing and powerful nation at the time when the depletion of our coal supply has reduced us to the position of a second-rate Power.

In searching for the cause of the enormous demand for coal in this country as compared with Germany, where the climate is far colder, we find that our coal production amounts to 6 tons per head of population, as against $3\frac{1}{2}$ tons in Belgium, $2\frac{1}{4}$ tons in Germany, and less than 1 ton in France, where wood is the chief fuel for domestic use; and it is clear that there must be something more than commercial activity to account for our consumption per head being more than double that of Germany.

The Royal Commission on Coal Supplies compiled statistics as to the proportion of the coal raised that was utilised for various purposes, which may be represented in percentages as follows:—

	Per cent.
Factories	22·97
Domestic	13·87
Iron and steel manufacture	12·17
Mines	7·80
Gas works	6·50
Railways	5·53
Potteries, brick works, glass works and chemical works	2·16
Metals and minerals	0·43
Coasting steamers	0·87
Steamers over seas	7·25
Exported	20·35

The first thing that strikes one is the high proportion of coal exported from this country, and further inquiry shows that this drain upon our coal supply is rapidly increasing, having more than doubled in the last thirty years, whilst the actual quantities exported in the last three years of which we have record were as follows:—

	Total quantity of coal exported from the United Kingdom
1905	47,477,000
1906	55,600,000
1907	63,601,000

Of this more than 14,000,000 tons went to Germany, an amount twice as large as was exported five years ago.

An instance of the amount of coal exported can be cited in the case of one colliery alone, the annual output of which is not less than a million tons per annum, but of this quantity not a single ton is retained in England, the whole amount being exported, and at a price at which it is able to compete with German coal even as far up the Rhine as Mayence. We must bear in mind, however, that of the 20 per cent. of exported coal a good deal is used for foreign coaling stations, and is there loaded into British ships, but this does not detract from the fact that steps should certainly be taken to prevent the depletion of our coal supplies for the benefit of our trade rivals.

As before stated, the estimated life of our coal supply is six hundred years, but at the rate at which it is being consumed it will not last, from a commercial aspect, for anything like this period, so that it is necessary for us to find out some means whereby economy in use can be secured. Isolated cases of fuel economy would have no effect on the consumption, but in the interests, not only of the country, but of each individual unit in our Empire, it behoves every-one to do his best to attain this result. It is possible, by slight alterations in the method of fuel consumption, to obtain the same manufacturing results as by the present system, with the added advantages of greatly reduced cost and reduction in the fouling of the atmosphere, a consummation which would soon tend to the benefit of the health and wealth of the community.

In England, conservatism to old ideas and methods has to a large extent checked the march of progress, but this does not obtain in other countries. In America and Germany, for instance, as soon as an improved method of working shows economy in manufacturing costs, the old machinery is regarded as obsolete and is ruthlessly scrapped; and although in certain directions we have begun to realise the logic of this practice, yet the majority of commercial firms are still pursuing the wasteful methods of their forefathers in the production of power and the generation of heat.

The Editor of Nature having kindly afforded me an opportunity of perusing the foregoing article in proof, it appears to me worth while to add the following note:—

It is a popular superstition that some new source of energy will be discovered before our coal supplies become scanty. The recent "marvels of science" have been so striking that the average semi-scientific or unscientific man, if directly asked, will almost confidently reply that "electricity," or something else, will replace coal. Now, there are possible sources of energy other than coal:—(*a*) Water-power, derived from rivers and reservoirs. These are few in Great Britain, and of no great potentiality. If they were all utilised, little would be added to our store of energy. (*b*) Water-power, derived from the tides. While such power might be utilised in a few favoured spots, it is certain that any machinery erected on our coast would be liable to destruction at any moment. When we consider that heavy breakwaters are every now and then demolished by storms, it is vain to expect that machinery to utilise the energy of the tides would escape. Moreover, the capital cost of such machinery (apart from the heavy depreciation charges) would preclude its use as an economical source of energy. (*c*) Wind-power, used for driving wind-mills, is a possible source of energy. It has been shown here, too, that the cost of installation and repair is so great as to make it an uneconomical source. (*d*) It is certainly possible to bore a shaft eight or ten miles in depth, and so tap the internal heat of the earth. Apart from questions of the slow flow of heat into such a shaft, the cost is prohibitive; and the time required to drive the shaft enormous. (*e*) Lastly, a catalytic agent might be discovered to accelerate the loss of energy by certain forms of matter. But we do not know for certain that common forms of matter are losing energy; we have, on the contrary, every reason to believe that any change would be endo-, not exothermic. Substances of the nature of radium are few in number, and small in quantity. It would be fair to state that it is in the highest degree improbable that any important supply of energy whatever is to be derived from such sources. (*f*) Heat engines, driven by solar heat, however possible in warmer climates, are for us impracticable.

For these reasons, as well as for those given by the author of the above article, the conservation of our coal-supply is of the very highest importance to the nation, and indeed to the human race.

W. Ramsay.

PLANT-LIFE IN KRAKATAU AND THE MEXICAN DESERT.[1]

ENGLISH readers owe a debt of gratitude to Prof. Seward and the Cambridge Press for an English edition of Prof. Ernst's account of the re-colonisation of Krakatau. It is five-and-twenty years since Krakatau and the neighbouring islands in the Sunda Strait between Java and Sumatra were transformed by the most violent volcanic outburst of historic times from forest-covered islands to deserts of pumice and volcanic ash. Long regarded as an extinct volcano, Krakatau, in the early summer of 1883, resumed activity, and towards the end of August the eruption culminated in an outbreak the effects of which were felt over almost the whole of the earth's surface. For a distance of twenty-two miles neighbouring land was covered with glowing stones and hot ashes, and it is estimated that the finer dust was spread over an area of some 234,000 square miles. As a result of this enormous loss of material, a large portion of the island fell in, and the Krakatau of to-day is less than half the size of the island of 1883, and has a quite different outline.

The islands therefore afforded an unprecedented opportunity for studying the development *ab initio* of the organic population of an oceanic island which rose several thousand feet above sea-level. The nearest land, the islands of Sebesi and Seboekoe, themselves half destroyed by the effects of the eruption, is twelve to fifteen and a half miles distant; the nearest points of Sumatra and Java are twenty-two to twenty-eight miles distant. Krakatau, the largest of the three islands affected, consists of the peak Rakata, 2700 feet high, which, on the north side, towards the disappeared portion of the island, forms an almost vertical wall, but on the south-east slopes steeply to a flat base in front of which is a small, level beach. In 1886, when Dr. Treub visited the island, its repopulation had already begun. Blue-green algæ, without doubt wind-borne, had formed a gelatinous layer on pumice and volcanic ash, and on the exposed rocks in the ravines on the mountain slopes; these formed a suitable nidus for the germination of wind-borne spores of mosses and ferns, as well as of seeds. Ferns preponderated at this early stage, being represented by eleven widely spread Indo-Malayan species; in the drift-zone of the beach were seedlings of nine phanerogams which had grown from sea-borne fruits or seeds; two of these were found in the interior and on the mountain slopes, with the addition of four species of Compositæ and two grasses, the fruits of which had obviously been brought by air-currents. Thus it was seen that the colonisation of an isolated high volcanic island does not proceed on the same lines as those of a coral island, where the elements of the strand-flora, brought by sea, are of the first importance. Here the wind-borne element played the principal part, and the flora of the interior had developed independently of the strand-flora, and with much greater rapidity.

It is to be regretted that more than ten years elapsed before the second exploration of the new Krakatau in March 1897. The number of species was then much increased, and amounted to fifty-three seed-plants and twelve vascular cryptogams; the ground was, in some cases, completely covered, and characteristic plant associations were forming; thus the *Ipomoea Pes-caprae* formation was a dominant feature on the beach. Further inland the vegetation constituted a kind of grass-steppe, the grass occasionally reaching a man's height and sometimes forming a thick jungle. On the hills and ridges were lower grasses with numerous ferns and a few seed-plants; ferns still predominated largely on the rock surfaces. Shrubs were few and trees rare. Of the fifty-three seed-plants it was estimated that thirty-two had come by sea, seventeen had been introduced by wind agency, and four by fruit-eating animals or by man. The results of a third expedition, in 1905, have not been published. In April 1906, was planned the short expedition of which the present is an account.

FIG. 1.—Clearing in the Strand-forest. To the left in the foreground *Scaevola Koenigii*; behind the grasses (*Saccharum spontaneum*) a group of coco-nut palms. South-east coast of Krakatau. From "The New Flora of the Volcanic Island of Krakatau."

The progress made by the vegetation since 1897 was remarkable; almost the whole south side of the island was seen to be covered with green. In the drift-zone on the beach was a great variety of fruit and seeds of land-plants, some quite fresh, some already germinated and rooted to the ground. They represent the widely distributed strand-plants which are the first colonists of recently formed coral reefs and islands, and owe their buoyancy to air spaces or light tissue in pericarp or seed-coat. Within the

[1] "The New Flora of the Volcanic Island of Krakatau." By Prof. A. Ernst. Translated by Prof. A. C. Seward, F.R.S. Pp. vi+74; with two sketch-maps and 13 photographs. (Cambridge: University Press, 1908.) Price 4s. net.

"Camp-fires on Desert and Lava." By W. T. Hornaday. Pp. xx+366; with 72 illustrations (8 in colour) and 2 maps. (London: T. Werner Laurie, n.d.) Price 16s. net.

drift-zone was the low growth of the familiar *Pes-caprae* formation—long, trailing, rooting shoots of *Ipomoea Pes-caprae*, with runners of Spinifex forming a network with which was associated some low-growing leguminous species, and here and there tall grasses, sedges, and other familiar strand-plants. Beyond this a young strand-forest of trees and shrubs recalled the similar formation on the Javan coast. Most conspicuous were tall Casuarinas (*C. equisetifolia*), 40 feet to 50 feet high, while slender climbing plants, such as Cassytha, Canavalia, *Vitis trifolia*, and others formed an almost continuous mass of foliage. Among the trees, *Calophyllum Inophyllum, Terminalia Catappa*, and the beautiful white-flowered *Barringtonia speciosa*, which has given a name to this type of strand-forest vegetation, were conspicuous. Coco-nut palms, clumps of screw-pine (Pandanus), and large-leaved figs were also seen. Beyond the strand-forest a monotonous steppe-like vegetation of tall grasses and reeds, sometimes associated with climbing plants to form dense jungle, extended into the ravines and on to the steep sides far up on the cone. A deep ravine, rich in trees and shrubs, extending half-way up the slopes of Rakata, promised a rich botanical harvest, but, unfortunately, the party was unable to make a way through the thicket with the equipment and time at its disposal, and much of the flora remains, therefore, still unexplored. Nevertheless, the results bring the total number of species collected up to 137; the ferns have not materially increased in number, but the seed-plants have risen to ninety-two species. Of the strand-flora, two-thirds are species which are cosmopolitan on tropical coasts, and the plants of the interior are also cosmopolitan, or represent the commonest species which are widely spread over the old-world tropics. Nitrogen-fixing bacteria were found in abundance in the soil. As regards the means by which the islands have been colonised, it is estimated that of the seed-plants 39 per cent. to 72 per cent. have been brought by sea-currents, 10 per cent. to 19 per cent. by birds, and 16 per cent. to 30 per cent. by air-currents; air-currents are also responsible for the presence of the ferns and lower cryptogams.

Fig. 2.—The Finest Organ-pipe Cactus. From "Camp Fires on Desert and Lava." Photograph by the author.

In "Camp-fires on Desert and Lava" the author gives a graphic account of the vegetation and animal life of the desert country in the extreme south-west of Arizona and the Mexican borderland. The book is a diary of a trip led by Dr. D. T. MacDougal, director of the recently formed Desert Botanical Laboratory at Tucson, Arizona. The ostensible object of the trip was the exploration of the unknown country round about Pinacate Peak, which lies between the international boundary and the Gulf of California. Mr. Godfrey Sykes, geographer to the expedition, supplies two new maps which show the route of the expedition and add considerably to geographical knowledge of the Pinacate district. But it is the naturalist and, above all, the botanist, who will find most of interest in the book.

Mr. Hornaday poses as Dr. MacDougal's pupil, but he has a keen eye for the plants, and has given as graphic an account as we have seen of the remarkable adaptations of plant-life to the almost waterless conditions of the sand-deserts or lava-strewn plains and mountains. The numerous excellent photographic illustrations are a great help towards realising the general ecological conditions of the district, as well as the habit of the components of its flora. The various Cacti, such as the giant cactus, or Saguaro (*Cereus giganteus*), the organ-pipe cactus (*Cereus Thurberi*) (Fig. 2), the Choya (Opuntia sp.), and the barrel cactus (Echinocactus), the Ocatilla (*Fouquiera splendens*)—"next to the giant cactus the most monumental and picturesque thing of plant growth found in two hundred miles of fertile deserts," when in full leaf resembling a bouquet of green wands held at the bottom by an invisible hand—the mesquite tree (*Prosopis velutina*)—the most persistent bush-tree of the deserts, the leaves and beans of which are eaten by horses and cattle when grass is not obtainable, while its wood is the general stand-by for fuel and almost the only available for house-building in the deserts of the south-west—and the *palo verde* (*Parkinsonia microphylla*), which, according to soil and water supply, varies from 3 feet to 15 feet in height—these and the many other characteristic xerophytes become very real to us from Mr. Hornaday's quite non-technical descriptions and the photographs taken by one or other of the party.

The author is also a sportsman, and the text has many interludes which will interest the sportsman rather than the botanist; and it would be unfair not to mention the numerous observations on animal-life, especially the valuable chapter on the mountain sheep of Mexico and the range of the species. A. B. R.

THE MOUNTAINS OF THE MOON.[1]

EASTERN equatorial Africa has three mountain groups capped by perpetual snow—Kilimanjaro, Kenya, and Ruwenzori. Though the last is the lowest, and was the most recently discovered, it has aroused the widest popular interest; for its discoverer, Stanley, with characteristic insight, recognised it as "the Mountain of the Moon," the snows of which, according to the well-known passage in Ptolemy's "Geography," nourished the sources of the Nile. Ptolemy's general account of the Nile lakes is sufficiently accurate to show that he wrote from positive information. Otherwise, as Signor De Filippi remarks, he must have been gifted with prophetic insight. The statement about the Mountain of the Moon and its snows is, however, probably only an Arab interpolation; that view, so plausibly advanced by Cooley in 1854, is accepted as probable by Dr. Luigi Hugues in an appendix to this volume. Stanley's identification of Ruwenzori with Ptolemy's Mountain of the Moon has been, of course, called in question, but the alternative theories are as emphatically rejected in this work as in most of its predecessors.

Since the discovery of Ruwenzori by Stanley, the mountain has been repeatedly visited and partially explored. Stühlmann passed along its western side and took some fine photographs of the snow-capped peaks. Scott Elliot entered the range, saw some of its glaciers, and discovered that they were formerly more extensive. His observations and collections showed that instead of Ruwenzori having been volcanic, as had been suggested from analogy with Kilimanjaro and Kenya, it is a tilted block of Archean rocks left upstanding between the Victoria Nyanza basin and the rift valley of the Semliki. The later expeditions that visited the mountain found it usually shrouded in the clouds that had hidden it from Stanley's predecessor, Baker. The peaks could seldom be seen, but gallant attempts were made to reach them, as is duly recorded in Cav. De Filippi's narrative. Most of the expeditions added materially to our knowledge, and the repeated failures to achieve complete success tempted the Duke of the Abruzzi to undertake the exploration of Ruwenzori. He organised an expedition on a royal scale, judiciously selected the most favourable time of year, and the easy route by the Uganda Railway and steamer across the Victoria Nyanza. He left Entebbe, the capital of Uganda, on May 14, 1906, at the head of a caravan of 400 men, including a distinguished scientific staff, a company of Swiss guides and porters, and the great

Mount Speke seen from the Senecio Forest at the foot of Scott Elliot's Col. From "Ruwenzori."

mountain photographer, Sella. Aided by the British officials, to whom warm thanks are expressed in the book, the Duke of the Abruzzi soon reached the eastern foot of the mountains, and established a light camp near the head of the valley, up which most of his predecessors had climbed to the Alpine regions of Ruwenzori. The expedition had been carefully equipped, and its resources were handled with the Duke's usual energy and courage. He overcame all obstacles, climbed all five of the ice-capped mountains, and most of the chief peaks; and his expedition returned with a series of mountain photographs unrivalled in African literature, a geological map of the main part of Ruwenzori, and detailed information as to its geography.

[1] "Ruwenzori: an Account of the Expedition of H.R.H. Prince Luigi Amedeo of Savoy, Duke of the Abruzzi." By F. de Filippi. Pp. xvi+408; illustrations, plates, 5 maps. With a preface by H.R.H. the Duke of the Abruzzi. (London: A. Constable and Co., Ltd., 1908.) Price 31s. 6d. net.

The history of the expedition has been compiled by Cav. De Filippi, and it is clear from his narrative that the expedition required great personal strength, courage, and endurance. The Prince and his two guides were badly smitten with snow blindness after the ascent of Mount Stanley, for they had to work all day in a glaring white fog, which was too dense to allow the use of goggles. The author mentions (p. 243) that the Prince spent seventeen days above the height of 13,000 feet, with a very light equipment, sleeping with the two guides in a Whymper tent, without a camp bed, and with clothes nearly always soaked with rain and snow. The climbing was in places very difficult, and the dangers were increased by the prevailing mists and bad weather. Some of the ascents taxed the skill of such expert climbers as the Prince and his two guides; but others were easy; thus the highest point of Mount Speke, 16,080 feet, though snow covered, did not require the use of the rope.

Commander Cagni, the surveyor of the expedition, has compiled a full sketch-map of Ruwenzori, including all its snow-covered peaks. The topographic data are stated in appendices. The mountains are illustrated by a series of magnificent photographic panoramas by Sella. The survey shows that the snow-capped peaks of Ruwenzori are arranged in a line curved like the letter G. Going from the upper point of the G to the tail, the peaks in succession are Mount Gessi, Mount Emin, Mount Speke, Mount Stanley—which includes the highest peaks of the ridge—Mount Baker, and at the end of the tail of the G is Mount Luigi de Savoia. The height of the highest point, Mount Margherita on Mount Stanley, is given as 16,815 feet.

The nomenclature is very carefully explained, and a table of synonyms (pp. 218-9) will be useful, as geographers are above rules of priority. Stühlmann's early names are quietly put aside, and the proposed native names are also rejected. There had been considerable confusion in the application of the early names, but this is perhaps hardly likely to be removed by some of the changes. For the worst alteration of names, the Prince, however, is not responsible, as he only yielded to the wish of the Geographical Society. It naturally desired that the Prince's name should be attached to one of five mountains, but unfortunately selected the one that had been named Mount Moebius by Stühlmann years earlier. The name Moebius has, therefore, been transferred to a minor peak in the central part of the range. The peaks called by Stühlmann Mount Semper are re-christened the Alexandra and Margherita peaks of Mount Stanley.

The full scientific results are being published in a supplementary volume which has not been translated, but some account of the results is included. The geological collections and geological sketch-map of the central part of Ruwenzori fully confirm the Archean age of its rocks, as to which doubt had been suggested by Mr. Wollaston's description of craters and crater-lakes; the author refers to some veins of basalt in the gneiss (p. 222) as the only formation on Ruwenzori of a volcanic nature, and such veins do not necessarily indicate volcanic action. The glaciers are proved to be ice-caps or calottes, with the glaciers extending as finger-shaped processes. The snow limit is at present at the height of from 14,700 to 14,800 feet, but it is now suggested that the glaciers extended even lower than was claimed by Scott Elliot. The evidence on which this low-level glaciation is based is, however, not given, and some doubt as to its value is raised by the remark that the exfoliation surfaces of granite, the characteristic weathering of granite in the tropics, are "somewhat similar to the rocks known as moutonnées in regions which have passed through a glacial period" (p. 91). However, as the rainfall in Ruwenzori is probably exceptionally heavy, it may well be that the glaciers there reached a lower level than on Mount Kenya. All students of African geography, and all interested in mountain exploration, will feel indebted to the Duke of the Abruzzi for the brilliant feat of travel by which he has wrested from the clouds of Ruwenzori the secrets they have concealed so long.

J. W. Gregory.

SOME ASPECTS OF THE WHEAT PROBLEM.[1]

Few agricultural problems appeal to a wider circle both among agriculturists and the general public than wheat production; the layman often considers it to be the farmer's chief business, and many farmers are still to be found who look back with regret on the days when it actually was so.

The area under wheat in the whole world exceeds 200 million acres, and something like 400 million quarters are raised. About 220 million quarters are grown in Europe, Russia being the chief producer, followed by France, Hungary, and Italy; 107 million quarters are grown on the American continent (more than 75 million in the United States, 20 million in the Argentine, and 10 million in Canada), and about 53 million quarters in Asia, three-fourths of which comes from India. It is noteworthy that the wheat area tends to decrease in old and highly farmed countries, but to expand in new countries or in old, backward countries just beginning to utilise their resources. To a certain extent, wheat is, therefore, a pioneer crop, and is relatively more important in the early stages of development of a country than later on when it simply takes its place in the rotation with other crops. It cannot remain so indefinitely, but there are still immense tracts to which it can spread. It requires warm, sunny summers, and not too much rain; indeed, it can do with astonishingly little rain if appropriate cultivation methods are adopted; where the summers are suitable, severe winters are no bar to the cultivation of wheat, though they may limit the yield.

The fact that wheat is one of the first crops grown in a new country renders necessary a thorough study of the effect of external conditions such as soil, climate, and manuring on its development. Much still remains to be done, especially with regard to the influence of water supply. There are also important breeding problems. No crop can be successfully grown on a large scale unless it is adapted to the local conditions, tolerably resistant to the local diseases, and commands an adequate price in the market. The first two conditions afford fairly straightforward problems. Wheats suitable to a given district are usually found by trying a number of varieties, and then improving on the most promising by the slow and mechanical process of selection—in other words, waiting for a "mutation" form to turn up. Resistance to rust, one of the worst diseases of wheat, has been shown by Biffen to be in all probability a Mendelian character; it should, therefore,

[1] A. E. Humphries: Journal of the Royal Society of Arts, No. 2034; A. Howard and G. L. C. Howard: Bulletin 14, Agricultural Research Institute, Pusa; A. E. V. Richardson: Journal of Agriculture of South Australia, vol. xii., No. 6; K. J. J. Mackenzie: Journal of the Board of Agriculture, vol. xv., No. 10.

only be a matter of time to obtain rust-resisting varieties. Saleability in the market is a somewhat artificial affair. At the present time millers require a "hard" wheat yielding a "strong" flour rather than a "weak" wheat, and, therefore, pay more for it. It is not claimed that strong wheat is more nutritious, but merely that it makes larger and more shapely loaves; there is the further advantage to the baker that a given quantity of strong flour makes a greater weight of bread because it takes up and retains more moisture than an equal weight of weak flour. No doubt an excellent case could be made out for "weak" flour, but that is not the business of the agriculturist; he has simply to provide what his customer wants. The scientific problem of discovering what constitutes strength is under investigation, and the fact that strength is inherited indicates the possibility of crossing it on to wheats possessing other desirable features.

The economic problems in wheat production have rarely been stated better than in Mr. Humphries's lecture before the Royal Society of Arts. For a number of years past British wheat has been sold at prices substantially lower than the best foreign wheat because it lacks strength. Probably few bakers would risk making bread from British wheat alone; they require foreign wheat to be mixed with it. Consequently, the mills are handicapped unless they are within easy access of a seaport. The Home-grown Wheat Association are trying to find whether strong wheat can be profitably produced in England; their experiments have already shown that strength is inherent in the variety, and is not the result of external conditions, though it is influenced by them; they have also demonstrated that the great Canadian wheat, Red Fife, keeps its strength when grown here. The Canadian farmer is satisfied with 20 bushels to the acre, but the British farmer, having heavier charges to meet, must get more than 30, and on occasions, in favourable districts, will even get 60 or more bushels of grain and good crops of straw. Unfortunately, Red Fife does not give these heavy crops, and is, therefore, not in much favour here. It it hoped, however, that crosses combining the strength of Red Fife with the cropping power of the standard English varieties will in time be available.

Other countries are also seeking to improve the strength of their wheats. Indian wheat, for instance, is at present no stronger than ours, but Mr. and Mrs. Howard have grown wheats at Pusa which were very favourably reported on by the English milling expert who examined them. One especially was praised, a wheat (Pusa 6) selected in 1906 and grown from a single plant. It has the further advantage that it is resistant to rust, and matures well even on second-class wheat soils. Canadian wheats are under constant investigation at Ottawa. The Agricultural Department of South Australia also conducts experiments, the results of which appear from time to time in its journal.

The introduction of strong wheats into English agriculture would unquestionably alter the conditions of wheat-growing here, and whilst strong varieties are being raised it is desirable to ascertain the precise cost of wheat production by modern methods and using modern labour-saving appliances. There is a great deal of work to be done in this direction. Mr. Mackenzie's paper in the Journal of the Board of Agriculture provides data for ascertaining the cost of harvesting; similar records for other operations are badly needed.

E. J. Russell.

THE LONDON INSTITUTION.

At the annual meeting of the proprietors of the London Institution, held on April 28, it was announced that, in view of the appointment of the Royal Commission on University Education in London, which had officially informed the Institution that they regarded it as coming under their purview, the scheme for amalgamation with the Royal Society of Arts must remain in abeyance. The solicitor of the institution had advised that Parliament would not pass a Bill altering the status of an institution the position of which was already under the consideration of a Royal Commission, and, assuming that opinion to be sound, as it probably is, it would certainly be inexpedient immediately to proceed with the Royal Society of Arts scheme, or any other that involved an Act of Parliament. A considerable opposition to the ratification of the scheme had been worked up, and an attempt was to be made to alter the constitution of the board, but upon the announcement that the scheme was not to be proceeded with at present, the opposition to the existing board was withdrawn. Whether the scheme which has now been shelved, at any rate for the present session, will be revived after the Royal Commission on University Education in London has reported is very doubtful.

From the outset the Royal Society of Arts has been unwilling to be a party to the scheme unless there was something like practical unanimity on the part of members of the London Institution. If the management of that institution had been in stronger hands it is probable that little would have been heard of opposition. Very similar opposition to the proposal to dispose of the Zoological Society's freehold premises in Hanover Square, and to expend the proceeds in providing suitable accommodation for the Society's offices and library at the Zoological Gardens, was summarily dealt with on April 29. But there seems to have been no strong hand at the helm at the London Institution, and the final result will probably be that a scheme which would have been of considerable benefit to two important institutions will fall through. The idea seems to be to make the London Institution a sort of school of economics, an excellent thing in itself, but not wanted, seeing that there is already existing an institution amply able to meet the requirements of the public in this direction.

At the meeting last week Lord Aldenham stated that the managers had received a letter from the Corporation asking whether they were open to receive proposals, and they answered in the affirmative, but no definite suggestion has been received from that source. Probably the best thing to do with the institution, if the scheme of amalgamation with the Royal Society of Arts is to fall through, would be to sell its land, and whatever else it has to sell, and divide the proceeds, so far as other claims permit, amongst certain educational institutions in the City.

NOTES.

The first of the two annual soirees of the Royal Society will be held on Wednesday next, May 12.

We announce with regret the death of Dr. F. G. Yeo, F.R.S., emeritus professor of physiology, King's College, London, at sixty-four years of age.

We regret to see the announcement of the death, at seventy-five years of age, of Dr. J. Marshall Lang, Chancellor and Principal of Aberdeen University since 1900.

A REUTER message from Ottawa states that the Government has established a geodetic survey department for Canada under Dr. W. F. King, chief astronomer of the Dominion.

AT a meeting of the Aëronautical Society of Great Britain held on Monday, the gold medal of the society was presented to Messrs. Wilbur and Orville Wright in recognition of their distinguished services to aëronautical science.

AT a special general meeting of the Zoological Society on April 29 it was decided to dispose of the site of the society's freehold premises in Hanover Square, and to expend the proceeds upon the erection of new offices, library, and meeting-room at the Zoological Gardens in Regent's Park, and on the general improvement of the gardens.

A DESPATCH to the *New York Evening Post* from a correspondent in the West reports the discovery, near Esperanza, Mexico, of a stone inscription believed to have been carved by the Mayas of Yucatan, and to be more than a thousand years old. Some pottery of the Mayas was found at the same time. There had previously been no evidence of their having come so far north. The discoveries have been made by Major F. R. Burnham, D.S.O., and Mr. C. F. Holder, of Pasadena.

THE Royal Society of London invites applications for two Mackinnon studentships, each of the annual value of 150*l*. These studentships, which are restricted to British subjects, are awarded for the purpose of conducting researches, one in the group of the physical sciences, including astronomy, chemistry, geology, mineralogy, and physics, the other in the group of the biological sciences, including anatomy, botany, palæontology, pathology, physiology, and zoology. The present holder of the studentship in biology offers himself for re-election. Applications must be sent in to the Royal Society not later than June 1 on forms which can be obtained from the assistant secretary of the Royal Society, Burlington House, W.

STATEMENTS have been made in the medical and general Press that the electric waves used in wireless telegraphy are injurious to the operators and produce various diseases, such as conjunctivitis, corneal ulceration, and leukoma. Mr. Marconi writes to the *Times* to deny these suggestions, for which, he says, there is no evidence whatever. He adds:—" During the twelve years or so of our operations we have had to deal with no single case of compensation for any injury of this origin, nor, so far as I can ascertain, has any such injury been suffered. Speaking for myself, I may remark that my own good health has never been better than during the often extended periods when I have been exposed for many hours daily to the conditions now challenged, and in the constant neighbourhood of electrical discharges at our Transatlantic stations, which I believe are the most powerful in the world."

THE annual meeting of the Naples Table Association for Promoting Scientific Research by Women was held on April 24 at the American Museum of Natural History. Miss Caroline McGill, of the University of Missouri, was appointed a scholar of the association at the Naples station. We are informed that the award of the prize of one thousand dollars offered every second year for the best thesis written by a woman on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical, or physical science, was made to Miss Florence Buchanan, D.Sc., of London University, fellow of University College, London, for a thesis entitled "The Time Taken in the Transmission of Reflex Impulses in the Spinal Cord of the Frog." Miss Buchanan has been engaged in research work at the University Museum, Oxford, since 1896, and has published sixteen papers. It is worthy of remark that, of the eleven theses presented in competition, five were sent from England and one from Canada. The subjects of four were morphological, of two bacteriological, of two zoological, one physiological, one was in the domain of physical chemistry, and one in parasitology. The general average of these investigations was very high, distinctly above those of the three previous competitions. A fifth prize will be offered in 1911.

THE year 1911 will be the centenary of the publication of Avogadro's celebrated memoir on the molecular constitution of gases. In that memoir he arrived at the generalisation that equal volumes of gases at the same temperature and pressure contain the same number of molecules—a law which has borne rich fruit both in chemistry and physics. To commemorate the discovery of Avogadro's law, a committee has been formed by the Royal Academy of Sciences of Turin to obtain subscriptions for the publication of the most important of Avogadro's works in one volume, and the erection of a monument to him at Turin, where he was born in 1776, and died, while still professor of physics there, in 1856. An appeal is made to chemists and physicists for contributions to the fund being raised. The committee is international in its constitution, and includes the names of many men of distinguished eminence in the world of physical science. Subscriptions should be sent to the treasurer, Royal Academy of Sciences, Via Maria Vittoria 3, Turin.

THE seventy-seventh annual meeting of the British Medical Association will be held in Belfast on July 23–31. The president-elect is Sir William Whitla, professor of materia medica and therapeutics, Queen's College, Belfast. The address in medicine will be delivered by Dr. R. W. Philip, that in surgery by Prof. A. E. J. Barker, and that in obstetrics by Sir John W. Byers. The popular lecture will be delivered by Dr. J. A. Macdonald. The scientific business of the meeting will be conducted in fifteen sections, which will meet on Wednesday, July 28, Thursday, July 29, and Friday, July 30. The presidents of the sections are as follows:—Anatomy and physiology, Prof. C. S. Sherrington, F.R.S.; dermatology and electro-therapeutics, Dr. W. Calwell; diseases of children, Mr. H. J. Stiles; hæmatology and vaccine therapy, Sir Almroth Wright, F.R.S.; hygiene and public health, Dr. L. C. Parkes; laryngology, otology, and rhinology, Dr. St. Clair Thomson; medicine, Prof. J. A. Lindsay; navy, army, and ambulance, Fleet-Surgeon J. Lloyd Thomas, R.N.; obstetrics and gynæcology, Dr. J. Campbell; ophthalmology, Dr. J. W. Browne; pathology, Prof. Wm. St. Clair Symmers; pharmacology and therapeutics, Prof. R. Stockman; psychological medicine, Dr. T. Outterson Wood; surgery, Prof. T. Sinclair; tropical medicine, Mr. C. W. Daniels.

THE Liverpool Marine Biological Station at Port Erin, in the Isle of Man, has been utilised, in all its departments, to the fullest possible extent during the past Easter vacation. A class of senior students from the University of Liverpool occupied the large upper laboratory, and went through a course of practical marine biology under the direction of Dr. Pearson and Mr. D. Laurie. The ground-floor laboratories have been occupied during the last six weeks by about ten or twelve investigators, including Dr. H. E. Roaf, working on the digestive ferments of various Invertebrata; Mr. W. J. Dakin, working on the nervous system of Pecten, and also making hydrographic observations on samples of sea-water; Mr. W. Riddell, assisting Prof. Herdman in his plankton investigations at sea; and several others. In the fish hatchery Mr. Chadwick has this year increased the output of young plaice; between nine and ten millions of eggs have been dealt with in the hatchery boxes during March and April, and Prof. Herdman has set free between seven and eight millions of young fry of the plaice from the S.Y. *Ladybird* at distances of from five to thirteen miles off land, in directions ranging from south-west to north of Port Erin, so that some millions have been carried by the south-going tide around the Chicken Rock to the eastern side of the Isle of Man, while others have been carried by the northern tidal system up the west and round the northern end of the island. In each year, recently, some fry produced in the fish hatchery have been retained in the spawning ponds until they underwent their metamorphosis and appeared on the bottom as healthy young flat-fish. These specimens reared in captivity were found on investigation to be feeding on diatoms, and at the present time, in the Irish Sea, the vernal increase in diatoms seems to be at about its greatest height.

WE have received a communication from Dr. J. B. Charcot, leader of the French Antarctic Expedition, from Deception Island, South Shetlands, dated December 24, 1908. The *Pourquoi-pas?* left Puntas Arenas on December 16, and arrived at Deception Island on December 22 in company with a Norwegian whaler that was met with off Smith Island. At Deception Island Dr. Charcot met two other Norwegian and one Chilian whaler, and thirty tons of coal were taken on board from the whaling station set up in Pendulum Cove by La Sociedad Ballinera Magellanes. So far, Dr. Charcot has naturally little news of interest, since the voyage has only begun. In fact, the chief interest is that now, for the first time for nearly a century, an exploring ship has met with sealers and whalers south of the latitude of Cape Horn. That an exploring ship can obtain its last supply of coal in 63° S. instead of 53° S. is of the utmost importance. Ships are able to cross the heavy seas of Drake Strait in better time, and have 600 miles extra start towards the south. The fact of this whaling station, with 200 men, two large steamers of more than 3000 tons, and eight small ones, existing at Deception Island is an eloquent testimony of commercial success following up scientific investigations. There was no word of such an industry being opened up before the departure of the Scottish and Swedish expeditions in 1901–4. When Dr. Charcot left Deception Island on December 25 general physical and biological investigations had begun, including actinometric observations during the eclipse of the sun on December 21, and pendulum records at the same point as Foster made them in 1829. He intended to steer for Port Lockroy and Port Charcot, and thereafter to the south and west along the west coast of Graham Land. During the three years the whaling station has existed, this region has never been so free of ice, which augurs well for the success of the French expedition.

APRIL was a record month for bright sunshine over the southern and eastern portions of England, and the duration of sunshine was in excess of the average in most parts of the kingdom. At Dover the sun was shining for 273 hours, and at several places in the south and east of England the duration exceeded 250 hours. At the London reporting station of the Meteorological Office, in Westminster, the bright sunshine amounted to 220 hours, whilst the previous brightest April occurred in 1906, with 207 hours. At Greenwich the duration of bright sunshine was 250 hours, which is 103 hours more than the normal, and there was only one day without sunshine. The mean temperature at Greenwich was 2·3° in excess of the average, and rain fell on thirteen days, yielding a total of 1·71 inches, which is 0·14 inch more than the average. The summary of the weather issued by the Meteorological Office shows an excess of sunshine since the beginning of the year over the whole of England and Ireland, but a slight deficiency in Scotland. In the south-east of England the excess of sunshine for the past four months amounts to 101 hours, and in the north-west of England to ninety-four hours.

IN No. 1665 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 191–6) Dr. O. P. Hay describes specimens of two fossil chelonians, one of which forms a new species.

IN the Journal of the Royal Microscopical Society (1908, pp. 529–43) Messrs. E. Heron-Allen and A. Earland describe, under the name Cycloloculina, a new genus of Foraminifera collected from the shore-sand of Selsey Bill between Bracklesham Bay and Chichester Harbour. The specimens on which the genus is founded are fossils, and were found in company with many other Foraminifera washed out of Secondary and Tertiary strata. They resemble Planorbulina in their general appearance, but when mounted in balsam are seen to have quite a different mode of growth. Two species are described as *C. annulata* and *C. polygyra*.

IN commemoration of Mr. Roosevelt's projected hunting trip in East Africa, the *National Geographic Magazine* devotes its March number to papers on Africa. Sir H. Johnston gives a delightful account, illustrated by admirable photographs, of the region which the ex-President hopes to explore. The Nandi forests he believes to be vestiges of the ancient forest-belt that stretched from the Indian to the Atlantic Oceans, and he points out that its *fauna* is more closely allied to that of East India and Malaysia than to West India or East Africa. The discovery of the okapi encourages the hope that if he explores this region in a systematic way, Mr. Roosevelt may discover other beasts and birds unknown to science. He may obtain specimens of the giant pig first discovered in Stanley's Ituri forest by Mr. N. E. Copeland, and he is anxious to secure the white or square-lipped rhinoceros, long supposed to be confined to Africa south of the Zambezi, where it is nearly, if not quite, extinct; it is now reported to exist in the north-western parts of British East Africa. He may also encounter the wonderful earthworm as large as a snake and coloured a brilliant verditer-blue. At any rate, he will find forests rivalled in luxuriance only by those of the Congo Free State and the Kameruns, the finest conifers in Africa, the largest continuous area of marsh, the largest lake, and the highest point in the continent. As for the people, he will meet pygmies, fanatical Mohammedans, enthusiastic Christians, and specimens of nearly all the most marked and interesting types of African man.

SOME years ago Sir Lauder Brunton suggested that it might be possible to relieve certain forms of heart disease by a surgical operation on the valves of the heart. Dr.

Bernheim records, in the Bulletin of the Johns Hopkins Hospital for April (xx., No. 217), some experiments performed on dogs in this connection; the results are encouraging, and suggest that the procedure offers no greater technical difficulties than numbers of others which are in daily practice.

IN a report by Mr. E. H. Ross on the prevention of fever on the Suez Canal (Cairo: National Printing Department, 1909), mosquito destruction at Port Said and its results are reviewed. After three years' work a great reduction in the number of mosquitoes has been effected, and in consequence malaria has much diminished, also continued fever and dengue. Although the population is increasing steadily, the death-rate for 1908 is 150 below the average for the previous five years. It is not possible completely to exterminate mosquitoes, and the campaign has to be continued. In an appendix certain interesting features in the biology of mosquitoes (*Culex fatigans* and *Stegomyia fasciata*) are detailed. It is found that male mosquitoes do not live more than a few days, and are much more numerous than females. The females apparently desire to suck blood only after fertilisation.

IN a third report on research work, Dr. Houston, director of water examinations, Metropolitan Water Board, discusses the value of the storage of raw river water antecedent to filtration as a means of purification. The medical advisers of the Local Government Board have long held the view that "time" is to be regarded as an important element among conditions that in nature combine to annul the vital activities of particulate matter which is the cause of disease, and in no direction perhaps is this "time factor" of more importance than in the storage of impure river water. The results of a large amount of experimental work, chemical and bacteriological, undertaken to investigate this question are given in this report. They show that the total number of micro-organisms and of *B. coli* are very considerably reduced by storage. The stored waters also contained less ammoniacal nitrogen and less oxidised nitrogen, and absorbed less oxygen from permanganate; as regards albuminoid ammonia, however, only Chelsea water showed a reduction; Lee water was unaltered, and Staines and Lambeth suffered an apparent increase. The engineers reported that the use of stored water prolongs the life of the filter-beds. It is concluded that an adequately stored water is to be regarded as a "safe" water, and its use would render any accidental breakdown in the filtering arrangements much less serious than otherwise might be the case. Although it would be preferable to regard thirty days as a minimum period of storage, this would entail the construction of huge reservoirs, and it is suggested that thirty days' storage might be considered a maximum, adopting in addition, during times of stress and storm, an intermediate system of purification (*e.g.* by mechanical filters or by precipitation tanks) between storage and sand filtration.

A SECOND part of the illustrated studies in the genus Opuntia, by Mr. D. Griffiths, has been received, being an advance publication from the twentieth annual report of the Missouri Botanical Garden. It consists chiefly of descriptions of new species from the States of Mexico, Texas, and Arizona, with illustrations to indicate the general habit, fruits, and seeds.

AN article by Mr. E. Maigre on geotropism and the statolith theory appears in the *Revue générale des Sciences* (March 15). Discussing the much-debated question as to the exact position at which the root is sensitive to geotropic stimulus, the author lays stress on Picard's experiment, in which the root was rotated round an axis oblique to the longitudinal axis of the root. The root was placed in different experiments so that the axis of rotation cut it at different points between the tip and region of growth, and thereby the stimulus produced by centrifugal force acted oppositely on the two regions. The author defends the statolith theory mainly on the strength of Buder's recent researches, which consisted in turning the root sharply through an angle of 180° at stated intervals, when it was found that the curvatures produced were in conformity with the theory.

MR. E. D. MERRILL contributes three articles to the botanical number of the *Philippine Journal of Science* (vol. iii., No. 6) published in December, 1908. A revision of native species of Garcinia shows seventeen species, of which twelve are endemic and five are new to science. The indigenous Ericaceæ are collated under the genera Vaccinium, with nineteen species, Gaultheria, Diplycosia, and Rhododendron, with sixteen species; all are plants growing at medium or high altitudes, and according to existing records, out of thirty-nine species as many as thirty-six are endemic. The third contribution relates to collections of plants from the Batanes and Babuyanes islands, which furnish evidence of a strong affinity with the flora of the other Philippine islands and a very slight affinity with the flora of Formosa. There is also a noteworthy communication to the journal by Dr. E. B. Copeland regarding new genera and species of Bornean ferns. The new genera are Macroglossum, a marattiaceous fern, and Phanerosorus, the latter being, however, a new title for *Matonia sarmentosa*.

THE reports on the botanic station, agricultural instruction, and experiment plots at Grenada are to hand. The chief industries of the island are cacao and nutmeg cultivation, but it is suggested that fodder crops and ground provisions might with advantage be more extensively grown. Interest is being taken in rubber planting; *Hevea brasiliensis* appears to be more promising than *Castilloa elastica*. It has been demonstrated that Sea Island cotton can be produced on land near the coast. The importance of improved methods of cultivation and treatment in cacao orchards has been continuously urged upon growers, and both large and small owners are adopting such methods. Prize-holdings competitions have been introduced among the peasantry, and have been found to encourage better methods of working.

MYCOLOGISTS will be interested in the regulations drawn up by the Board of Agriculture of British Guiana, and recorded in the *Agricultural News* for March 20, dealing with the importation of sugar-canes, and having for their object the exclusion of plant diseases so far as is possible. Canes from stated places must not be imported in any description of earth or soil. They are to be inspected on arrival by the Government botanist, and if infected with any pest or disease not commonly known in the colony they are to be destroyed; if infected with any common pest or disease they are to be treated as the botanist directs. Those passed by the botanist are to be planted in a nursery apart from the general cultivation, and subject to inspection for twelve months; if during that time any pest or disease appears, they are to be destroyed if the pest is new, or treated as the botanist directs should it already occur in the colony. The regulations are very stringent, but the introduction of new pests and diseases is a very serious matter to agriculturists, and entails a great amount of trouble besides considerable financial loss.

Three parts of the "Palæontologia Indica," just received from the Geological Survey of India, contain important memoirs on the Lower Mesozoic invertebrate faunas of the Indian region. A collection of fossils, chiefly bivalved shells, obtained by Messrs. T. D. La Touche and P. N. Datta from the Napeng beds of the Northern Shan States of Burma, is described by Miss Maud Healey, who shows the fauna to be remarkably similar to that from the Rhætic formation of Europe. Even the characteristic *Avicula contorta* occurs. The fossils, however, are much distorted, and preserved only as imperfect casts, so that their exact determination is almost impossible. Miss Healey remarks that very similar bivalves have also been found in rocks on the west coast of Sumatra which are not Eocene, as hitherto supposed, but really of Rhætic age. New collections, chiefly of Cephalopoda, from the Trias of Spiti, in the Himalayas, are described by Prof. Carl Diener, who makes an interesting contribution to our knowledge of this much-discussed formation. He treats especially of the Upper Muschelkalk, and compares in detail the several zones with those recognised in Europe. A remarkable collection of fossils from scattered blocks of Upper Triassic and Liassic age, found in the frontier district between Hundes and Malla Johar, is also described by Prof. Diener. Basing his studies chiefly on ammonites, he concludes that "the difference between the Liassic faunæ of Würtemberg or England and the Alps is more conspicuous than that between the Mediterranean and Tibetan faunæ of the Lower Lias."

Mr. B. Gomme recently issued the "Index of Archæological Papers published in 1907," which forms the seventeenth annual number of this publication, originally started by his father, Mr. G. L. Gomme. It contains references to the proceedings of fifty-two learned societies in Great Britain and Ireland, and is likely to be useful to all who are interested in archæology. Many societies are subscribers to this index, which they issue with their annual Proceedings, a course which may be safely recommended for general adoption. This publication would be of much more practical value if, in addition to the bare titles of communications, a short abstract of the contents or a summary of the views advocated by the author were appended.

In the April number of *Man* Mrs. M. E. Cunningham directs attention to a remarkable feature in the entrenchment known as Knap Hill Camp, in Wiltshire. Along the exposed side of the camp the entrenchment is pierced by no fewer than six openings or gaps, which were formerly supposed to be cattle-tracks or made for agricultural purposes. Excavations, however, show that none of them is the result of wear or accident, and that they represent gangways intentionally left in the circumvallation. Something of the same kind was remarked by General Pitt-Rivers at Winkelbury Camp, and he supposed that they were gangways adapted to allow in an emergency a considerable number of cattle to enter the camp. In this case, Mrs. Cunningham urges that it would have been simpler to make one or two wide entrances. From the fact that these causeways lie askew to the gaps in the rampart she suggests that they may have been purposely left as positions from which the defenders could enfilade the ditch, the distance from one causeway to another being not greater than could be covered by hand-thrown missiles. It is to be hoped that the fuller exploration of the site which the writer promises will throw further light on the interesting problems connected with prehistoric fortresses which are raised in this communication.

The report of the Danish Meteorological Institute on the state of the ice in the Arctic seas during 1908 shows that the general distribution of the Polar ice was almost the opposite of that observed in the preceding year. During 1907 greater masses of ice than usual drifted from the Arctic Ocean towards Franz Joseph Land and Spitsbergen and along the east coast of Greenland, whereas during 1908 those regions were more approachable and free from ice than is normally the case. The supposition that the change was due to the ice having found an outlet elsewhere is supported by the fact that the ice conditions were reported as specially unfavourable in the Bering and Beaufort Seas.

The meteorological and magnetical report of the Royal Cornwall Polytechnic Society, containing the observations made at Falmouth during 1908, has been received. This important observatory receives an annual grant of 250*l.* from the Meteorological Committee for the supply of hourly meteorological observations, and is at present subsidised by the Royal Society and British Association for the maintenance of magnetic observations. At the request of the International Conference on Terrestrial Magnetism it supplies a table of the daily magnetic records to the Royal Netherlands Institute for publication with similar data from other observatories; the magnetic results are also published by the National Physical Laboratory. A comparison of the air- and sea-temperature observations for 1908 shows that the mean of the latter (52·9°) was 1·3° above that of the air; from May to July inclusive the mean sea temperature was lower than that of the air. The rainfall amounted to 37·6 inches, being 4·4 inches below the average. A chart is added to the report showing the annual rainfall for thirty-seven years, 1872–1908, registered by the self-recording rain-gauge; the wettest year was 1872, rainfall exceeding 64 inches, and the driest 1887, rainfall less than 30 inches. The mean magnetic declination for the year was 17° 54′ W.

Mr. S. S. Buckman has sent us a copy of a paper (Oxford: Parker and Son) in which he advocates a scale of notation with radix 8 instead of 10. His proposals are more revolutionary than this change necessarily implies, for he would write the numerals upside down, and completely alter his weights, measures, and coinage down to a charge of 7½*d.* for telegrams. Apart from the object-lesson that in Austria even the change from *kreuzer* to *heller* took years to accomplish (and kreuzer are probably not dead yet), we note that the advantages of "octonary numeration" were clearly and plainly set forward, without the introduction of unnecessary complications, by Prof. Woolsey Johnson in October, 1891 (Bulletin New York Mathematical Society, i., 1).

The importance of the discovery made by Prof. Townsend last year, that when a gas is ionised by Röntgen rays positive ions are produced having double the electric charge previously regarded as the ionic charge, has led Drs. J. Franck and W. Westphal, of the University of Berlin, to investigate the properties of these doubly charged ions in some detail, and their results were communicated to the German Physical Society on March 5. They find that the mobility of the ions in an electric field, as measured by a modification of Zeleny's method, is identical with that of the singly charged ions, while their rate of diffusion, as measured by a method identical in principle with that first used by Townsend, is only half that of the singly charged ions. The double charge is thus accompanied by double mass, and the number of double ions produced by Röntgen rays is, the authors find, only about 9 per cent. of the total number of positive ions.

Dr. W. W. Coblentz, of the United States Bureau of Standards, recently completed an investigation of the radiation constants of metals with a view to account for the high efficiency of the new metallic filament incandescent electric lamps, and his results are published in part iii. of vol. v. of the Bulletin. The radiation from the filament of an incandescent lamp provided with a fluorite window, after passing through a fluorite prism, was measured by the bolometer while the temperature of the filament was kept constant. From the curve of distribution of energy throughout the range of wave-lengths examined, the radiation constant α of the formula $dE = C\lambda^{-\alpha}e^{-c/\lambda t}d\lambda$ is found for the material of the filament at various temperatures. Its value for a "cavity" black body is known to be 4, while for platinum it is 6. Dr. Coblentz finds it to be about 6 for "flashed" and for untreated carbon, to be between 7 and 8 for silica-coated carbon, between 6 and 8 for platinum and tungsten, between 6 and 7 for tantalum, and to be about 6·8 at all temperatures for osmium. As the temperature at which the lamp is run increases, the radiation constant decreases in the case of the metallic filaments with the exception of osmium. At the normal voltage the constants have the following values:—metallised carbon, 6·1; tantalum, 6·3; tungsten, 6·6; osmium, 6·9. The high value of α explains the superiority of the osmium lamp.

The Proceedings of the American Academy for March contain two papers from the Harvard Laboratory on the atomic weight of chromium. Since the early determination of Berzelius in 1818 (Cr = 55·95), thirty-three values have been placed on record, the earliest being those of Peligot (1844) and the latest those of Meineke (1890). Rejecting one high and one low value, the eleven figures given by Meineke ranged from 52·03 to 52·27, mean 52·12, in good agreement with the earlier values of Siewert (1861), 52·07; Baubigny (1884), 52·13; and Rawson (1889), 52·09. The methods now adopted by Baxter and his colleagues consisted in converting silver chromate and dichromate into the chloride and bromide, and thus deducing the percentage of silver in the chromium compounds. Conversion of chromate into chloride gave Ag = 65·0345 per cent., and into bromide Ag = 65·0321 per cent., mean 65·0333 per cent., whence if Ag = 107·88, Cr = 52·008; conversion of dichromate into bromide gave Ag = 49·9692 per cent., whence Cr = 52·013. It is noteworthy that the final value, Cr = 52·01, differs from the whole number by only one-hundredth of a unit, whereas the figure adopted by the International Committee for the present and previous years, Cr = 52·1, differed by a tenth of a unit. It will be remembered that the recent revision of the atomic weight of nitrogen also resulted in bringing the value within 0·01 of the integer.

Mr. J. H. Shaxby asks us to state that, by an unfortunate mistake, he wrote "Faraday" instead of "Tyndall" in his letter upon the fluorescence of *Lignum Nephriticum*, published last week (p. 249).

OUR ASTRONOMICAL COLUMN.

Development of Martian Canals.—Through the agency of the Kiel Centralstelle (Circular No. 107) we have received a message from Prof. Lowell saying that the development of the Martian canals corroborates the prediction that they would be seen leaving the south polar cap of the planet.

Colours and Magnitudes of Stars.—In a note appearing in these columns on February 4 (p. 410, No. 2049, vol. lxxix.) we directed attention to Mr. Franks's conclusions regarding the relation of star colours to star magnitudes in galactic and non-galactic regions.

A note by Miss Bell, appearing in No. 5, vol. lxix., of the Monthly Notices, confirms Mr. Franks's in showing that there appears to be a slightly more intense relation between luminosity and colour in the galactic regions. This result was obtained by the statistical method of contingency, and a further calculation shows that, as a chance coincidence, the chances are 500 to 1 against there being a group of stars so divergent from stars as a whole as are the galaxy stars, whilst they are 2500 to 1 against any random sample showing the divergency from the whole that the non-galactic stars display.

A Group of Red Stars in Sagittarius.—Whilst examining the Draper memorial photographs of stellar spectra, Mrs. Fleming has found that a plate covering the area R.A. 18h. 48m. to 19h. 29m., dec. 13·0° S. to 23·1° S. (1900), shows an abnormal number of red stars having peculiar spectra. The positions and spectral types of these stars are given in Circular No. 149 of the Harvard College Observatory. The area includes the n.f. portion of the constellation Sagittarius, and is in the southern border of the Milky Way. Besides twenty-one stars having spectra of the third type, there are six of the same type with the addition of bright hydrogen lines (class Md) and one of the sixth type (class R).

In contradistinction to the above, Mrs. Fleming found that a similar plate of a neighbouring region (R.A. 17h. 24m. to 18h. 11m., dec. 27° 8′ S. to 38° 0′ S.) shows a deficiency of red stars, but contains several stars having peculiar spectra. These include stars of the third type, a variable of the fourth type, two of the fifth type with bright lines, and two gaseous nebulæ.

The Calculation of Cometary Orbits.—It frequently occurs that the definitive calculation of a comet's orbit is carried out by two or more calculators working independently, and without the whole of the available observational data. This leads to varying results and confusion, which Prof. Kobold is trying to obviate. For this purpose he publishes in No. 4319 of the *Astronomische Nachrichten* a list of comets since 1757, with the names of the workers by whom the definitive orbits have been, or are being, worked out. The present list accounts for forty-six comets, and Prof. Kobold will welcome any additions thereto.

Photometric Observations at Catania.—A paper by Signor A. Bemporad, in which he describes and discusses the photometric observations made at Catania during the three years 1904–6, appears as an abstract from vol. xxxvii. of the *Memorie della Società degli Spettroscopisti Italiani*.

The programme of work included (1) the determination of the wedge constant; (2) the study of the extinction curve for Catania and then for the Etna Observatory; (3) the determination of the atmospheric absorption at both places; and (4) the observations of variable stars. The results obtained under each heading are fully discussed in the memoir, and the light-changes of a number of variables are compared with previously published ephemerides.

Recent Solar Research.—As a reprint from vol. xxxvii. of the *Memorie della Società degli Spettroscopisti Italiani* we have received an interesting paper, in which Prof. Ricco discusses the recent work done in the field of solar research. Most of the subjects have already been discussed in these columns, *e.g.* Hale's vortices, Deslandres's filaments, Belopolsky's anomalous forms of the K line in 1906–7, &c., but readers of Italian will find Prof. Ricco's review to be a useful *résumé* of all these researches.

Occultations of Planets.—In a brief note appearing in No. 5, vol. lxix., of the Monthly Notices (p. 431), Dr. Downing gives the data for two occultations of planets by the moon, during the present year, observable at British observatories. Times and position-angles of immersion and emersion are given for occultations of Mars and Venus visible at Ottawa and Sydney respectively, the former on September 1, the latter on November 17.

SS Aurigæ (31.1907) an Irregular Variable.—A note from Prof. Hartwig, appearing in No. 4319 of the *Astronomische Nachrichten*, announces that the Bamberg observations show the star SS Aurigæ to be an irregular variable of the SS Cygni type.

THE ERUPTION OF VESUVIUS OF APRIL, 1906.[1]

FOR thirty years Dr. Johnston-Lavis has devoted much of his life to the investigation and elucidation of volcanic phenomena as illustrated by the classical type-volcano Vesuvius. To him we owe the great geological map of Vesuvius and Somma, and a detailed memoir in which he worked out the geology of that very complex Neapolitan volcano, as well as numerous papers upon several eruptions.

FIG. 1.—The aspect of the great cone of Vesuvius on May 4, 1906, as seen from the Punta del Nasone on M. Somma looking due south. The dotted line is that of the outline of Vesuvius in October, 1903, taken with the same camera and lens, and represents, except for a faint variation at the extreme summit, the actual outline of the cone before it was truncated by the late eruption.

In a monograph lately issued by the Royal Dublin Society we have a careful vulcanological study of the great paroxysm of 1906, and an attempt to read from the recorded phenomena and the ejected materials the physics of such an eruption.

A quarter of a century ago, and in frequent communications since, Dr. Johnston-Lavis has pointed out that in the ejecta, and especially in the fragmentary materials, we have a key for interpreting the physical causes and phases of an eruption.

He holds that the aqueous and other vapours of an igneous magma are derived from materials acquired and dissolved by the igneous paste on its way towards the surface. There is evidence that the H_2O and other volatile elements really exist in the form of a solution of gases in a liquid, and that variations in the phases of an eruption are due to the separation of such volatile materials from solution and the expansion to the gaseous state on the relief of pressure or the increase of the amount and resulting tension of them. He maintains that the same physical laws that govern the solution of CO_2 in water under varying pressure and temperature are identical with those which govern the solution of H_2O, volatile chlorides and sulphates in a mixture of fused silicates.

This is the thesis that the author follows in the description of the last great outburst of Vesuvius, and still further claims his old favourite as the type-volcano of the world.

In the first chapter is a review of the changes that have occurred at Vesuvius since 1872, the date of the last important eruption. Next follows a diary of the daily and hourly changes at the volcano during its great paroxysm, partly from Dr. Johnston-Lavis's own observations and partly from those of other observers. The observations are then analysed in a chapter on general considerations and a scheme of grades and varieties of the activity of volcanoes is given, in which the eruption of April is classed under the *paroxysmal vesuvian* type, as distinguished from ordinary Vesuvian type. A protest is made against the application of the terms *vulcanian* and *pelean* to this outburst, the term being considered to be more applicable to acid volcanoes, in which the higher viscosity of an acid magma gives rise to a very different series of phenomena, namely, (*a*) amount of lava above the lateral outlet; (*b*) the secular output of lava; (*c*) the rise of magma due to its expansion from increased vesiculation after the relief of pressure from the fluid column above it has drained or blown away. The different phases of the eruption are studied, and the varying output of lava examined from these points of view.

The lava in this eruption was of the usual *aa* type of Vesuvian rapid outflows, and differs from the *pahoehoe* type of slow dribblings such as built up the great lava cones of 1891 and 1895. A comparison of microscopic characters shows that the felspars are more developed in the slow outflows, whilst the leucites dominate in the rapid floods of lava. A series of excellent photographs taken by the author exhibit many striking phenomena of lava flows on the open slopes, along narrow ravines, and amidst streets, houses, railroads, bridges, &c.

The so-called bombs which are frequent on the surface of lava streams were shown by the author some years ago to be due to the fragments of solid materials caught in the lava stream and floated to the surface by the vesiculation on their surface, which latter acts in a catalytic manner. They have condensed on their surface a crust derived from the fluid rock which gives them their bomb-like appearance. A photograph is given in which the nucleus is composed of a piece of wall, thus indicating their true origin. The author aptly compares them to a dumpling, and proposes in future to call them by that name to distinguish them from other so-called bombs.

FIG. 2.—The great cone of Vesuvius as seen from the west at the foot of the Colle Umberto, looking due east across the Atrio on May 3, 1906, to show the truncation of its top and the remarkable barrancos formed on its sides by the slipping of loose fragmentary ejecta.

Several reasons are given for the slight variations in the composition of the lavas, scorias, and dusts, such as the effect of aërial sorting, loss of chloride and sulphates, or the acid radicles of such salts leaving the bases behind, fumarolic exhaustion, &c., which are each reviewed in turn.

[1] Scientific Transactions of the Royal Dublin Society, vol. ix. (Series ii.), part 8. (Dublin: University Press.)

Two plates are devoted to a series of detailed sections of the fragmentary materials as distributed around the volcano, and the conditions that influenced the distribution of such materials are discussed.

The essential ejecta are shown to be represented by two strata of brown and black scoria that form the base of the great sheet of lapilli which covered the north-east sector of the volcano, and were so destructive to Ottajano, S. Giuseppe, and other towns. These were followed by the still more important and larger volume of the accessory ejecta derived from the fragmentation and ejection of the upper part of the great cone. One-third of that great cone has gone, as can be seen by the photographs in some of the plates, and a tremendous crater half a mile in diameter and of unknown depth afforded these materials.

The remarkable photographs of the great cone showing this truncation, compared with its original outline and that of the new crater at different dates, make impressive pictures. Plate V. of the memoir, here reproduced in Fig. 2, will remain as a classical view of the general shape of the cone with its scored sides, and Plate VI. of the details of those remarkable barrancos that are like the pleats in a half-opened umbrella. This scoring of the slopes of volcanoes was formerly supposed to be due to aqueous erosion, but is shown in this eruption to be caused by the slipping down of avalanches of loose fragmentary materials piled on the steep slopes of the cone towards the end of the eruption, when the ballistic energy was unable to throw them farther afield.

FIG. 3.—Lava that invaded the court of the villa of M. and T. Borosio at Boscotrecase.

Some remarkable "hollow dykes," first described in the 1885 eruption, are given on p. 185, and the mechanism of their formation explained. The author believes they were possibly the canals by which issued the lavas of the Colle Margherita and the Colle Umberto.

The microscopic and other characters of the essential ejecta are illustrated by some plates of photomicrographs. The size of the vesicles, the relative amount of glass, microliths, and state of the magnetite are shown to indicate the position of the magma in the volcanic conduit, the amount of volatile constituents it acquired or lost at different depths, and their relationship to the different phases of the eruption.

The minerals and other eruptive products of the eruption are described in so far as they bear on the interpretation of the eruptive phenomena, but the author avoids petrographical and mineralogical details that he considers have no special bearing on the study of this outburst.

In addition to a large number of reproductions from photographs taken by the author, there are plans, figures, and maps. The last plate is a plan, on the scale of 1/10,000, of the modifications wrought in the cone and crater, printed specially for this memoir by the Istituto Geografico Militare of Italy.

TANTALUM AND ITS INDUSTRIAL APPLICATIONS.[1]

WHEN the announcement was made in the year 1878 that "the division of the electric light had been successfully accomplished," many people believed that the days of lighting by gas had come to an end, and acted accordingly, much to their own disadvantage, for the competition of the glow-lamp served only to stimulate its rival to new life. Burners of improved construction, regenerative burners, and finally gas mantles, helped to restore to gas the ground it had lost, and until a short time ago even threatened to check the spreading of electric lighting.

Not only this growing competition of gas, but the universal necessity of cheapening the production of commodities that are for general use, forced electrical engineers to study in all its aspects the question of improving the efficiency of electric lighting. As a guide in their researches they had the well-known principle that the illuminating power of a solid body increases at a much greater ratio than its temperature, or, in other words, that with the increase of temperature a greater percentage of the energy expended for heating the body is converted into light. There is plenty of room for improvement, for even the most economical source of light, the electric arc lamp, converts only about 1 per cent. of the energy of the electric current flowing through it into light, the rest appearing as heat, so that in reality all methods of lighting devised by men are to a much greater extent methods of heating.

The first successful incandescent lamp consisted of a carbon filament, and for a long time carbon appeared to be the only suitable substance, although the temperature to which such a filament can be raised is limited to about 1600° C., as above this point the carbon begins to disintegrate rapidly. At this temperature the lamp consumes from three to three and a half watts per candle-power, while any attempt to produce light more economically by raising the temperature of the filament results only in shortening its life and destroying, thereby, its power of competing with gas lighting.

An improvement on this result was introduced by Prof. Nernst, of Göttingen, who suggested as the source of light refractory earths, similar in character to those used for gas mantles, which, however, conduct electricity only when they are hot. Lamps constructed on Prof. Nernst's principle have, therefore, to be fitted with contrivances for heating their filaments when starting, which complicate the construction of the lamp.

Another step forward was made by the invention of the osmium lamp, which is produced in a somewhat similar manner to the carbon lamp, by squirting a plastic mixture of metallic oxide and a reducing agent into the shape of a filament, which is gradually heated in a glass bulb by the passage of an electric current, while the bulb is being exhausted by an air-pump or an equivalent device. So far as utilisation of energy goes, these lamps are a great improvement on carbon lamps, but their filaments are very brittle, and the total production of osmium per year is only about 8 kg. for the whole world, of which 5 kg. are required for medical purposes.

In January, 1905, Dr. W. von Bolton, the head of the chemical laboratory of the firm of Siemens and Halske, announced in a lecture to the Elektrotechnische Verein of Berlin that he had succeeded in producing pure tantalum, and his discourse was followed by Dr. O. Feuerlein describing how tantalum had been utilised for filaments in the lamp works of the firm. These discourses presented the result of long years of research work based on the general principle already alluded to, that that filament would give the best economical results which could be maintained for the longest time at the highest temperature.

The number of substances capable of conducting electricity and of sustaining such high temperatures is very limited, and platinum, the most refractory of the well-known metals, had been tried and found wanting. It became, therefore, necessary to start the research by

[1] Discourse delivered at the Royal Institution on Friday, April 23, by Alex. Siemens.

devising methods for producing the rare metals in a commercially possible manner, and then to try one after the other as filaments of incandescent lamps.

While working on these lines Dr. von Bolton succeeded, in the first instance, in producing a vanadium filament by heating a mixture of vanadium pentoxide and paraffin to 1700° C., and thereby producing sticks of vanadium trioxide, which in their turn were heated by electric currents in a glass bulb exhausted by an air-pump, and so converted into metallic filaments. As it was found that vanadium melts at about 1680° C., such filaments were no improvement on carbon filaments, and the next substance to be investigated was niobium, which belongs to the same group of elements, but has nearly double the atomic weight. Treated in a similar manner, the niobium filament gave somewhat better results, but still its melting point, estimated at 1950° C., was too low for practical purposes.

In this connection it should not be forgotten that at a temperature considerably below their melting points all these metals begin either to soften or to disintegrate, so that their "working" temperature is not identical with their melting temperature.

Turning his attention to tantalum, which has an atomic weight of 181, Dr. von Bolton experimented with the black metallic powder produced by the method of Berzelius and Rose, and found that it could be rolled into a fairly coherent mass in the form of ribbons. Alternative experiments, conducted on the lines by which vanadium and niobium had been obtained, resulted in the production of pure tantalum in the form of a metallic button, which was found to be tough and malleable like steel.

These and other qualities convinced Dr. von Bolton that nobody before him had handled pure tantalum, although Berzelius had first obtained the metal by a chemical process in 1824, and later Moissan succeeded, in 1902, in producing it in his electric furnace. The latter describes tantalum as a hard, brittle metal of the specific gravity of 12·8, and a non-conductor of electricity, but he adds that the substance obtained by him contained about half a per cent. of carbon.

Considering the high atomic weight of tantalum, this admixture of carbon evidently exercises a great influence on the physical qualities of tantalum, and explains the differences between the observations of Dr. von Bolton and those of his predecessors. In nature, ores containing tantalum are found in many places, principally in Scandinavia, North America, South-west Africa, and Western Australia. Columbite from South Dakota contains from 10 per cent. to 40 per cent. of tantalum pentoxide (Ta_2O_5), and a good deal of niobium, combined with iron and manganese in various proportions.

As the separation of tantalum and niobium is somewhat troublesome, it is preferable to utilise tho tantalite, which consists almost entirely of iron and manganese combined with tantalum pentoxide. From these ores tantalum is separated in the form of a fluoride in combination with potassium (K_2TaFl_7), and subsequently reduced by metallic potassium to the black powder already mentioned, which, however, still contains some oxide and some hydrogen.

In order further to purify the product, the powder is pressed into the form of small cylinders, which are melted in a vacuum, by an electric current under certain precautions, into small buttons of pure tantalum such as are exhibited.

Since the production of tantalum has been carried out on a commercial scale it has been possible to improve many details of the process, so that the tantalum produced by it at the present time is even purer than that shown in 1905 at the discourse of Dr. von Bolton and Dr. Feuerlein.

Some specimens of this latest tantalum have been submitted to Sir James Dewar, who has very kindly made experiments with reference to its specific heat and to its thermal conductivity. He ascertained the specific heat by plunging small spheres of tantalum, which had been heated to the temperature of boiling water, into water of 14° C., then transferring them to melting carbonic acid (−78° C.), and finally to liquid air (−183° C.), and as an average of several experiments the specific heat was found to be between 100° C. and 14° C. = 0·033, 14° C. and −78° C. = 0·032, −78° C. and −183° C. = 0·028, while Dr. von Bolton in 1905 gave the specific heat as 0·0363. Multiplying these results by the atomic weight (181), it will be seen that Dr. von Bolton's value (6·57) is slightly higher and Sir James Dewar's value (5·97) lower than 6·4, which, according to Dulong and Petit, is the atomic specific heat.

The result of Sir James Dewar's experiments proves tantalum to have about three-quarters the conductivity of iron and about one-eighth the conductivity of copper. At ordinary temperatures, say below 300° C., pure tantalum resists the action of all acids except fluoric acid, of all alkalies, and of moisture, so that it is an ideal material for chemical apparatus which do not require high temperatures, and for any implements which, when made of steel, are liable to rust.

It has already been stated that pure tantalum is tough and malleable, so that it can be hammered out into thin sheets or drawn into fine wire, the diameter of the filament wire being 0·03 mm., or about one eight-hundredth of an inch; all the same, it is elastic and as hard as soft steel, and has a tensile strength of 93 kg. per square mm., which is equal to 57 tons per square inch. This means that the filament wire is capable of supporting about 80 grams, or 2·8 ozs., as can be shown by actual experiment.

Tantalum sheet can be stamped into various shapes, and out of bars of tantalum springs can be bent. Another use made of tantalum is as material for writing pens, manufactured in the usual way. When it was first offered for this purpose it was found that the material could not pass the test prescribed for pens made of steel. These are pressed by a weight of 180 grams on writing paper which is moving at the same speed as ordinary writing, and while 10 km. (6¼ miles) of paper are passing the loss by abrasion must not exceed 0·7 mg. (0·01 grain).

At first the tantalum pens lost more than double the permitted weight, but it was found that slightly oxidising the surface of the pens hardens them so much that they only lose 0·8 mg. by the 10 km. test. By weight this is still more than is permitted for steel pens, but having regard to the specific weights of the two substances the actual volumetric abrasion of the tantalum pen is the lesser of the two.

Although only the surface of the pens had been oxidised, it was found that the rate of abrasion remained the same for the whole length of 10 km., when it was expected that this rate would increase materially after the skin of oxide had been ground off.

Advantage was taken of this circumstance when an inquiry was received from India as to whether it would be possible to manufacture cataract knives for oculists out of tantalum. The qualities demanded of such a knife are that its blade should be (1) intensely hard, so as to be able to acquire a very sharp edge of great smoothness, and to retain this fine edge for a long time; (2) very tough, without any tendency to bend; (3) chemically and mechanically stable, so that it can be easily sterilised and that it is not liable to rust; (4) capable of acquiring a high polish. Manufacturing such a blade out of pure tantalum, and slightly oxidising it before polishing it, appears to fulfil these stringent conditions, but as the knife, which is on the table, has not yet been actually tried for an operation, it can only serve to demonstrate the similarity of tantalum to steel for such purposes.

Another field for the application of tantalum may be found in the supply of dental instruments, owing to its immunity from chemical changes, but beyond showing two cases of such appliances there is no necessity to go further into details. While possessing all these qualities of a true metal, tantalum has some others which rather limit its usefulness. When heated to a dull red heat it absorbs gases greedily, especially hydrogen and nitrogen, and by combining with them it loses its tensile strength and becomes brittle.

Here are three pieces of tantalum wire taken from the same coil; one of them has been heated in an atmosphere of nitrogen, the other in hydrogen, and the third has not been interfered with. The consequence is that the latter has retained its strength, while the former have become brittle and useless. On heating tantalum in air, it shows first a yellow and then a blue tint like steel, but when the heating is continued it burns to pentoxide. The black powder and thin wires can even be lighted by applying a match to them, as the experiment shows.

Its melting point *in vacuo* lies between 2250° C. and 2300° C., which makes it particularly suitable for electrodes in vacuum tubes, especially as it does not disintegrate. For example, it is extensively used in Röntgen tubes. Its specific weight is 16·6.

Turning now to the electrical qualities of tantalum, its specific resistance was stated by Dr. von Bolton in 1905 to be, on the average, 0·165, with a temperature coefficient of 3 per cent. between 0° and 100° Celsius.

Further experiments conducted by Dr. Pirani in the laboratory of Siemens and Halske revealed the fact that wires of various thicknesses varied in their specific resistance from 0·173 to 0·188, but after they had been heated to 1900° C. in a high vacuum for from 100 to 200 hours, they all possessed the same specific resistance, viz. 0·146, and their temperature coefficient between 0° and 100° C. had risen to 0·33 per cent.

As the temperature of a tantalum filament, when consuming 1·5 watt per candle-power, is about 1850° C., and its resistance about six times its resistance at 100° C., the temperature coefficient between 100° C. and 1850° C. may be taken, on the average, as 0·29 per cent.

No doubt the difference between these results is caused by alterations in the structure of the wires during their manufacture, and the heating *in vacuo* served a similar purpose to the annealing of steel, so that Dr. Pirani's results published in 1907 may be taken as standards.

At present the most important industrial application of tantalum is its use for filaments of incandescent lamps, which may be said to date from July, 1903, when Dr. Feuerlein succeeded in producing a tantalum wire one-twentieth of a millimetre in diameter. Of this wire he made a glow lamp with a filament 54 mm. long, using a current of 9 volts 0·58 ampere, and giving a light of 3·5 candles (Hefner), at the rate of 1·5 watts per candle-power.

A simple calculation shows that for a current of 110 volts 660 mm. of the same wire would be required, giving at the same rate of consumption of energy a light of 43 candles.

In carbon lamps, for 220 volts the length of filament is only 400 mm., and the filaments remain hard until they disintegrate. Tantalum filaments, like other metallic filaments, soften, however, to such a degree that they cannot be used in the same shape as carbon filaments.

After trying various methods of housing the long Ta filament in a glass bulb of approximately the same dimensions as the carbon glow lamps, the present form was arrived at during the year 1904. In this lamp, which was adopted as standard, the length of the filament was 650 mm., its diameter 0·05 mm., and its weight 0·022 gram, so that about 45,000 of these lamps contain 1 kg. of Ta.

Since then these dimensions have been modified to a certain extent; for instance, the diameter of the filament is now only 0·03 mm., but the external shape has not been altered.

It was soon found that after burning a short time the filament underwent certain structural changes and lost its great tensile strength. Examination under a microscope revealed the fact that in about 1000 hours the smooth, cylindrical filament shows signs of capillary contraction, as if the cylinder was going to break up into a series of drops, and the surface, from being dull, commences to glitter. This contraction of the filament after being heated is readily recognised by comparing a new lamp with an old one. On the stars of the new lamp the filament hangs loosely, while in the old lamp the filament is evidently in tension.

The characteristic difference between carbon filaments and tantalum filaments is shown by a diagram representing the influence of temperature on the electric resistance of the two filaments in proportion to each other.

In order to have the differences at once shown in per cents., the normal pressure and the normal resistance of both filaments, when giving the light of 1 candle for 1·5 watts, is marked as 100, and it is immediately seen that the resistance of Ta alters directly, and that of carbon inversely, as the temperature. Owing to this quality a Ta filament is better able to resist overheating than a carbon filament, as the following experiment shows, where two lamps, one Ta and one C, burning normally at 110 volts with 1·5 watts per candle-power, are gradually exposed to higher voltages. The C lamp breaks, while the Ta lamp stands up to 200 volts, the highest voltage available here. Of course, its useful life will be shorter than at its normal voltage.

As stated at the beginning of the discourse, the primary object of all the research was to find a filament more economical in the consumption of electrical energy than the C filament, and the following experiments will show that the Ta filament is in this respect a great improvement on the C filament. To begin with, a comparison can be made by burning a Ta and a C lamp under water, each being immersed in a vessel containing the same quantity of water. Owing to the C lamp requiring more energy to give the same light as the Ta lamp, the temperature of the water in the C vessel rises quicker than in the other vessel. Another way of showing the difference is by measuring the current taken by each of the two lamps when giving approximately the same light, or by sending the same current through both lamps in series and noting the difference in candle-power.

In conclusion, two interesting qualities of Ta should be noted. The first is that, when a Ta filament is heated in a high vacuum, it will expel any oxygen that has combined with it. It is possible to detect whether a filament contains any oxide by very gradually heating it up, when the parts containing oxide will appear brighter than those consisting of pure Ta, owing to the greater electrical resistance of the oxide.

These lamps have been purposely exposed to the air while they were being exhausted, and have become "spotty" in consequence, but if they are raised a little above their proper voltage and left burning for a few minutes their filaments become quite uniform by the expulsion of the oxygen.

The second quality is that Ta will act as a rectifier when used in an electrolyte, that is to say, it will allow the passage of the positive current only in one direction. In the apparatus shown the positive current passes through the lamp to a Ta anode, thence to a Pt kathode, but in a very short time the Ta anode covers itself with a film of oxide which stops the current. When the current is reversed the lamp lights again, and continues to burn. When an alternate current is connected to the lamp it will also continue to burn, but with diminished brilliancy.

All these experiments are intended to show the remarkable qualities of this material, and when they are fully appreciated and its limitations are properly understood there appears to be a great field open to tantalum and its industrial applications.

CONFERENCE ON ROADS.

A CONFERENCE arranged by the County Council Association, in conjunction with the Association of Municipal Corporations, the Urban and Rural District Councils' Association, the Association of Municipal and County Engineers, and the County Surveyors' Association was held in London last week, and lasted over three days. The meetings were divided into three sections, which met at the Institution of Civil Engineers, the Mechanical Engineers, and the Surveyors' Institution.

This conference was very largely attended by borough and county engineers, chairmen and members of the Roads and Bridges Committee of county councils, and others interested in automobiles.

Following on the International Road Congress held at Paris last year, this gathering together of those responsible for and interested in the management of the highways of this country shows the increasing importance of road traffic and of the interest taken in the condition of our highways.

Forty papers were contributed for reading and discussion, the subjects dealt with relating to the construction and maintenance of roads; motors and traction engines, their weight and speed, and effect of wear and tear on the roads; nationalisation of the roads, and Exchequer grants towards their maintenance; the collection of statistics and standardisation of these.

There can be no doubt that a very considerable change has come about in the requirements of roads since the advent of the motor-car. After the introduction of railways the main roads became very much neglected, and little interest was taken in their condition, but now they are more used than even in the old coaching days. For the traction engine, the motor-car, or the steam trolley the old methods of management are unsuitable, and the new conditions require different treatment. The greater part of the roads in rural districts may be described as having grown or developed, and have been built up by the use of the metalling placed on the surface without any foundation. This accounts for their unsuitableness for the rapid and heavy traffic with which they have now to contend, and for the excessive cost of maintenance.

The old turnpike roads, which constitute the greater part of the main roads now under the control of the county or borough councils, have been, as a rule, well made, and are under the management of qualified engineers, and on these roads considerable attention has been paid in the endeavour to adapt them to the altered circumstances; but on the highways which are under the management of rural district councils the case is different. These rural councils, from a false idea of economy, make use of perishable materials for repairing the roads, such as limestone or gravel, because these can be procured in the neighbourhood, and can be obtained at less price than suitable road material brought from a distance. With the same false idea of keeping down the cost, unqualified men are employed as surveyors at small salaries. Sometimes the only qualification that the applicant for this office possesses is that he has been unsuccessful in his business as a farmer.

In a pamphlet on the repair and management of roads, issued by the Roads Improvement Association for the use of surveyors of highways, it is clearly shown that roads well maintained and kept in good order cost less than bad roads repaired with inferior material. An example is given of a turnpike road which had been much neglected, of which, owing to change of management and the use of granite in place of local stone, the cost was not only considerably reduced, but from the improved surface of the road one horse was able to draw as large a load as formerly required double the number. In the same district it was also shown that the parish roads, which cost the most to maintain, were without exception those that were kept in the worst condition, and that when these were placed under efficient supervision, while the roads improved, the cost of their maintenance diminished.

The use of self-propelled vehicles, owing to the way in which they affect the surface of the roads, more than ever emphasises the necessity for the use of skilled supervision. There was a unanimous expression of opinion at the conference that the cost of maintaining the roads had very considerably increased, and that in many cases, owing to the want of proper foundations or inadequate metalling, they are quite unsuited for the class of traffic that they have now to bear.

In one of the papers read at the congress it was shown that to cover such roads with a coating of suitable material of a thickness of 3 inches, in place of the flint or limestone at present in use, would cost 1100*l.* per mile, or five millions of pounds for the south-eastern division of England, where the motor traffic is the heaviest, and to which the paper more particularly referred.

The cost of maintaining the main roads has been very largely increased owing to the wear and tear of automobiles. During the last nine years the annual cost of the main roads, which extend over a length of 27,600 miles, has risen from 2,024,711*l.* to 2,766,903*l.*, or at the rate of 76·1*l.* to 100·2*l.* per mile. In one of the southern counties the cost has been doubled.

A matter that received considerable attention at the conference was the nuisance due to the dust which prevails in dry weather along the roads frequented by self-propelled vehicles moving at great speed. Motor-cars not only raise and distribute dust in a manner previously unknown, but also are responsible for its production. This is especially the case on the roads that are in the worst state of repair. On a loose surface the fine particles, which act as a binding material to the larger stones, are sucked up by the tyres of the wheels and distributed over the road, causing inequalities and providing material for dust. A great deal of damage is also done by the sucking out of the water from the puddles when the road is wet. A rubber-tyred wheel splashing into a puddle sends the water flying out of it with a speed and force greater than any other vehicle, and converts a small puddle into a larger one. This effect is greatest where the surface is repaired with soft material, or where the material used for binding is unsuitable. On roads under the management of unskilled surveyors any material is considered sufficient for binding the larger stones used for covering the surface of the road. The scrapings of the mud off the road in winter are often made use of for this purpose, and in one of the papers read at the conference it is stated that in one district even material was dug from the sides of the road, and the metalling bedded with this. Under such practices the result, of course, cannot be otherwise than a muddy surface in winter and dust in dry weather.

Various processes have been tried as a means for preventing the generation of dust, but the one most generally adopted in this country is to make the surface of the roads waterproof by the use of pitch or tar, either as a matrix for binding the stones together or as a surface dressing. Already 1500 miles have been treated in this way. The best results are obtained where there is a good foundation, and a surface covering of sufficient thickness of the hardest and toughest material, well consolidated by rolling, with just sufficient fine chippings of the same stone to fill the void spaces, the surface being rendered impervious to water or the action of frost by the use of tar or some bituminous material. Tar macadam, which consists either of the whole material used or only of the binding material being mixed with tar before being placed on the road, has been largely used. Opinions varied as to the use of this process. In some cases it has been a complete success, in others a failure. This is probably owing to the manner in which the material has been prepared and laid, and to the quality of the tar or pitch used. To be successful it requires that the material must be mixed with the tar when it is dry, and dry weather is required when it is put on the road. If improperly mixed it either breaks up in patches, which are difficult to repair, or becomes so soft in hot weather as to work into a very uneven surface.

For surface dressing on roads already made and in good condition, spraying with tar either by hand or by a machine made for the purpose is effective, and as it adds considerably to the life of the road it does not add much to the cost of maintenance.

No reference was made in any of the papers to the practice in use in the United States, and which now extends over many hundreds of miles in California and other States, of using petroleum or bituminous oil for spraying instead of tar, which is there found to be very effective. The oil is spread from a specially designed tank-car at a rate varying from one to two gallons to the square yard. Roads so treated are fit for traffic twenty-four hours after being sprayed; they are thus rendered impervious to rain-water, and the surface remains hard and firm in hot weather.

MAGNETIC SURVEYS.[1]

The first volume referred to below may be regarded as the coping-stone of the work done for the Coast and Geodetic Survey by Dr. Bauer during his tenure of the office of chief of division of terrestrial magnetism. Dr. Bauer had actually transferred his services to the Carnegie Institution of Washington before the volume

[1] Department of Commerce and Labour, Coast and Geodetic Survey, United States Magnetic Tables and Magnetic Charts for 1905. By L. A. Bauer. Pp. 154. (Washington: Government Printing Office, 1908.)
Magnetic Survey of the Dutch East-Indies, 1903–7. By Dr. W. van Bemmelen. Pp. 69; with charts. (Batavia: Government Printing Office, 1909.)
Survey of India. Extracts from Narrative Reports, 1906–7. (Calcutta: Superintendent Government Printing, 1909.)

appeared, but the responsibility for the work seems entirely his. The volume represents a complete magnetic survey of the United States for the epoch January 1, 1905, based on observations at 4149 stations, including 3311 in the United States itself, 575 in Canada, 201 in Mexico, and 62 in the West Indies. The great majority of the stations were occupied by Coast and Geodetic observers, but acknowledgments are made to Señor Felipe Valle for results from some seventy of the Mexican stations, and to Dr. King and Prof. Stupart for a good many results from Canada. In the United States the density of the stations varied from one per ninety square miles in Maryland to one per 2924 square miles in Idaho, the average being one per 973 square miles. Details as to instruments, methods, and sites of stations are not given, having been dealt with in previous volumes of the Survey.

Table I., pp. 18–87, summarises all the observations. It gives the name, latitude, and longitude of the station, the date of observation to 0·1 of a year, the observed values of the three elements declination (D), inclination (I), and horizontal intensity (H), the values of the elements reduced to the epoch 1905·0, and, finally, the authority. D and I are given to 0′·1, and H to 0·0001 C.G.S. (or 10 γ). The results are grouped under the States of the Union. Table II., pp. 91–5, summarises results obtained at sea in the Atlantic and Pacific Oceans, and in the Gulf of Mexico, at 241 stations, between January 1, 1903, and midsummer, 1907. In this case results are given for total intensity as well as for D, I, and H. Table III., pp. 101–7, shows the secular change in D at eighty stations representing specified portions of different States of the Union. Values of D are given at ten-year intervals from 1750, when available, down to 1900. The values for 1905 and the estimated annual changes at that date are added. Table IV., pp. 114–9, gives secular-change data for D, I, and H for five-year intervals, from 1840 downwards, for forty-seven geographical positions; *e.g.* twelve have latitude 45°, their longitudes being respectively 65°, 70° . . . 110°, 115°, and 122°·5 W. Table V., pp. 123–150, contains values of D, I, H (along with its north and east components), as well as values of the vertical intensity (V) and total intensity (T), at the intersection of all degrees of latitude and longitude on the North American continent between 17° N. and 49° N. Values of D and I are given to 0°·1, values of H to 0·001 C.G.S. These data for D, I, and H are obtained by scaling from the charts, the process not claiming an accuracy exceeding 0°·05 in D and I, or 0·0005 in H. The other force elements were apparently computed from these, but they are given to four significant figures.

The first five charts, dealing respectively with D, I, H, V, and T, are each about 28 inches by 22 inches. As to the method of construction of the charts for the three first elements, we are told (p. 153) that "the reduced values for 1905·0 . . . were plotted on a base map of about four times the size of the charts. Next the lines (isogonals, isoclinals, isomagnetics) were drawn to conform as strictly as possible with the plotted results." The V and T charts are based on values calculated by combining values of H and of I scaled from the charts for these two elements. The aim is at least to indicate all local irregularities of any importance, and, as Dr. Bauer truly remarks, "one cannot fail to be impressed by the manifold irregularities shown by the lines." This remark is especially true of the isogonals, but the V and T isomagnetics are also exceedingly irregular in the regions bordering on the great lakes. In the charts, successive D and I lines differ by 1°, successive H, V, and T lines by 0·01 C.G.S. These lines are drawn in red, geographical details being in black. The D, I, and H charts also contain blue lines, drawn to pass through the places where the secular change of the element is the same. In 1905 the agonic line—along which the needle points to the true north—ran from a little to the west of Charleston, in South Carolina, in a north-westerly direction to the north-east corner of Lake Michigan. The line of no secular change ran, roughly, parallel to the agonic line, but about 250 miles to the west of it. To the east of the line of no secular change the needle is moving to the west, and to the west of this line it is moving to the east. The extreme annual change—met with on the Pacific coast—is only about 4′. The phenomena, in a general way, are such as would ensue from a southerly movement of the north magnetic pole, and this is in general harmony with the secular changes in the other elements. H is falling and I increasing over nearly the whole United States, except in the extreme north-east, west, and north-west. There have, however, been remarkable changes in the set of the secular change of late years, showing that the real phenomenon is of a very complicated character, which renders any forecast for the future very uncertain.

The two last charts are of a different character from the others. No. 6 shows "magnetic meridians," defined as horizontal lines which have for their tangent at every point the direction of the compass needle. No. 7 gives secular-change curves of two types, one showing the change of absolute direction in space of the freely dipping needle, the other showing changes in the horizontal intensity.

The work is one which merits, and will doubtless receive, close attention from all who are engaged, or are likely to be soon engaged, in magnetic surveys. It is interesting to learn (p. 13) that corrections for diurnal inequality were applied only in the case of the declination. In the case of the inclination and horizontal intensity, Dr. Bauer's opinion seems to be that corrections for diurnal inequality "are, in general, of the order of the error of observation, and certainly much less than the 'station error' due to the irregular distribution of the earth's magnetism." He was presumably influenced, in part, by the consideration that secular change in H varies over the United States from +20 γ to −70 γ per annum, so that a knowledge of the annual change, even to the nearest 10 γ, must be difficult to acquire in the regions more remote from magnetic observatories. How disturbances are dealt with does not seem to be stated. If Dr. Bauer's views are correct, and they are based probably on a wider experience than that of any other man living, one cannot help thinking that extreme refinement in field instruments or observations may be largely thrown away in the case of a general survey of a large area. If we may borrow and extend a military metaphor, supreme importance attaches, not so much to the gun, or even to the man immediately behind it, as to the general.

In the second volume we have a survey for the epoch 1905·5 of the Dutch East Indies, made under the direction of Dr. W. van Bemmelen, of the Batavia Observatory. The area included extends from Sumatra in the west to the borders of Dutch and German New Guinea in the east (95° to 141° E.), and from Timor in the south to Mandanao (Philippines) in the north (11° S. to 8° N.). The area is thus very big, including much sea and many small islands, in addition to Sumatra, Java, Celebes, and parts of Borneo and New Guinea. There were 158 stations, a considerable number being on the smaller islands, but none at sea; they were occupied during 1903 to 1907. Owing, no doubt, in part to the relatively small number of his stations, Dr. van Bemmelen's practices are in many respects the antithesis of Dr. Bauer's. The former attaches comparatively little importance to the exact site of his stations. On the other hand, though having continuous records from only one observatory, he applies corrections to all the elements to eliminate the diurnal inequality and irregular variations, going to 0′·1 in declination and dip, and to 1 γ in horizontal force. The Dutch charts, again, unlike the American, take no account of local peculiarities, but resemble the world charts of the British Admiralty in the bold sweep of their lines. They are drawn on thick paper in the body of the volume, and, again unlike the American, present quite an artistic appearance.

Dr. van Bemmelen gives the values of the magnetic elements at intersections of degrees of latitude and longitude, going to 0°·01 in declination, 0°·1 in dip, and to 0·0001 C.G.S. in the total force and in its vertical, horizontal, southerly, and easterly components. He reproduces, with some corrections, the results of two previous surveys of the East Indies, one for the epoch 1848·0, by Captain C. M. Elliot, the other for 1876·5, by Dr. E. van Ryckevorsel, and makes use of these in discussing the secular change. Though representing a much smaller amount of field work than the American, the Dutch survey presents—as one expects from Dr. van Bemmelen—many ingenious ideas, which, if not all equally valuable, are at least suggestive. Observers in tropical countries, for instance, will be interested to learn how he dealt with mosquito troubles, and how he rendered the beats of his chronometer audible during rain-storms. To those now engaged in the magnetic survey of India, the work must be one of especial interest.

The third volume describes the work done in 1906–7 by the Survey of India. Besides interesting details as to pendulum and tidal work, levelling and ordinary surveying, it gives an unusually full account of the progress of the magnetic survey under Captain Thomas, R.E. As in previous volumes, there is an account of elaborate instrumental investigations, but the most novel part is a discussion of formulæ got out by Mr. J. Eccles—acting, apparently, on a suggestion by Sir A. Rücker—for deducing the diurnal inequalities of declination and horizontal force at any intermediate place from those recorded at two magnetic observatories. There are comparisons of the inequalities observed at one magnetic observatory with those calculated for its latitude and longitude from the inequalities at two other observatories. The agreement is pronounced very satisfactory. The formulæ seem based on the assumptions that the diurnal inequality at a given latitude is a function only of the local time, and that for the area concerned the rate of variation with latitude of the departure at any local hour from the mean value for the day is constant both for the northerly and easterly components of force.

So limited a hypothesis seems hardly likely to prove very satisfactory unless confined to somewhat restricted areas, and when one looks into the observed and calculated values, especially those for the declination, one finds that, *relatively to the amplitude of the inequality*, the agreement is less satisfactory than one would have inferred from the comments made. The declination diurnal inequality, however, in India is so small that even large percentage departures from accuracy would be of minor consequence from a survey point of view.

Various prospective difficulties are referred to in connection with the distribution of magnetic storms, the difference between mean values from all and quiet days, and similar matters. The nature of the answer to several of the problems mentioned might perhaps be anticipated from what is already known from other sources; but one cannot avoid a suspicion that, unless India is singularly free from local magnetic disturbances, some of the difficulties referred to may prove to be of secondary importance. It will certainly require no small amount of knowledge and ingenuity to utilise to the full all the refinements which it is intended to introduce into the observational material.

C. Chree.

BIRD NOTES.

From Dr. Thienemann, director of the Vogelwarte (ornithological station) at Rossitten, on the Baltic, we have received three papers relating to the recent work of that establishment. The first of these, which deals with marked storks and swallows, is an extract from Reichenow's *Ornithol. Monatsberichte* for October, 1908; the second, in which the migration of storks is discussed at some length, was originally published in *Land- und Forstwirkschaftliche Zeitung* for September; while the third, relating to marked storks in Africa, gives no clue as to its place of publication. A note on this third paper appeared in the *Times* of April 5. In connection with these, it may be mentioned that a very interesting article by Mr. A. L. Thomson on the work of the Rossitten station, and more especially the method of marking birds, is published in the April number of Witherby's *British Birds*.

As regards the capture of marked storks in Africa, reference in Nature has been already made to the specimen recently killed in Natal. Dr. Thienemann now tells us of the capture, at Morija, Basutoland, of a Rossitten bird in February last. This is the most southerly point reached by a stork liberated in east Prussia, but the Natal bird, which was set free in Hungary, went further, although the distance from the point of liberation was less. Other records include a stork, one of a brood of three marked near Königsberg in June, 1906, the ring and foot of which were brought by natives to a French officer near Lake Tchad, the bird having been snared in October of the same year on the Fittri Lagoon. A stork from a brood of three, liberated near Koslin, Pomerania, in July, 1907, was taken the following winter near Fort Jameson, Rhodesia. It is now, therefore, certain that European storks habitually migrate to South Africa, and the next point to ascertain is whether they ever breed south of the equator.

According to the *Times* of April 26, the capture of a marked stork near Jerusalem has been reported to the Hungarian Central Bureau for Ornithology, Budapest. A flock of more than 2000 storks alighted to rest by one of the lakes near Jerusalem, and five were caught. The marked bird was hatched at Egri, in eastern Hungary, last season, and marked with the stork-ring No. 293 on July 8, 1908; it will be placed in the new Palestine Museum. The storks seen were on their homeward journey, probably from South Africa. This capture is considered important as showing that these birds do not pass over the Mediterranean Sea, but follow the longer route over the land.

That the South African honey-guides (Indicatoridæ) are parasitic in the matter of egg-laying has been long known, but it appears from a paper by the Rev. Noel Roberts in the April number of the Journal of the South African Ornithologists' Union that this habit is shared by certain members of the whydah-bird group (Ploceidæ). From a paper in vol. iii., No. 1, of the same journal, it seems that this parasitic habit has been demonstrated in the case of the pied whydah-bird (*Vidua principalis*), and in the issue now before us Mr. Noel gives reasons—although these are not quite so clear or convincing as they might be—that the same holds good in the case of the typical species of the genus Quelea. In the author's opinion, this bird deposits its eggs, at all events in some instances, in the nests of another member of the same family, namely, *Pyromelana oryx*. It may be hoped that further investigations will be undertaken for the purpose of confirming these interesting observations.

Naturen for April contains a paper, by O. J. Pettersen, on the habits and distribution of the redbreast.

In the course of his annual report on Norfolk ornithology, published in the April number of the *Zoologist*, Mr. J. H. Gurney comments on the scarcity of nightingales, spotted flycatchers, willow-wrens, and various kinds of warblers during the summer of 1908. This scarcity the author attributes to the great snowfall which took place on April 23 of that year. Three features in the autumn migration were noteworthy, namely, the number of redstarts on September 23, the great flights of rooks, crows, and starlings on October 18 and 19, and the abundance of woodcock.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—An anonymous benefactor has expressed his willingness to contribute a sum of 500*l*., if required, to supplement the 500*l*. which the Senate has already voted towards defraying the cost of the Darwin commemoration.

Prof. Woodhead has been re-appointed as the representative of the University of Cambridge on the council of the Lister Institute of Preventive Medicine.

At the Congregation on Thursday, May 13, the following Grace will be offered to the Senate:—That there be established in the University a professorship of astrophysics, and that such professorship be governed by the following rules:—(1) the professorship shall be called the professorship of astrophysics, and shall terminate with the tenure of office of the professor first elected; (2) it shall be the duty of the professor to promote by research and teaching the study of astrophysics; (3) the professor shall receive no stipend from the University; (4) the special board of studies to which the professor shall be assigned shall be the special board for physics and chemistry.

Major P. G. Craigie, C.B., will deliver the Gilbey lectures for 1909, on the history and economics of agriculture, on May 10 and 11, at 5 p.m., in the University Chemical Laboratory, Pembroke Street. The lectures will deal largely with the sources of the cereal supply and with the agricultural history and economic position of the Russian Empire; of British India and its varying wheat exports; with the developing areas of the Argentine Republic, both as regards wheat and meat export; and will conclude with an examination of the resources and exporting prospects of the possessions of the British Crown in Australasia and in the Dominion of Canada.

London.—Offices have now been definitely assigned to the Royal Commission on University Education in London, and all communications in reference thereto should in future be addressed to the joint secretaries, 12 Queen Anne's Gate, S.W.

A course of eight lectures on the "Structure and Functions of the Central Nervous System" will be given in the Physiological Institute (University College) by Dr. W. Page May on Tuesdays at 5 p.m., beginning on Tuesday, May 11. The lectures are open to all students of the University, also to qualified medical men on presentation of their cards.

Oxford.—Much interest has been aroused by the publication of the Chancellor's letter on "Principles and Methods of University Reform." All parties seem agreed in appreciation of the fulness and lucidity of the memorandum, and of the statesmanlike qualities shown by its author. Many of Lord Curzon's proposals will be accepted in most quarters as practicable and salutary; as to others, opinions will differ. It is too soon as yet to attempt any detailed criticism of the proposed new measures, but it is satisfactory to see that Lord Curzon fully recognises the obligation that rests on the University to take its part in extending the boundaries of science. "Oxford," he says, "should train its scholars, not merely to acquire knowledge, but to increase it." The efforts of the University should be directed towards attracting, by encouragement and rewards, men who are capable of advanced and original work. Various means are suggested by which this might be done more effectually than at present, among the most important being the establishment of a system of coordination between the university and the colleges, having for its object the adoption of a general policy of research.

The April number of the Journal of the Association of Teachers in Technical Institutions contains the programme of the Whitsuntide meeting of the association, to be held in Liverpool from May 29 to June 2. The arrangements include a visit to the R.M.S. *Mauretania*, and one to Eaton Hall. In addition to the accounts given of matters more particularly interesting to members of the society, there are useful short articles on methods of teaching in technical classes. Under the title "The Artisan's Claim to Technical Education," Mr. W. T. Emery advocates the establishment of trade schools in all our towns, believing that they would be efficient substitutes for the dying apprenticeship system. In time they would become much more, and he hoped for legislation to "limit employment under eighteen years of age to thirty hours a week, with thirty hours' technical instruction" (*cf.* Minority Report of the Poor Law Commission).

The recently issued administrative report of the Missouri Botanical Garden, and an announcement of Washington University concerning the Henry Shaw School of Botany, indicate that the Shaw foundation is on the eve of entering on a much increased activity. Although Henry Shaw in 1885 endowed a school of botany in Washington University, to the head of which Prof. Trelease was called from the University of Wisconsin, the provision made was practically for only a chair of botany. Four years later, on the death of Mr. Shaw, his fortune, appraised at several million dollars, passed to the care of trustees for the maintenance of his long-established and well-known garden, and for the further development of an institution of research and instruction in botany and allied sciences, the head of the school of botany being selected as its director. It is now announced that a definite step toward the development contemplated by the founder and planned by the director has been taken in the establishment of the post of plant physiologist at the garden, and the creation of a professorship of plant physiology and applied botany in the Shaw School of Botany; with provision for two research fellowships in botany. Dr. George T. Moore has been appointed to the new professorship.

Our esteemed contemporary, *Engineering*, in a leading article of April 23 dealing with "Engineering and Mathematics," takes exception to our recent remarks upon the advantage of theoretical training to the artisan. The writer of this article says that every foreman and works manager will asseverate with no little emphasis the opinion that the best handicraftsmen amongst his apprentices are not generally to be found amongst those most constant in their attendance at technical classes. We agree that this, unfortunately, is too often the case, but cannot accept the writer's explanation that this is generally owing to lack of interest in theoretical principles on the part of apprentices. Any teacher who has had extended experience of evening classes will easily give the correct explanation by referring to the huge annual bundle of reasons for absence—almost invariably overtime on the part of his best students. Overtime costs money in wages at a higher rate, and inferior apprentices are not wanted for overtime; consequently the best are selected by the foreman or manager, who, being too often himself without theoretical training, has little sympathy for his apprentices' progress in this direction. We suggest that our contemporary should refer to those cases in which the works' authorities give full facilities, without compulsion, for attendance at classes, when the opinion expressed will be probably modified.

We have received the first volume of the report of the United States Commissioner of Education, dealing with the year ended June 30, 1908. The greater part of the work (nearly 400 pages) is occupied by statistics, accompanied by running commentary. Recent progress is reviewed, not only in the United States, Porto Rico, and the Philippines, but also in the United Kingdom, in Europe, and in Spanish-American countries. We learn that the Bureau of Education has re-organised its library so as to render this collection of 150,000 educational publications available for direct service to the institutions of the country. From the commissioner's introduction we gather that the marked features of the year were the State Educational Commissions now working in ten States, the rigour of voluntary organisations, and the general effort to "standardise" American education. This is described as "the pure-food movement in our spiritual world, necessary to the soundness of our educational freedom and experimentation." International congresses were remarkably numerous last year, and the commissioner regards as the main movement in England, France, and Germany the gradual integration of the educational system. As specially characteristic of British cities, he notes the completeness with which the entire child population is brought under control, and the provision made for promoting the physical well-being of the children. He notes the growing agencies for assisting children in their search for work when their school life is ended. He considers London to be far inferior to New York in the extent of its *public* provision for education beyond the elementary stage. Whereas in the States the disposition is to open higher education freely to all children, the effort in England is to discover and encourage special ability.

SOCIETIES AND ACADEMIES.

London.

Royal Society, December 10, 1908.—"Electrolytes and Colloids. The Physical State of Gluten." By Prof. T. B. **Wood** and W. B. **Hardy**, F.R.S.

Gluten is the chief protein of wheat flour. In presence of water and salts it forms a tenacious, stringy substance, which confers upon dough its characteristic physical properties. Like other colloids, the physical state of gluten is determined by the electrolytes which are present. If the salts be washed away with ordinary distilled water, gluten gradually loses its coherence, and disperses as a cloudy, colloidal solution or hydrosol, which is precipitated by a trace of salt or alkali. The change is due, not to the water, but to the carbonic acid which is present. In the absence of salts cohesion is destroyed by traces of acid or alkali. With low salt content 0·0001 normal acid, for instance, disperses the protein almost instantaneously. Strong acids, however, disperse gluten only when their concentration is low. Above a certain critical value, *e.g.* 0·05 normal HCl, the acid restores and maintains cohesion. Alkalies act in the same way.

A hydrosol of gluten is precipitated by salt, and the gluten restored to its characteristic stringy state. There is, therefore, an antagonism between salts and acids or alkalies.

The relations between acids and salts were investigated by varying the concentration of acid and determining the concentration of salt necessary to maintain cohesion, *i.e.* to oppose completely the dispersive power of the acid. The results show that at first, as the concentration of acid increases, the concentration of salt must be increased also until a point is reached beyond which further addition of acid lessens the quantity of salt which is needed to preserve cohesion.

We may conclude from this that the dispersive action of acid increases with increasing concentration to a maximum beyond which it decreases to zero. A weak acid, such as lactic acid, will not maintain cohesion at any concentration.

Very dilute acid or alkali breaks up coherent gluten by forming round each protein particle a double electric layer. The protein may be looked upon as an amphoteric electrolyte similar to an amino-acid. It reacts with acids or alkalies to form salts of a peculiar nature, which, by ionisation, form double electric layers. Excess acid or alkali suppresses the feeble ionisation, and so restores cohesion.

The potential difference between protein and fluid was determined by measurements of the migration of the protein in unit field. It was found to increase with increase in the concentration of a strong acid up to a maximum, beyond which it diminishes. The curve expressing the relation of concentration of acid to the potential difference has the same form as that which expresses the effect of a salt upon the dispersive power of acid. Salts act by preventing the formation of electric double layers.

April 29.—Sir Archibald Geikie, K.C.B., president, in the chair.—Note on the results of cooling certain hydrated platin-cyanides in liquid air: J. Emerson **Reynolds.** Some months ago Sir James Dewar directed the writer's attention to the fact that a colourless crystalline material, which was supposed to be lithium platino-cyanide, became temporarily *red* when cooled in liquid air. On repeating the experiment with some of the material which Sir James Dewar had placed in the writer's hands for examination, he found that, after several repetitions of the treatment, a permanent yellow substance was also formed, which did not return to the usual colourless condition at ordinary temperatures. Chemical examination of the material led to the conclusion that it was a mixture of lithium chloride, cyanide, and sulphate, including merely a trace of platino-cyanide, but that rather less than 5 per cent. of *lithium platinicyanide* was present, and that the colour changes at low temperatures were due to the presence of the latter salt. Pure lithium platino-cyanide was freshly prepared for comparison, and when analysed was found to consist of $Li_2Pt(CN)_4,5H_2O$. The grass-green crystals of this salt did not become red when immersed in liquid air, but merely became paler in tint, therefore that salt could not be concerned in the production of the phenomena noted above. On the other hand, pure lithium platinicyanide, when fully hydrated, was shown by analysis to have the composition

$$Li_2Pt(CN)_5,3H_2O.$$

When the nearly colourless crystals of this compound were slowly cooled in liquid air they became of an intense *red* colour, and this change was found to coincide with the loss of one molecule of water of crystallisation, which was resumed when the temperature was allowed to rise, the colourless tri-hydrate being reproduced. Further, on *rapid* cooling of the tri-hydrate, a portion always passed beyond the red stage, and more or less of a *yellow* substance was formed. This turned out to be a yellow mono-hydrate. This hydrate also resumes water at ordinary temperatures, and affords the colourless tri-hydrate; but it was found that when certain neutral salts are present, as in the case of Sir J. Dewar's material, this re-hydration is inhibited, and the yellow mono-hydrate persists at higher temperature—hence all the phenomena noted at the outset were explained. Similar changes of colour and composition can be effected by heating the platinicyanide, but this appears to be the first case in which successive stages of dehydration of a crystallised salt have been traced on cooling the substance in liquid air.—A phenomenon connected with the discharge of electricity from pointed conductors; with a note by John Zeleny: H. T. **Barnes** and A. N. **Shaw.** In the study of point discharge made by Prof. John Zeleny, it was noticed that, when examined under the microscope, steel needle points, after discharging as anode, showed an irregular deposit, which extended outwards some little distance, and resembled ordinary rust. A much smaller deposit was noticed when the point was made the kathode. The authors have investigated, somewhat in detail, the character of this deposit, not only for steel points, but also for points of other metals. Using a microscope of high power, it was possible to distinguish characteristic forms of the deposit. These the authors classify as (1) a granular deposit; (2) a tubular deposit; (3) a smooth formation; and (4) a thin film formation. The four types are all probably connected with each other, but in appearance they are quite distinct. The tubular formation is perhaps the most interesting, and appears to be a tube of oxide growing up around a minute droplet of water, or, perhaps, hydrogen peroxide. These tubes were seen to elongate under the microscope when blown upon by moist air, and to swell up at the end as though water vapour were condensing through the thin film of oxide closing the tube. In some cases the swelling caused the oxide film to burst. In dry air the liquid appeared to recede in the tube, leaving a hard, horny structure of oxide extended. The granular deposit appeared to be broken down tubes, while the smooth formation appeared to be drops of liquid with oxide so hardened as to be incapable of extension. The thin film formation was produced only on metals less easily oxidised. The appearance of water drops on the point makes it seem probable that it is the water vapour in the discharge chamber which has condensed around the negative ions and been swept into the anode point. Discharging in absolutely dry air gave no sign of any deposit on even the most easily oxidised metals. The slightest trace of moisture in the chamber caused a growth of deposit as much as 50 per cent. of the total amount obtained when discharging in steam. The metals giving the greatest deposit were aluminium, zinc, steel, and cadmium, while gold was found to give no deposit at all. Prof. Zeleny points out that the presence of water droplets on the point indicates a much lower temperature there than the luminosity might lead us to expect. This he verifies by making a point out of the junction of two dissimilar metals.—The effect of temperature on ionisation: J. A. **Crowther.** The effect of temperature on the ionisation produced in a gas by Röntgen rays was first investigated by Perrin, who, using air, concluded that the total ionisation in a gas was independent of the temperature if the pressure were kept constant. McClung, however, who repeated these experiments later with air, carbon dioxide, and hydrogen, found that the ionisation in a gas was independent of the temperature if the density of the gas is kept constant, that is, if it is heated at constant volume. Although no source of error could be indicated in Perrin's work, there was little doubt that the later experiments of McClung were correct, and that between the limits of his experiments (15° C. to 272° C.) and for the gases used the ionisation produced by Röntgen rays was independent of the temperature when the gas was kept at constant density. It is well known that the ionisation produced by rays of given intensity in certain gases and vapours, for example, methyl iodide, ethyl bromide, or carbon tetrachloride, is much greater than that in air or carbon dioxide. The present investigation was made to discover

(i) if the effect of temperature on the ionisation produced in these gases and vapours were the same as for air; (ii) if cooling down air to a temperature near its condensation point produced any appreciable alteration in the ionisation produced in it by rays of given intensity. As it is almost impossible to clean out completely a vessel which has once contained organic vapours, the second experiment was performed first. The ionisation produced by Röntgen rays has been measured in air at the temperature of liquid air, and in ethyl bromide and methyl iodide, at various temperatures up to 184° C. It was found that in every case the amount of ionisation produced was independent of the temperature of the gas if the density of the gas remained constant.—The wave-making resistance of ships: a theoretical and practical analysis: T. H. **Havelock.** The usual estimates of the wave-making resistance of ships rest on a formula obtained for "two-dimensional" motion, that is, for motion confined to transverse waves of uniform height; if a is the amplitude of the waves and v their velocity, the wave-making resistance R is proportional to a^2 for deep water. Hence there arise formulæ which make R proportional to v^4, by supposing that a varies as v^2. Regarding, however, the ship as in this respect equivalent to a travelling band of pressure disturbance, a simple type of distribution leads to wave-ridges giving a formula for R in which the velocity enters in the form e^{-a/v^2}. This function is shown to have the general character of experimental curves of residuary resistance. From a consideration of the waves diverging from bow and stern, and the interference of these systems, a semi-empirical formula,

$$R = \alpha e^{-2\cdot53/9c^2} + \beta\{1 - \gamma \cos(10\cdot2/c^2)\}e^{-2\cdot53/c^2},$$

is obtained. Here R is in lbs. per ton displacement of the ship, and c is the speed-length ratio, viz. (speed in knots)/$\sqrt{}$(length of ship in feet); α, β, γ are adjustable constants, which depend upon the form of the ship. Various experimental model curves are examined, and it is shown that these can be represented very well by a formula of the above type. It is found that the constant α is small relatively; and if the comparison is limited to values of c from about 0·9 upwards, the curves can also be fitted by an alternative formula of the type

$$R = \beta\{1 - \gamma \cos(10\cdot2/c^2)\}e^{-n/c^2}.$$

The effect of finite depth of water is considered, and a modification of the formula is obtained to express this effect as far as possible. Starting from an experimental curve for deep water, curves are drawn from the formula for the transverse wave-resistance of the same model with different depths; although certain simplifications have to be made, the curves show the character of the effect, and allow an estimate of the stage at which it becomes appreciable. Finally, the question of other types of pressure distribution is discussed, and one is given in illustration of the wave-making resistance of an entirely submerged vessel.—The ionisation of various gases by secondary γ rays: R. D. **Kleeman.** The ionisations of a number of gases relative to the ionisation of air by the secondary γ rays from substances exposed to the γ rays of radium were measured. Secondary radiators of lead, zinc, and carbon were used. It was found that the ionisations of gases the molecules of which consist of atoms of H, C, N, O, S, Cl, with the exception of H_2, are practically the same as those obtained with the primary γ rays; but the secondary rays produce a greater relative amount of ionisation than the primary in gases the molecules of which contain atoms of higher atomic weight than that of chlorine. The ionisation of H_2 is abnormal; it is smaller with the secondary rays than with the primary. The ionisations of the various gases, with the exception of H_2, obey approximately an additive law. The atomic ionisations, by means of which the ionisations in the gases can be calculated, increase more rapidly with the atomic weight with the secondary rays than with the primary.

Geological Society, April 7.—Prof. W. J. Sollas, F.R.S., president, and afterwards Mr. H. W. Monckton, vice-president, in the chair.—Overthrusts at Tintagel (north Cornwall): H. **Dewey.** In this paper the author deals with the geological structure of the Tintagel area. After brief reference to the stratigraphy north of Bodmin Moor, mention is made of the apparent difference in order of superposition of the beds near Tintagel. The several types into which the Upper Devonian rocks are divided are next described.—The Lahat "pipe": a description of a tin-ore deposit in Perak (Federated Malay States): J. B. **Scrivenor.** Large quantities of tin ore have been obtained during recent years in the Kinta district of Perak, principally from detrital deposits, but also in some cases from the limestone which forms the floor of the Kinta Valley. From 1903 until 1907 the Société des Étains de Kinta secured more than 1000 tons of dressed tin ore from a peculiar deposit which had the form of a pipe in the limestone, measuring only 7 feet by 2 feet at the surface, but widening when followed downwards. It was worked to a depth of 314 feet. The veinstone was a deep red mixture of calcite and iron oxide with some quartz, chalybite, and chalcopyrite, but no tourmaline was found in it. In this the cassiterite occurred in irregular pieces and broken fragments, some of which consisted of radiating needles. In Kinta the tin ores occur in the limestone in two different ways:—(1) As lodes or veins with fresh sulphides, but not iron oxides. The tin-oxide crystals have a definite arrangement. (2) As transformed masses, deposited in fissures. The cassiterite is in rounded grains, and quartz, tourmaline, and other materials, also well rounded, accompany it. The Lahat pipe is a lode deposit which has been converted into a detrital deposit *in situ*.—The sculptures of the Chalk Downs in Kent, Surrey, and Sussex: G. **Clinch.** The author classifies the various forms of sculpture of the Chalk Downs under three heads, namely, (1) dry valleys of simple form; (2) dry valleys of complex form; and (3) wet valleys. He directs attention to the relatively small catchment-areas of the dry valleys, and to the large number of tributary valleys found in some districts, two points which he considers have not received hitherto entirely satisfactory explanation. While accepting the view that frozen conditions in former times altered the drainage system of the Chalk, he argues that the most potent excavating force was the frost itself acting on Chalk saturated or highly charged with water. He propounds a theory to account for (1) the great size and breadth of the valleys in relation to their catchment-basins; (2) the ramifications of some of the valley systems; and (3) the remarkable fact that many dry valleys die out just before the crest of the Chalk Downs is reached.

Royal Anthropological Institute, April 20.—Prof. W. Ridgeway, president, in the chair.—The Blackfeet Indians of Montana: W. **MacClintock.** The author has an intimate acquaintance with these Indians, having been adopted as son by Mad Wolf, one of the chiefs. The Indians were shown in their great summer encampment on the plains, and views were given of many of the lodges. These are all painted with various symbols of great interest, the heavens being usually shown at the top of the lodge, and the earth at the bottom, with various sacred animals in the middle. One of the lodges was painted with a pictorial description of the owner's victories and achievements, as also was the chief's war-horse. The great feature of this summer camp was the sun ceremony, for the tribe believes that it is descended from the sun and moon, whose grandchild, the son of the morning star, was sent down to earth. A spotless woman is the chief of the festival, and on arrival at the chosen place this woman, with her attendants and priests, fasts and prays for four days, during which time the other inmates of the camp amuse themselves with mimic warfare and games. On the third day the woman proceeds to a spot already selected, and offers a meat offering of buffalo tongues. On this spot the sun tent, a simple erection of poles, is erected, and after it has been blessed by the holy woman it becomes the central point of all the subsequent ceremonies. These consist of games, acting, and the recitation of their deeds of valour by the chiefs. The ceremonies conclude by the chief priest wishing the tribe prosperity during the coming year.

Royal Meteorological Society, April 21.—Mr. H. Mollish, president, in the chair.—Percolation, evaporation, and condensation: Baldwin **Latham.** The author gave the results of the observations which he had carried out at Croydon on these subjects during the last thirty years. Two percolation gauges were used, both of which were exactly a superficial yard in area, and contained a cubic yard of natural soil, one of chalk and the other of gravel. The average annual amount of percolation through the chalk gauge was 10·84 inches, and through the gravel gauge 10·34 inches. The average yearly rainfall was 25·46 inches. It appears that the rate of percolation is governed by the rate of rainfall, for when once the gauges have become sensitive, by being thoroughly wetted, the rate at which rain percolates depends entirely on the quantity of rain immediately falling. The evaporator used for determining the evaporation was a floating copper vessel 1 foot in diameter supported by a life-buoy ring, connected by four arms with the evaporating vessel, the whole being floated in a tank of 4 feet internal diameter containing about 3 feet depth of water. The average annual amount of evaporation by this gauge was 18·14 inches, and the average amount of condensation was 0·36 inch.—The meteorological conditions in the Philippine Islands, 1908: Rev. José **Algué**. The year 1908 was one of extraordinary meteorological conditions. Heavy floods occurred, and frequent violent cyclonic storms passed over or affected the archipelago. The author stated that out of the fourteen typhoons of extraordinary intensity which have occurred during the past twenty-nine years, five occurred in the year 1908, the most violent being those of September 23, October 13, and December 5. It seems that the part of the archipelago which is visited the most frequently by these extraordinary typhoons is the northern part of Luzon from the parallel 15° 30′ to the Batanes Islands, and from parallel 11° to 14° N.

Mathematical Society, April 22.—Sir W. D. Niven, president, in the chair.—The principles of the general theory of integral functions: F. **Tavani**.—The equations of electrodynamics and the null influence of the earth's motion on optical and electrical phenomena: H. R. **Hassé**. Solution of a certain transcendental equation: G. N. **Watson**.—Physical applications of certain conformal transformations of a space of four dimensions and the representation of a space time point by means of a sphere: H. **Bateman**.—Some criteria for the residues of eighth and other powers: A. E. **Western**.—Discontinuities of a function of one or more real variables: Dr. W. H. **Young**.

Institution of Mining and Metallurgy, April 22.—Mr. Edgar Taylor, president, in the chair.—The valuation of mining areas on the Rand: W. Fischer **Wilkinson**. In this paper the author points out that, to calculate the most suitable rate of working for any given area, it is necessary, in the first place, to make an estimate of the probable tonnage and the value of the ore, and that then the problem is to be solved in accordance with the following elements:—capital expenditure required for a given production, the available tonnage and its value, the cost of working, and the rate of interest required. On account of the last-named element, time is the important factor, and the paper proceeds to quote instances of the bearing of this factor on the profitable working of any given property, in the correlation of profit per ton and the suitable duration of life of the mine. Incidentally, the author is in favour of attacking the rich reefs and the richest sections of the poorer reefs first, in order to give a higher grade during the early years of a mine's life.—The "wholesale" idea in gold mining: W. R. **Feldtmann**. The author of this paper is in favour of increasing reduction plant up to the practicable producing limit of a mine, his claim being that large-scale working is directly conducive to the best economic results, and that it is the maximum total net profit during the life of a mine that should be striven for rather than low costs or high profits per ton, as the case may be, one of the factors being the reduction of costs per ton and the other the grade and annual quantity of ore available, these interacting one on the other. This is illustrated by a series of diagrams, which serve to bear out the author's argument that, on a paying mine, an increase in the tonnage crushed, by additions of ore of a yield grade anything in excess of the "unit charge," will result in an increased annual and total working profit.—The computation of the present value of developed and undeveloped mines: W. H. **Goodchild**. In this paper the author deals with certain debatable points in the practice of computing the present gross value of a mining property, giving instances of the different methods of calculation adopted by various authorities, and the influence produced by the peculiar characteristics of a given mine and its state of development.

Paris.

Academy of Sciences, April 26.—M. Émile Picard in the chair.—Invisible pathogenic micro-organisms and the physical proofs of their existence: A. **Chauveau**. The organism of ordinary vaccine is still unknown; the effects produced by inoculating with vaccine of gradually increasing dilution prove that the virulent agents are constituted by independent corpuscular elements, held in suspension in the fluid. That the virus is not of a crystalline or colloidal nature is shown by the fact that a vaccine covered with water, and allowed to diffuse, does not communicate any virulent properties to the upper layers. The invisible agents of the virulence of vaccine are regarded as being certainly living beings.—The resinous nature of the bark of Sarcocaulon of the Cape and of some Kalanchœ of Madagascar: Édouard **Heckel**.—The hydrodynamical conditions of form in fishes: Frédéric **Houssay**. A description of experiments on the loss of energy during the propulsion through water of six models of geometrical form. From the results, the form of a fish would not appear to correspond to that of minimum resistance; loss of speed would seem to correspond to a gain of stability.—The photographic determination of the colours of the stars: Oesten **Bergstrand**. A grating, with bands 1·5 mm. in width, was placed before the opening of the telescope, thus producing a series of symmetrically placed diffraction spectra at the focus. By measuring the distance between the two spectra of the first order, the effective wave-length of the light from the star in question could be determined. The results are expressed in a scale in which 0 corresponds to a mean wave-length $\lambda = 419·9\ \mu\mu$, and 12, $\lambda = 449·6\ \mu\mu$. Stars can be divided into two well-marked classes—white stars ($\lambda = 420\ \mu\mu$) and yellow stars ($\lambda = 440$ to $450\ \mu\mu$). The qualities of the two groups appear to be quite different, and the transition from the one to the other is sudden.—Congruences of normals and contact transformations: Jules **Drach**.—The theorem of the existence of implicit functions: W. **Stekloff**.—Critical logarithmic points: Mme. Valérie **Dienes**.—A partial differential equation of the hyperbolic type: A. **Myller**.—Hyperelliptic surfaces: M. **Chillemi**.—Stability and diffusion; the action of mass. Mechanical analogies of the laws of displacement of equilibrium: C. **Raveau**. Polarisation by lateral diffusion: Georges **Meslin**. It is known that when a ray of light passes through a column of a transparent liquid, the light issuing perpendicular to the direction of the ray is polarised. If the liquid contains crystalline particles in suspension, the quantity of light issuing laterally is increased, but the proportion of polarised light is diminished. In the present note a singular exception is described in the case of boric acid associated with a liquid of a refractive index greater than 1·42 (that of boric acid itself). In this case, the light issuing laterally is partially polarised, with its plane of polarisation perpendicular to the plane of diffusion. Another anomaly afforded by boric acid is that liquids in which it is a constituent possess spontaneous dichroism. A divergent amplifying microscope: Alphonse **Berget**. A doubly concave lens is placed between the objective and the eye-piece. The arrangement permits of an objective of longer focal length being employed for a given magnification.—The evaporation of aqueous solutions: P. **Vaillant**. The vapour pressure is determined by observing the loss of weight of the solution placed in a flat dish on a sensitive balance.—Researches on the density of acetylene: E. **Mathias**. Details of a series of observations on carefully purified acetylene. The densities of the liquid and vapour were measured at various temperatures between −23·75° and 32·93°. The critical temperature, measured by the method of S. Young, was found to be 37·05°. The values are compared with the corresponding figures for carbon dioxide.—Cuprous sulphate: A. **Recoura**. By working in an organic medium, in the absence of water, solid cuprous sulphate, Cu_2SO_4, has been obtained in the pure state, according to the equation $Cu_2O+(CH_3)_2SO_4=Cu_2SO_4+(CH_3)_2O$. This compound is instantaneously decomposed by water, giving copper and cupric sulphate. Cuprous sulphate on oxidation gives a substance which behaves as a mixture of cupric oxide and cupric sulphate.—Researches on the magnesium derivatives of the xylyl bromides: P. **Carré.** The *ortho-* and *para-*xylyl bromides give ditolylethanes: the *meta*-compound gives some magnesium derivative, from which, by the action of trioxymethylene, metatolylethyl alcohol was obtained.—The oxidation of aromatic nitro- and nitroso-derivatives by ammonium persulphate: A. **Seyewetz** and L. **Poizat.** 2:4-Dinitrophenol and picric acid are completely oxidised by ammonium persulphate, forming carbon dioxide, hydrocyanic acid, and nitric acid.—Researches on the ketodibasic acids. α-Oxalglutaric acid and α-ketoadipic acid: H. **Gault.**—The composition of bauxite: H. **Arsandaux.**—Respiration in singers: M. **Marage.** The influence of the mode of breathing is paramount in speaking or singing.—The influence of the reaction of the medium on the activity of the maltases from maize: R. **Huerre.** Certain species of maize furnish enzymes the maximum activity of which is exerted in alkaline media; in other species the enzyme action attains a maximum in neutral or very slightly acid media.—The influence of age on the quantity and chemical distribution of the phosphorus contained in nerves: Ch. **Dhéré** and H. **Maurice.**—A metallic filter with regular interstices of variable dimensions, and reducible to ultramicroscopic magnitudes: Émile **Gobbi.** The filter consists of a nickel ribbon wound tightly in a helicoidal form, and held together with a screw. The liquid filters through the folds of the ribbon, and, according to the mode in which the ribbon is wound, can be adjusted to hold back particles of different sizes. Sterile water can be obtained by filtration through one of these filters, and the filtrates after six days' use are still sterile.—The structure of the central part of the Hautes Plaines, Algeria: A. **Joly** and L. **Joleaud.**—The periodic character of the mutability of mesonummulitic Cerithium of the Paris basin: Jean **Boussac.**—The value and the variability of barometric means: Alfred **Angot.**—The earthquake of April 23, 1909: Alfred **Angot.**

DIARY OF SOCIETIES.

THURSDAY, MAY 6.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—Reciprocal Innervation of Antagonistic Muscles. Note XIV. On Double Reciprocal Innervation: Prof. C. S. Sherrington, F.R.S.—Note on a Curious Property of Neon: Prof. J. Norman Collie, F.R.S.—The Properties of Colloidal Systems. I. The Osmotic Pressure of Congo-red and of Some Other Dyes: Dr. W. M. Bayliss, F.R.S.—The Origin and Destiny of Cholesterol in the Animal Organism. Part V. On the Inhibitory Action of the Sera of Rabbits fed on Diets containing Varying Amounts of Cholesterol on the Hæmolysis of Blood by Saponin: Miss Mary T. Fraser and J. A. Gardner.—Some Effects of Nitrogen-fixing Bacteria on the Growth of Non-leguminous Plants.—Prof. W. B. Bottomley.

LINNEAN SOCIETY, at 8.—On some Zoantheæ from Queensland and the New Hebrides: Mrs. Leonora J. Wilsmore.—The Œcological Relations of the Tiger-Beetles: Dr. V. E. Shelford.

RÖNTGEN SOCIETY, at 8.15.—An Illustrated Description of the Historical Collection of Tubes recently deposited at the Albert and Victoria Museum: Dr. G. H. Rodman.—On X-rays Produced at a Magnetically Deflected Kathode Focus: J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Theory and Application of Motor Converters: H. S. Hallo.

FRIDAY, MAY 7.

ROYAL INSTITUTION, at 9.—The Campaign against Malaria: Major Ronald Ross, C.B., F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Lower Chalk of Lincolnshire: Rev. C. R. Bower and J. R. Farmery.

MONDAY, MAY 10.

ROYAL SOCIETY OF ARTS, at 8.—Aërial Flight: F. W. Lanchester.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Western Pacific: Sir Everard F. im Thurn, K.C.M.G.

TUESDAY, MAY 11.

ROYAL INSTITUTION, at 3.—Cosmogonical Questions: Prof. Svante Arrhenius.

ZOOLOGICAL SOCIETY, at 8.30.—(1) On Hitherto Unrecorded Specimens of *Equus quagga*; (2) Differentiation of the Three Species of Zebras; (3) On a Portion of a Fossil Jaw of one of the Equidæ: Prof. W. Ridgeway.—On a New Race of Deer from Sze-chuen: R. Lydekker.—The Batrachians and Reptiles of Matabeleland: E. C. Chubb.

WEDNESDAY, MAY 12.

ROYAL SOCIETY OF ARTS, at 8.—The Principles of Heredity as Applied to the Artificial Production of New Forms of Plants and Animals: Prof. A. Dendy, F.R.S.

GEOLOGICAL SOCIETY, at 8.

THURSDAY, MAY 13.

ROYAL SOCIETY, at 4.30.

ROYAL INSTITUTION, at 3.—Newfoundland: J. G. Millais.

ROYAL SOCIETY OF ARTS, at 4.30.—Some Phases of Hinduism: Krishna Gobinda Gupta.

MATHEMATICAL SOCIETY, at 5.30.—Ternary Quadratic Types: H. W. Turnbull.—The Theorem of Gauss in the Theory of Attractions: Dr. J. G. Leathem.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Economics of Medium Sized Power Stations: A Study of Comparisons between Steam, Gas and Oil Engines: A. J. J. Pfeiffer.

FRIDAY, MAY 14.

ROYAL INSTITUTION, at 9.—Solar Vortices and Magnetic Fields: Prof. G. E. Hale.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—On a Bifilar Vibration Galvanometer: W. Duddell, F.R.S.—Effect of Temperature on the Hysteresis Loss in Iron in a Rotating Field: W. P. Fuller and H. Grace.—On a Method of Testing Photographic Shutters: A. Campbell and T. Smith.

MALACOLOGICAL SOCIETY, at 8.—Descriptions of the Animals of Two Land Shells from Perak; Skeat Expedition in the Malay Peninsula, 1899–1900: Lt.-Col. H. H. Godwin-Austen, F.R.S.—List of Mollusca from Christmas Island, Indian Ocean, and Descriptions of New Species: E. A. Smith.—Further Notes on Holocene and Recent Non marine Mollusca from Perranzabuloe: Rev. R. Ashington Bullen.—On Non-marine Mollusca from an Early Neolithic Interment at Cuxton, Kent: A. S. Kennard.

CONTENTS.

THURSDAY, MAY 13, 1909.

THE ORIGIN OF VERTEBRATES.

The Origin of Vertebrates. By Dr. Walter Holbrook Gaskell, F.R.S. Pp. iv+537; 168 figures. (London: Longmans, Green and Co., 1908.) Price 21s. net.

TWENTY years ago the author of this interesting book was led by his studies on the innervation of the heart to make a comparison between the central nervous system in vertebrates and that in appendiculate invertebrates. This led him to a highly original theory of the derivation of vertebrates from an arthropod stock, and the researches of twenty years have strengthened his confidence in this conclusion. Encouraged by what Huxley wrote to him in 1889, "There is nothing so useful in science as one of those earthquake hypotheses, which oblige one to face the possibility that the solidest-looking structures may collapse," Dr. Gaskell has published paper after paper in support of the view that the infundibulum may represent the old œsophagus, the ventricles of the brain the old cephalic stomach, the canal of the spinal cord the long straight intestine, the cranial segmental nerves the infra-œsophageal ganglia, the cerebral hemispheres and optic and olfactory nerves the supra-œsophageal ganglia, and the spinal cord the ventral chain of ganglia.

"Not having been educated in a morphological laboratory and taught that the one organ which is homologous throughout the animal kingdom is the gut, and that therefore the gut of the invertebrate ancestor must continue as the gut of the vertebrate, the conception that the central nervous system has grown round and enclosed the original ancestral gut, and that the vertebrate has formed a new gut, did not seem to me so impossible as to prevent my taking it as a working hypothesis, and seeing to what it would lead."

As is well known, there are various rival theories as to the origin of vertebrates, though the prevalent position is agnostic. Thus an attempt has been made to derive vertebrates from annelids by supposing a reversal of surfaces, but the author regards the difficulties of this hypothesis as "insuperable." On another view the annulate and the vertebrate types had a separate origin; in the former, the digestive tube pierced the central nervous system and was situated dorsally to its main mass; in the latter, the segmented central nervous system was situated from the first dorsally to the alimentary canal, and was not pierced by it. According to Gaskell, this theory does not explain the tubular appearance of the central nervous system. This, which seems to some an unimportant architectural consequence of the mode of development from a medullary groove, is to Gaskell a recapitulation of the way the nerve cord grew round the old gut. Gaskell also says that the extraordinary resemblance between the structure and arrangement of the central nervous systems of vertebrates and arthropods is against the view of their phyletic distinctness. But, given segmentation in two distinct types, we naturally expect similarity in the general plan of innervation.

Dr. Gaskell thinks that the nervous system furnishes the most important clues to relationship, and arthropods alone possess a central nervous system closely comparable with that of vertebrates. "The vertebrate tissues resemble more closely those of the arthropod than of any other invertebrate group." Argument from analogy "compels one to the conclusion that the fishes arose from the race which was dominant at the time when the fishes first appeared," i.e. from the Palæostraca. And do not the ancient fishes, like Pteraspis, Cephalaspis, and Pterichthys, resemble in a remarkable manner members of the Palæostracan group, "so that again and again palæontologists have found great difficulty in determining whether a fossil is a fish or an arthropod"? Thus various lines of argument indicate the origin of vertebrates from arthropods, or, more precisely, that the vertebrate was formed from the Palæostracan without any reversal of surfaces, but by the amalgamation of the central nervous system and the alimentary canal. The vertebrate's cerebral hemispheres and basal ganglia correspond to the supra-œsophageal ganglia of the arthropod, the crura cerebri to the œsophageal commissures, the infra-infundibular part of the brain to the sub-œsophageal ganglia, the infundibular tube to the œsophagus, the third ventricle to the cephalic stomach, the canal of the spinal cord to the intestine. The vertebrate's gut is, of course, a new formation "necessitated by the urgency of the case." Its homology with the invertebrate gut is a morphological illusion. It is only an analogue.

All sorts of difficulties rise in the mind as one considers this hypothesis, but the author is nothing if not ingenious in meeting them. Our old clues—through lancelets, tunicates, and enteropneusts—are brushed aside, and the ammocœte—so peculiar in many ways—is trusted to as the lowest perfect vertebrate. The highly specialised character of Limulus and the Palæostraca would deter many from looking to them as even near probable originators; but this is not the author's view. If the infundibular tube be "œsophagus," the third ventricle "cephalic stomach," the spinal canal "intestine," and the neurenteric canal the old way to the anus, we land in difficulties which seem to us as insuperable as those of the reversal hypothesis seem to the author. We want to know, for instance, where the arthropod's mesenteron has gone. But this is only one of the most obvious difficulties, and it is no difficulty to the author, who throws the germ-layer theory overboard as a morphological anachronism, a survival of a dogma due to the lively imagination of Haeckel.

In his second chapter Dr. Gaskell finds support for his thesis in the eyes. The pineal gland represents a pair of median eyes; Ostracoderms had median as well as lateral eyes; so has the king-crab, and so had Eurypterids. The inverted retinas of the vertebrate lateral eyes find their counterpart in the lateral eyes of arachnids, and the Palæostraca were ancestral to both. But do not the vertebrate lateral eyes develop characteristically in the most intimate connection with optic diverticula from the neural tube? Dr. Gaskell meets this objection by insisting that the retina and optic nerve were originally outside a non-nervous tube—an anterior diverticulum on each side from the alimentary canal—and he remarks:—

"It is again a striking coincidence to find that Artemia, which with Branchipus represents a group of living crustaceans most nearly related to the trilobites, does possess two anterior diverticula of the gut which are in extraordinarily close relationship with the optic ganglia of the retina of the lateral eyes on each side."

We are accustomed to think of arthropods as typically provided with a chitinous exoskeleton, and thus contrasted with vertebrates, which have an internal skeleton of cartilage or bone. But Dr. Gaskell shows that this difficulty "vanishes into thin air" before the discovery of the branchial cartilaginous bars of Limulus, together with that of the internal prosomatic plastron. He quotes Schmiedeberg, who pointed out that glycosamine is a bridge between chitin and chondrin. The Palæostraca were the dominant arthropod race when vertebrates first appeared, and "not only had they manufactured an internal cartilaginous skeleton, but they had got it both in structure and position, exactly at the stage at which the vertebrate skeleton starts." This almost sounds like proving too much, yet it does not account for the vertebrate's dorsal axis.

Morphologists are accustomed to lay some emphasis on the branchial clefts of vertebrates, but Dr. Gaskell thinks of the branchial unit as a gill-bearing appendage, and does not hesitate to describe in ammocœtes a respiratory chamber into which a symmetrical series of sunk-in branchial appendages, the so-called diaphragms, are dependent. Two large longitudinal venous sinuses in Limulus correspond to the two veins which come together to form the heart and ventral aorta of the vertebrate. Morphological dogmatism is startled by the homology between the breathing organs in king-crab and lamprey, but it is shocked by the derivation of the thyroid gland from the palæostracan uterus—a derivation the violence of which, as it seems to us, is not lessened by the light it sheds on the mysterious physiological nexus between the sexual organs and the thyroid in man and other animals. The nasal tube of ammocœtes corresponds to the olfactory tube of a scorpion-like animal, and the pituitary body shows by similarity of structure, as well as of position, that it arose from the coxal glands, which were situated at the base of the four endognaths. Special sense-organs, such as are found in the flabellum of Limulus and in the pectens of scorpions, may be looked upon as giving origin to the vertebrate auditory apparatus. Even more surprising than these conclusions is the ingenuity of the evidence that the author uses in support of them.

We cannot follow Dr. Gaskell in his detailed comparison of segments, nerves, and musculature in vertebrates and arthropods, but we must direct attention to the twelfth chapter, where the difficulties suggested by the characteristic segmental excretory organs of vertebrates and by the state of the cœlom in arthropods are dealt with. The author shifts off from the Palæostraca to the hypothetical Protostraca—ancestral to both arachnids and crustaceans—which possessed in every segment a pair of appendages and a pair of cœlomic cavities, each with excretory organs or coxal glands. The hypothetical Protostraca arose from the polychætes. As to the notochord and the vertebrate gut, the author starts from a trilobite-like animal with a deep ventral groove and pleural fringes; the groove becomes a tube, and sinks in as the notochord; a continuation of the same process of ventral groove-formation, combined with the obliteration of appendages and the growth of pleural folds, leads to the closed vertebrate gut. All seems consistent with an earthquake-hypothesis.

In his extremely interesting fourteenth chapter, Dr. Gaskell shows that the development of a vertebrate, *e.g.* as regards nerve-tube, branchial skeleton, cranial segments, and excretory organs, reads like a recapitulation of the steps which led long ago from arthropod to vertebrate. He also expounds the suggestive view that a very much more important embryological idea than that of the three germinal layers is that which centres the metazoan body in the nervous system, and not in the gut. In the body there are master-tissues—all the neuro-muscular and neuro-epithelial structures—and within the meshes of these there are germ-cells, blood-corpuscles, lymph-corpuscles, connective-tissue cells, &c., living a symbiotic existence independent of the central nervous system.

The author regrets that his previous publications bearing on the palæostracan origin of vertebrates have not been adequately criticised. We suppose that this is because the author pays no heed to the conventional canons of morphological work. We may say that the known Palæostraca are much too highly specialised animals to be regarded as plausible starting-points for a new phylum, but the author does not share this view. We may say that the ammocœte is a very peculiar larval chordate type, likely to mislead, and that it is quite illegitimate to ignore the hints offered by Amphioxus and the tunicates; but the author does not agree. The author makes out a seemingly strong case by showing extraordinary and unsuspected resemblances between ammocœte and king-crab, and there is no use criticising these in a general way. The supposed homology of the branchial cartilaginous bars in king-crab and in ammocœte—to take one instance—must be examined in detail by an unprejudiced expert. We wish simply to point out that the ingenious author flits a little from type to type; arachnids are called in where crustaceans will not help; Peripatus is summoned when the Palæostraca prove broken reeds; and, after all, the author takes refuge in the hypothetical Protostraca, which have a good deal of the annelid about them. We do not think that the author gets over the difficulties presented by the vertebrate's gill-slits, notochord, cœlom, ventral heart, and so on, but we agree that there are difficulties in face of every attempt to affiliate vertebrates to an invertebrate stock. The question is as to which theory presents least difficulty

—if, indeed, any theory is legitimate. As we have already indicated, we are of opinion that Dr. Gaskell's theory is fatally condemned because, as he says, it makes the assertion that what was hypoblast in the arthropod has become epiblast in the vertebrate, and what was epiblast in the arthropod has become hypoblast in the vertebrate. But Dr. Gaskell thinks that the germ-layer theory argues in a vicious circle, and he practically throws it overboard which we are not prepared to do. Yet this makes criticism very difficult.

No one can read this book without being impressed with the author's audacious ingenuity, with his patient following up of clues into remote recesses, and with the good humour with which he holds his *unus contra mundum* position. Whether he is right or wrong, he has written an entertaining book and found out a lot of interesting things by the way. We cannot pass from the book without feeling the precariousness of pedigree-construction and the need for some re-statement of the principles of morphology. Perhaps we should also recall the fact that if it be impossible to attach the vertebrate phylum with even plausibility to annelid or arthropod or any other stock, a more modest inquiry remains—How, from what we know of invertebrates, can we conceive of the origin of the various characteristic vertebrate features? To this inquiry, which seems to us more promising and profitable than the search for a lost pedigree, we think that this fascinating book has made several noteworthy contributions.

AN INSULAR FLORA.

Botany of the Faeröes. Based upon Danish Investigations. Published by the aid of the Carlsberg Fund. Vols. 1–3. Pp. xxviii + 1070; illustrated with 24 plates and 202 figures in the text. (Copenhagen and Christiania: Glydendalske Boghandel, Nordisk Forlag; London: John Wheldon and Co., 1901–1908.)

ANY addition to our knowledge of the natural history of the islands on the north-west fringe of Europe must be welcome. Most people know little more of one such group—Faeröe Islands—than that they are somewhere in the North Atlantic There are eighteen islands in all, lying, mostly more or less befogged, in 62° N. lat. and 70° W. long., at the meeting point of a warm Atlantic current with a cold polar one from the east coast of Iceland. They are nearer the Shetlands (300 kilos. distant) than Iceland (480 kilos. distant). They are all basaltic in origin. The basalt occurs in horizontal beds, contains 10 per cent. of lime, and weathers easily. There are 15,000 people and 100,000 sheep on them. Their mountains are 3000 feet in height, and are still unexplored for the most part. The average annual temperature is 6·5° C., the winter being mild, and summer cold, with rapid changes. There are 23 per cent. dry, 12 per cent. calm, and only 5 per cent. clear days in the year.

In the work before us, Prof. Warming and his Danish colleagues have given, within the limits of 1100 octavo pages, in an excellent English translation, with very few slips, a model survey of the flora of the islands, on the practical completion of which (begun in 1896) they are to be congratulated. Not the least valuable feature in the publication is the large series of beautiful illustrations, some of which, reproduced on a larger scale in the "Vegetationsbilder" of Karsten and Schenk, are the best photographs of marine algæ the writer has seen.

The many contributions to the report do justice to the work of Lyngbye and other early investigators. After a short historical introduction by Warming, Ostenfeld devotes a hundred pages to the description of the geology and physical geography of the islands. We are reminded of the island of Heligoland, which, like the Faeröes, is being worn away on its west and north-west coasts by the sea, so that, in both cases, in the course of time the islands will disappear. In the case of the Faeröes subsidence is contributing to this result.

In a short review it is impossible to do more than mention the work of the various experts. In the lists of each group there are valuable notes accompanying many of the species, as well as general conclusions and comparisons with the distribution of the same group in Norway, Iceland, and Scotland. The comparison with the flora of the Shetlands, especially of the lower groups of plants, is vitiated by the incompleteness of the information available. In one case the Danish observer visited the Shetlands to collect the information needed for the comparison.

Broadly speaking, the conclusion on each group of plants studied is that the islands have such a flora as their geographical position would lead one to expect—a touch of the subarctic tyoe found in Iceland and North Scandinavia, with, in the main, the temperate-European and Atlantic types. The hawkweeds (twenty-one species and two varieties) examined by H. Dahlstedt are all endemic; half of them are of the Atlantic type, and post-Glacial in origin. The vascular plants are dealt with by C. H. Ostenfeld, who, in vol. i., treats of their distribution, and in vol. iii. makes a valuable contribution to plant-ecology. This account has been also issued as a separate work, and includes an account of Raunkiaer's biological types, which are based on the selective adaptation of plants by bud protection to unfavourable climatic conditions. There are 298 vascular plants (flowering plants and ferns), and of these 90 per cent. are herbaceous perennials. There are no trees on the islands, and only fourteen species at all woody. Two of these are *Dryas octopetala* and *Salix herbacea*. The illustrations (*e.g.* that on p. 904, showing how the hapaxanthic *Cochlearia officinalis* becomes perennial) are excellent.

C. Jensen describes in his enumeration of the 391 forms of Bryophyta one new species, *Pohlia faeröensis*, and many new varieties. Sphagnum is well represented, and peat occurs on nearly every island. There is also some coal of inferior quality. The lichens, 220 species as listed by Branth, are generally stunted, due in part to competition with the mosses which thrive in the moist climate, and in part to the strong winds and the browsing sheep. E. Rostrup records seven new species of fungi. This group is the least fully dealt with. Perhaps this is due to its comparative economic unimportance in the Faeröes, where the agriculture is in a very backward state. Thus the land, as is still the case in some parts of the west of Ireland, is too often allowed to seed itself after a barley crop.

F. Börgesen describes 323 species of fresh-water algæ, exclusive of diatoms, showing a comparatively rich flora. The fresh-water diatoms listed by E. Östrup number 269. This writer also reports on the marine diatoms, and sees in them no slight resemblance to the coastal diatoms of Greenland. The marine algæ are very thoroughly considered by F. Börgesen. His accompanying notes and figures are valuable, and his report deserves publication as a separate treatise for the sake of algologists. *Fucus serratus* and *Saccorhiza bulbosa* do not reach the Faeröes. *Halosphaera viridis* is plentiful. Several perforating algæ are recorded.

In the discussion of the origin of the Faeröese flora there is a healthy difference of opinion. Warming and others decide in favour of the view of its origin by the agency of wind, ocean currents, and migrating birds. Others, including Ostenfeld and Jensen, believe that the flora arrived along a post-Glacial land-bridge from Scotland. Sufficient has, we hope, been said to show that the Danish botanists have prepared a satisfactory account of the flora of the Faeröes, and, in addition, have made an important contribution to the study of phytogeography and plant ecology.

T. J.

SCIENCE TEACHING IN GERMAN SCHOOLS.

Sammlung Naturwissenschaftlich-pädagogischer Abhandlungen. Edited by Prof. O. Schmeil and Prof. W. B. Schmidt. Bd. ii. (Berlin: B. G. Teubner, 1908.) Price 12 marks.

THE volume contains eight essays dealing with various scientific subjects—chemistry, natural history, &c.—from the schoolmaster's point of view—that is to say, the writers are concerned with the organisation of the school curriculum and with the problem of how to make their respective subjects appeal to boys, or, perhaps, as a German would prefer to put it, how to make scientific instruction educative. Whilst the essays are entirely independent of each other, several of them are written from the Herbartian standpoint, which means that a writer on chemistry in the school is not satisfied with discussing the question of his immediate business—giving the boys an understanding knowledge of chemistry—he must also discuss the relation of the subject and the method of its presentation, to the formation of character, under which head much that the average Englishman would take for granted is somewhat sententiously set forth.

The leading place in the volume is given to an article on the importance of experiment in the teaching of chemistry. We should not expect to find anything of the kind in an English book, for the simple reason that, both in theory and in practice, we have long since abandoned the attempt to teach science in the schools without well-equipped laboratories and lecture-rooms. Rightly or wrongly, the German taxmaster has not felt justified in calling upon the people to provide the costly apparatus necessary. Four years ago it was possible to find even a Berlin *Oberrealschule* almost destitute of all we regard as *sine quâ non* for the adequate teaching of science. Of course, the German will reply that it has not been a question of parsimony in education. What has been saved in the schools has been spent in the scientific equipment of the universities. The question of where the money may be most advantageously laid out is one which we have not, perhaps, considered very carefully, or, having considered it, those who decide these matters have come to a conclusion strikingly different from that of Prussia and other German States.

What is true of the higher schools of Germany is true also of the training colleges, in many of which there is no provision for practical work in science. The fact that the elementary-school teachers had no acquaintance with the handling of scientific apparatus led a recent advocate of chemistry in the primary school to make a rather quaint suggestion. Why should the teachers not avail themselves of the facilities afforded by the nearest chemist's shop? There they might learn the art of experimentation so far as it is necessary to the teaching of the elementary facts of the subject. It does not appear that the suggestion has found favour in the eyes of the teachers!

Some of the most interesting essays in the volume are concerned to change the character of school science from that of a mere accumulation of facts selected and systematised from a restricted standpoint to a form in which the work is directed to the realisation of a great general principle, or in which procedure is determined by the question of what general problems are accessible to the minds of the pupils at various stages in their intellectual development. Particularly interesting in this regard is the one entitled "Der dynamologische Lehrgang," in which the author sketches at considerable length a course of science for boys from eleven to fourteen. Nature is always a happening, a becoming, or a dissolving, and nature knowledge is really nothing else than clearness concerning processes—growing, breathing, blossoming, fading away. Indeed, every object in nature is a summation of processes, and only when we regard it in this way can there be a scientific study of nature.

In school, particularly, the science-teacher is to keep the unity of nature steadily before the children's minds, and he should frame his syllabus to bring out the connectedness of natural phenomena in a systematic way. The botanist does not usually regard a knowledge of the movements of the air as an essential preliminary to lessons on modes of fertilisation, nor would a teacher dealing with air-currents and their causes usually treat the subject from the point of view of a great source of energy which is essential to many natural processes. Each science as such takes its facts out of their natural surroundings and puts them into a logical system more or less complete within itself, and the young student often completely misses the relation of that which occupies his mind to the universe as a whole. The author has worked out his idea in an ingenious and suggestive way.

It is impossible in a brief notice to deal adequately with the volume as a whole. In many points it shows that the writers are dealing with a condition of things that has really passed away in our country. For example, we should expect a sentence like this in an English book of a generation ago:—

"The reform we are advocating calls for nothing less than a fight *à outrance* against verbalism in every form. Such a battle could issue in nothing but good. Writers on the teaching of science have begun it already, but the old mistakes and prejudices are not easily overcome."

Whilst there is not doubt that in the material equipment of our schools on the scientific side we are a long way ahead of the Germans, it still behoves us to remember that verbalism is not impossible side by side with lecture experiments and laboratory courses. It is the "carrying idea" that gives vitality to what the boys are doing—whether it be essay-writing or using a balance. There is still a good deal of misunderstanding in regard to this matter. Sensory accessories do not constitute the difference between the real and the verbal.

J. A. GREEN.

COUNTY GEOGRAPHIES.

Cambridge County Geographies:—Essex. Pp. viii+167. *Kent.* Pp. viii+146. *Surrey.* Pp. viii+151. *Sussex.* Pp. viii+144. By G. F. Bosworth. (Cambridge: University Press, 1909.) Price 1s. 6d. each.

THE idea of this series is excellent. A series of elementary geographies, each dealing with a single county, obviously ought to exist. The present volumes are all on one model, and the model is good. First a short survey of the origin of the county under notice, and of its name, is given. Its extent, relief, river-system, geology, natural history, and climate follow. Next the population and industries are dealt with; then the history of the county, its antiquities, its communications past and present, its administrative divisions ancient and modern, and the roll of famous men born within it. Finally there is an alphabetical gazetteer of the chief towns and villages (which, it may be added with regret, is the nearest approach to an index provided in the volumes). Following the text are certain diagrams showing density and other features of population, and agricultural conditions. At the beginning of each volume is a map (by Messrs. Philip) showing the relief of the land by the flat-colour contour system, and at the end another map, the same in outline, but coloured according to geological formations.

Here, then, is an excellent skeleton, and on the whole it is well clothed. Of details of the clothing, however, some criticism may be offered. If we rightly apprehend the purpose of the series, the treatment of the relief of the land appears to have been given less prominence than is perhaps its due, while the geology—a subject which, in its strict sense, cannot appeal to a large circle of students—is given proportionately too much. In each volume the remarks introductory to some of the subjects differ hardly at all save in wording. This may have been inevitable, though it might have been thought sufficient to infer the reader's acquaintance with the generalities of each subject. At any rate, it is a matter for congratulation that in the introductory remarks on climate common to all the volumes, the faint praise of the Meteorological Office's weather forecasts, "which are often correct," only occurs in one instance. Some of the sections deserve special commendation—the notices of the history of the counties and their architectural and other antiquities may be indicated.

The illustrations are partly from photographs and partly from line drawings. In each case the reproduction is well carried out. The architectural photographs are the best as a class. One would have welcomed a better attempt to illustrate characteristic land-forms, and in any case photography is a better medium for illustrating a work of this sort than line drawings, which in the present cases are not wholly successful. The maps are bound in on the excellent plan of attaching half of each one completely to the cover of the book—a good method of preserving them. Considered cartographically, while otherwise very fair, they have the somewhat serious fault of showing no physical features or geological formations beyond the confines of the county dealt with, so that they do not help in considering the county in relation to its surroundings, as the text very properly does.

But after these remarks it should be said that the series is well conceived, and so far well produced, and deserves success.

O. J. R. H.

SOLID AND PLANE GEOMETRY.

(1) *Practical Solid Geometry.* By the Rev. P. W. Unwin. Pp. xii+267. (London: G. Bell and Sons, 1909.) Price 4s. 6d.

(2) *Cassell's Elementary Geometry.* By W. A. Knight. Pp. vii+253. (London: Cassell and Co., Ltd., 1909.) Price 2s. 6d.

(1) THIS volume deals with the orthogonal projections of solids and of their plane sections, with explanations of figured plans and scales of slope of planes, followed by a chapter on metric or parallel pictorial projections, and one on miscellaneous problems.

It is an excellent book, well graduated, with clear though concise explanations of the numerous fully worked problems, and seems to be remarkably free from misprints for a first edition.[1] It should well fulfil the author's desire to make his readers "think in space." This volume is arranged to cover Stage 1

[1] We have found only one, viz. on p. 102, l. 4, where H.P. should be V.P

of the Board of Education Examination, and to meet the requirements of Army candidates. In the chapter on parallel projection, the theory on which it depends, viz. that it is the view, *on the YZ plane*, of the solid and the various coordinates *and* the coordinate axes, obtained by parallel rays inclined to that plane at some specially chosen angle, is not put quite so clearly as perhaps it might profitably have been, but the author expressly says that the theory is to be dealt with in the second volume, which is in course of preparation, and the chapter in question very clearly shows how the constructions are to be made and used for measurements. The sentence on p. 92, lines 13–16, contains an erroneous and incomplete argument, very unlike the author's usual careful accuracy. The sentence as it stands implies that vertical planes are necessarily perpendicular to horizontal lines.

There is a useful appendix on algebraic solid geometry, dealing with planes and lines, as far as the tangent plane to a sphere, and two other appendices give the requirements of the Board of Education in solid geometry and some sets of its papers.

There are a good number of examples attached to each chapter for the student to solve, and we are glad to see a good index, which greatly facilitates reference.

(2) It is difficult for the writer of a geometrical text-book for beginners to decide how much of the philosophy underlying the subject should be given. The author's treatment of the straight line and of parallel straight lines is not satisfactory. He defines a straight line as the shortest distance between two points, but makes no use of that definition in the text, and parallel straight lines are defined as straight lines drawn in the plane in the same direction. It may be contended that this is sufficient for young students, though it certainly will not satisfy all teachers. It is, however, an appeal to common notions, and, after all, a good many propositions do depend on these, however carefully the philosophical foundations may be laid. A more serious defect is where the author, after proving, by means of opposite rotations, that lines are parallel when the alternate angles are equal, promises another proof, and eventually gives one which depends on a proposition deduced from the previous one, a most flagrant case of reasoning in a circle.

The author has adopted the excellent plan of elevating a number of standard problems and theorems into the text which are usually only given as riders, and though occasionally we would have liked to see slightly different methods of construction or of proof, on the whole they are complete and clear, and the propositions are accompanied by a good number of well-chosen exercises. The range of the book is as far as the end of the sixth book of Euclid, with the omission of one or two propositions at the end. We cannot, however, find the very important proposition on which the proofs of the properties of similar triangles depend, viz. that if one transversal is divided into equal parts by a series of parallel straight lines, all transversals are also divided by them into equal parts. The nearest approach to this is on p. 84, where a construction is given for dividing a line into equal parts, but it is merely said that "it is easy to show" the congruence of certain triangles, &c. The full proof should have been given, or, better still, the construction should have been preceded by the general theorem. Of course, the teacher can supply the omission, but it is notorious how young students usually fail to remember proofs which are not in their text-book.

OUR BOOK SHELF.

The Story of Gold. By E. S. Meade. Pp. xv+206; illustrated. (London: Appleton and Co., 1909.) Price 2*s*. 6*d*. net.

THE author of this book appears to believe that all human progress depends on a continuous rise in prices, that a rise in prices is always due to a great addition to the stock of gold in the world, and that consequently it behoves statesmen to see that gold is produced from the mines in a rapid and increasing stream. Rome decayed because the Spanish mines stopped producing. Europe weltered in misery until 1492 because the stock of precious metals continued to diminish. Thereafter all went well until about 1810. (N.B.—The price of wheat in 1809 was 157*s*. per quarter, with wages much lower than now.) Then the revolt of the Spanish American colonies cut off the production of the mines, and began a period of stringency which was not relieved until after 1849. From 1873 to 1896 the new gold supplies were again inadequate, prices fell, trade was bad, the human race languished. Then for a time the enormous production of gold allowed progress to be resumed. The pace, however, is rapidly becoming hotter. Although the output of gold is even more enormous now and is still increasing, the supply of other commodities has overtaken it, and unless the gold miners redouble their efforts there is little chance of a revival of prosperity.

The author is a professor of finance of the University of Pennsylvania, and consequently his discussion of geological, chemical, and engineering problems connected with gold need not be taken seriously. Nevertheless, a long succession of careless misstatements such as appear in the book becomes wearisome, and creates an atmosphere of prejudice against the author, so that his most lugubrious predictions and stirring calls to action leave the reader unconvinced and apathetic. Even when his information is correct, the author's utterances are somewhat cryptic, *e.g.* "Gold is remarkable for its freedom from corrosive solutions."

His main thesis is, of course, tinged with exaggeration. There is no doubt that rising prices benefit all those who buy to sell again, including speculators as well as merchants. How far the whole community benefits is not quite so certain. It is often contended that a flat level of prices would be best of all. Moreover, it is hardly fair for the representative of almost the only nation still addicted to frenzied finance to attribute its disasters to those laggards the gold miners.

There is no need to be pessimistic as to the adequacy of the supply of gold, but if it really became scarce, it is perfectly obvious to unprejudiced observers that gold need not be retained as the sole medium of exchange. In a sense most of its work is done already by cheques, bank notes, silver, and the like. Although in earlier times it was prized for itself alone, it is now of very little intrinsic value. It retains its place by a convention which remains valid owing to the force of long-continued custom. If the fluctuations in prices as measured by it became too great, it would have to be discarded as a standard of value. T. K. R.

Artificial Waterways and Commercial Development (with a History of the Erie Canal). By Dr. A. Barton Hepburn. Pp. ix+115. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 4s. net.

After a long period of effacement, artificial waterways are beginning to regain some amount of public interest and concern. The advent and rapid development of railways during the last century was responsible for their relegation into a background of indifference and neglect, and so long as men's minds were dominated by schemes of rapid locomotion at any cost, it was difficult, and, in fact, impossible, for canals to maintain any footing in competition with a system of transit infinitely more expeditious and direct. But a change is taking place in public feeling. It is being recognised that canals have been at an undue disadvantage, and that, as a means of locomotion, they possess features which merit encouragement and development. Inland water carriage for goods, though slow, is safe and cheap, and canals possess a striking advantage over railways in that, in place of isolated depôts at long intervals, they possess a continuous frontage workable throughout their entire length. On these and other grounds, public interest in canals has been aroused, and a Royal Commission in this country has lately had under consideration the means best adapted for their revival and amelioration.

Dr. Hepburn's book is a timely contribution to the evidence on the subject. Written from an American standpoint, it constitutes an appeal to the citizens of the United States in regard to the development of their artificial waterways. It recites in brief compass the principal historical facts connected with canals throughout the world, and then proceeds to consider in more extended detail the canal system of New York, describing its inception, development, and present condition. Thence the author passes, by a transition natural to a patriotic American, to an account of the Panama Canal, with its vicissitudes and possibilities. The volume closes with fifteen statistical appendices.

Hydrographical Surveying. A Description of Means and Methods employed in constructing Marine Charts. By the late Rear-Admiral Sir William J. L. Wharton, K.C.B. A new edition, revised and enlarged by Rear-Admiral Mostyn Field, F.R.S. Pp. viii+475. (London: John Murray, 1909.) Price 21s. net.

The late Admiral Wharton's "Hydrographical Surveying," which has been for so many years a standard work and one of the best books for surveyors that has ever been published, has now been brought up to date by his successor, Rear-Admiral Mostyn Field, the present hydrographer to the Admiralty. Admiral Field has endeavoured to alter the text of the former work as little as possible, but at the same time to enlarge it considerably by the addition of new features, including expedients connected with work in the field which have been found useful in practice, in order especially to assist the young surveyor by directing his attention to useful methods of procedure which otherwise he would only pick up as his experience ripened. In addition to these features, all the latest improvements are fully described, such as the use of photography for the reproduction of charts, automatic tide gauges, improved instruments for observing currents and taking deep-sea soundings, and, finally, the usefulness of the Barr and Stroud range-finder for surveying purposes.

The volume as it now appears, brought thoroughly up to date and accompanied by excellent diagrams, cannot fail to be of the utmost value to all surveyors. H. C. L.

Œuvres complètes de Christian Huyghens publiées par la Société hollandaise des Sciences. Vol. xi., Travaux mathématiques, 1645–1651. Pp. iv+369. (La Haye: Martinus Nijhoff, 1908.)

This volume is divided into several parts. The first part deals with Huyghens's early writings (1645–6), and is preceded by an account of a manuscript by van Schooten which formed the basis of Huyghens's first mathematical studies. The writings in question deal, *inter alia*, with elementary geometrical considerations relating to the parabola and funicular polygons. The next portion consists of Huyghens's three books entitled "De iis quæ liquido supernatant" (1650), forming a collection of applications of the principle of Archimedes to floating bodies of simple shapes. A number of geometrical problems dated 1650 follow, and the volume concludes with the "Theoremata de quadratura hyperboles, ellipsis, et circuli ex dato portionum gravitatis centro" (1651). The volume is well got up, and forms an interesting contribution to the history of mathematics.

The General Characters of the Proteins. By Dr. S. B. Schryver. Pp. x+86. (London: Longmans, Green and Co., 1909.) Price 2s. 6d. net.

This is another of the series of monographs on biochemistry which are being issued by Messrs. Longmans under the editorship of Drs. Hopkins and Aders Plimmer. The previous monographs have been already noticed in these columns, and two of these dealt with the proteins from the more strictly chemical point of view. Dr. Schryver now adds another chapter to, and by no means exhausts, this large subject. The first section deals with the physical properties of the proteins (solubilities, crystallisation, heat coagulation, rotatory power, electrical conductivity, and so forth); the second with their general chemical characters (tests, distribution of nitrogen, compounds with acids, bases, halogens, &c.); and the third with the precipitin reaction, which is commonly known as the biological test.

The whole is treated in a technical but clear manner; references are given to the authorities quoted, and the booklet will prove a useful addition to the library of the physiologist, and should be found in every laboratory devoted to biochemical research. W. D. H.

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 intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Gravitative Pull upon the Moon.

The error made by Mr. McLennan in Nature of May 6, p. 276, is a curious one, which may perhaps be made more often than we are aware of, and therefore is worth correcting.

It is true that gravitational pull and centrifugal force both decrease as square of distance increases, each with its own cause of decrease, so as to remain equal and opposite; but then the two causes of decrease are not to be piled on to one of those forces! That is the error.

Mr. McLennan has done his arithmetic correctly, but the calculation is really extremely simple, as thus:—

The moon's mass is 1/80th that of the earth, which is 6×10^{21} tons. At the moon's distance, which is 60 earth's radii, terrestrial gravity is reduced to 1/3600th of its value at the earth's surface. Consequently, the weight of the moon, *i.e.* the earth's gravitative pull on it, is equal to the ordinary commercial weight of

$$1/3600 \times 1/80 \times 6 \times 10^{21} \text{ tons.}$$

An *alternative*, but not a supplementary, way of doing the sum is to say that the moon revolves through the angle 2π in, say, $27\frac{1}{3}$ days, and that therefore the centripetal force necessary to hold it in is

$$m\omega^2 r = \frac{6 \times 10^{21}}{80} \text{ tons} \times \left(\frac{2\pi}{27\frac{1}{3} \text{ days}}\right)^2 \times 60 \times 4000 \text{ miles.}$$

The acceleration part of this is about 13,000 miles per day per day, which is the same as 32/3600 feet per second per second; and this is obviously in accordance with the law of inverse square. OLIVER LODGE.

A Direct Estimate of the Minimum Age of Thorianite.

I WISH to record an experiment lately made which affords more direct proof of the great antiquity of radioactive minerals than anything previously attempted.

The principle of the method is to determine (1) the total accumulated helium in the material; (2) the rate of formation in the *same* material at present.

A sample of thorianite was found to contain 9 c.c. helium per gram.

Four hundred grams of this thorianite was got into solution, and all traces of helium boiled out with scrupulous care. After it had been allowed to stand for seven weeks, the solution was boiled out again. A little nitrogen and nitric oxide were evolved. These were removed by charcoal cooled in liquid air, and the residual helium collected in the capillary of a McLeod gauge. D_3 could be seen in the spectrum, but the volume of the gas was too small to measure. It was certainly less than 2×10^{-6} c.c., perhaps much less.

Thus the annual rate of production of helium per gram is less than $3{\cdot}7 \times 10^{-8}$ c.c. The 9 c.c. initially present cannot, therefore, have accumulated in a less time than 240 million years. Experiments on a larger scale, which are in progress, will probably lead to an extension of this estimate.

Prof. Joly, in his interesting book, "Radio-activity and Geology," has brought various objections against the radio-active method of measuring geological age. These will require to be carefully weighed. I may remark, however, that in the present case no uncertainty arises on the ground that the substance may formerly have contained much more uranium or thorium than at present, for thorianite consists almost entirely of the oxides of these elements. R. J. STRUTT.

Imperial College of Science, May 11.

Sense of Smell in Flies.

BY far the most efficient of fly-destroyers with which I am acquainted is a dilute solution of formaldehyde. If two teaspoonfuls of formalin (40 per cent. formaldehyde) be added to a soup-plate filled with water, flies go to it, one after the other, to drink, especially in the early afternoon. Some die in the water; many fall in the immediate neighbourhood of the plate; others succumb on window-sill or floor. As the result of leaving a single plateful of the solution on the kitchen table (I am writing in the south of France) hundreds of dead flies are each day swept up from the floor. Formalin water is free from the gruesome associations of fly-papers and other traps which hold their struggling victims. It may even be turned to ornamental uses. A wire cage placed in the centre of the dish may be crowned with flowers, which flourish equally as well, with some slight but interesting changes in tint, in dilute formalin as in pure water. The solution neither attracts nor repels flies. Two similar dishes placed side by side, the one containing pure water and the other formalin, are visited, so far as one can judge, with equal frequency. It is somewhat strange that so small a dose proves fatal when taken into the fly's alimentary canal. I find that, to free a room from flies by vaporising formalin, the air must be rendered quite irrespirable by a human being. The room needs to be amply ventilated before one ventures into it.

The interest which attaches to this observation, that flies will drink a solution of formadehyde, lies in the proof which it affords that the mechanism of their sense of smell is similar to our own. No volatile body the density of which is not greater than that of air is a stimulant of our olfactory membrane. Formaldehyde, H_2COH, has a density of 15 only. Playing in paradoxes, one might say that it undoubtedly has a malignant odour, but we cannot smell it. If the nose be placed close to a vessel containing a dilute solution of formalin a scent is recognisable, but this I take to be due (a chemist will correct me) to impurities present in the commercial product. Yet I find that when I sit within a yard of it my eyes begin to smart. In this respect, however, I am, I know, exceptionally sensitive. I cannot dissect specimens preserved in formalin until after they have been long soaked in water and spirit frequently changed. Once, when conducting a *viva voce* examination with the aid of formalin preparations, I developed so acute and painful, although happily transient, an attack of conjunctivitis as made it impossible for me to attend the examinees' meeting. The fact that so deleterious a volatile body as formadehyde does not appeal to our sense of smell would seem to confirm the only theory of the physics of olfaction at present plausible, though far from comprehensible, namely, that which attributes to the hairs of the cells of the olfactory membrane the capacity of responding to the alterations in the vibration frequency or amplitude of molecules of air which are caused by the presence amongst them of heavier molecules. ALEX. HILL.

Mentone.

The Production of Radium from Uranium.

EXPERIMENTS on which I have been engaged for the past six years have until now failed to establish the production of radium from uranium. With carefully purified uranium salts, using considerable quantities, the growth is too small to be detected for the first two or three years, and is less than 1/10,000th of what would occur if a direct change of uranium into radium took place. With commercial uranyl nitrate, on the other hand, purified from radium by precipitating barium sulphate in the solution, a distinct though small production of radium was observed in 1905, and subsequently confirmed (*Phil. Mag.*, October, 1908, 632). This is explained by the existence of an intermediate parent of radium in the series with a very long period of life, which has been found by Boltwood and by Rutherford in preparations of actinium, and recently isolated by the former from uranium minerals, and called "ionium."

I have now been able to establish the production of radium in all the solutions of very carefully purified uranyl nitrate prepared by Mr. T. D. Mackenzie and myself (*Phil. Mag.*, August, 1907, 272). Three separate solutions containing 255, 408, and 278 grams of uranium (element), and of age since purification at the present time respectively 3·53, 2·40, and 2·73 years, have been kept under observation. The method of testing has been much improved since formerly, and the error of a single determination as now carried out probably does not exceed 10^{-12} gram of radium. The quantity of radium in the oldest solution is now about 4×10^{-11} gram, which is nearly twice as great as initially. During the past year five measurements of the quantity of radium in this solution have been made, and they show that, within the stated limit of error of observation, the production of radium has proceeded during that period *proportionally to the square of the time*. The tests on the other solution show that in them also the production of radium is now proceeding according to the same law and at a similar rate.

That the initial rate of production of radium from uranium should vary according to the square of the time was deduced mathematically by Rutherford (*Jahr. Rad.*, 1908, v., 164) on the assumption that there was only one intermediate substance of period of life long compared with the time of experiment in the uranium-radium series. It is easily shown, provided all the periods are long, that the initial rate of production must be proportional to the same power of the time as the number of substances (including uranium itself) in the series before radium. These experiments, therefore, indicate that there is only one intermediate substance in the uranium-radium series with a long period of life. Assuming what is probable, but not yet known, that the present law and rate of production will be continued in the future, it is possible to fix the period of average life of the intermediate substance from the existing data, with a margin of uncertainty probably not greater than 20 per cent. Rutherford has shown that the initial production of radium in grams from a kilogram of uranium is equal to $6\times10^{-8}\lambda T^2$, where $1/\lambda$ is the period of average life of the intermediate body in years, and T is the time in years. This gives for the average life of the intermediate body the period of 10,000 *years*. This is about four times that of radium itself, and there should exist in uranium minerals about 1·36 milligrams of the substance per kilogram of uranium. The initial rate of production over the first two years appears less than that calculated, as though another intermediate substance of period of the order of two years existed in the series; but greater refinements will be necessary before this can be definitely proved by experiments of this character.

FREDERICK SODDY.

Physical Chemistry Laboratory, University of Glasgow.

Wave Motion and Bessel's Functions.

THE property, enunciated by Dr. Johnstone Stoney, according to which any wave motion can be regarded as built up of a combination of plane waves, may be used with advantage for a verification of the formulæ for the solutions of Bessel's equation in the form of definite integrals.

Consider, for example, the hydrodynamical problem of circular waves about the axis of z in a liquid of uniform depth extending from $z=0$ up to the free surface $z=h$. Imagine the wave motion to be built up by the superposition of a continuously infinite number of plane waves, symmetrically distributed about the axis of z. By taking α to denote the angle which the normal to any wave front makes with the radius vector to any point, and by integrating the expression for the velocity potential of the corresponding train of plane waves with respect to α, we get the expression

$$\phi = A\int_{-\pi}^{\pi} \cos m\{r\cos\alpha - vt + \epsilon\} \cosh mz\, d\alpha,$$

where

$$v^2 = \frac{g}{m}\tanh mh.$$

The above expression for ϕ being a solution of Laplace's equation, it follows that

$$\int_{-\pi}^{\pi} \cos m(r\cos\alpha)\, d\alpha \text{ and } \int_{-\pi}^{\pi} \sin m(r\cos\alpha)\, d\alpha$$

are solutions of the corresponding Bessel's equation in r.

Next, taking an unsymmetrical distribution of plane waves, and confining attention to the particular case in which the phase relative to the origin is independent of the direction, the amplitude between the directions α and $\alpha+d\alpha$ being $F(\alpha)d\alpha$, we find for the potential at the point (r, θ, z) the expression

$$\phi = \int F(\alpha) \cos m\{r\cos(\alpha-\theta) - vt + \epsilon\} \cosh mz\, d\alpha,$$

the integral being taken between limits for α differing by 2π. By writing $\alpha-\theta=\omega$, and suitably choosing the limits, we find

$$\phi = \int_{-\pi}^{\pi} F(\theta+\omega) \cos m\{r\cos\omega - vt + \epsilon\} \cosh mz\, d\omega,$$

and taking the particular cases of $F(\alpha)=\cos$ or $\sin n\alpha$, we obtain the solutions of Laplace's equation

$$\cosh mz \cos \text{ or } \sin n\theta \int_{-\pi}^{\pi} \cos \text{ or } \sin n\omega \cos \text{ or } \sin m(r\cos\omega)\, d\omega$$

leading to solutions of Bessel's equation of order n, namely,

$$\int_{-\pi}^{\pi} \cos \text{ or } \sin n\omega \cos \text{ or } \sin m(r\cos\omega)\, d\omega.$$

G. H. BRYAN.

University College of North Wales, Bangor.

Dew-Ponds.

LIKE "E. A. M." in NATURE of April 22, I have always been extremely sceptical about Mr. Hubbard's theory of dew-ponds since it first appeared in "Neolithic Dew-ponds and Cattle-ways." My own experience of lakes and ponds is that they lose their heat slowly, and that, after radiation has set in at night, they indicate a much higher temperature than the ground adjoining or the air above.

It has been a matter of frequent observation on Coniston Lake in summer that, after a night of heavy dew, the bottoms of the boats inside were perfectly dry, whilst the gunwale was covered with moisture, showing that the portion of the boat in contact with the water had been raised to a temperature above the dew-point. Prof. Miall and myself a few years ago made a special expedition to the Berkshire downs, in the neighbourhood of Wantage, to determine the temperature of the dew-ponds, and we found precisely the same thing, that is to say, the water at night was warmer than the air. It is impossible, therefore, that dew could deposit on the ponds under these conditions.

Moreover, as "E. A. M." points out, it is inconceivable that the clay or straw in a full dew-pond can have much connection with the temperature of the water. My own conviction is that the straw is merely used to bind the clay, and the bed of clay above the chalk serves no other purpose than to make the pond bottom water-tight. No satisfactory explanation of dew-ponds has yet been propounded, and, as your correspondent says, "there is room for more experiment." I have seen no reference to what may, I think, constitute one important factor in the replenishment of dew-ponds. Aitken has shown that the greater portion of the moisture deposited as dew is derived from the ground and not from the air, and in this connection it should be remembered that the chalk, on which the ponds are usually constructed, absorbs water like a sponge. Consequently, any lowering of temperature may cause a heavier dew or mist formation than on less absorbent material. Seeing that many of the ponds lie quite exposed on the very summit of the downs, drainage of dew cannot feed them, and it seems probable that mist may in some cases play a more important *rôle* than dew.

J. B. COHEN.

The Imperial Side of the Fuel Question.

THE article in NATURE of May 6, and Sir W. Ramsay's comment upon it, direct attention to a most important economic question. It has often crossed my mind that by a simple legislative enactment a marked saving might be effected in our factory consumption of coal. If Parliament would enact that after a given year, say 1920, a considerable penalty should be payable by the owner of any factory where the consumption of fuel coal exceeded $1\frac{1}{2}$ lb. per hour per indicated horse-power, it is probable that almost all factories would by that date be improved up to that level of efficiency.

It is probable that the average efficiency of steam plants is only about 3 lb. per indicated horse-power hour, and your article shows the factory consumption to be about sixty-one million tons per annum. On those figures, halving the consumption on the above lines would save about thirty million tons a year. The modernisation of plant involved would pay for itself (from the factory owner's point of view) in a very few years, and so would be a remunerative investment, so much so that financing the change should be within reach of even the weaker firms.

The thirty million tons I suggest might be saved is more than 11 per cent. of the production (figures of 1907), so that the saving is well worth the attention of all who are concerned to conserve our coal, and I trust that the idea may be pressed forward in influential quarters.

Manchester, May 10. ARTHUR MCDOUGALL.

CLOUD PHOTOGRAPHS FROM A BALLOON.

THE two photographs which accompany this short note were taken during a balloon trip commencing at Battersea and terminating at Hadlow,

FIG. 1.—Cloud scenery from balloon at an elevation of 5800 feet. Photographed by Dr. W. J. S. Lockyer.

near Buxted, in Surrey, on February 6 of the present year.

Leaving the ground at 12h. 24m. p.m., the wind, or what there was of it, gradually took the balloon away in a direction a little east of south. There were thick, heavy cumulus clouds hanging over London at the time, and between them one beheld the sea of houses below. At 1h. 3m. p.m., at an altitude of 4000 feet, we became fairly enveloped in one of these clouds, and some minutes later, at an altitude of 5200 feet, we emerged from its top out into the brilliant sunshine. The heat of the sun acting on the gas in the envelope gradually expanded it, and we rose to our greatest altitude of the day—namely, 7300 feet, or about 1·4 miles, reaching this elevation at 2h. 12m. p.m.

From the time the balloon was above the clouds the panorama was a glorious one to behold. The billowy tops of the cumuli stood out as white as snow in the sunshine. In the interspaces between the cloud masses there was present thin stratus cloud, which sometimes gave the appearance of lakes between snow-capped mountains or of the sea with snow-capped hills for the coast-line.

If one regarded this fine panorama in the same azimuth as the sun, the effect of contrast was most striking. The billowy cumuli were outlined in brilliant white, while the portions turned towards one were of intense blackness, and afforded a fine background for the sunbeams passing over the cloud tops. In other directions the cloudscape exhibited beautifully soft effects.

The first of the two photographs here shown (Fig. 1) was taken at 1h. 33m. p.m., when the balloon was nearly over Crookham, at an altitude of 5800 feet, or a little more than a mile high. The camera was directed nearly horizontally, and the balloon was only about 800 feet above the cloud tops. In this, one can observe the sea-like nature of the stratus cloud, bordered by the tops of the cumulus clouds, suggesting an Arctic scene.

The second photograph (Fig. 2) was taken later, at 1h. 50m. p.m., at an altitude of 6700 feet, or about a mile and a quarter. The balloon was then over the neighbourhood of Claydene, and the camera was pointed slightly down from the horizontal and in the same azimuth as the sun. This photograph shows the great expanse of the billowy cloud tops and

FIG. 2.—Cloud scenery from balloon at an elevation of 6700 feet. Photographed by Dr. W. J. S. Lockyer.

the bold contrast of the scenery, but the picture conveys only a general idea of the beauty of the scene.

After another interesting hour among the clouds, a gentle descent was made to earth at Hadlow Down, the trip lasting 2 hours 26 minutes. To escape, even for a brief interval of a few hours, from the turmoil of London, and to be, in the space of a few minutes, amongst such magnificent scenery as the view above the clouds affords, is one of the greatest fascinations of ballooning, even if one has to be carried where the wind wills. WILLIAM J. S. LOCKYER.

THE REFORM OF OXFORD UNIVERSITY.

BEFORE entering upon any discussion of the scheme presented by the Chancellor to the University of Oxford, and of the consequent action taken by the Hebdomadal Council, it is important to make a few introductory remarks on the conditions under which the effort for reform from within is about to be made.

In the first place, there is no question or debate about the inestimable value of collegiate residence. On this point all in Oxford, and it may be hoped all outside it, are agreed. Secondly, the strongest difference of opinion on questions of university policy exists, as it has existed in the past at Oxford, without the least personal feeling. It is useless to attempt to conceal the fact that under the existing system there is and must be conflict between the interests of the university and the colleges, but those who take the strongest line on the one side will be among the first to admit, nay, to proclaim, the devotion and self-sacrifice which are brought to the support of the other. In many cases, indeed, a university policy is most firmly sustained by men whose interests are bound up with the colleges. The question is what is best for Oxford, and through Oxford for the Empire, and to hold a strong opinion in such a controversy does not weaken a loyal and sympathetic cooperation with those who maintain the opposite position.

The point of view which will be maintained in the present article, and from which the Chancellor's book and the resolutions of Council will be examined, is that of the university as opposed to the colleges. We maintain that Oxford will gain as a seat of research and learning and in its influence—already beneficial in the highest degree—on the lives of its students by restoring to the university much of its ancient power and authority, and by leaving the colleges as dignified and historic homes, where, if teaching is carried on at all, it will be under the control of the university.

The first series of resolutions deals with the three governing bodies of the university—Convocation (M.A.'s who retain their names on university and college books), Congregation (such M.A.'s residing within a mile and a half of the centre of Oxford), and the Hebdomadal Council. This latter important body, by which alone legislation can be initiated in Congregation and Convocation, consists of three *ex-officio* members, the Vice-Chancellor and the two Proctors, and eighteen members elected by Congregation. Of these eighteen, six must be heads of colleges, six professors, and six M.A.'s. The power of Council will be best understood by the statement that, except on its initiative, no modification can be made in the existing examination system, no expenditure of a sum exceeding 100*l*., no loan to a reader of book or manuscript out of the Bodleian Library.

It is impossible in the brief compass of a single article to do more than sketch the broadest outlines, but it is submitted that details here necessarily omitted do not substantially modify the accuracy of the picture suggested to the reader. Thus Congregation includes, but is not substantially affected by including, a complex list of *ex-officio* members; the Chancellor is a member of Council, but is very rarely present; the Bodleian has the power of lending to the Radcliffe Library, and consequently to the readers of the latter.

Lord Curzon proposes that the three categories of Council should be given up, and Council itself has resolved so far as possible "to abolish or modify the existing division into three orders." There is no doubt that the power of the university would be seriously weakened by the abolition of the professorial category unless provision be made for university representation of some other kind. The heads are collegiate appointments, for even at Christ Church, the headship of which is in the gift of the Crown, it is customary to select a Dean from the governing body. In addition to the power given to the colleges by the presence of the six heads on Council, it should be remembered that the Vice-Chancellor must, under the present constitution, be the head of a college. The Oxford of an older day, with its greater leisure and greater freedom, gave to the colleges heads almost invariably picturesque and sometimes inspiring. In an organisation mainly developed with reference to the rush and tumble of the modern race for first-classes between the colleges, the headship of the future will generally be, if not the retiring pension, at least the pension of a retiring tutor or bursar. If it be impossible to modify this system, an effort should be made to render the income of the position more commensurate with its duties. A small increase of stipend would amply compensate for the loss of much drudgery and an acceptance of the dignified and not exacting position of chairman. In these circumstances, too, it would be beneficial to abolish the category of heads in Council and the custom of necessarily selecting the Vice-Chancellor from among the heads. For ourselves, however, we should greatly prefer to leave the emoluments and the university status of the heads unchanged, but to give the university a voice in their appointment. Among the headships are some of the few fairly well paid posts in Oxford, and it would be an immense gain to the university, and an even greater gain to the colleges, if it were generally understood that they should be filled by men for whom leisure and opportunity, and the release after long service from teaching, would mean more time spent and greater efforts made in the cause of learning.

The two Proctors, popularly supposed to be mainly concerned with the behaviour of undergraduates outside their college walls, are in reality the representatives of the M.A.'s, and in this capacity hold their *ex-officio* seats on Council as well as on nearly all the important boards of the university. Lord Curzon's proposal that they should serve for two years, and go out of office in rotation, would undoubtedly facilitate business, but is open to criticism for the following reason. The educating effect of a proctorship is remarkable. It is an important advantage that every year a member of the governing body of two colleges should learn by personal experience that the University of Oxford is something more than a name. The Proctors certainly do learn this lesson, and a man who has held the office, although only for one year, looks on his university with different eyes. We should seriously question the wisdom of reducing the number of those who receive so illuminating an experience. The principle of Lord Curzon's proposal would be carried into effect and its main advantages secured by rotation with a half-yearly period.

That Congregation should be restricted to those

M.A.'s who perform academic functions (Resolution ii., b) is, like many another desirable reform, merely a return to the original intention. It was proposed by Council a few months ago, but rejected by a small majority in Congregation. We may now hope and believe that with the support of the Chancellor and the renewed support of Council it will become an actual fact. The academic functions here suggested as qualifying for membership of Congregation are "teaching and administrative." Of course, all academic teaching to be valuable must be associated with research, and "teaching" was doubtless intended to be read in this sense; but in England it is unfortunately still premature to trust to the general acceptance of such an interpretation.

We do not touch on the tremendous and perhaps rather barren problem of the reform of Convocation. It is possible that, with greatly increased powers conferred on the Boards of Faculties, the consideration of this much disputed and very intricate question might advantageously be postponed.

The principle strongly advocated by the Chancellor and adopted in Resolution iii., a, "that Greek be no longer required as a necessary subject for a degree in Arts," was some years ago accepted by Council and successfully brought before Congregation, although the subsequent attempt to introduce a definite scheme was attended with failure. It is difficult to understand the feelings of those students of the noblest of all languages and all literatures in attaching so much value to the miserable and irritating minimum now required. It is sometimes said that the scientific student, requiring to propose new terms, would be benefited by possessing a knowledge of Greek, but it would be disastrous to the interests of language were he, with a hundredfold the experience, to make the attempt. The field is a very dangerous one, and full of pitfalls even for the most accomplished scholars. It is also said that the Englishman without Greek would find difficulty in understanding the meaning of numbers of English words. The answer is obvious. The moderate number of Greek words which are used over and over again in English should be taught as part of that most important, most neglected branch of a boy's education—his own language.

The principle of an entrance examination (iii., b) preliminary to matriculation would relieve the university from its present undignified position, compelled as it is to matriculate any and every student presented by a college.

The Chancellor's principle of a Board of Finance, accepted by Council in Resolution iv., is of the highest importance. Indeed, this principle alone may go far to secure the dominant influence of the university. It is to be presumed that the board will possess the power of preventing the waste of funds by unnecessary duplication of teaching no less than by unnecessary or extravagant buildings. Of equal importance is the cooperating principle accepted in Resolution v., "that some reconstitution of the faculties and boards of faculties should take place, with a view to the more systematic and economical organisation of university and college teaching." It is to be hoped that the reconstituted boards, with the addition of a Council of the Faculties, may relieve the Hebdomadal Council of the entire examination system, propose names for honorary degrees, advise the board of finance in the administration or control of the combined tuition fees, appoint all lecturers, and exercise advisory powers in the appointment of tutors.

Resolution vii., appointing a committee "to consider and confer with the colleges as to the emoluments and tenure of senior scholarships and of fellowships," is of almost equal importance to that of the two resolutions last touched upon. It is to be regretted that the whole system of prize-fellowships as instituted by the last commission, including the award by examination, was not condemned. It is sometimes said that it is such a good thing for politics, the Bar, and journalism that an able young man should be supported during the early barren years. No doubt it is a very good thing. Then let politics, the Bar, and journalism see to it. While there are capable students unable to pursue their researches in Oxford for the want of such funds, it is a scandalous abuse of academic endowment that they should be used in London to smooth the path to a professional career.

With regard to the following proposals made in resolutions of which the numbers are quoted, we need say no more on the present occasion than that they command our entire sympathy and approval:—The reconsideration of the scheme of college scholarships and exhibitions (vi.), an improvement in the executive machinery of the university (vii.), a better constitution of electoral boards to professorships (x.), and the provision, if possible, of a professorial pension scheme (xi.), a reconsideration of university and college fees (xiii.), and a discussion as to the possibility of reducing the expenses of living in college (xiv.)

There remains, however, one important reform which touches closely the dignity of the university. Oxford ought to regain its ancient long-lost power of admitting students, just as Berlin or Paris admits them, without compelling them to join any other body. If a senior American or Continental student now desires to work in Oxford under a professor, and to become for the time a member of the university, the authorities can only reply that he must first arrange to attach himself to a college or to the body of non-collegiate students. The situation is so strange to those accustomed to the ways of other universities that the student would probably in most cases be invited to work without joining the university, which thus loses the fees he is willing to pay and much of the distinction conferred by his researches. A proposal to admit such students to the university only just failed to pass Council a few years ago, and then only in consequence of opposition raised on behalf of the non-collegiate students. It is possible that the advantages of a collegiate title to express what has from the first been a reality would conciliate much of this opposition. It would be a wise policy to admit frankly that the non-collegiate body, in everything except residence within the walls of a college, possesses a collegiate structure, to adopt the name "St. Catherine's College," and to let the clumsy title "non-collegiate student" go the way of the older and even less desirable term "unattached." We might then reasonably hope that some benefactor interested in hard work and economical living at the university would be glad to erect a building where all the immense advantages of corporate life would be conferred on a large and deserving body of the poorer students. In such a college, if well managed, living ought to be considerably cheaper than in "licensed lodgings" in the city. In this way we believe that "the improvement of the position of non-collegiate students" sought by the Chancellor and by Council (in Resolution ix.) can best be brought about.

We have said enough to show how wide-reaching and remarkable, and, as we believe, beneficent, is the scheme of reform presented to Oxford University by the Chancellor. Not less remarkable is the effect it has already produced upon a seat of learning sometimes described, in old days perhaps correctly, but now with singular inaccuracy, as "sunk in port wine and prejudice."

SEVENTH INTERNATIONAL CONGRESS OF CHEMISTRY.

THE arrangements in connection with the seventh International Congress of Chemistry, which is to meet in London on May 27, are now practically completed. The series of meetings, which take place every third year, was originally started by a meeting of the Association of Sugar Chemists in Brussels. It was then extended to take in all branches of chemistry. Successive congresses have been held in Paris, Vienna, Paris again, Berlin, and Rome. With each successive meeting the popularity of the congress has increased, and it appears that this one will be not a whit behind those which have previously been held. There are seventeen sections and subsections, and a large number of contributions have been promised to each. The largest number of papers so far promised are for section ii., inorganic chemistry, and section x., electrochemical and physical chemistry. The growth of this latter section within the last few congresses is remarkable.

The amount of work and the number of papers to be got through in many of the sections will entail very careful organisation, and a very strong presidential hand to prevent prolixity. In section x. alone there are already about eighty papers promised, and the actual working time is eighteen and a half hours.

Beside the sectional work, there are to be four general lectures to the whole congress by Sir Boverton Redwood and by Profs. Haller, Paterno, and O. N. Witt. The first act of the congress will be a social one, when the Lord Mayor and Corporation will hold a reception at the Guildhall on Wednesday evening, May 26. On the next morning, at 10 o'clock, the joint organising committee will meet, and at 3 o'clock in the afternoon the inaugural meeting will take place at the Royal Albert Hall, when H.R.H. the Prince of Wales will formally open the congress. In the evening there will be a reception by the Foreign Office. On May 28 the various sections will start work in earnest, when they will be hard at it from 10 to 1.30; and at 2.30 Profs. Haller and Paterno will give their general lectures to the whole congress. In the evening there is to be a banquet at the Crystal Palace in the central transept. The Palace was taken because there is no other place in London sufficiently large to dine 2000 people, and it is hoped that at least this number will be present.

On Saturday morning the sections will meet from 10 to 2 o'clock, and in the afternoon there is to be a garden party at the Botanic Gardens, given by the ladies' committee. In the evening the hard-worked members of the congress will attend a reception given by the London section of the Society of Chemical Industry at the University of London. Sunday is to be devoted to private hospitality, as also is Monday evening. In this matter British hospitality is showing up well, as already the offers of private parties will absorb about 1500 members of the congress.

On Monday morning, May 31, the sectional meetings will take place from 10 to 1.30, and at 2.30 Prof. O. N. Witt will give a lecture to the whole congress, after which the sections will hold session from four to six.

The morning of Tuesday, June 1, is to be devoted to sectional work, and at 2.30 Sir Boverton Redwood will address the combined sections. Sectional meetings will then take place from 4 to 6. In the evening there is to be a reception at the Natural History Museum.

The official closing meeting of the congress is fixed for 10 o'clock on Wednesday, June 2, and in the afternoon the congress will visit Windsor Castle by permission of the King.

It should be mentioned that the annual meeting of the Society of Chemical Industry will commence on the morning of May 26; the presidential address will be delivered at 10.30, and a reception will be held at 4.30, so that those who are members of the Society of Chemical Industry and also of the International Congress will have a very severe week of work, both intellectual and social.

The meetings of the congress will be held in the buildings of the University of London at South Kensington, and at the Imperial College of Science and Technology, where the offices are located.

THE GOVERNMENT AND AËRONAUTICAL RESEARCH.

MR. ASQUITH'S announcement that a special Government Department for Aërial Investigation is being formed will be read with the keenest satisfaction by everyone who is interested in scientific research. It is but a short time ago that the Aërial League was founded under the chairmanship of Colonel Massy, mainly with the object of stimulating national interest in the aërial problem. The evidence before us points to the belief that, whatever other causes may have been at work, Colonel Massy's movement has been to the forefront among them. Of this we have abundant proofs in the fact that about the middle of April proposals of the League were discussed by a committee of the War Office appointed by Mr. Haldane.

An important feature of the movement is the appointment of a scientific committee to organise continuous researches, experimental and otherwise, on problems connected with the design and construction of aërial machines. The National Physical Laboratory at Teddington is to be the centre for these researches, and the committee consists of Lord Rayleigh (president), Dr. Glazebrook (chairman), Major-General Sir Charles Hadden, and Captain R. H. S. Bacon, representing the Army and Navy, Sir A. G. Greenhill and Prof. J. E. Petavel, Dr. W. N. Shaw, and Messrs. Horace Darwin, Mallock, and Lanchester. The Prime Minister has stated that special and adequate funds have been placed at the disposal of the committee, the War Office, and the Admiralty for carrying out the programme.

Regarding the working of the committee, nothing definite has as yet been announced. It seems, however, understood that in addition to experimental work, one of their functions will be to advise the Admiralty and War Office on inventions which may be submitted to them or on processes which it may be in the interests of the country for the Government to acquire instead of allowing them to be divulged.

It is clear, both from the constitution of the committee and from the accounts given in the Press, that mathematical and physical investigations are to receive a large share of attention, and that the mere building of aëroplanes and experience in manipulating them are not to interfere with the less enticing and no less important work of finding out the fundamental principles underlying their construction. The problem of stability is specially singled out for mention. The mathematics of this problem is pretty complicated, and it is easy to remain for a long time within clear sight of final conclusions when there is still much ground to be covered before reaching them. But, given the necessary methods of calculation, experiments are still required to determine the data involved in obtaining numerical results. A mathematical investigation now in progress tends to show that broad aëroplanes may be less stable than might be inferred from ordinary calculations of their resultant thrust and centre of pressure. But such an investigation is necessarily based on hydrodynamical assumptions, and laboratory experiments are required before any practical use can be made of the conclusions. It must be remembered, on the other hand, that questions of stability or instability of particular types of machine can never be decided by flights in which the human element has a guiding influence. There is still work to be done with models. On the practical side the committee will have abundant experimental work in connection with propellers, for the motion of a screw in fluid presents complications which render any attempt at hydrodynamical treatment practically hopeless.

It is scarcely surprising that the cry "too much theory; fears that talk may injure work" finds its way into the papers, and that some members of the Aëro Club put in a plea for the "practical man." The fact seems, however, to be overlooked that the appointment of this committee forms only part of a general scheme, the practical side being provided by the War Office and the Admiralty, both of which departments have dirigibles in course of construction. A Parliamentary committee embracing politicians of all parties is also announced.

It would be more correct, however, to describe the present position of aëronautics in England as "too much theorising and too little theory." Many papers have found their way into aëronautical and other periodicals, some of them full of algebraic symbols and formulæ, but an investigation is not necessarily mathematical because it contains equations, and the author is not necessarily a mathematician because he employs them. Indeed, in many cases it is the "practical man" who revels in the excessive use and abuse of formulæ, and the mathematician and physicist who would like to bring themselves into touch with practical problems are consequently deterred from reading such literature. Moreover, there is a want of suitable journals for the publication of mathematical and physical investigations bearing on aëronautics. They would be rather out of place in physical journals which deal more with such subjects as electricity and radioactivity; while any writer bold enough to try the journals just mentioned would probably find himself involved in a controversial correspondence, and would learn that too much talk *did* injure work, especially as no good would probably come of his attempts to enlighten his correspondents.

The need is thus becoming imminent for a clear division of labour between the practical man and the physicist, and if such a division should do no more than make the practical man confine his attention more exclusively to experimental work, much would be gained, and his researches would be made more accessible and useful. A division of a similar kind has now, we are glad to learn, been arrived at between the three leading societies devoted to aëronautics, namely, the Aëronautical Society, the Aëro Club, and the Aërial League. The Aëronautical Society mainly exists for the purpose of promoting discussions on aëronautical matters, and these consequently fall within its province. The Aëro Club undertakes the development of aëronautics from the point of view of sport. It desires to encourage men of means and leisure to practise aviation and ballooning for the pleasure they derive, and with the incentive of competing for prizes. Finally, the Aërial League is to be the paramount body in influencing public opinion in the development of the subject from the point of view of national defence. An agreement to this effect has been drawn up and signed by the presidents of the several societies.

England's neglect of science has lost the chemical and optical industries, and in the automobile industry France had a long start of us. It certainly does appear evident that in regard to aëronautics at least a serious attempt is being made to recover lost ground in the field of international competition.

G. H. BRYAN.

DR. GERALD F. YEO, F.R.S.

THROUGH the death of Dr. Gerald F. Yeo, Emeritus professor of King's College, London, physiology has lost within a few weeks yet another of those men who, within the last thirty years, materially assisted in the creation of a British school of this science, which, though of late development compared with Continental schools, has grown with a rapidity and vigour equalled only by the advances made on the bacteriological side of pathology. In the foundation of the Physiological Society, which at first included hardly a score of members, Yeo took an active part, being its honorary secretary for fifteen years from 1874 to 1890.

Born in 1845, he was one of the sons of Henry Yeo, J.P., of Howth, received his education at the Dungannon School, then entered Trinity College, Dublin, and obtained his medical degrees in 1867. After some months of study in the hospitals of Paris, Berlin, and Vienna, he returned to Dublin, where he practised as a surgeon and taught anatomy until 1874. In this year he was elected assistant surgeon of King's College Hospital, and professor of physiology in King's College, the histological part of the work being undertaken by Groves During this time, until his resignation in 1890, Gerald Yeo, by his lectures, his research work, and, in particular, by his strenuous advocacy of the necessity of the experimental method in physiology, as the chief of those methods by which material advances in this science could alone be made, occupied a prominent and influential position. In 1885 he published a "Manual of Physiology," a book primarily addressed to students, which gave a concise account of the elements of this science. In the Arris and Gale lectures delivered at the Royal College of Surgeons in 1882 on "The relation of experimental physiology to practical medicine," Yeo has probably given all the essential arguments which have so repeatedly been urged by those who claim that the sure basis of physiological knowledge must rest upon experimental work. An excellent account of the systems of medicine not dependent upon physiology compared with the modern methods of rational treatment which depend upon physiological and pathological knowledge, together with a most accurate account of the growth of physiology, is to be found in these lectures. Among other points, Yeo emphasised the paramount influence of Haller, who, not only by his experimental work, but by a comprehensive survey of what was then known of physiology, may be said to have created this science, a science conceived in the days of Galen, quickened in the time of Harvey, but born only in the eighteenth century.

Gerald Yeo was elected a Fellow of the Royal Society in 1890. His original work covered a somewhat restricted field. In 1850 Helmholtz had measured the delayed time, or latent period, which precedes the actual contraction of muscle by the method of Pouillet. Instead of 0·01″ for frog's muscle, Yeo, in papers published by himself, and with Cash and Herroun, succeeded, with the pendulum myograph, in halving this value, which in its turn was finally found to be too long by Burdon-Sanderson, who, working with unweighted or slightly weighted muscles, obtained 0·04″ as the shortest time of delay.

which is not appreciably slower than the latent period of the current of action. Other papers published with Ferrier in 1881, on the functional association of motor fibres in the anterior roots of the brachial and sacral plexuses of the monkey, and in 1884, on cerebral localisation in the Philosophical Transactions, formed early and important contributions to those investigations on the functions of the central nervous system which have since been so extensively carried out by English physiologists. One of Yeo's researches, that on the gaseous metabolism of cardiac muscle, was of particular interest. He determined, by spectroscopic examination of the living heart and its fluid contents, the rate at which resting and active muscle utilised the oxygen of oxy-hæmoglobin.

At the time of the resignation of his professorship Yeo practically severed his connection with physiology, and his interest in this was largely replaced by the occupations of a country life. He was therefore but little known to younger men, who may not remember that much of the organised attack on the experimental methods of physiologists and pathologists was directed against work carried out by Yeo and others in his laboratory. Apart from his actual scientific work, he will be remembered by all who have the best interests of medicine at heart for his uncompromising attitude towards those who, either from ignorance or mistaken views of the ethics of the subject, strove to hinder, if not actually to prevent, physiological research in this country. G. A. B.

DR. BINDON BLOOD STONEY, F.R.S.

WITHIN a few weeks of his eighty-first year, Dr. Bindon Blood Stoney, F.R.S., died at Dublin on May 5. Dr. Stoney was born at Oakley Park, Birr, in 1828, and educated at Trinity College, Dublin, where he had a distinguished engineering course, graduating in 1850. His abilities were early perceived by the then Earl of Rosse, whom he assisted in the astronomical researches of the early 'fifties of last century. In 1852 he went to Spain, and was engaged on railway work in that country. On his return home he was engaged in the important work of the Boyne Viaduct, which was regarded as a remarkable engineering achievement at that time. It is, however, by reason of his work as engineer to the Dublin Port and Docks Board that Dr. Stoney will be most remembered. He was appointed assistant engineer to the board in 1856, and three years later chief engineer to the port, a position which he held until 1898. During his tenure of office, Dublin was converted from a purely tidal port into one in which some of the largest vessels may be moored alongside the quays and lie constantly afloat, and the river so deepened that the cross-channel steamers may enter and leave at all states of the tide. In this work Dr. Stoney used the method of laying down the harbour walls by means of large blocks of masonry, weighing as much as 350 tons, and sunk by means of shears on a prepared foundation, the quay walls of the Alexandra Basin, the North Quay extension, and other work being laid in this manner.

During the period of his association with the Port and Docks Board, Dr. Stoney was also engineer for the construction of the O'Connell Bridge and the building of the Butt Bridge, and the reconstruction of the Grattan Bridge over the River Liffey. Dr. Stoney was a Master of Arts and Master of Engineering of the Dublin University, and in 1881 the honorary degree of Doctor of Laws was conferred on him in recognition of his eminent position in the world of engineering. He was the author of "The Theory of Stresses and Strains," a standard book in its day, and of various papers in the transactions of scientific and engineering societies. He was president of the Institution of Civil Engineers of Ireland in 1871, and for many years a most active member of that body. He was elected a Fellow of the Royal Society in 1881, and in 1874 was awarded the Telford medal and premium of the Institution of Civil Engineers; he was also the recipient of many other honours. In addition to being a great engineer, Dr. Stoney was a man of wide and varied reading, and his judgment in letters and in art was of the soundest. His sterling worth and the value of his services to the City of Dublin will be long remembered.

NOTES.

THE secretary of the Royal Society made the following announcement at the meeting of the society on May 6:—Sir David Bruce, who is in charge of the Sleeping Sickness Commission at present in Uganda, cabled to the society on April 3 that the commission had confirmed Kleine's observations on the period during which the tsetse-fly was capable of transmitting a trypanosome infection. A letter was received on April 30 from Sir David Bruce, dated Mpumu Chagwe, Uganda, April 3, confirming the telegram, and stating that the commission had "repeated Dr. Kleine's experiments with *Trypanosoma gambiense* and *Glossina palpalis*, also with a trypanosome of the dimorphon type and the same tsetse-flies, and found the flies infective after sixteen, nineteen, and twenty-two days."

IT is well known that Lord Walsingham has long been an unwearied collector and student of the smaller moths, and that his collection of the Micro-lepidoptera is the best in the world, as he has not only added to it largely by his own efforts, having collected assiduously during his travels in various parts of Europe and North Africa, California, Jamaica, &c., but has taken the opportunity to purchase the most celebrated foreign collections, among others those formed by Zeller, Frey, Christoph, and Hofmann, as they successively came into the market. He has also contributed numerous papers on the subject to the Transactions of the Entomological Society, the *Entomologist's Monthly Magazine*, &c., and has also published several independent works, especially on the Tortrices and Pterophoridæ of North America. In 1891 this valuable collection was formally made over to the British Museum by deed of gift, Lord Walsingham arranging to retain it in his own hands as long as he desired to do so; but we now understand that it is his intention to transfer the collection to the care of the trustees of the British Museum (an office which he himself shares with others) in the course of next year.

DR. R. P. VERNEAU has been appointed to the professorship of anthropology in the Paris Museum of Natural History in succession to the late Prof. Hamy.

THE fifth Congrès préhistorique de France will be held at Beauvais on July 26–31. The general secretary of the congress is Dr. Baudouin, 21 rue Linné, Paris.

THE *Times* announces the death of Dr. John Thomson, of Brisbane, at the age of sixty-one. Dr. Thomson was a graduate of the University of Edinburgh, and settled in Brisbane more than thirty-three years ago, where he became recognised as an authority upon matters relating to sanitary science. He served as president of the Royal Society of Queensland, and was president of the Intercolonial Medical Congress in 1899.

Mr. E. De Koven Leffingwell, the American explorer, is about to start from Seattle for a three years' expedition to northern Alaska. His main object is to map out the coast-line for a few hundred miles on either side of Flaxman Island, his winter quarters. As opportunity offers, he will also study the geological formations of the territory, and try to find out some large rivers in the interior of which the natives speak vaguely. His yawl, the *Argo*, will carry an auxiliary engine, besides sails, and its cargo will be limited to thirteen tons.

The successful congress in connection with the suppression of frauds in food, which was inaugurated last year at Geneva, will be succeeded by a similar congress to be held in Paris during October of the present year. The principal object will be to define such methods as will prevent the fraudulent adulteration of food, but there will also be sections devoted to chemical products, pharmaceutical preparations, mineral waters, and similar substances. Further information as to the congress can be obtained from Mr. Loudon M. Douglas, College of Agriculture, Edinburgh. The general secretary is Mr. Robert Fazy, 42 Rue du Rhone, Geneva.

On Tuesday next, May 18, Prof. J. Garstang will deliver a lecture at the Royal Institution on (1) "Monuments of Egypt and Asia Minor," being the first of a course of two lectures on "The Hittites," and on Saturday, May 22, Dr. W. H. R. Rivers, F.R.S., will begin a course of two lectures on "The Secret Societies of the Banks' Islands." The Friday evening discourse on May 21 will be delivered by the Hon. Ivor C. Guest, on "Afforestation," and on May 28 by Dr. Emerson Reynolds, F.R.S., on "Advances in our Knowledge of Silicon as an Organic Element." An extra Friday evening discourse will be delivered on June 18 by Mr. A. Henry Savage Landor, on "A Recent Visit to the Panama Canal."

The many friends of the late Mr. Bennett H. Brough will be glad to know that the proposal to establish some permanent memorial to him has taken definite shape. Shortly after Mr. Brough's lamented death, a fund for his widow and children was started by the council of the Iron and Steel Institute, of which he was secretary, and the sum of about 6000*l.* was raised. There are, however, many old students of the Royal School of Mines, as well as others who came under the influence of Mr. Brough's inspiring personality, who, now the institute's fund is practically closed, desire to show their appreciation of his life and work by a lasting memorial. A committee has therefore been formed to raise a fund for this purpose, and has issued an appeal for subscriptions. It is suggested that the memorial should take the form of a scholarship for boys from the City of London School, where he was educated, tenable at the Royal School of Mines, where, both as student and teacher, he did such excellent work. Contributions should be sent to Mr. R. E. Commans, Speer Road, Thames Ditton, Surrey.

Considerable changes are announced in the staff and administration of the London Zoological Gardens. For several months past a special committee has been investigating the state of affairs at the gardens, and the innovations, which are expected to lead to decided improvements in the well-being of the animals, are the results of the deliberations of that body. Dr. Chalmers Mitchell, the secretary, will continue to act as chief administrative officer in the gardens (where he will reside when the society's library and offices are transferred there), for the efficiency of which he alone is responsible to the council. As subordinates, he is eventually to have under him three curators, one each for mammals, birds, and reptiles. Mr. R. I. Pocock, who is to retain his present post of garden-superintendent, will have charge of the mammals, and temporarily of the reptiles, while Mr. D. Seth-Smith is to take over the custody of the birds, combining with this duty the office of inspector of works. Each curator is to have a head-keeper under him, and the aim of the council is that both curator and head-keeper should devote their whole attention and time to the care of the animals under their charge. If this work is properly done, the curators will have no time to spend on scientific zoology, as the care of the animals is quite enough to occupy their whole energies.

On May 7 Lord Avebury presided at the annual conversazione of the Selborne Society. He alluded to the Bill to stop the destruction of rare and beautiful birds for the sake of their feathers, which the society, acting on the suggestion of Mr. Buckland and in conjunction with the Linnean Society, Zoological Society, and the Society for the Protection of Birds, introduced into the House of Lords last year. The House of Lords was very sympathetic, and passed the Bill, but the House of Commons could not spare time to consider it. This year, said Lord Avebury, Sir William Anson has introduced a similar measure, and he heartily wished it success. Mr. James Buckland afterwards exhibited a number of slides bearing on the destruction of egrets. The subject of flight was considered by Mr. F. W. Headley, of Haileybury, who showed by means of slides how birds fly, while Mr. T. W. K. Clarke followed with a lecture on how men fly, in which he contrasted the methods by which birds fly with mechanical flight, and showed by means of gliders how machines are automatically balanced. He also made a strong point of the fact that in the science of aëronautics Englishmen in the past led the way, and cited the names of Sir George Cayley, Henson, Stringfellow, and Wenham. As usual, there was a large series of interesting exhibits. The following attracted considerable attention;—a working exhibition showing the processes of the manufacture of microscope lenses, Messrs. W. Watson and Sons; an attachment for converting a tourist's telescope into an instrument for insect observation, Messrs. H. F. Angus and Co.; and a plan showing the position of the nesting-boxes and nests during the coming month in the Brent Valley Bird Sanctuary, Mrs. Wilfred Mark Webb.

An influential deputation waited upon Mr. Runciman, president of the Board of Education, on May 6, to place before him the objections to the alleged intention of the Government to distribute what is known as the Indian Collection at the South Kensington Museum. Lord Curzon, in introducing the deputation, gave a historical summary of the nature and position of the collection. Briefly, the facts are as follows. Last year a departmental committee was appointed to draw up a comprehensive scheme for the re-arrangement of the products in the South Kensington Museum, in the interests, first, of people engaged in commercial production, and, secondly, for the due encouragement of art. The committee reported in favour of classification by material of all the contents of the Victoria and Albert Museum. This recommendation has provoked much opposition; and the object of the deputation was to urge that Indian art demands independent treatment, and that the ethnographical features of the present collection would be altogether sacrificed if the distribution according to subjects were carried out. The hope was expressed, therefore, that the Government would not agree to the dispersion of the collection, and would consider favourably some scheme by which it would be given a permanent and suitable house as a whole. In his reply, Mr. Runciman did not commit himself to either proposition, though he said, "I do not wish to leave the present collection in the present bad building, and I do not intend to scatter it in the sense which was at first proposed." The whole matter is to be given full consideration again before any action is taken. The situation provides another instance of difficulties arising owing to the want of scientific system in the organisation and administration of our national museums, upon which we commented on April 29. Thirty years ago, the original collection was broken up, the geological and mineralogical products being sent to Jermyn Street, the vegetable products to Kew, some of the antiquities to the British Museum, and others to South Kensington. Now it is urged that this distribution was a mistake, and that all the collections should be brought together under one roof. We express no opinion upon these plans of aggregation and segregation, but we do say that if our national museums were controlled by men of knowledge and authority a definite and continuous policy would be the result, and the demand for re-consideration which now arises when any change is proposed would rarely arise.

To the May number of the *Century Illustrated Magazine* Mr. E. B. Bronson communicates an article on big game in East Africa, with special reference to the conditions and incidents attending lion-hunting and the pursuit of other dangerous animals. The author, who was for a year the guest of Mr. McMillan at Julia Farm, near Nairobi, from which he made excursions to the game-country, has had thirty years' experience of big-game shooting in America, and his views in regard to African sport of this nature accordingly possess a more than ordinary value and interest. Mr. Bronson was much struck with the extraordinary abundance of game on both sides of the railway between Voi and Nairobi, where the passengers are seldom out of sight of some kind of game-animals during the daytime. Special reference is made to the dangers connected with the pursuit of buffalo and rhinoceros, the author appearing to endorse the general opinion as to the excessive risks attendant on buffalo-shooting.

In the April number of *Das Blaubuch* Dr. T. Zell discusses the question whether animals take advantage of experience and become cleverer than their parents, the question being answered in the affirmative. Among numerous other instances mentioned by the author, reference may be made to the following. From early times it has been noticed that vultures have learnt to accompany armies in the field, for the sake of the prospective feast after a battle. Killer-whales accompany whaling-vessels, and gulls do the same. Crows in like manner learn to accompany the chamois-hunter as soon as they have seen the first victim fall to the rifle, and rough-legged buzzards follow the sportsman in pursuit of winged game. Birds and quadrupeds have learnt to take no notice of railway trains, as have horses of motors, and nowadays many fewer birds immolate themselves by flying against telegraph-wires than was formerly the case. Game animals of all kinds have learnt to know the range of modern rifles, while greyhounds have learnt to leave rabbits alone, just as foxhounds, if properly trained, take no notice of either hares or rabbits. Sheep-dogs, again, know by experience that it is only the members of their masters' flocks that it is their business to collect.

The sixty-seventh volume of the Journal of the Royal Agricultural Society, for 1908, opens with a portrait and biography of the late Sir Nigel Kingscote, and contains a number of papers on agricultural subjects and fruit-growing. Among these is one by Mr. H. Rigden on Sussex cattle, which are stated to be nearly allied to the Devon, but larger, bigger-boned, and more hardy in constitution, both breeds being probably derived from old medium-horned red cattle of the south and south-western counties. In colour, Sussex cattle, which are still mainly confined to the home counties, should be wholly red, with white tail-tufts, but white flecks may appear on the body, and the muzzles of the bulls must be white. A century and a half ago it was noted that Sussex cattle, like the pigs of the same county, were unusually long-legged, and it was suggested that this feature was due to the bad state of the roads. Be this as it may, when the Weald district was the centre of a great iron-producing industry the strong-limbed Sussex steers were specially well adapted for hauling timber through the heavy undrained tracks of the partially cleared forest. The Lyne herd, dispersed in 1903, were descended from the old working breed, and were probably the oldest in Sussex.

Dr. A. S. Hitchcock has prepared a catalogue, with analytical key, of the grasses of Cuba, that is published as the sixth part of vol. xii. of the Contributions from the United States National Herbarium. It is based largely on the specimens collected by Charles Wright, and named by Grisebach, Wright, and Sauvalle about 1870, and on recent collections made by members of the herbarium staff. There is a tendency to split the genera, as in the segregation of Syntherisma and Alloteropsis from Panicum. There is one genus of the tribe Bambuseæ, Arthrostylidium, with seven species. The new plants named by the author, which are enumerated in a separate list, include one new genus, Reimarochloa.

A forest pamphlet (No. 5) has been issued by the Government of India, in which Mr. A. L. McIntire deals with the production of "sal," *Shorea robusta*, in Bengal. Certain data are given for growth which indicate how greatly the figures vary according to the locality. In the Terai, saplings may grow 8 feet to 10 feet in as many years, but in dry districts the period would be thirty years or more. Natural reproduction from seed is difficult, as the seedlings are checked by faster growing species and creepers. A method of artificial reproduction consists in placing baskets of soil under seed-laden trees into which the seed falls and germinates; the baskets are then planted out where required.

In the latest number of the Journal of the Royal Horticultural Society (vol. xxxiv., part iii.) there will be found the proceedings of the conference held last October on the spraying of fruit trees. The four papers read at the conference contain a considerable amount of negative expression of opinion, but there are many useful suggestions regarding the composition and value of different fungicides and insecticides, more especially in Prof. Theobald's paper and the appendices giving the proportions for various washes. Mr. G. Massee generally advocated winter spraying to combat fungus diseases, while Prof. Theobald pointed out that, as a remedy against insects, spraying must be applied at a time when the insect can be reached by the wash. The efficacy of tobacco washes was generally conceded, the one drawback to them being the expense.

An important contribution to the cryptogamic flora of Leicestershire is made by Mr. A. R. Horwood in a paper read before the Leicester Literary and Philosophical Society, and reprinted, with amplification, in the Transactions (vol. xiii., part i.). The author offers some general remarks on distribution, and provides a list of new records since the publication of the county flora in 1886 for all the crytogamic groups. Two well-marked regions are distinguished, the Charnwood Forest and the lowland region overlying Coal-measures, Keuper Marl, Lias Clay, or Sandstone. In these areas the chief plant associations are the calciphilous, the humus and peat dwellers, or oxylophytes, and the silicicolous. The lichens, liverworts, and mosses have been well worked, but there is opportunity for adding considerably to the records of fungi.

As a first step towards the preparation of a handbook on the trees of the Transvaal for the use of foresters, Mr. J. Burtt-Davy has compiled a preliminary catalogue of the native trees, that is published in the *Transvaal Agricultural Journal*. The species are catalogued according to their occurrence in four phytogeographical zones, the mist-belt, high-veld, middle-veld, and low-veld, and are also enumerated with vernacular names in systematic sequence. The mist-belt is the true forest region, and contains many species common to that part of the Transvaal and the eastern province of Cape Colony, such as the two species of Podocarpus, *Curtisia faginea*, *Olea laurifolia*, and others. The high-veld and middle-veld are steppe and savannah regions, but in the low-veld such important trees as the baobab, *Excoecaria africana*, *Afzelia quanzensis*, and *Copaifera mopane* are found.

We have received the first part of the *Eugenics Review*, a new quarterly journal issued by the Eugenics Education Society (6 York Buildings, London, W.C.). In a short "foreword" by Mr. Francis Galton, it is explained that the review is not intended to rival the more technical publications of the Eugenics Laboratory, but rather to supplement them by demonstrating the bearing of eugenics on legislation and practical conduct; the review is consequently rather of a popular than a strictly scientific character, and the reader will hardly look for original contributions to knowledge in its pages. In the present issue Mr. Montague Crackanthorpe contributes an article on the eugenic field, the Rev. Dr. Inge an address on some moral aspects of eugenics, and Dr. Saleeby writes on the psychology of parenthood. Sir Edward Brabrook also deals briefly with the eugenic aspects of the Report of the Poor Law Commission. The address by Dr. Inge is of special interest as a thoughtful contribution to the subject with which it deals from a professor of divinity.

Dr. J. J. Dobbie, F.R.S., director of the Royal Scottish Museum, Edinburgh, in his report for 1908 gives a good account of the progress made in extending and rearranging the important collections under his charge. In the archæological section the most valuable additions are the prehistoric Japanese collection of Dr. N. G. Munro, which is of the same type as that of Prof. Gowland, now in the British Museum, and a Babylonian clay tablet, which is believed to contain a missing portion of the Creation epic. Those of Dr. Felkin from the Upper Nile and of Dr. M. Pirie from the Burun country are interesting additions to the ethnographical series. The natural-history cabinets now contain the large collection of eggs of British birds made by Mr. O. A. J. Lee; a fine pair of Californian sea-elephants (*Macrorhinus angustirostris*), long supposed to be extinct, but lately re-discovered on the island of Guadalupe, some 200 miles off the coast of Lower California; and an example of the rare deep-sea oar-fish or ribbon-fish (*Regalecus glesne*), cast ashore at Dunbar. It is disquieting to learn that the safety of the collections is seriously endangered by the close proximity to the main building of two spirit stores, and it may be hoped that the Government will take early steps to acquire and demolish them.

Under the title of "The Romanichels, a Lucubration," Mr. Bob Skot issues privately through Messrs. R. McGee and Co., of Liverpool, a reprint of a lecture delivered before the Clevedon Naturalists' Association, in which he discusses the history, persecutions, character, and customs of the Gypsies. In this pamphlet he has brought together much curious information on this interesting people from sources not easily accessible, and he has reproduced, with the musical score, eleven characteristic Gypsy melodies, which were sung, probably for the first time before a learned society, during the delivery of this lecture. It is curious to find among the Gypsies survivals of the rule of concealed burial of the dead, streams, it is said, having been diverted, and the corpse buried in their beds, after which the water was allowed to resume its ordinary course. The writer attributes the custom, occasionally practised in this country at the present day, of burning the effects of deceased members of the tribe, not to the belief that these follow the dead man to the spirit world, but to the theory that the soul is so firmly attached to the body and its possessions that it cannot obtain freedom until these are destroyed. The custom of abstaining during life from the favourite food of a lost relation, and the belief that vessels are defiled by the touch of a dog's tongue or of a woman's skirt, suggest reminiscences of customs and taboos derived from the eastern home of the race.

Prof. G. Mercalli has recently published a short account of the destructive Calabrian earthquake of October 23, 1907. The centre of the earthquake appears to have been near Ferruzzano, a small town on the east coast near Gerace. Here, 158 persons (or 8 per cent. of the inhabitants) were killed, and, immediately after the shock, the sea advanced inshore 30 metres, and then retreated. The district is one in which few earthquakes originate, but five preparatory shocks occurred in it, the first on the day after the earthquake of 1905, the last three minutes before the principal earthquake. Though the ground was fissured in places, there were no faults; there was no marked shifting of railway-lines, and no permanent displacement of the earth's crust. The number of after-shocks was small. Prof. Mercalli attributes the excessive damage at Ferruzzano to its erection on an isolated eminence and on a slope, and to the friable nature of the ground on which the houses were built.

The Publications of the Iowa Geological Survey are usually devoted to economic subjects, but the eighteenth volume, just received, consists chiefly of a memoir of general scientific interest. This work, by Dr. Charles R. Eastman, of Harvard University, is entitled "Devonian Fishes of Iowa"; but it is, in fact, a discussion of the Lower Palæozoic fishes in general, with special reference to those found in North America. It is a critical summary of the subject, with many quotations from the latest memoirs, and a brief statement of Dr. Eastman's own opinions, which have already been published in scattered papers. The Devonian rocks of Iowa itself have yielded only fragmentary fish-remains, but one quarry in the upper beds has furnished an astonishing number of the teeth of Chimæroids and Dipnoans, which exhibit much variety. Dr. Eastman thinks that, when well-preserved skeletons are found, the Devonian Chimæroid fishes will prove to have been armoured with thin dermal plates and with dorsal fin-spines. The most interesting discovery recorded is that of a new palæoniscid fish, *Rhadinichthys deani*, from the uppermost Devonian shales of Kentucky. It occurs in phosphatic nodules, and the state of preservation is such that even the brain and organ of hearing can be examined and described. According both to Dr. Eastman and to Dr. G. H. Parker, the brain, semi-circular canals with ampullæ, and even some of the blood-vessels, are actually phosphatised, and can be perfectly exposed by cutting away the investing bone. Dr. Parker adds a detailed description of these parts, showing that they differ in no respects from those of a typical modern bony fish, but the accompanying illustrations from photographs are unfortunately not satisfactory. Dr. Eastman concludes his memoir with a useful list of the Devonian fishes hitherto discovered in North America.

We have received from the Meteorological Office charts referring to the meteorology of the North Atlantic and Indian Oceans, and from the Deutsche Seewarte similar charts for the North Atlantic, for the months of April and May, 1909, which are, as usual, replete with mean statistical and current information useful to seamen. In addition to data relating to normal conditions of winds, currents, &c., both institutions give special charts of fog and mist in the North Atlantic. During the warm season, from April to August, fog is a source of great danger to navigation, especially on the eastern part of the Newfoundland Bank, owing to marked differences of temperature between sea and air, and this danger is increased by the southern drift of icebergs across the sailing routes. From a useful report on the state of the ice in the Arctic seas in 1908, recently issued by the Danish Meteorological Institute, the opinion is expressed that there will be no abnormal risk from ice in 1909 either along the south-west of Greenland or near Newfoundland.

To the *Cairo Scientific Journal* for January last Mr. B. F. E. Keeling communicates an interesting paper on climate changes in Egypt. There is a strong belief amongst residents that changes have occurred within the last ten or twenty years (possibly due to increased irrigation) which are distinctly "sensible," without the aid of instruments. Mr. Keeling quotes the mean temperature at Abbassia for each pentade from 1870–1904, and for the four years 1905–8; but the results show that the differences are hardly greater than might be caused by difference of exposure of the thermometers. As regards humidity, also, there is very little evidence of any decided change during the last forty years. It is confidently asserted by many persons that the rainfall has increased during quite recent years, but the author shows that there is little, if any, evidence of such being the case. The total rainfall of any year is often influenced by the fall on a single day, and is consequently very variable from one year to another; the driest year on record at Abbassia is 1892, with little more than a quarter of an inch of rain, and the wettest, 1904, with less than 3 inches, the mean for 1887–1908 being approximately 1·4 inches.

In No. 1, vol. i. (second series), of the Proceedings of the Tokyo Mathematico-physical Society, Mr. H. Nagaoka publishes the results of a recent research on the complex structure of some of the lines in the spectrum of mercury. The experiments were made with a 35-plate echelon spectroscope made by Hilger, and having a resolving power of 430,000 for light of wave-length 5000 Ångström units. The lines at λ 5790, λ 5769, and λ 5461 were analysed, and Mr. Nagaoka finds several companions in each case which were not recorded by Janicki, Galitzin, Stansfield, or Baeyer. A remarkable feature of the companions of the green line (λ 5461) is the symmetrical arrangement of certain pairs of them about the principal line, and an apparent constancy of wave-length difference between consecutive lines. Further research will be necessary to establish these features as objective realities, a point which is not overlooked by the author, who discusses at length the possibility of certain lines being illusory, optical phenomena.

The origin of the colours of the spectrum forms the subject of an article, by Prof. P. Zeeman, in the *Rivista di Scienza*, v., 9. The first part is mainly philosophical in character, and deals with the question whether white light is really a mixture of rays of different wave-lengths or a mere succession of impulses, the phenomena of colour in the latter case being due to the action of the spectroscope. The second part contains a summary of recent results relating to magnetic action on light. Some recent experiments on the shifting of the middle line of a triplet are described by Prof. Zeeman in the Proceedings of the Amsterdam Academy, published January 27. In the *Archives Néerlandaises* (2), xiii., p. 260, Prof. Zeeman discusses the following questions:—applications of the decomposition of rays to the measurement of the intensity of magnetic fields; relation between the intensities of the components of a triplet; the dissymmetry in intense fields; observations by Fabry and Pérot's methods; determination of the charge on electrons; observations in the direction of lines of force; and dissymmetry of the triplets in the spectrum of tungsten. A note on Hale's observations of the magnetic decomposition of the lines of the spectra in sun-spots appeared in the *Physikalische Zeitschrift*, ix., 23, pp. 834, 835.

A simple method of finding indices of refraction of liquids under the microscope is described by Dr. Enrico Clerici in the *Atti dei Lincei*, xviii., 7. In its simplest form it consists of a glass slip with a thick cell, and a triangular glass prism cemented on it. A line ruled on the under side of the prism is brought into collimation with a wire in the focal plane of the eye-piece, and when the cell is filled with any liquid the apparent displacement of the line determines the index of refraction.

On September 21, 1908, Dr. Hermann Minkowski read a paper before the German Naturalists' and Medical Association at Cologne on "Space and Time." It was his intention to develop the ideas into a more complete theory of mechanics, in which time would appear to be regarded as a fourth dimension coordinated with the three dimensions of space. Unfortunately, Minkowski did not live to realise his project, his life coming to a premature end on January 12. In accordance with a wish expressed by him, "Space and Time" has now been printed by the Teubner Press, of Leipzig, with a preface by Prof. Gutzmer, of Halle, and a portrait of Minkowski. It is an interesting memorial of the author, and the printing and general get-up are of the best.

Designers of posts and brackets for electric street lighting will be interested in two well illustrated articles on these fittings in the April number of the *Illuminating Engineer* of New York. Although many of the posts figured are most elegant in design, there is obviously a tendency in America to introduce Corinthian columns more appropriate for supporting substantial buildings than arc or incandescent lamps.

La Nature for April 24 contains an account of the experiments and measurements which have been made to discover what was the cause of the notoriously bad acoustical properties of the large hall of the Trocadéro at Paris. The work has led to several valuable conclusions as to the effect of a sound reaching the ear by two paths which differ in length by various amounts up to 34 metres. One of these is embodied in the statement that, for good audition, surfaces far from the audience must be absorbent, while surfaces near them must be reflecting.

It will be remembered that two years ago the well-known "pleochroic haloes" observed in rock sections were shown to be due to the radio-activity of the inclusion round which the halo occurs. The point was brought out about the same time by Prof. O. Mügge in Germany and by Prof. Joly in this country. The former author now contributes further observations on the action of radium in producing these effects on a variety of minerals. His results will be found in the *Centralblatt für Mineralogie* (1909, p. 65).

Mr. C. Baker, of 244 High Holborn, W.C., has submitted to us two microscope objectives of a new formula which he has recently placed on the market. They are (1) a one-sixth inch numerical aperture, 0·75; (2) a one-twelfth inch numerical aperture, 1·30. The former has approximately a working distance of one millimetre, which for its focal length is considerable, and is intended for use with thicker cover glasses or with a hæmocytometer. The one-twelfth inch objective is particularly suited for bacteriological work, and, considering that it has a large field, its definition is excellent. We have tried these lenses both visually and photographically, and can find little fault with them. They are of the type that most English makers have recently introduced, and are intended to meet the need for cheap lenses for students' purposes and for ordinary use in the commercial applications of the microscope. The prices of these lenses are thirty shillings and five pounds respectively, and it is somewhat reassuring to find that English firms are making a determined effort to meet the severe Continental competition in the cheaper class of microscope apparatus, by introducing lenses of such a high order for so reasonable a price. Photographically, both these lenses are most satisfactory, and, if used in conjunction with a light yellow screen which cuts out the blue-violet portion of the spectrum, the results to be obtained with them are excellent. In common with most lenses of this type, their focal length is slightly shorter than marked, but this but little detracts from their performance.

The new White Star liner *Laurentic* left on her first voyage to Canada on April 29. The performance of this vessel, built by Messrs. Harland and Wolff, of Belfast, will be looked for with interest, as she is the first Atlantic liner to be fitted with a combination of reciprocating and turbine machinery. Meanwhile, we note from an article in *Engineering* of April 30 that the vessel has a length of 565 feet 6 inches over all, beam 67 feet 3 inches, and depth, moulded, 45 feet 6 inches; the displacement at service draught is about 20,000 tons. The idea of the combination of machinery is to utilise in the turbine the remaining heat energy in the exhaust steam from reciprocating engines, which is generally at a pressure not less than 10 lb. per square inch absolute. The Parsons steam turbine enables such steam to be expanded economically to a very low absolute pressure. In the *Laurentic* the reciprocating engines are of the triple-expansion type, with four cylinders to ensure perfect balancing. There are twin reciprocating sets, the low-pressure Parsons turbine being placed in the centre of the ship and abaft the main engines, giving three propeller shafts. Arrangements are provided for throwing the turbine out of action for all manœuvring, the reciprocating engines then passing their exhaust steam direct to the condenser. The experience derived from this vessel should be of service in proportioning the machinery of the two 45,000-ton White Star liners now being built in Belfast.

OUR ASTRONOMICAL COLUMN.

Mercury as an Evening Star.—In the comparatively clear evening skies of the past week, the planet Mercury has not been difficult to locate when one knew the direction in which to look for it. At present it is in the constellation Taurus, to the south-west of β Tauri, and sets about two hours after sunset.

The greatest eastern elongation takes place on May 20, but the planet is better seen some days before, rather than after, an elongation occurring in the spring. At 8.30 p.m. on Saturday last, May 8, it was easily found with opera-glasses whilst some four or five degrees from the horizon, and then watched for some time with the naked eye.

The Present Solar Activity.—A large group of spots was seen coming round the eastern limb of the sun on Friday last, May 7, and was in full view on Saturday, when it was seen to consist of two moderately large spots with several smaller ones, and to cover a fairly extensive area. On Sunday the group was visible to the naked eye, shielded by a piece of smoked glass, whilst with a pair of opera-glasses ($\times 3$), similarly shielded, it was quite a prominent object.

Spectroscopic observations made at the Solar Physics Observatory by Mr. W. E. Rolston on Saturday showed that the dark D_3 (helium) line was to be seen quite marked in the different inter-umbral areas and beyond the group.

The Intra-Mercurial Planet Problem.—As reported in our discussion of the results obtained by the Lick-Crocker eclipse expedition to Flint Island (Nature, No. 2038, vol. lxxix., p. 70, November 19, 1908), Prof. Campbell considers that the negative results obtained at successive eclipses in the search for a possible intra-Mercurial planet demonstrate that no such planet exists as would account for the anomalies in the motion of Mercury.

In the May number of the *Popular Science Monthly* (vol. lxxiv., No. 5, p. 494) he now gives a most interesting popular account of the search for the hypothetical planet, and the means whereby its existence has been disproved.

In closing this account, Prof. Campbell refers favourably to Prof. Seeliger's recently published conclusions that the Mercury anomalies may be accounted for by the action of the material which gives rise to the zodiacal light, and shows that the figures calculated by Seeliger agree, within the probable errors, with the observed values, as reduced by Newcomb, of the perturbations of Mercury, Venus, the earth, and Mars.

The Lick Observatory search is fully discussed, in Bulletin No. 152, by Dr. Perrine, who points out that, whilst small bodies may yet be discovered near the sun, the eclipse plates show that no planet of the eighth magnitude was photographed. Such a planet would hardly exceed twenty or thirty miles in diameter, and it would require about a million such bodies to account for the outstanding Mercury perturbations.

Partial Eclipse of the Sun in Canada.—From Dr. Downing we have received particulars of the partial phase of the solar eclipse of June 17 as visible at the Canadian observatories. At Ottawa the greatest phase (0·601) will occur at 7h. 43m. (standard time, 5h. W.), and the sun will set partially eclipsed at 7h. 50m.; first contact will occur at 6h. 52m. At Toronto the times will be:—first contact, 6h. 57m.; greatest phase (0·540), 7h. 48m.; sunset, 8h. 0m. In each case the sun's altitude at first contact will be approximately 9°.

Spectroscopic Binaries.—A number of newly discovered spectroscopic binaries are discussed briefly in No. 3, vol. xxix., of the *Astrophysical Journal*. Prof. Campbell reports that, in the course of the regular observing programme with the Mills spectrograph, the following eleven stars have been shown to have variable radial velocities:— γ Persei, ξ Tauri, θ^2 Tauri, l (53) Eridani, ζ Aurigæ, ρ Orionis, β Canis Majoris, ν Draconis, 70 Ophiuchi, 111 Herculis, and ϕ Cygni. Of these, γ Persei and l Eridani probably have long, whilst θ^2 Tauri and β Canis Majoris probably have short, periods, and 70 Ophiuchi is a well-known double star with a period of eighty-eight years.

As the result of the recent investigations of the D. O. Mills expedition to Santiago, Chile, Dr. Heber D. Curtis announces that five stars, ζ Canis Majoris, τ Puppis, o Velorum, d Carinæ, and q Velorum, have been shown to be spectroscopic binaries, the first four probably having long periods. Two other stars, ν Puppis and ν Octantis, also photographed at Santiago, are announced by Prof. W. H. Wright as spectroscopic binaries.

Harvard College Observatory.—Prof. Pickering's report of the work performed at the Harvard College Observatory during the year ending September 30, 1908, directs special attention to the large amount of publication during that period. With the help of a monetary grant from Mr. Fairchild, no fewer than six volumes of annals have been completed, the publications of the twelve months exceeding in amount those of the first thirty years of the observatory's existence. Fourteen thousand settings with the polarising photometer related chiefly to variables of the Algol type, and will serve to determine their light-curves and epochs of minima. About thirteen hundred settings on the asteroids Iris and Eros showed that at present their light does not vary. Four thousand one hundred stellar photographs were taken at Cambridge and 3509 at Arequipa during the year, and numerous nebulæ, stars with peculiar spectra, six meteor trails, and many variable stars were thus discovered.

THE PERCY SLADEN TRUST EXPEDITION TO THE INDIAN OCEAN.

Final Explorations.[1]

The field work of the above expedition has now been completed with the return of Messrs. H. Scott and J. C. F. Fryer from the Seychelles and Aldabra on March 29. Mr. Scott has brought with him more than 40,000 insects from the Seychelles as a result of eight months' collecting. Among these are many remarkable forms, including a very large number of beetles, which will take some years to determine. The tropical rains of December and January brought out a great variety of insects not previously obtained.

Mr. Fryer spent nearly five months in Aldabra. His preliminary report, which is subjoined, is of great interest as showing the foundations on which that so-called atoll is built. Aldabra contains about fifty square miles of land, and was supposed to be a typical atoll, almost completely land-locked. It was also known for its still containing numerous gigantic land-tortoises, and for its partially peculiar avifauna. Some sand from it, which I obtained in 1905 in Seychelles, showed the presence of a considerable quantity of silica, on account of which we deemed its exploration necessary.

Mr. R. H. Rastall, who has examined some fragments of the Aldabra rocks, forwarded to me by post, writes that "they promise to be of very great petrological interest, as they consist for the most part of spherulitic and devitrified volcanic glasses."

J. Stanley Gardiner.

I arrived in Aldabra at the end of the south-east monsoon. Owing to the extreme dryness of the season I decided to explore the island at once with regard to its geological formation, leaving its zoology and botany until the wet season.

[1] For earlier reports see Nature, April 13, August 10, October 5, November 9, December 21, 1905, January 25, 1906, and December 17, 1908.

I had four camps, *i.e.* on Michel Island, at Takamaka on Main Island, on Esprit Island, and on Picard Island, from which I examined every portion of the so-called atoll. Owing to the dense and almost impenetrable scrub there were always great difficulties, as I had everywhere to cut paths; in addition, I cleared several broad sections from the sea to the lagoon in order to get a clear idea of the sequence of the rocks and vegetation and of the relative elevations.

The nature of the ground and of its vegetation is such that the land may be divided into four somewhat irregular zones, from the lagoon outwards, as follows:—

(1) Mangrove swamp—varying in size up to nearly a mile in maximum breadth.

(2) Champignon—the surface much metamorphosed, highly crystalline, coral rock, usually with sharply defined dark portions, in which the crystals appear to be imbedded in a brown amorphous substance. It has evidently been subjected to heavy rain denudation, its surface being a mass of points and pits. The vegetation is a scrub of *Pemphis acidula.*

(3) Platin—fairly smooth, composed mainly of coral fragments and reef débris with a few shells, weathering into large flat slabs with soil accumulating in the crevices. In places are larger depressions, in which there are usually clumps of trees. The soil is guano, with a mixture of disintegrated rock. The vegetation is varied, containing numerous small bushes and trees, Pandanus, Ficus, Euphorbia, &c.; the fauna is also varied, and comparatively rich.

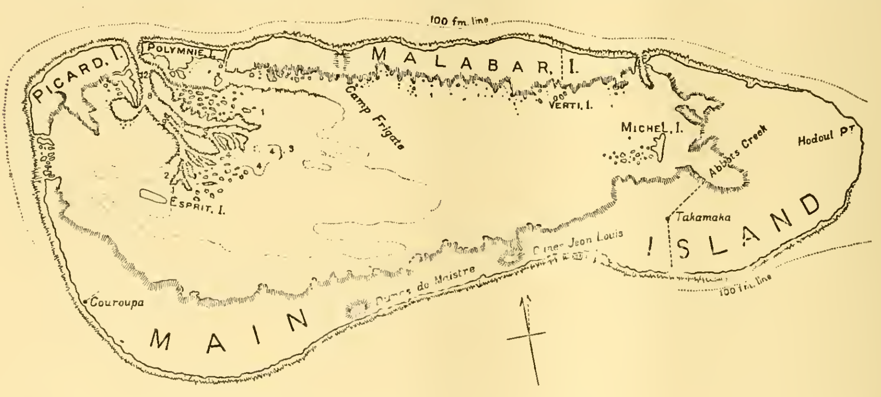
(4) Shore zone—largely of blown sand, with a stunted and wind-swept vegetation; large clumps of Pandanus, Tournefortia, and Scævola everywhere very numerous.

In a broad sectional clearing which I made at Takamaka, the seaward reef commences with a fissured edge, succeeded by a sand flat, the sand being bound together by beds of grass-like Cymodocea, its rhizomes greatly overgrown by Lithothamnia; the buttresses between the fissures are themselves largely covered with sand; live coral is almost absent; not far from the edge are a few small boulders of dead coral, all much encrusted with Lithothamnia; a few species of seaweed are found in the pools left at low tide. The landward edge of the reef is formed of cliffs 12 feet to 15 feet high, just outside which is usually a small depression in the reef with 2 feet or 3 feet of water. The cliffs are sloping, not overhanging, and are divided into buttresses; they consist of a mass of corals cemented together with lime. The corals are all in the position in which they grew, and so perfect that they give the impression that they are only just dead. On the landward side of the cliffs is a ridge, 2 feet or 3 feet higher, of grass-covered sand; this marks the seaward edge of the shore zone, which is about 250 yards wide, the sand being shallow and lying on a basis of coral rock. Then comes a ridge, 4 feet to 6 feet higher, the rock more solid and less denuded; this, the highest part of the section, is some 25 feet above sea-level. From the landward side of this ridge the level gradually decreases to about 10 feet above sea-level. It passes into a zone of Champignon, which here lies outside the Platin zone, which latter extends to the mangrove swamp. The Platin is all very similar in appearance, except that it is more wooded near the lagoon; it terminates with a sharp drop through the last 4 feet or 5 feet to the lagoon surface. At Takamaka there is a spring of fresh water and a grove of large Calophyllum and Ficus trees. This spring, with three others all lying between Takamaka and the lagoon, is the only constant source of fresh water on the islands. The section finishes at Abbot's Creek, which is a narrow passage from the lagoon with a thick undergrowth of mangroves on each side; its bed is rocky, and covered with very fine white mud; at its termination in the land it passes between small cliffs, all much overhung and obviously breaking down.

In another section, which passes from Vert Island in the lagoon northward to the sea, the country is all, with the exception of the shore zone, of the Champignon type, Platin being entirely absent. There is a gradual slope from the lagoon, becoming steeper at the beginning of the shore zone; right up to the latter salt water is often found in pits in the rock, fluctuating, apparently, with the lagoon tides. The cliffs on this north coast are 4 feet or 5 feet higher than those before described, and are always much overhanging. Caves penetrate far into their faces, large portions of which have at intervals fallen on to the reef; this fallen rock appears to become disintegrated quickly, as small pieces are uncommon, the action of the sea being assisted by boring animals (small Gephyreans, boring molluscs, &c.). As elsewhere round the coast, the rock shows its component corals in a way which leaves no doubt as to their being absolutely in the same position as previous to their elevation. On the reef here there are three or four distinct regions; close to the cliff there is a small belt of bare rock, often worn into hollows containing 3 feet or 4 feet of water; then a large area, mainly of broken coral fragments covered with Lithothamnia, and edged outside with a small boulder zone; and outside this, again, buttresses with a few colonies of living corals in the channels. Such are the usual features of the fringing reef at Aldabra, the appearance in the Takamaka section being quite exceptional.

After the previous descriptions it is possible to speak more generally of Aldabra. The cliffs, as stated, show their structure wonderfully clearly; except in the Southern Bight, where they are sloping and buttressed, they are much overhung, and are crumbling fast. The general which has been worn away in places so as to make clear its section. The ridge itself is formed mainly of a sort of brown conglomerate or pudding stone, which in one place is capped by a chalky deposit, in which there is a certain amount of flinty rock. On the south side, towards the east end of the ridge, are some large masses of dark-brown rock at sea-level. The greater part of the body of the ridge is formed of the conglomerate, but this darker rock seems to enter more into its composition at lower levels. On the sides of the ridge are pinnacles of a rough and pointed rock, which is apparently a calcareous deposit, perhaps a mollusc bed, as it is largely formed by shells. The pinnacles are only a few feet high on the outer side of the ridge, but towards the centre of the island form a series of grotesque, upstanding pillars and walls, varying up to 15 feet in height, and standing on brown conglomerate rock.

Picard Island is mainly of the typical coral-rock structure. To the south-west there is a plain of Platin country, on the east side of which is a large basin in subterranean connection with the lagoon. On the floor of this basin I found several small lumps of dark brown rock, apparently the same as on Esprit, and on its north side there is a certain amount of the same conglomerate, though the main portion of the rock is apparently calcareous; much of it is highly crystalline calcite. Some



The Aldabra Group. Scale, about 3½ miles to 1 inch.

variations in level across the land are similar; the highest point is near the sea, and there is a steady decrease in level to the lagoon.

As regards the nature of the land, all the northern portion of the atoll—Polymnie Island, Malabar Island, and the north-east part of Main Island—consists of Champignon. The south-east portion of Main Island is chiefly Platin. In the centre of the south of Main Island there is a wide shore zone, and then a belt of Champignon. To the east and west of this portion are large mounds (65 feet in height) near the shore. They are obviously wind dunes, the seaward slope being gradual with little vegetation, the landward very steep and covered with bush. Opposite each dune the cliffs have almost entirely vanished, a direct slope of sand leading up to the dune. It is noticeable that in Aldabra, as in the other islands of this part of the ocean, dunes are only formed on the coast facing the strong south-east trades. The west portion of Main Island is chiefly Champignon. At Couroupa there is a dip in the rock which appears to extend from the shore right across to the mangrove swamp; it is filled with sand, and attains a maximum depth of 8 feet.

There are two islands now left which are of peculiar importance, *i.e.* Esprit and Picard. Round the south and west of Esprit there is a ridge of rock about 30 feet high, extraordinary pieces of rock were found, apparently a calcareous matrix thinly enamelled with a transparent brown substance. Bones, the teeth of sharks and rays, and the remains of other organisms at present unidentified, were numerous in the calcareous rock, and also in a rock which appears to be conglomerate of a fine texture. As at Esprit, there is also a considerable quantity of the pinnacled shell rock.

It is, of course, quite unnecessary to emphasise the interest of the above formations. It appeared to me that the whole must have been volcanic in origin, and it is to be hoped that the examination of the rocks from Esprit and Picard may furnish a clue as to the nature of the base on which Aldabra is built.

The four Passes into the lagoon are also interesting, and perhaps give a clue to its formation. They have usually deep central channels, with reefs on either side. Small rock islets are present on these reefs, and it appears certain from their existence that the Passes are steadily increasing in size, and that their reefs are really the remains of the land kept up to low-tide level by growing coral. Live coral extends for some distance into the lagoon, there being in all cases a luxuriant bed just inside the Pass. At the mouth of the Pass all corals are largely encrusted with Lithothamnia, and further seawards many are completely killed by these algæ.

Besides the existing Passes, it should be noted that there seems a likelihood of at least three more being formed—at Camp Frigate the mangrove swamp extends right through the island to the sea, and no doubt a certain amount of water already traverses the land at that point; in Polymnie Island, at one place the swamp is within 100 yards of the shore, and a Pass will probably be formed in time; at Dune Jean Louis there is only a quarter of a mile between the sea and the swamp, and if the lagoon erosion continues no doubt Main Island will be divided at this point. It is worthy of note that fresh Passes seem always to be formed by lagoon erosion, and not from the seaward side.

The lagoon itself is very shallow, and the bottom sandy in the middle, changing into fine mud as one approaches the mangrove swamp. Everywhere one is forcibly struck by the extent of the erosion in the lagoon. Judging by its maze of small islands and mushroom-shaped rocks, at least one-third, or even more, of the lagoon can be shown to have been land at one time. At spring tides the amount of fine mud carried out to sea in suspension is very large, and it is obvious that the lagoon is still growing in size. There is some difficulty in accounting for the rapid transformation of the rock into mud, as boring animals are not common; I would suggest that possibly the mangroves have some further action on the rock than merely helping to split off large pieces.

As regards the vegetation, it is impossible to say much until the specimens collected have been worked out. The mangrove swamps extend right round the lagoon sides of the islands, Rhizophora and Brugiera being the predominating genera, though there is also a large quantity of Ceriops. Rhizophora seems to require a deep mud, but Brugiera thrives better in the more rocky places and on the small islands. In the extreme east of the atoll there is a large forest of the pseudo-mangrove Avicennia. The only other fact that need be mentioned is that Esprit Island has several plants not found elsewhere, or which are common to it and Picard Island alone.

The fauna also must be left until the collections arrive and have been examined. So far as can be seen at present, it appears to be of the regular coral-island type, with such additions in the land animals as would be natural considering the large amount of land and the larger flora. It should, however, be remarked that the mangrove swamps were very disappointing in their fauna, a condition very different from that described in mangrove swamps in other localities.

Large numbers of giant land-tortoises still exist, but the problem of their distribution does not relate to Aldabra alone, as I have found their remains on Assumption and Cosmoledo, and they are also known to have occurred in nearly all the Seychelles islands, two of which, Bird and Dennis, are coralline in structure.

In conclusion, I would suggest that the reefs and islands of the Aldabra-Farquhar line present a most interesting series in the possible life of an atoll.

(*a*) *Astove*.—Land rim of atoll almost perfect, and mostly rocky. Only one small Pass of recent date. Lagoon exceedingly shallow, but getting rapidly deeper. Formation of another Pass proceeding.

(*b*) *Aldabra*.—Land rim still very perfect, and mostly rocky. Several Passes already in existence. Strong evidence of increase of lagoon at expense of land. Lagoon deeper, and at least three Passes in course of formation.

(*c*) *Cosmoledo*.—Land rim broken up into a series of small islands only. Most of encircling reef bare, but evidence of a former rock-cap in mushroom-shaped rocks and minute islands. A noticeable increase of sand on the island, and decrease of rock. Lagoon deeper than that of Aldabra, and more open.

(*d*) *Farquhar*.—Judging from your description,[1] land rim very small. Island nearly all sand, and typical coral rock very scarce. Lagoon still more open.

(*e*) A final or hypothetical stage may be imagined as an atoll with a considerable lagoon, without, perhaps, any land, or, if land is present, only as sand cays piled up on the reef.

J. C. F. FRYER.

[1] Stanley Gardiner, Trans. Linn. Soc., xii., pp. 140–5.

ROAD MOTORS AND PROBLEMS CONNECTED WITH THEM.

THE "James Forrest" lecture was delivered at an extra meeting of the Institution of Civil Engineers on April 26 by Colonel H. C. L. Holden, R.A., F.R.S. The author took for his subject the road motors of the present day, and some unsolved problems connected with them. The modern era of mechanically propelled road vehicles was inaugurated with the passing of the Act of 1896. In the case of steam traction engines there has since then been no rapid progress; problems awaiting solution in this class are (*a*) greater economy of fuel; (*b*) means of condensing all or part of the water converted into steam; (*c*) reduction of weight and increase of adhesion surface to the road with minimum pressure per unit area on the road, without sacrifice of other qualities, including speed.

The problems regarding medium and light road motors are similar, and the author devoted most of the paper to the latter type, which includes passenger vehicles, light delivery vans, and motor-bicycles, tricycles, &c., the speed of which is limited by law to twenty miles per hour. Though by far the greater number of such vehicles are driven by petrol engines, there are others driven by steam, electricity, and combined systems; compressed air and liquid air have also been tried, but have never passed the experimental stage. It is estimated that, of the 100,000 motor-cars and cycles in use in the British Isles, more than 99 per cent. are driven by petrol engines. In spite of the great inherent advantages of the steam engine, steam-driven road motors form so small a proportion of the whole as to render it obvious that at present their advantages do not outweigh their disadvantages. For heavier goods and public passenger vehicles they may in time compete with petrol vehicles, but for private motor-cars the boiler and burner will always, in the author's opinion, handicap the system's other advantages. Electric propulsion would be ideal if a source of electricity were available which would bear comparison with petrol in weight, cost, and portability. The generation of electricity direct from the oxidation of coal or other fuel cannot be said to be impossible, and it may be actually within our reach if we only knew how and where to grasp it.

Nearly all the internal-combustion engines in use employ the Beau-de-Rochas or four-stroke cycle. Greater uniformity in the turning moment has been secured by having multiple cylinders, and at high speeds of rotation there would not appear to be much room for improvement in this respect. At the same time, individual impulses are not entirely damped out before they reach the road, and these leave their effect to a certain extent evident on the wearing surfaces of the tyres. It is difficult to see how a more uniform turning moment can be obtained with reciprocating engines. An engine of the rotary or turbine type would be effective, but no successful example at present exists. The moving parts of the engine, and also the explosion pressures on the pistons, can be balanced so perfectly by use of the double-piston type that, if the car is at rest, it is difficult to detect by eye or ear if the engine is running. The turning moment, however, cannot be balanced, and reacts on the whole car when running, especially at full power and slow speed, as when climbing a hill. A more perfect solution may be obtained at some future time, but it would necessitate the employment of an entirely different type of engine and transmission mechanism.

The use of the spray or jet carburettor has now become universal. The carburettor that will supply a constant mixture at constant pressure and temperature under all conditions of running of the engine is one problem which has yet to be solved. When to this has been added some device whereby this constant mixture shall be diluted with air to exactly the correct extent to give perfect combustion on explosion in the cylinder, then, and then only, will perfection in this matter have been reached. The whole question of carburation is very complex, and the author regards with satisfaction the fact that it has now been taken up seriously by scientific experimenters.

No universal method of ignition has been arrived at, though electricity in some form or other seems more nearly to approach the ideal than anything else. The electric system of ignition enables the moment of ignition to be varied exactly as required, giving very complete control over the speed and power of the engine within limits. However, these limits constitute the weak points in what might otherwise be a perfect system. Hot as the spark is, it is unable to ignite with readiness mixtures which have more than a certain percentage of air, and the ignition, being so extremely local, prevents the flame in a weak mixture being readily transfused throughout the whole of the charge. Improvements in the original system have been in the direction of substituting mechanical for chemical means of production of the current. Owing to the fact that a slight difference in the mixture or in the amount of compression entails an alteration in the time when the charge must be ignited in order to obtain the best result, and owing to the difficulty of maintaining each cylinder of an engine in identical conditions in these respects, it is obvious that an ignition system that does not take such variations into account cannot be perfect.

The Ackermann system of steering, invented nearly 100 years ago for horse-drawn vehicles, is now almost universally employed for all road motors, except traction engines. Each of the steering wheels turns separately on a vertical pivot, which should, theoretically, pass centrally through the vertical plane of the wheel and its contact with the ground. An obstacle met by the wheel would then have no tendency to disturb the steering of the car. The said arrangement is difficult to obtain mechanically, and a compromise is sometimes made by inclining the pivots or by inclining the wheels. It is not easy to see how the best types of the present system can be improved, although it must be admitted that none is perfect.

Horizontal cylinders may be lubricated by feeding oil through a hole in the cylinder on to the piston, allowing a portion to flow through a hole in the piston to lubricate the gudgeon pin. The oil is drained away at the front end of the cylinder, and is not used again. In vertical engines splash lubrication is generally employed for the lubrication of the piston, gudgeon pin, and in many cases the crank shaft and other engine bearings. The oil in this system is thrown up from the crank chamber by the crank dipping into it. At the best it seems to be a happy-go-lucky method of a most unscientific order; the only thing which can be said in its favour is that in actual practice it has been found to work. For crank shafts and similar bearings a forced feed system would be better, provided some perfect system for road motors could be found of freeing entirely the oil from grit before re-feeding it to the bearings. Bath lubrication of gear wheels is effective as regards lubrication, but absorbs power in churning up the oil.

There is still a good deal that can be effected in design in reducing friction by the substitution of ball or roller bearings for plain ones in suitable places, and by the use of metals having a low coefficient of friction. There are many ways in which power can be lost between the engine and the road wheels. None of the many forms of friction clutch can be depended upon not to slip in the way that a clutch which is positively engaged can. The use of Hooke's universal joints involves loss in transmission, as is demonstrated by the rapidity with which they often wear. The total transmission losses are not accurately known under road conditions, but it may be indirectly estimated that such losses may amount to from 20 per cent. to 40 per cent., or even more.

The advantages of pneumatic tyres, owing to their resilience and low resistance, are counterbalanced by their high cost, rapid wear, and vulnerability. Methods of decreasing the vulnerability are only obtained at the sacrifice of other, and possibly more important, qualities. Owing to the large area of contact with the ground, and consequent low pressure per unit of contact area, the coefficient of friction is so small that skidding occurs if the road is greasy. No remedy has been found which does not impair the action of the tyre as a pneumatic one. Again, owing to the rapidity of recovery of the tyre on passing over an obstacle, oscillatory movement of the vehicle is started, and, given favourable conditions of speed and road, may be maintained, or even increased, to a dangerous extent. A partial remedy exists in the shock absorber applied between the sprung and unsprung portions of the vehicle. An inherent defect of the pneumatic tyre is its dust-raising properties. The tyre raises the dust, and the eddies produced by the passage of the car scatter it far and wide. This subject is one which is attracting the attention of the authorities representing road-makers and users. So far, the only effective remedy has consisted in treatment of the surface of the road.

The study of the composition of the exhaust gases is of importance. It ought to be possible to ensure that the exhaust gases contain not more than 1 per cent. of carbonic oxide. Governing by retarding the ignition is effective, but is objectionable on account of its liability to increase the percentage of CO in the exhaust; it is also unscientific, and very wasteful of fuel.

To obtain an average speed of twenty miles per hour, experience tells us that the maximum speed will not be less than 50 per cent. greater than the average during some periods of the journey; assuming a moderate efficiency of transmission of power, the provision of an engine capable of giving 1 brake-horse-power per cwt. of the gross weight of the vehicle and its load of passengers, &c., would not be excessive.

Deductions made from data known to be approximately correct for the speed, power, and wind area of various cars having ordinary touring bodies lead to the formula $P=0{\cdot}0017AV^2$, in which P = resistance in lb. per square foot, A = projected area of car in square feet, and V = velocity in feet per second. Experiments are needed to provide data as regards the form of car offering the least resistance to the air.

The gross ton-miles which should be obtained from a gallon of petrol of about 0·720 specific gravity at a speed of twenty miles per hour should not fall below thirty under ordinary conditions. There is room for improvement in this. Many other items, tyres especially, have to be considered, which swell the bill to such an extent as to render the cost of fuel but a small part of the whole.

The weight of a pleasure motor-car is high compared to the useful load of passengers. The useful weight in this case would be about one-quarter of the weight of the vehicle. Medium-weight passenger or goods' vehicles may carry a useful load of three-quarters the weight of the unladen vehicle; heavy vehicles having a slow speed may carry a load equal to the weight of the vehicle. It would appear that some improvement may be reasonably looked for in the reduction of the weight of the car as compared with its useful load.

Brakes on the steering wheels give immunity from skidding, but are very difficult to arrange for. It is best to apply both brakes required by law to the driving wheels, rather than to have one of them applied to the secondary transmission shaft. The distance in which a car can be pulled up without damage to the tyres on an ordinary road and under normal conditions may be approximately found from the formula $S=0{\cdot}04V^2$, where V is in miles per hour and S is the distance in yards in which the car should come to rest. At ten miles per hour it should stop in 4 yards, and at twenty miles per hour in 16 yards. These distances are greater than is desirable, and also greater than most drivers would be prepared to admit, probably owing to time, and not distance, being the factor that a driver judges by when called upon to stop quickly. Improvement is only to be sought for in increasing the surfaces of adhesion, as by braking all four wheels, or by more equal distribution of the braking effect than we have at present.

Petroleum spirit is practically the only fuel employed; other fuels which might be used are petroleum, paraffin, benzol, and alcohol. Suction gas producers may be used for the heavier classes of vehicles.

THE "BROMOIL" PROCESS.

ABOUT five years ago Mr. G. E. H. Rawlins introduced, as a practical method of making photographs, a process described fifty years previously by Poitevin. Paper coated with gelatin is sensitised by soaking it in a solution of potassium bichromate, dried, and exposed under a negative. Where light has acted the gelatin is rendered less able to absorb water, so that if the print is moistened, and a roller charged with a greasy ink is passed over it, the ink is taken up by the print more readily where the light has produced the most change and the water has been the least absorbed. The use of rollers for the application of the ink soon gave way in favour of brushes. This process commended itself to many photographers, especially those who desired to "control" their prints, that is, to produce what they desired rather than what they were able to secure by photographic methods, for it is possible to put on much or little ink, and to reduce or increase the quantity in the various parts of the print as the taste of the worker may dictate. Obviously a wide choice of colours is available, and the method has the advantage of giving the peculiar richness and depth of tone associated with oil colours.

About a year ago it was found possible to render bromide enlargements available for this process, the silver image in the enlargement effecting the reduction of the bichromate. Thus no large negative is needed, and no exposure to light after the bromide enlargement has been made. Mr. F. J. Mortimer calls this last method of work the "bromoil" process, and he has now on view at the house of the Royal Photographic Society, 66 Russell Square, more than fifty examples of his own work. The exhibition will remain open, free on presentation of visiting card, daily from 11 a.m. to 5 p.m., until June 8. Mr. Mortimer has been known for a considerable time as the producer of fine marine and coast-scenery photographs, but here he shows also landscapes and portraits of various kinds. Those who are interested in such methods of work will get a better idea of the possibilities of the "bromoil" process by a study of these examples than they have ever had an opportunity of getting before.

ARBORICULTURE IN GERMANY.[1]

THE German Arboricultural Society came into existence in the year 1892, and now has a membership of 1800, of whom 120 attended its annual meeting in August, 1908, in Alsace Lorraine; Strassburg and Colmar being its headquarters. The president is Count Schwerin, who is ably helped by the secretary, L. Beissner, the conifer expert. The report just issued gives a detailed account of the meeting. The first three days were devoted to the reading of papers now published. Then followed visits to private parks, where many fine exotic and native trees, some of which are illustrated in the report, were seen. Each member, who was himself listed and conspicuously numbered, received a numbered list of the trees worthy of note in each centre visited. The list gave the name, girth, height, and age of each tree, with further remarks in some cases.

The lists embodied in the report may serve as an indication of the perfection of arrangement which characterised the meeting. Everything was planned to the minute, and nothing was allowed to interfere with the programme. Thus at Ollweiler Prof. Engler was in danger of being left behind after a hurried inspection of a fine specimen of *Quercus sessiliflora*, 250 years old. La Schlucht and Hoheneck gave a peep into the forests on the slopes of the Vosges Mountains. This district, with Longuemer and Retournemer, was also visited by the botanists fresh from the Botanical Congress at Strassburg, and was full of interest.

A few only of the articles in the report can be noticed. In addition to many contributions by the president, including one on the hardiness of certain trees, and one by Beissner on conifers, C. S. Sargent, an honorary member, gives an illustrated account of the Arnold Arboretum, Koehne writes on Taxodium, Forster on exotic trees, Berg on *Pseudotsuga Douglasii* in Europe, while St. Olbrich and Hübner write on trees suitable for avenues and towns, and Sprenger and Rehder on new or rare arboreous plants.

Following on more than twenty important papers there are many smaller contributions. One of these may be noticed. Unger, just returned from a residence of twenty years in Japan, proposed the cultivation of *Broussonetia papyrifera* for the supply of Japanese paper. As twenty degrees of frost is fatal to the plant, Germany was declared by experience unsuitable for the industry. Several pages are devoted to descriptions, in Latin in many cases, of new species or forms. A useful feature is a correspondence section for the supply of information on such subjects as Platanus diseases, and pitch pine. A place is also found for reviews of books on trees. Obituary notices appear, including one on John Booth, a Teutonic Scot, who strove successfully to introduce exotic timber trees into Germany, and one on George Nicholson, of Kew. Altogether the publication is astonishingly rich in contents of wide and general interest, and is very cheap.

A curious feature of the report is the entire absence of any reference to the many beautiful illustrations, there being sixteen full-page ones and many others incorporated in the text. Members of the Society, by payment of an annual subscription of five marks, obtain the report, certain privileges at the meeting, and supplies of packets of seeds as well as of living plants. This result is mainly due to the enthusiastic devotion and organising skill of the president, who has personally made all the detailed arrangements for the meeting at Cottbus in 1909, and provided the necessary particulars for two alternative places of meeting in 1910. The society would be delighted, I learnt, to visit the British Isles in the company of British arboriculturists. Cannot this be arranged for by the three British arboricultural societies?

A re-issue of the reports for the year 1892–1901, in one volume of 500 pages, at not more than nine marks, is offered for subscription. T. J.

[1] Mitteilungen der deutschen dendrologischen Gesellschaft. No. 17, 1908. Pp. 285; with many illustrations. (Bonn—Poppelsdorf: L. Beissner, Geschäftsführer der Gesellschaft.) Price 5 marks.

GROWTH OF NERVE FIBRES.

THE view that each nerve fibre develops as an independent outgrowth from a nerve-cell, finally becoming united to other tissues (*e.g.* muscle fibres) in the periphery of the body is associated especially with the name of His, and has been accepted by the majority of embryologists. Those who have worked at the question of nerve repair or have studied the mechanism of the regeneration of nerve fibres which leads to restoration of functions are divided into two camps; the majority hold, as Waller originally taught, that the nerve fibres grow in a distal direction from the cut stump attached to the central nervous system, ultimately finding their way into the peripheral segment. A minority of researchers hold the contrary view, namely, that restoration occurs in the peripheral segment independently of connection with the central nervous system.

Within the last year, Mr. Ross Harrison, of Yale, has demonstrated the correctness of the views of His in a very remarkable way. He has actually seen the fibres growing outwards in embryonic structures. Pieces of the primitive nervous tube which forms the central nervous system were removed from frog embryos and kept alive in a drop of lymph for a very considerable time; the cilia of the neighbouring epidermic cells remained active for a week or more; embryonic mesoblastic cells in the vicinity were seen to become transformed into striated muscular fibres, and there was therefore no doubt that even under these artificial conditions—rendered necessary for microscopic purposes—life and growth were continuing. From the primitive nervous tissue, and from this alone, nerve fibres were observed growing and extending into the surrounding parts. Each fibre shows faint fibrillation, but its most remarkable feature is its enlarged end, which exhibits a continual change of form. This amœboid movement is very active, and it results in drawing out and lengthening the fibre to which it is attached, and the length of the fibre increases at the rate of about 1 micromillimetre per minute. Those interested in this subject should refer to Mr. Harrison's last paper, published in the *Anatomical Record* (Philadelphia, December, 1908), where they will find figures representing the growing fibres in various lengths drawn at intervals of half an hour or thereabouts.

Such observations show beyond question that the nerve fibre develops by the overflowing of protoplasm from the central cells, and thus give us direct ocular evidence in favour of the view which most embryologists previously held mainly as the result of circumstantial evidence. It is not surprising to find that as this and other facts all bearing in the same direction are brought to light, the prevalent idea regarding nerve regeneration after injury follows the same lines. Indeed, the number of those who hold the so-called "autogenetic theory" of nerve regeneration is being reduced nearly to vanishing point.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Adams prize for 1909 has been awarded to G. A. Schott, late scholar of Trinity College.

The Adam Smith prize has been awarded to J. M. Keynes, fellow of King's College, for an essay on the "Method of Index Numbers."

LIVERPOOL.—On May 8 the following honorary degrees were conferred, among others:—*LL.D.*, Mr. A. J. Balfour, Lord Charles Beresford, Mr. Birrell, M.P., Sir John Brunner, M.P., Dr. Richard Caton, Lord Crewe, Sir Donald Macalister, Mr. Marconi, Lord Roberts, and Prof. Paul Vinogradoff; *D.Sc.*, Mr. Francis Darwin and Prof. J. L. Todd; *D.Eng.*, the Hon. C. A. Parsons. At a luncheon after the ceremony Mr. Balfour spoke upon the growth of the university movement. In the course of his remarks he referred to this growth as one of the most important and fruitful facts which has emerged in the experience of this generation. We live in an age of scientific discovery and industrial invention—in an age in which, from the very nature of the case, there is, and must be, a tendency to put into a less prominent position relatively, though not absolutely a less important position, the ancient studies which for centuries have occupied the educational interest and intellect of Europe. The problem to be decided is how to combine all the cultivation of these ancient studies with their newer sisters which have so much closer relation to the cultivation of the material needs of great industrial communities. There is no way of coordinating except to bring all the highest intellects concerned with both into a single organisation. It is an honour to be associated with a movement which is going to have a world-wide influence in the direction of not merely increasing industrial dexterity, but also improving and adding to the knowledge of nature, which is the greater security that the industrial and scientific movement in future shall never be divorced from those humanistic influences which have been the greatest element of intellectual progress in the history of our race.

MR. T. H. LABY has been appointed professor of physics in Victoria University College, Wellington, New Zealand.

HARVARD UNIVERSITY will lose one of the most distinguished members of its faculty in September by the resignation of Prof. G. L. Goodale, who will by that time have completed his seventieth year. Dr. Goodale has been connected with Harvard since 1872, when he was appointed instructor in botany and lecturer in vegetable physiology. In 1873 he was promoted to the assistant professorship in the latter subject. Since 1878 he has been Fisher professor of natural history and director of the botanic garden.

THE *Physikalische Zeitschrift* for April 15 contains the list of lecture courses to be given in the German universities during the summer semester. We note that at the University of Berlin seven professors and lecturers will deal with mathematics, five with astronomy and geodesy, thirteen with various branches of physics, three with meteorology, two with wireless telegraphy, twenty with the various branches of physical, inorganic, and organic chemistry, and ten with technical, physiological, botanical, and photographical chemistry.

BY a recent Act of the United States Legislature, provision has been made, says *Science*, for a biological station to be located on the shores of Devil's Lake, North Dakota. An appropriation has been made for building laboratories and providing annual maintenance. This laboratory will be well situated for the study of many interesting ecological and physiological problems, inasmuch as Devil's Lake is a large body of brackish water with no outlet, and represents the collected water supply of a large interior drainage basin. The direction of the laboratory will be under the charge of the biological department of the State University, of which Prof. Melvin A. Brannon is head.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 6.—Sir Archibald Geikie, K.C.B., president, followed by Mr. A. B. Kempe, vice-president and treasurer, in the chair.—Reciprocal innervation of antagonistic muscles. Note xiv. Double reciprocal innervation: Prof. C. S. **Sherrington.** This communication establishes that the algebraic summation of excitation and inhibition pointed out in a previous note in regard to extensor muscles holds good also for flexor muscles. In regard to the mutual action of antagonistic muscles, it shows that three types of result have to be distinguished, and that in each of these reciprocal innervation is the controlling factor. The importance of reflex inhibition for the grading of intensity of reflex actions is illustrated by various examples, in some of which the excitatory stimulus remains of constant intensity while the inhibitory is varied, and in others the inhibitory stimulus is kept constant in intensity while the excitatory is varied; in both cases a very delicate grading can be obtained even with artificial stimulation, electric and so on. The action of strychnine on the flexor inhibition is shown to be, as in the case of extensor inhibition, a conversion of the inhibition into excitation. These effects, namely, grading, algebraic summation, and conversion of inhibition into excitation, are all found readily both in the decapitated and spinal animal and in decerebrate rigidity.—Note on a curious property of neon: Prof. J. Norman **Collie.** During some work with specially pure neon, it was noticed that, as the gas escaped at ordinary pressure from a Töpler pump up through the mercury in an inverted test-tube, each bubble glowed with a fine red glow. This property is very apparent if the neon is sealed up in a glass tube with mercury, and the tube shaken violently. It was expected that the glow would always be produced when the tube containing the neon and mercury was shaken. This was found not to be the case, for it was noticed in many instances that, after shaking for some time, the glow became very feeble. These tubes could at once be brought back to their original condition by allowing a discharge to pass through them from an induction coil. Sometimes, however, when a powerful discharge was passed through them, exactly the opposite effect was produced, and further sparking did not improve them. Platinum wires sealed through the ends of the tubes did not interfere with the property of glowing when shaken. Another tube was strongly etched inside with hydrofluoric acid, also without effect on the glow. Heating the tubes strongly did not destroy the effect, but, on the contrary, restored those tubes that had been spoilt by passing heavy electric discharges through them. It was found possible to produce in this way tubes that possessed the property of glowing only at one end, or glowing at both ends and not in the middle. The slightest trace of moisture entirely stops the glow. The tubes were filled at different pressures, varying from 120 mm. to 200 mm. pressure, as it was found that the glow was as bright at these as at ordinary pressures, and a saving in neon was thus made.—The properties of colloidal systems. I. The osmotic pressure of Congo-red and of some other dyes: Dr. W. M. **Bayliss.** Congo-red, although a colloid in the sense of not being diffusible through parchment-paper and exhibiting other colloidal properties, such as those dependent on surface effects, has an osmotic pressure equal to that which would be given if it were present in true solution in single molecules. The solutions are not resolvable into particles under the ultra-microscope. The theoretical osmotic pressure is only to be obtained in the complete absence of extraneous electrolytes. Even the carbonic acid present in ordinary distilled water is sufficient to cause a marked fall in the pressure recorded. The manner in which electrolytes produce this fall is by causing aggregation of molecules to form particles. This is the case whether acid, alkali, or neutral salt be in question. The action of a stable colloid in protecting against the effect of electrolytes is shown to consist, in the cases of congo-red and of arsenious sulphide, in the production of minute aggregates, which, although causing fall in osmotic pressure by diminution of effective concentration, are not of sufficient size to precipitate. Hence the protective power can only be regarded as a limited one, due probably to the formation of complex colloids. The free acid of congo-red forms a deep blue colloidal solution when dialysed. This is easily resolvable under the ultramicroscope, but gives a definite and measurable, though small, osmotic pressure, about 14 mm. Hg for a 1 per cent. solution. Assuming the kinetic theory to be correct, this means that the aggregates contain, on an average, twenty molecules. Estimations of the molecular dimensions of this blue colloid were made on the basis of enumeration of the particles in unit volume by means of the ultramicroscope. The values found are larger than the accepted ones for water, &c., about 100 times, in fact. The whole of the results are capable of explanation on the assumption that colloidal particles possess the kinetic energy of molecules, but lend no support to any view that postulates the necessary presence of foreign electrolytes.—The origin and destiny of cholesterol in the animal organism. Part V.—On the inhibitory action of the sera of rabbits fed on diets containing varying amounts of cholesterol on the hæmolysis of blood by saponin: Mary T. **Fraser** and J. A. **Gardner.** In an earlier paper it was shown by comparative estimations of the total cholesterol-content of the blood of rabbits that had been respectively fed on ether-extracted bran, and on the same extracted bran with the addition of known amounts of cholesterol, that some, at any rate, of the cholesterol absorbed found its way into the blood-stream. It seemed desirable to ascertain whether the cholesterol was absorbed into the blood-stream as such, or in the form of esters, or in both states, and also whether the phytosterol of vegetable food can be utilised for the formation of cholesterol in the organism. Use was made of the observations of Hausmann, Abderhalden, and Le Count, who showed that, whereas cholesterol and phytosterol inhibit the hæmolytic action of saponin, their esters do not do so. A series of comparisons were made of the inhibitory action of sera of rabbits fed on extracted bran alone, on extracted bran, and, in addition, measured quantities of cholesterol, cholesterol esters, and phytosterol, respectively, on the hæmolytic action of saponin. Care was taken to keep the animals under strictly comparable conditions, and the different sets of hæmolytic experiments were carried out under diverse conditions. *Conclusions.*—(1) When cholesterol is given with the food of rabbits, some is absorbed, and finds its way into the blood-stream as free cholesterol; only a portion of the total cholesterol given in the food is absorbed, the rest being excreted unchanged. (2) Cholesterol when in the form of esters undergoes hydrolysis in part, at any rate, during digestion, and appears in the blood-stream as free cholesterol. (3) When animals are fed on phytosterol, this substance is in part absorbed, just as in the case of cholesterol, and appears in the blood-stream either itself or in the form of cholesterol.—Some effects of nitrogen-fixing bacteria on the growth of non-leguminous plants: Prof. W. B. **Bottomley.** Bacterial cultures prepared from the algal zone of Cycas tubercles taken from below the surface of the soil always contain a species of Azotobacter associated with *Pseudomonas radicicola.* Pure cultures of these organisms were obtained, and it was found that when they are growing in association there is an increased assimilation of free nitrogen.

Control	0·48 mgr. N. per 100 c.c.
Pseudomonas alone ...	0·91 ,, ,,
Pseudomonas + Azotobacter	1·21 ,, ,,

In Cycas tubercles the bacteria live, usually imbedded in a slime, in the open spaces of the algal zone, and the projecting cortical cells presumably absorb the nitrogenous products of bacterial activity. Experiments made to ascertain to what extent, if any, a mixed culture of Pseudomonas and Azotobacter applied to the roots of other non-leguminous plants might influence their growth, the nitrogenous bacterial products being absorbed directly by the plant, gave the following results:—*Oats.*—Pot experiments with oats grown in sand dressed with phosphates, potash, and lime. Treated pots watered once with the mixed culture solution. Average weight per plant: untreated, 0·42 grm.; treated, 0·74 grm.; increase, 0·32 grm. = 76 per cent. *Barley.*—Field experiments on limed plots of 484 square yards. Seed only treated with bacterial culture. Yield per plot: untreated, 608 lb.; treated, 691 lb.; increase, 83 lb. = 13·6 per cent. The barley from a treated plot also yielded a higher nitrogen content.

	Mgr. N. per cent.	Weight of 1000 corns	Mgr. N. per corn
Untreated ...	1·55	48·5 grms.	0·75
Treated	1·76	49·5 ,,	0·87

Bulbs.—*Galtonia candicans* grown in sandy soil, manured and limed, 250 bulbs of equal size in each bed. Treated bed watered twice with mixed culture solution. Weight of bulbs when lifted and dried at end of season: untreated, 69 lb. 3 oz.; treated, 82 lb. 1½ oz.; increase, 12 lb. 14½ oz. = 18·6 per cent. *Parsnips.*—Grown in garden soil, manured and limed. Half the bed watered once with mixed culture solution. Every parsnip grown in the bed included in the weights. Untreated, 68 roots weighed 22 lb. 14 oz.; average per root = 5·38 oz.; treated, 65 roots weighed 26 lb. 10 oz., average per root, 6·55 oz.; increase per root, 1·17 oz. = 21·7 per cent. In all the experiments the soil was treated with lime before the mixed culture was applied.

Royal Microscopical Society, April 21.—Mr. E. J. Spitta, vice-president, in the chair.—The recent and fossil Foraminifera of the shore sands of Selsey Bill, Sussex: E. **Heron-Allen** and A. **Earland.**—The disappearance of the nucleolus in mitosis: E. J. **Sheppard.**

Physical Society, April 23.—Dr. C. Chree, F.R.S., president, in the chair.—A want of symmetry shown by secondary X-rays: Prof. W. H. **Bragg** and J. L. **Glasson.** When a primary X-ray strikes an atom, a secondary X-ray sometimes starts out from the place of impact. The experiments described in the paper were made with the object of comparing the intensity of emission of the secondary X-ray in a direction making an angle of about 45° with the primary with the intensity in a direction making an angle of 135°, and therefore turning back almost completely. It was found that in the case of atoms of platinum, tin or aluminium, or of such light atoms as are contained in celluloid, the former was larger than the latter, being sometimes three times as great. Madsen has obtained similar, but much greater, inequalities in the case of the γ rays. When atoms of copper or iron were tested, atoms which give rise to a very soft radiation, there was little inequality. A similar inequality effect also occurs in the case of β rays. On the original pulse theory, calculation showed that there should be no inequality of the secondary X-radiation in any case. If that theory were abandoned, and the X-rays were supposed to be bundles of energy travelling through space, there did not appear to be sufficient definition of such entities as would enable any comparison to be made between theory and experiment. If the rays were supposed to be material the facts were generally in agreement with expectation, and afforded another instance of close parallelism between the phenomena of the X and the γ rays.—Transformations of X-rays: C. A. **Sadler.** It has been shown that the members of the group of metals chromium—silver emit under suitable primary beams radiations which are homogeneous, and which increase in penetrating power with increase of atomic weight of the radiator. Using these homogeneous beams, the tertiary radiation excited by them in other metals has been studied by the author. It was found that the tertiary radiation excited in any member of the group Cr—Ag was homogeneous, and its penetrating power was that characteristic of the radiation from the substance when excited by a primary beam. With any given tertiary radiator it was found that the intensity of the homogeneous type of radiation emitted when the homogeneous radiations from the members of the group Cr—Ag successively fell upon the radiator was inappreciable unless the exciting radiation was more penetrating than that characteristic of the radiator.—Theory of the alternate-current generator: Prof. **Lyle.** The author points out that the theory of armature reaction as ordinarily discussed by electricians is unsatisfactory, as an important effect due to the mutual induction between the current in the field winding and the current in the armature circuit is neglected. To simplify the problem, the case of a simple ironless single-phase alternator is first discussed, and then the effects of hysteresis and eddy currents. The action of "dampers" in diminishing the heat-losses in the field circuit and the theory of the synchronous motor are also discussed.

Zoological Society, April 27.—Prof E. A. Minchin, vice-president, in the chair.—A review of the species of the lepidopteran genus Lycænopsis, Feld. (Cyaniris auct. nec Dalm.), on examination of the male ancillary appendages: Dr. T. A. **Chapman.**—(1) Some points in the structure of *Galidia elegans*, and on the post-caval vein in Carnivora; (2) the post-caval vein and its branches in certain mammals: F. E. **Beddard.**—The comparative osteology of the passerine bird *Arachnothera magna*: Dr. R. W. **Shufeldt.**

Challenger Society, April 28.—Prof. d'A W. Thompson in the chair.—Photophores in Decapoda: S. W. **Kemp.** While many decapods emit a luminous secretion from various glands, true photophores are at present known only in five species of the three genera Sergestes, Acanthephyra, and Hoplophorus; in all of them an intensely blue pigment is associated with the organ; in one the pigment is situated in the corneal lens, in the others in the (presumably) light-producing cup of cells which lies immediately behind the lens, and the general body-pigment is absent where they occur. The organs increase in number with age, and exhibit morphological stages. They are placed much as in Euphausids.—A new method of plotting currents from observations of drifters, used by the Scottish Fishery Board in the international study of the North Sea: Prof. **Thompson.** On a large chart divided into squares of 1° lat. and ½° long. all the observations were recorded by arrows of true direction and proportionate length; the "resultants" of these arrows, calculated for each square, showed a uniform cyclonic current from Shetland down and across the North Sea to Norway, in concentric belts round the area of dead water which had been shown to exist by the observations of a previous year.

CAMBRIDGE.

Philosophical Society, March 8.—Prof. Sedgwick, president, in the chair.—The nature of anthocyanin: Miss **M. Wheldale.** The communication deals with the red-purple-blue pigment "anthocyanin" occurring in plants. Following up the suggestion made by various investigators that there is some intimate connection between tannins and anthocyanin, genera from various natural orders were examined for tannin, and at the same time their pigments were subjected to the action of various chemical reagents. It was found that substances of the flavone series of natural colouring matters are widely distributed in plants, and from evidence based upon chemical tests and the results obtained in genetics these flavones appear to be essential to the constitution of anthocyanin.—An experiment on ionisation with γ rays: L. **Vegard.** The paper gives a short account of some experiments made with the object of finding whether the ionisation with γ rays is strictly an additive property. The additivity is tried for different angles between the directions of the two ray bundles, and in all cases the ionisation is found to be additive within a fraction of 1 per cent. In the introduction the author mentions that if the γ rays consist of pulses with a continuous wave-front, some departure from additivity under certain conditions was to be expected.—The nature of the ionisation produced in a gas by γ rays: R. D. **Kleeman.** It was found that when a volume of air is exposed to γ rays, and the ionisation in this volume by the secondary kathode radiation from surrounding objects is eliminated by a magnetic field, there still remains a considerable amount of ionisation due to the direct action of the γ rays on the gas. Now, it has been shown by Laby and Kaye that the ionisation in an ionisation chamber due to the penetrating radiation from the gas is small in comparison with the total ionisation. From a comparison of these two results it follows that γ rays produce, directly, δ rays, that is, kathode rays which have not sufficient velocity to produce any further ions themselves.—Uniform oscillation: Dr. **Young.**—The parametric representation of the coordinates of points on a cubic surface in space of four dimensions: H. W. **Richmond.**—The irreducible concomitants of two quadratics in n variables: H. W. **Turnbull.**

MANCHESTER.

Literary and Philosophical Society, April 6.—Mr. F. Jones, vice-president, in the chair.—Some colour demonstrations of the dissociating action of water: R. L. **Taylor.** When highly coloured solutions of ferric sulphocyanide and ferric salicylate are diluted with water the colour disappears. On the other hand, if a few drops only of a solution of potassium permanganate are added to half a litre of water a permanent coloration is produced. The author pointed out that the peculiar behaviour of these bodies was adequately accounted for by the "theory of ionic dissociation," according to which the ferric sulphocyanide and the ferric salicylate are dissociated into colourless ions of iron and sulphocyanide, whereas the potassium permanganate is dissociated into potassium and coloured manganic ions.—Report on the recent Foraminifera from the coast of the island of Delos (Grecian Archipelago): H. **Sidebottom.** Some of the most interesting forms described in the paper were *Polytrema miniaceum*, Linné, sp., *Truncatulina variabilis*, d'Orbigny, and a decorated form of *Rotalia beccarii*, Linné.—Permian foot-prints: G. **Hickling.** By the aid of numerous figures the author showed the very close correspondence there was between foot-prints found in the sandstones of Mansfield, Notts, and Penrith, and those of the sandstones of Dumfries-shire and Elgin. The former rocks are undoubtedly of Permian age, but the age of the Dumfries-shire and Elgin sandstones is not definitely fixed owing to the fewness of the fossil remains found in them. The author suggested that the identity of the types of foot-prints here considered should be regarded as affording sufficient evidence to fix the age of the rocks in which they occur as Permian, and so settle a much controverted matter. This conclusion, he added, was further strengthened by the fact that not one of these forms could be matched by those found in the Triassic rocks.

EDINBURGH.

Royal Society, May 3.—Prof. Ewart, F.R.S., vice-president, in the chair.—*Strophanthus sarmentosus*, its pharmacological action and use as an arrow-poison: Sir Thomas **Fraser** and Dr. A. P. **Mackenzie.** Most of the material had been collected by members of the Colonial Medical Service in Nigeria, especially Dr. Dalziel and Dr. Dutton, and a number of poisoned arrows had been supplied by Sir Frederick Lugard. The main constituent in this arrow poison was made from the seed of *Strophanthus sarmentosus*, which resembled in its pharmacological properties those of *Strophanthus hispidus*. To determine its action an alcohol extract freed from substances soluble in ether was used. A detailed account was given of its action on the heart and skeletal muscles, both in small and large doses. The effects on the heart are the most important, small doses tending to produce a diastolic type of change and large doses a systolic type. There seem to be no direct effects on blood pressure or on respiration.—The histological changes in the liver and kidney after chloroform administered by different channels: Dr. G. Herbert **Clark.** The chloroform was administered in three ways:—(1) by inhalation; (2) in olive oil by the stomach; (3) by injection into the subcutaneous tissues of the back. By the first method the effect produced was very small. By the second method the mortality was great, and the organs underwent extensive changes and degeneration. Similar effects were produced by the third method, although the degree of degeneration was not so great. The changes were described in detail, and illustrated by microscopic slides.—The pathogenesis of *Micrococcs melitensis*: Dr. J. **Eyre.** The pathogenic effects produced by inoculation in various rodents and Carnivora were studied in detail, the injection being intracerebral, intravenous, intraperitoneal, or subcutaneous. The question of infection was of importance in regard to the Maltese goat, and it was established by experiment that the micrococcus appeared in the milk of an infected goat. It was thus not improbable that the infection might be cutaneously carried from goat to goat by the act of milking. Man is susceptible to infection by subcutaneous inoculation, to infection through apparently intact mucous membranes, and the administration of infective food. Several cases of accidental laboratory infection, leading to acute and subacute attacks of melitensis septicæmia, were described.—Life and chemical work of Archibald Scott Couper: Prof. Richard **Anschütz**. Translated by Prof. Crum Brown. In this paper Prof. Anschütz gives a critical account of Couper's two experimental communications on benzene and on salicylic acid, and of his "new chemical theory." These papers were originally published in the *Comptes rendus* of the French Academy of Sciences within a period of less than twelve months. Couper was unfortunate with both his chief pieces of work. The presentation of the new theory to the academy was delayed, by no fault of Couper's, so that it did not appear until after the publication of Kekulé's famous paper, in which substantially the same theory was propounded. There is no doubt, as is conclusively proved by Prof. Anschütz, that Couper's work was quite independent of Kekulé's, but the delay in its publication necessarily threw it into the shade. Couper's experiments on salicylic acid were repeated by several eminent chemists, but none of them obtained Couper's results, and the general opinion was that Couper had made a mistake in the matter. It was not until twenty-seven years had elapsed that the investigations of Prof. Anschütz proved that Couper was right, and showed how his successors had failed. Couper's work was all done within one year, and nothing was heard of him by any of his fellow-chemists after 1858. Indeed, none of them knew whence he came, many supposed that he was a Frenchman, and none knew what had become of him. Prof. Anschütz and his friends made diligent search, and at last Prof. Crum Brown came upon a clue which led him to Kirkintilloch. There Dr. Whitelaw introduced him to Couper's cousins, and from them and from Mr. T. A. Dollar, London, the eminent veterinary surgeon, also a cousin, he obtained much information as to Couper's history. By a strange concurrence of circumstances Prof. Crum Brown made the acquaintance of an old friend of Couper, Geheimrat Berring, of Coblenz, who had studied with Couper at Berlin. From him much interesting matter was obtained. Couper was born on March 31, 1831, at Kirkintilloch, where his father was a manufacturer. He studied classics and philosophy in the universities of Glasgow and Edinburgh, and, along with his friend Alexander Hamilton, paid several visits to the Continent. In 1855 and 1856 he studied chemistry in Berlin, and in August, 1856, went to Paris to work in Wurtz's laboratory. He remained there until the autumn of 1858, when he returned to Scotland, and in December, 1858, accepted the post of second laboratory assistant in Playfair's laboratory in the University of Edinburgh. Near the end of that winter session his health broke down, and although he somewhat recovered, he remained an invalid, unable to undertake any kind of work, until his death on March 11, 1892. For the last thirty years of his life he lived at Kirkintilloch with his widowed mother, who survived him, dying in 1895 at the age of ninety-three. Prof. Anschütz says:—"In the history of organic chemistry the sorely tried Archibald Scott Couper deserves a place of honour beside his more fortunate fellow-worker, Friedrich August Kekulé."

PARIS.

Academy of Sciences, May 3.—M. Émile Picard in the chair.—The internal pressure of fluids and the law of intermolecular attraction: E. H. **Amagat**. The conclusion is drawn that the intermolecular attraction varies inversely as the fourth power of the distance.—A hæmogregarian of *Python sebai*: A. **Laveran** and A. **Pettit**. Nine diagrams accompany the paper, showing the parasite in various states of development. The species appears to be new, and the name *H. sebai* is proposed for it.—Singular systems of associated O networks: C. **Guichard**.—The application of Stefan's law in astronomy: Ch. **Féry**. The correction term for atmospheric absorption would appear to have been overestimated. A correction of 25 per cent. would appear to be nearer the truth than the 50 per cent. indicated by Crova.—A definition of the number of dimensions of an abstract *ensemble*: Maurice **Fréchet**.—The uniform analytical functions which remain continuous on a completely discontinuous *ensemble* of singularities: Arnaud **Denjoy**.—Remarks on the preceding communication: M. **Painlevé**.—The movement of a disc in a fluid: A. de Gramont **de Guiche**.—The use of the torsion balance as a seismograph: V. **Crémieu**.—The photographic registration of Brownian trajectories in gases: M. **de Broglie**. A microscope furnished with a camera is focussed on the gaseous suspension illuminated laterally by the concentrated beam from an arc lamp, and forms an image on the plate magnified about forty diameters. For a given size of particles the light diffused in the direction of the axis of the microscope is sufficient to make a record on very sensitive plates, in spite of the rapidity of the movements. A reproduction of such a negative is given.—The laws of the slope of water in canal of constant length and practically constant depth connecting a tidal with a non-tidal sea of the same mean level. The determination for each point of the canal of the limit of the maximum current, and the time at which the maximum current is produced: Philippe **Bunau-Varilla**.—The discontinuous discharge in a Geissler tube: H. A. **Perkins**.—The coefficients of expansion of gases: A. **Leduc**. A re-calculation of the values published twelve years ago, making use of the recently determined molecular volumes.—The fusibility of mixtures of gold and tellurium: H. **Pélabon**. The compound Au_2Te_4 is the only one indicated by the curves of fusion of mixtures of gold and tellurium; no indication was obtained of the gold telluride Au_2Te described by Margottet.—The melting point of platinum: W. **Waidner** and G. H. **Burgess**. The apparently close agreement between the values obtained for the melting point of platinum by different observers with the platinum, platinum-rhodium, or platinum, platinum-iridium thermocouples is due to the use of the same empirical extrapolation in each case. A different formula, equally well applying to the actual observations between 300° C. and 1100° C., leads to quite a different melting point for platinum. As regards the application of radiation methods to this problem, the divergence of the figures found appears to be due in great part to an insufficient knowledge of the exact value of the constant C_2 in Wien's equation $J = C_1\lambda^{-5}e^{-c_2/\lambda\theta}$.—The magnetic dichroism of mineral species: Georges **Meslin**.—A new automatic mercury pump: P. **Klein**. A description, with a diagram, of a modified Töpler pump. It is worked by means of an ordinary water pump, is made entirely of glass, and works without taps. A pump using about 650 c.c. of mercury gave a Crookes vacuum in a 500 c.c. vessel in fifteen minutes.—The conditions necessary for direct reactions and the sense of the electric current produced in the attack of metals by sulphur: Albert **Colson**. The heat of formation, the knowledge of which is indispensable in the study of chemical equilibrium, has not the same influence upon direct irreversible reactions which take place at a high temperature.—The physicochemical interpretation of differences of potential in living tissues: Pierre **Girard**. From a consideration of the changes of electromotive force produced in concentration cells by the interposition of an animal membrane, a physicochemical interpretation of the potential differences in living tissues is obtained.—The freezing of mixtures of water and normal butyric acid: H. **Faucon**. The acid was examined at twenty-nine different concentrations, and neither the fusion-point curve nor the microscopical examination of the separated crystals points to the formation of a definite hydrate.—The action of some oxidising agents upon silicochloroform: A. **Besson** and L. **Fournier**. Oxygen gives the known oxychloride Si_2Cl_6O, together with viscous oxychlorides of unknown composition. Silicochloroform reacts explosively with nitrogen peroxide, even at low temperatures. In solution (carbon tetrachloride) the reaction can be moderated, and corresponds mainly to $SiHCl_3 + 2NO_2 = SiO_2 + 2NOCl + HCl$, some water being also formed by a secondary reaction between

HCl and the NO_2.—The influence of the colloidal state on dyeing: Léo **Vignon.**—A new method of isomerisation in the terpene series: Géza **Austerweil.** Pinene, heated to a moderate temperature with an organic acid in sealed tubes, gives a yield of about 18 per cent. bornyl esters; if the pressure in the autoclave is raised some atmospheres by means of a bottle of carbon dioxide, the yield is much higher.—The suboxides of cæsium: E. **Rengade.** The oxide Cs_7O_2 was isolated and analysed.—Contribution to the study of the rocks of the eastern edge of the Armorican *massif*: L. **Vandernotte.**—The rational use of superphosphates: J. **Dumont.** It has been shown by cultivation experiments on the large scale that the application of superphosphate mixed with farm manure gives better results than the same manures applied separately.—The relation of insects, especially Lepidoptera, with the flowers of Asclepiadeæ, and in particular with that of *Araujia sericofera.* The mechanism of their capture: J. Künkel **d'Herculais.**—The indol-producing bodies of the urine: Ch. **Porcher.**—Bilirubin: M. **Piettre.**—The action of electrolytes on the hydrolysis of fats by the pancreatic juice: Émile F. **Terroine.**—Research on the hydrolysis of the proteins by acids: Henri **Mathieu.**—The mechanism of the synthesis of light impressions received by the compound eyes of the Diptera: P. **Vigier.**—The reproduction of Aphelinus and the individual interest in acts relating to the conservation of the species: Paul **Marchal.**—The enteroïds of the Acraspedes: Edgard **Hérouard.**—The formation of the Straits of Gibraltar: Louis **Gentil.**—The grotto of Bosse in the commune of Morée, Loir-et-Cher: Armand **Viré** and André **Piédallu.**—Some seeds and microsporangia of Pteridosperms found in the Nord coal basin: Alfred **Carpentier.**

DIARY OF SOCIETIES.

THURSDAY, May 13.

Royal Society, at 4.30.—Recent Solar Research: Dr. George E. Hale, For. Mem. R.S.—Utilization of Energy stored in Springs for the Production of Mechanical Work: A. Mallock, F.R.S.—The Elastic Limits of Iron and Steel under Cyclical Variations of Stress: L. Bairstow.—Functions of Positive and Negative Type: J. Mercer.—On a New Kind of Glow in Vacuum Tubes: Rev. H. V. Gill, S.J.

Royal Institution, at 3.—Newfoundland: J. G. Millais.

Royal Society of Arts, at 4.30.—Some Phases of Hinduism: Krishna Gobinda Gupta.

Mathematical Society, at 5.30.—Ternary Quadratic Types: H. W. Turnbull.—The Theorem of Gauss in the Theory of Attractions: Dr. J. G. Leathem.—On the Continuity or Discontinuity of a Function defined by an Infinite Product: J. E. Littlewood.

Institution of Electrical Engineers, at 8.—Economics of Medium Sized Power Stations: A Study of Comparisons between Steam, Gas and Oil Engines: A. J. J. Pfeiffer.

FRIDAY, May 14.

Royal Institution, at 9.—Solar Vortices and Magnetic Fields: Prof. G. E. Hale.

Royal Astronomical Society, at 5.—Spectroscopic Comparison of o Ceti with Titanium Oxide: A. Fowler.—On some Points with regard to the Light Fluctuations of Variable Stars. A Rejoinder to Mr. H. C. Plummer's Criticisms: Karl Pearson.—Note on certain Coefficients appearing in the Algebraical Development of the Perturbative Function: R. T. A. Innes.—On Inclined Lines in Stellar Spectrograms, and on a New Method of Focussing a Star on the Slit of a Spectrograph: J. Lunt.—Observations of Helium D_3 Absorption in the Neighbourhood of Sun-spots in 1908: Capt. R. A. C. Daunt.—Note on certain Lines ascribed to Argon in Celestial Spectra: J. Lunt.—The Long-period Variable RT Cygni in 1908: A. N. Brown.—Results of Micrometer Measures of Double Stars made with the 28-inch Refractor in the Year 1908: Royal Observatory, Greenwich.—New Double Stars: Rev. T. E. Espin.—Note on the Solar Constant and the Apparent Temperature of the Sun: C. Fery.—On Absorption in Jupiter's Atmosphere, and its Probable Effect on the Colour and Albedo of the Belts and Zones: J. H. Reynolds.—*Probable Paper*: Solar Parallax Papers, No. 7, The General Solution for the Parallax: A. R. Hinks.

Physical Society, at 8.—On a Bifilar Vibration Galvanometer: W. Duddell, F.R.S.—Effect of Temperature on the Hysteresis Loss in Iron in a Rotating Field: W. P. Fuller and H. Grace.—On a Method of Testing Photographic Shutters: A. Campbell and T. Smith.

Malacological Society, at 8.—Descriptions of the Animals of Two Land Shells from Perak; Skeat Expedition in the Malay Peninsula, 1899–1900: Lt.-Col. H. H. Godwin-Austen, F.R.S.—List of Mollusca from Christmas Island, Indian Ocean, and Descriptions of New Species: E. A. Smith.—Further Notes on Holocene and Recent Non-marine Mollusca from Perranzabuloe: Rev. R. Ashington Bullen.—On Non-marine Mollusca from an Early Neolithic Interment at Cuxton, Kent: A. S. Kennard.

TUESDAY, May 18.

Royal Institution, at 3.—The Hittites: (1) Monuments of Egypt and Asia Minor: Prof. John Garstang.

Royal Society of Arts, at 4.30.—Canada as a Field for British Investment: J. Obed Smith.

Royal Statistical Society, at 5.—The Meat Supply of the United Kingdom: R. H. Hooker.

WEDNESDAY, May 19.

Royal Microscopical Society, at 8.—On the Recent and Fossil Foraminifera of the Shore-sands of Selsey Bill, Sussex, Part ii.: E. Heron-Allen and A. Earland.—A New Illuminator for the Microscope: J. W. Gordon.

Royal Society of Arts, at 8.—Railway Development in China: A. J. Barry.

Royal Meteorological Society, at 4.30.—The Anticyclonic Belt of the Northern Hemisphere: Col. H. E. Rawson, C.B.—Errors of Estimation in Thermometric Observations: A. Walter.

THURSDAY, May 22.

Royal Society, at 4.30.—*Probable Papers*: Observations on the Urine in Chronic Disease of the Pancreas: Dr. P. J. Cammidge.—*Trypanosoma ingens*, n.sp.: Colonel Sir David Bruce, C.B., F.R.S., and Captains A. Hamerton, H. R. Bateman and F. P. Mackie.—The Incidence of Cancer in Mice of Known Age: Dr. E. F. Bashford and Dr. J. A. Murray.

Royal Institution, at 3.—Newfoundland: J. J. Millais.

Institution of Electrical Engineers, at 8.—Annual General Meeting.

FRIDAY, May 21.

Royal Institution, at 9.—Afforestation: Hon. Ivor C. Guest, M.P.

SATURDAY, May 22.

Royal Institution, at 3.—The Secret Societies of the Banks' Islands: Dr. W. H. R. Rivers, F.R.S.

CONTENTS.

THURSDAY, MAY 20, 1909.

THE UNIVERSITY TEACHING OF CHEMISTRY.

Leçons sur le Carbone. La Combustion. Les Lois chimiques. By H. le Chatelier. Pp. xiv+456. (Paris: Dunod and Pinat, and A. Hermann, 1908.) Price 12 francs.

THIS is a book which is likely to have a most important influence on the teaching of chemistry, certainly in France, and probably in other countries. The fact that it is the first general treatise on chemistry from the hand of M. le Chatelier is sufficient in itself to attract the attention of chemists. But it is much more than this; it is an attempt to lead a reform of a far-reaching character, to part from traditions honoured by time, and to show university teachers a more excellent way of presenting the essential science of chemistry to the ever-increasing number of students who come to them for guidance. It is very rarely that a book on general chemistry appears which exhibits anything like the individuality that is to be found in M. le Chatelier's new work, one that is at the same time so free from extravagance in developing a new idea, and one, it may be added, that is so entirely worthy of study by all who have the duty of teaching chemistry.

According to M. le Chatelier, the system of teaching inorganic chemistry in France has been completely unchanged for three-quarters of a century. In 1825, Gay-Lussac and Thénard inaugurated what was then a new treatment of the subject, and this was stereotyped in the text-book of Regnault founded on his notes of Gay-Lussac's lectures. Whilst Lavoisier had treated chemistry primarily as a body of principles and generalisations, the new system regarded it primarily as a classification and description of substances. The only attempt to break away from the tradition is due to Mendeléeff, whose treatise is arranged on an entirely special plan. In pleading for a change of our methods, M. le Chatelier admits that chemistry cannot be placed in the same position as physics. It is impossible merely to lay down general principles and tables of constants; chemistry must still include the enumeration of a host of detailed facts, methods of preparation, methods of analysis, methods of manufacture. It is to be remembered that this is not in itself science, but mere documentation, and that it is the body of chemical principles which really constitutes the science of chemistry. Since 1825 a revolution in chemical knowledge has taken place by the discovery and application of the laws of chemical mechanics, and to this full effect should be given in the courses of chemical instruction. Special chapters dealing with these matters are, indeed, commonly included in the text-books, but whereas the subsequent detail of the books is permeated by the laws of quantitative composition, no such general application is made of the laws of chemical dynamics.

There is a second matter of importance that leads the author to depart from established custom. Higher scientific teaching to-day has not, he says, the exclusive aim of training future teachers; the majority of students will spend their lives in quite different fields—medicine, agriculture, industry. The instruction given in universities ought to be so conceived as to fit people for doing their best for themselves and their country in the particular sphere they will occupy. It is necessary, above all, to form *des ésprits pratiques.* It is often said with some justice that scientific teaching does not develop good sense; it produces too often, not men of action, but *théoriciens, des ésprits faux.* Scientific instruction is, in fact, essentially analytic; it regards things too much in one aspect at one time. In speaking of the electric conductivity of copper we ignore deliberately its other properties, and yet in all the electrotechnical uses of copper we cannot get rid of the existence of mass, specific heat, tenacity, &c., nor prevent them from exhibiting themselves sometimes in a most embarrassing manner. Some examples of industrial science should be introduced into a scientific course to direct the attention of students to the complexity of the actual phenomena, to the importance of applying the details of knowledge and sifting them according to their relative practical importance for achieving the end in view. The usual superficial description of industrial processes is not enough; it is merely a part of general culture.

> "Il faut avoir vu, sinon en nature, au moins en image, un haut fourneau, une chambre de plomb, une cornue Bessemer, au même titre que des tableaux de Raphaël, l'arc de Triomphe, ou la Tour Eiffel, mais ces descriptions rapides n'ont aucune valeur didactique, elle ne peuvent contribuer ni à la formation intellectuelle, ni au développement des aptitudes professionelles."

M. le Chatelier insists again and again on the fruitfulness of a close association between theory and practice. Lavoisier, he says, was led to his great work by taking part in an open competition for a better system of lighting Paris. His constant preoccupation with practical questions—the making of plaster of Paris, the exploitation of coal mines, the metallurgy of iron, the manufacture of gunpowder, the organisation of hospitals, agriculture—enabled him to escape without effort from the fictions and conventions amid which the chemists of his day simply marked time. Similar remarks apply to Carnot, Deville, Pasteur, and others.

M. le Chatelier has some trenchant and timely remarks to make about another aspect of chemistry. The science, he says, is suffering from a very grave malady, *le surmenage.* Since chemistry has begun to afford a remunerative calling, chemists have betaken themselves to an intensive cultivation, seeking at all costs to make discoveries which shall create a title to promotion—quantity, from their point of view, superseding quality. To happen upon a substance sufficiently devoid of interest to ensure that, in all probability, no one else will examine it for a decade, procures a situation free from all anxiety; the mistakes will not be discovered before the published work

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has produced its useful effect. From this point of view, organic chemistry, with its innumerable compounds, offers precious opportunities, but inorganic chemists also, though less favourably situated, are too often led into this artificial adding to the number of real substances. Taking a large general treatise on chemistry, M. le Chatelier hazards the opinion that at least half the substances described have never had any existence. It is, therefore, of great importance to give young chemists a timely respect for exactitude, to accustom them, not only to make measurements, but to discuss their degree of precision and to criticise systematically every experimental result.

With regard to the use of hypotheses, M. le Chatelier is no less decisive. He dispenses with all hypotheses relating to the constitution of matter. These hypotheses, he says, can render great service to a trained mind that will use them as tools, to be cast aside when they are no longer useful; in the instruction of young minds they are dangerous, as tending to *imprecision*, which is the most redoubtable enemy of science. Too often one comes to believe firmly in these products of imagination, to bandage one's eyes and blind oneself to the most evident experimental facts. When we see what has become of the two fluids of electricity, of the projectiles of the emission theory of light, of the india-rubber molecules of Berthollet, of the indivisible atoms of Dalton, we have a right to entertain some anxiety about the future in store for ions and electrons.

The text of M. le Chatelier's book is a verbatim report of his first course of lectures on general chemistry in 1907–8, given at the Sorbonne, where he occupies the place of Moissan. Probably few chemists would care to have their wisdom offered to the world in this way, and it is to be hoped that few will do so. But it is not too much to say of this particular case that one can only rejoice in the author's lack of time to give the book the revision which he contemplated, for its supreme value lies in the reflection it gives of the living teacher. It is a good deal to say of a book on chemistry that it is human, at least in any other respect than in being tinged with error, but M. le Chatelier's book is human in exhibiting, not only the mind, but something of the personality of one of the greatest contemporary chemists, and assuredly of a very exceptional and inspiring teacher.

The aim of the book is to use carbon and some of its inorganic compounds as a vehicle for imparting the essence of modern chemistry. The chapters bear the following headings:—Henri Sainte-Claire Deville—Moissan; propriétés physiques et chimiques; combustibles; chauffage, pouvoir absorbant, allotropie; carbures métalliques; acide carbonique; carbonates métalliques; oxyde de carbone; combustion des mélanges gazeux; origines de la chimie; résumé des lois de la mécanique; lois de la mécanique chimique; lois pondérales de la chimie; poids moléculaires et poids atomiques; détermination expérimentale des poids moléculaires.

The treatment of these topics is in accordance with the general principles which have already been indicated. The choice of carbon as the central subject is, of course, arbitrary. It may be defended on several grounds, and doubtless it may be criticised on others, but it must be remembered that M. le Chatelier lays down no law about such choice. It is the method and spirit of the treatment that are all-important, and in choosing carbon the author brings himself into the region where his own researches have given him quite exceptional knowledge and authority. We feel that we are reading something altogether different from the compilations to which we are so inured, and that the author is imparting what he has made his own. It is for this reason that it is impossible in the present notice to give any adequate idea of the quality of the book.

No doubt there is much left out in the way of facts that many people would consider very important, but M. le Chatelier has boldly faced a problem that confronts every teacher, and has refused to carry on the burden of teaching all that convention sanctioned a generation ago along with the vast accumulation of new things that have since come to light. Much of the old matter of chemical books and chemical lectures has become relatively unimportant, and may well be left to take care of itself. Nowadays a man may be an excellent chemist, and withal profoundly ignorant of cadmium and its compounds, of the various formulæ proposed for bleaching powder, of the methods of analysis of German silver, and of a thousand other things which were the common stock of his immediate scientific ancestors.

The criticism, exhortation, and censure to be found in M. le Chatelier's book are no doubt primarily addressed to his own countrymen, but they are applicable elsewhere. Perhaps more has been done than M. le Chatelier implies to alter the form and substance of introductory university courses of chemistry. Prof. Ostwald's "Inorganic Chemistry" and Prof. Alexander Smith's recent work are, perhaps, the most notable books indicative of a movement that is probably existent in many university centres, but to judge from examination papers the old order still largely prevails.

There is no doubt a national genius which exhibits itself in science as in other domains of thought and action. M. le Chatelier's book displays this scientific genius of his country in its classic form.

"Les uns," he says, "ne trouvent à la vérité toute sa grâce que lorsqu'elle est parée d'ornéments à la mode du jour, d'autres préfèrent admirer sa fière beauté dégagée de tous voiles. À chacun la liberté de prendre sa joie où il la trouve."

The Frenchman, with a language incomparable for expository uses, can tell us the plain truth without the chill that is associated with our own "dry light." He is apt, perhaps, to lay a little disproportionate weight on the achievements of his own countrymen, and this tendency appears in M. le Chatelier's book to an extent that may provoke some readers. But in all other respects there can be no question that a strict fidelity to facts characterises the book from cover to cover.

ARTHUR SMITHELLS.

THE FLOWERING PLANTS OF AFRICA.

Die Blütenpflanzen Afrikas. Eine Anleitung zum Bestimmen der Gattungen der Afrikanischen Siphonogamen. By Franz Thonner. Pp. xvi+672; with 150 plates and 1 map. (Berlin: R. Friedländer und Sohn, 1908.) Price 10 marks.

THIS is not the first attempt by the author of making keys on a large scale. In 1895 we had from him an "Analytical Key to the Natural Orders of Flowering Plants," in 1901 an "Excursionsflora von Europa," essentially a key to the genera of the flora of Europe, and now we find him directing his energy in the same way to the whole of the phanerogamic flora of Africa and the African islands. If we consider that this flora includes 262 families and 3648 genera, the formidable character of the task becomes at once apparent. No one can possibly claim an intimate knowledge of so vast a number of genera, and if some one came near to it he would probably be the last to care for the work. In fact, if the thing is to be done it is just as well that the author should not know too much of the details and of the real complexity of the problem. General and rather extensive than intensive familiarity with the families, sound judgment in the selection of the authorities which supply the material for the key, method, good memory, and infinite patience will further the work more than anything else.

The book is distinctly one of those which must be tried, and frequently tried, before it is possible to judge whether they serve their purpose or not. In this instance the object aimed at is to provide the traveller or colonial in Africa, as well as the student outside Africa, with a key for the easy and correct determination of the generic names of the African plants. A general inspection of the book and occasional checking on some of the more puzzling genera have certainly created the impression that the author, to a considerable degree, possesses the qualities necessary for the task he has set himself. There are, of course, blemishes and weak points; but they are practically unavoidable, and it would be ungracious to insist upon them. On the whole, the key—or, rather, the system of keys—works well enough. Nobody expects more than a certain amount of guidance from a key of such dimensions, particularly when applied to a flora so rich and in many aspects still imperfectly known. The difficulties with which the key-maker has to contend arise mainly from the overlapping and the varied combinations of characters, the sexual heteromorphism and the diœcism of flowers, and the so-called anomalous forms; they are smaller towards both ends of the taxonomic ladder, but really formidable where the families are concerned. This accounts, no doubt, for the fact that dichotomous keys to families on a large scale have so seldom been attempted. To devise such a key purely on the basis of affinities, and so that the units follow the same sequence as in the system, is impracticable, and the author has very wisely not hesitated to break up the families whenever necessary, and to let them or their components come in where the characters which were found most workable bring them in. But if twenty-seven families of Choripetalæ are cut up, each into from six to fourteen parts, and therefore appear in as many different places in the key, one cannot help thinking that the author has gone too far. The same applies to a still higher degree when we find relatively so homogeneous families as the Ericaceæ, Apocynaceæ, and Convolvulaceæ each in eight to ten places, and the small families of the Pedaliaceæ and Plantaginaceæ in six and seven places respectively. It ought to be possible to focus, if I may say so, those families far better. The author has freely used combinations of characters, and, although much more rarely, conditional alternatives. The key-links are in this way apt to run into several lines, and we may occasionally get impatient over having to read through them; but it pays in the end, whilst those terse and trim apodictic keys which play with pairs of contrasting characters, and allow barely one line to each link, generally break down in practice.

In establishments with large herbaria, where the naming of African plants is part of the regular routine, there will probably be little demand for the book. On the other hand, it ought to prove very useful where the workers, without being especially familiar with the African floras, have occasionally to "run down" members of those floras, and particularly so when the plants belong to families which have been dealt with in the early volumes of the "Flora of Tropical Africa" and the "Flora Capensis," volumes which for completeness have long been out of date. It is, however, a very different question whether the ordinary botanically inclined traveller or colonial will benefit very much by the book. As it covers Africa from Algiers to Cape Town, and from the Canaries to Madagascar, a very great portion of the work must for either of them necessarily remain ballast, and the traveller especially will feel little disposed to burden himself with an extra $4\frac{1}{2}$ lb. on the chance of worrying out a few generic names which he can, after all, not verify on the spot. There remains of field-workers only the professional collector, and he will probably find it quite worth his while to take the volume with him, provided he grasps the purely German terminology, which, with the Latin equivalents, is explained in a glossary at the end of the book.

The conception of the families and genera is, as might be expected, that of Engler's "Natürliche Pflanzenfamilien," and in so far quite up to date, whilst the recent English literature has perhaps been considered less fully, witness, for instance, the retention of the West Indian genus Biovularia. A peculiar feature of the work is the addition of not fewer than 150 plates representing types of as many distinct families. They are throughout originals, and many, if not most of them, portray species which had not been figured previously. The habit figures which we owe to the skilled and artistic draftsmanship of Herr J. Fleischmann are as charming as they are exact. They alone are worth buying the book for. Analyses are added in all cases. They are, on the whole, satisfactory; but the absence of all lettering of parts, even in cases of complicated figures, will occasionally be felt as a great drawback. The volume also contains a map of Africa, with Engler's "Florengebiete und Provinzen," and a census of the African flora, as compared with that of the whole world. The figures, especially for the species, are, of course, mostly approximate, but even so the totals are interesting enough to be quoted, namely:—Genera (of Siphonogams or Phanerogams) for the whole world 9942 (species 136,000); Africa 3486 (species 38,600); North Africa 981 (species 4850); Tropical Africa (continental) 2185 (species 18,300); Mascarenes and Madagascar 1266 (species 5950); South Africa 1393 (species 13,300).

The publishers deserve great credit for the excellent get-up of the book and the astonishingly cheap price. Taking the book as a whole, it is remarkable as a feat of painstaking industry, and it bears witness to the extraordinary development of the botanical exploration of Africa during the last twenty or twenty-five years, and to the general interest in its flora; but, after all, on laying down the book one cannot quite resist a suspicion that so much labour, so much skill, and last, not least, so much knowledge, might have been applied to a more lasting purpose than the making of a stupendous key which in five or ten years may be out of date.

Otto Stapf.

SOCIAL PSYCHOLOGY.

Völkerpsychologie, eine Untersuchung der Entwicklungsgesetze von Sprache, Mythus und Sitte. By Wilhelm Wundt. Zweiter Band, Mythus und Religion, Dritter Teil, 1909. Pp. xii+792. Price 18 marks. Dritter Band, Die Kunst, second edition, 1908. Pp. x+564. (Leipzig: W. Engelmann.) Price 12 marks.

THIS encyclopædic work, of which we have here two volumes, is a prolegomena to sociology. Wundt is tracing the evolution of language, art, myth, religion, and custom from their beginnings to the civilisation of the present day. In his own phrase, he is giving us a study of the development of "mental communities," those "changing pluralities of mental unions which are interlaced in the most manifold ways and become more and more numerous as development progresses."

The basis of such development is language.

"The prime necessity of every mental community at its beginning, and a continually operative factor in its further development, is the function of speech. This is what makes the development of mental communities from individual existences psychologically possible. . . . It becomes the indispensable form for all the common mental contents. These common contents, or the mental processes which belong to the whole community, may be divided into two classes, which are merely interrelated components of social life. . . . The first of these classes is that of the common ideas, where we find especially the accepted conclusions on the questions of the content and significance of the world—these are *the mythological ideas.* The second class consists of the common motives of volition, which correspond to the common ideas and their attending feelings and emotions—these are *the laws of custom.*"

The whole mental development of man in society is thus schemed out, with language as its essential condition, into mythology and religion, decorative, pictorial, and plastic art, epic, lyric, and romantic literature, dance, music, opera, mime, and drama; the result is a philosophy of culture based on the latest psychological principles.

The greater part of the study naturally is occupied with the earlier stages of development, but each form of mental activity is followed right up to the present time. In one volume, for instance, we may find an exposition both of primitive magic and of latter-day pragmatism and modernism.

The author omits nothing of importance; recent and ancient theories are assigned positions according to their relevance; the facts selected are generally well chosen. The whole work, encyclopædic as it is, has the unity of one mind—that of the greatest of psychologists.

It is significant to compare the author's treatment of ethnographical data with that of the majority of anthropologists to-day, and with that of Tylor and Spencer some years ago. Spencer applied the exact psychology of his time to the data for his sociology; Tylor treated the data for his primitive sociology in an acute but inexact method, the result being that the conclusions of the amateur have outlasted those of the professed psychologist. In the interval of thirty years or so psychology has been revolutionised and become more and more an exact science. It is, of course, the only concrete science. Its predominant importance to-day is due to Wundt himself above all. In these volumes we have, for the first time since Tylor and Spencer, a scientific analysis of the development of culture; carried out by a psychological instrument far surpassing theirs in exactness and precision, the analysis is correspondingly a great advance. Comparing it with the anthropological work of the day, it is to be regretted that so much of the latter has no psychological value. The author shows on every page—*solvitur ambulando*—that the only sound results producible for anthropology are those which are based on psychological evidence. He has pointed out to anthropologists "the only way."

At the same time, the anthropologist may regret that the author has not driven his analysis more deeply and more searchingly in various directions. To do so is more than can be expected of one man, but perhaps a reduction of the historical description and an amplification of the psychological analysis would have been more useful to science. For instance, a closer analysis of the facts of animism and fetishism is much to be desired. There is considerable obscurity about the origin of these tendencies. They are, as a rule, slurred by students, or receive an additional superstructure to crown an edifice built upon misconception and pseudo-science. The author should be better able than any man to give a final explanation of spiritism, but he has not done so.

Again, in reference to the mythologic process, his position is that in the function which gives rise to all mythological ideas we have a characteristic kind of apperception belonging to all naïve consciousness, and suitably designated by the name personifying apperception.

"Myth-making or personifying apperception is not to be regarded as a special form or even as a distinct sub-form of apperception. It is nothing but the natural inceptive stage of apperception in general."

There is nothing to complain of here, in this illuminating identification of primitive mythological impulse with primitive apperception, except the term "personifying." For the sociological amateur the term "personification," and its connotation to the effect that early man assigned a human personality, with sensations, feelings, and volitions, all human, to everything in nature, from the mammoth and the lion to the humblest insect, and not only this, but to all inanimate objects, all processes, from the sun and the moon to the sand on the sea-shore, from the thunder and lightning to the rustling of a leaf—this has been an intellectual fetish for too long. But unless the author's meaning has been misunderstood, it would seem that he has not reached the true explanation, simple as it is, of the facts which gave rise to this easy result of "mythology in science." We still need an exact demonstration by psychology of the mental habits of early man in the direction of animistic and personificational beliefs.

The content of the social mythological consciousness is huge. Wundt, we are glad to observe, emphasises the predominance of the motive of "luck" in *Märchen*, fable, and saga. Here the free mental activity connects with the economic basis of life, which, by the conditions of the work, is not brought forward to any great extent. The hypothesis of an original monotheism or crypto-monotheism is rejected. The complex origin of religion is fully discussed, and its development is traced to the present day. Popular Christianity as tritheism, Christianity as a religion of feeling and will in contrast to intellectualistic systems like Buddhism, are among the interesting side-issues which the author follows out.

The origin and function of art supply a peculiarly fruitful field for psychology. It is interesting to notice that from Aristotle onwards the criticism of this expression of mind has been in striking contrast to that of other expressions in its freedom from metaphysical prejudice. The theory of art has been studied more or less empirically from the beginning.

"Play," as Wundt remarks, following the well-established opinion, "is the mother of art." As a motor-expression of ideas art is in interesting connection with cult and custom. Like everything else, it has its historical and its psychical origin. Thus, the Greek drama has its historical origin in the religious play, its psychical origin in imitation and catharsis. Aristotle gives us both; we mention his explanation by way of directing attention to the modern development in psychology of his original idea. He would recognise in the present analysis of the play-impulse his own germ-idea in a complete differentiated form.

In the description of early forms of art, significant tendencies are well illustrated. Its momentary character and its frequent bondage to assimilation are interesting peculiarities. For instance, the double-formed objects of Egyptian and Assyrian art are equally prevalent in savagery. The curious tables made out of animals with flat backs; the decorative motive of the alligator in Chiriqui art; the Gorgon series in Greek sculpture, are well-chosen types.

The dramatic magical plays of the Central Australians deserve analysis. Is not also the theory of sexual selection still to be reckoned with in the origin of art?

These are but "requests for more" where so much is given. Science owes a debt to one of her greatest intellects for this application of his psychology to the concrete mental history of the world.

A. E. CRAWLEY.

THE RIDDLE OF OLD AGE.

The Problem of Age, Growth, and Death: a Study of Cytomorphosis. By Prof. Charles S. Minot. Pp. xxiii+280. (London: John Murray, 1908.) Price 6*s.* net.

FROM the time of Cicero, perhaps before, the problems of longevity and of the cause of old age have again and again been subjects of speculation. Not long ago, Metchnikoff, in his optimistic work, "The Nature of Man," ascribed old age to a poisoning by bacterial poisons developed as a result of fermentations occurring in the large intestine. The effect of this poisoning is to produce a weakening of various cells and tissues, which then become a prey to the scavenging cells of the body, the phagocytes.

Prof. Minot, in the work under review, develops another conception of the nature of "growing old." Although in old age a condition of atrophy is frequent, and various degenerations of cells and tissues are usually present, in particular of the arterial system, so that it has been said "a man is only as old as his arteries," Prof. Minot combats the view that old age is a kind of disease, and regards it as a necessary consequence of the changes in the cells of the body, which are inevitably progressive from birth to death; this succession of cellular changes is termed "cytomorphosis." In the development of his subject, the author first discusses the rate of growth in the embryo and in the young after birth. The rate of growth, very rapid at first, becomes slower and slower, and with the progress of growth various structural changes in the cells can be demonstrated to occur. These changes always progress, and ultimately end in degeneration and death, so that even at the period when the body is most vigorous, cellular death is of constant occurrence. The rate of growth is instructively illustrated by tables and curves of the height and weight of boys and girls, and of the weight of rabbits, guinea-pigs, and chicken at various age periods. It is shown that the greatest percentage increase of weight after birth occurs in those animals which are born least mature. Thus in the guinea-pig, which is born in a relatively mature state, the daily percentage increment of weight just after birth is 5 per cent., while the rabbit, which is born much less mature than the guinea-pig, daily adds 17 per cent. to its weight. In embryonic life, cellular division and increase in weight are still more marked, and Prof. Minot estimates that 98 per cent. of the original growth power has been lost at birth, and the power of growth becomes less and less as age advances.

Differentiation and rejuvenation of cells are next considered. In the embryo the cells differ but little from one another; they do not display structural differentiation, whereby it could be said from what part of the embryonic body they were derived; while in the adult the microscopic characters of a cell generally suffice to determine its place of origin. Moreover, with the differentiation of cells with age, the protoplasm increases in amount relative to the nucleus. The conception is therefore reached that the growth and differentiation of the protoplasm and relative diminution of nuclear matter are the cause of the loss of the power of growth.

If cells suffer from old age as their protoplasm increases and becomes differentiated, a general and progressive process in the individual, there should be some mechanism for rejuvenation; this the author regards as accomplished by the segmentation of the ovum, during which process an *increase* of nuclear matter takes place at the expense of the protoplasm. The author believes that there is no satisfactory evidence that the progeny of old cells (other than of the ovum) can resume the primitive state and undergo re-differentiation. In cases in which regeneration of excised parts, &c., is effected in the individual, *e.g.* in planarians and ascidians, the regenerated part is always the product of undifferentiated cells, and is not derived by the growth of the old tissues.

The usual method of rejuvenation adopted by nature is by the separation of cells in the primitive and undifferentiated condition, and their isolation as the germ or sex cells. Age then represents the result of a progressive cytomorphosis of which death is the culmination. Longevity, the duration of life, depends, therefore, upon the rate of cytomorphosis, which varies much in different species, and perhaps in different individuals of the same species. Whether rejuvenation can be improved and senescence delayed are questions to which the author gives no definite answer, though he surmises that in the future it *may* be possible to increase the activity of nuclei and prolong the younger system of organisation. Death he regards as acquired during the process of evolution in consequence of cytomorphosis. As organisation becomes higher and higher, the need for differentiation becomes greater; this involves the end, and death is the price we have to pay for the differentiation which exists in us, and to which we owe our great array of faculties!

This, in brief, is the argument of Prof. Minot, which is presented in an attractive form with many appropriate illustrations, and we have perused this work with considerable interest. Finally, a suggestion of some importance is made. The author develops the conception that not only physical but also psychological development is most rapid in early life, and progressively declines as age advances. He suggests, therefore, that the tendency there is in some quarters to postpone the period of learning is wrong, and that as much use as possible should be made of the early years of life. R. T. H.

THE SONGS OF BIRDS.

Kunst und Vogelgesang in ihren wechselseitigen Beziehungen von naturwissenschaftlich-musikalischen Standpunkte beleuchtet. By Dr. B. Hoffmann. Pp. ix+230. (Leipzig: Quelle und Meyer, 1908.) Price 3.80 marks.

THIS is the most interesting book on the songs of birds that has appeared since the late Mr. C. A. Witchell published his "Evolution of Bird-song" in 1896, and it excels that work both in soundness of judgment and in knowledge of music. Its object, however, is not quite the same as that of Mr. Witchell's volume (which does not seem to have fallen into Dr. Hoffmann's hands); the latter was an attempt to trace the development of song from call- and alarm-notes, and also from imitation of natural sounds, while Dr. Hoffmann's work may be described as an essay on the relation between the music of birds and the music of art.

For dealing with this subject the writer is evidently well qualified; he is clearly a close observer of all sounds made by birds in their wild state, and wisely abstains from making use of the music of birds in captivity, and at the same time he is quite at home in the subtleties of the musical art. The result is that we have here no foolish attempt to represent the music of birds on our musical scale, except in a few cases where it is possible to do so as a means of illustrating certain points rather than as an exact reproduction of the notes of the singer. For Dr. Hoffmann is well aware that the great majority of singing birds do not use the intervals of our scale, though he is right in claiming that a few occasionally do so. So, too, in a very interesting section on rhythm in song, he denies that it is to be found in any sense in a great number of songs, while rightly asserting that it is present in those of certain species, such as quail, great tit (Kohlmeise), wood-pigeon, and song-thrush.

In another section (pp. 99–122) he asks the question how the bird comes by a sense of rhythm, and, rejecting Bücher's theory that rhythm in music can be traced to the movements of the body, he is disposed to think that in the case of birds it has its origin in the action of the heart; but this is a delicate question, for which the reader must be referred to the author's own statement of it. Dr. Hoffmann also discusses the question of "Metrik" in bird-song, *i.e.* Can the strains sung by any birds be divided into feet or bars? On p. 84 foll. he maintains that in the song of the nightingale, the most highly developed singer of all, this quality can be found as well as rhythm and invention. Whether we agree with him or not in some of these details, it is a pleasure to be able to say with confidence that all he writes deserves careful study, for which every conscientious ornithologist will be the better.

The only thing that seems wanting is a discussion of the *quality* of tone (not quantity) in various species. Thus the formal likeness between the songs of the chaffinch and the willow-wren is noticed (p. 31), but nothing is said of the fact that they are produced by totally different instruments. To the ear of the present writer the songs of both species of redstart are "played" on an instrument which no other bird possesses. We would suggest that Dr. Hoffmann should add a section on this subject in another edition, and shorten, if need be, the discussion at the end of the volume on the use made by musical composers of the songs of birds, which is only of incidental interest. Before leaving this interesting work, which well merits translation into English, it may be as well to say that the author is disposed to reject Darwin's theory of the development of song by sexual selection, and to hold that the root of it is to be found in the enjoyment of life and the love of play, especially, but not entirely, in the breeding season.

W. W. F.

OUR BOOK SHELF.

The Scientific Aspects of Luther Burbank's Work. By D. S. Jordan and V. L. Kellogg. Pp. xiv+115. (San Francisco: A. M. Robertson, 1909.) Price 2 dollars net.

This is a small book, consisting of two papers reprinted from the *Popular Science Monthly*, describing and appreciating the work of the great American plant-breeder. It is attractively illustrated by photographs, and is intended for the general as well as the scientific reader.

Luther Burbank was born in 1849, and after a local education started life in his uncle's plough factory. He soon gave this up for market gardening, and in 1875 moved to Santa Rosa, California, where he has since worked on a large scale, and produced many new and important varieties, both of fruits and flowers. He has discovered no new laws, but his results are so obviously successful that it is interesting to know the methods by which they have been obtained. Like most practical men, he is a firm believer in the heritability of the direct effects of environment, but he makes most use of the indirect ones—the "indefinite variations" of Darwin—and recognises as their chief cause the re-combination of characters consequent on hybridisation, and, in a lesser degree, on cross- or self-fertilisation.

The first step in the method usually followed is the inducing of these variations by nutritive changes or by the crossing of forms as widely separated as is compatible with fertility. The useful variations are then accumulated by stringent selection until they become fixed. Mr. Burbank finds that six generations are generally sufficient to accomplish the process. He holds that there is practically no limit to the results which can be obtained by unassisted selection, and many of his size and colour varieties of flowers have been obtained by this method alone. Sometimes, on the other hand, a new variety is produced by the careful propagation, without much selection, of one individual which showed a fortunate mutation. The Burbank stoneless plum is an example of the effective combination of the three processes of searching for natural mutations, hybridising, and selection. A plum was found in a small wild species with only part of a stone. This species was crossed with the French prune, and some of the offspring found to be quite stoneless. Further selection is still increasing the proportion of stoneless, and at the same time large, fruits. The desirable qualities of two varieties can generally be combined by crossing; indeed, some of the offspring often possess a quality in a higher degree than either of their parents. Some of the photographs illustrating the increase of size in fruits show this in a striking manner.

We do not for a moment doubt that Mr. Burbank has "a broad intelligence and a sensitive soul." If he is also "as sweet, straightforward, and as unspoiled as a child," it is just possible that he can stand being told so. But his portrait is so singularly charming that it might have been left to speak for itself.

Text-book of Petrology, containing a Summary of the Modern Theories of Petrogenesis, a Description of the Rock-forming Minerals, and a Synopsis of the Chief Types of the Igneous Rocks and their Distribution, as illustrated by the British Isles. By Dr. F. H. Hatch. Fifth edition, revised and rewritten. Pp. xvi+404. (London: Swan Sonnenschein and Co., Ltd., 1909.) Price 7*s*. 6*d*. net.

This new edition of a well-known text-book for students marks a decided advance on its predecessors. It is clearly written, well illustrated, and has, as a rule, been brought up to date.

There is a brief but readable account of the eutectic theory of the process of crystallisation of igneous rocks, as well as of the different explanations which have been offered of the formation of porphyritic crystals.

The descriptions of the rock-forming minerals are in most respects accurate and sufficient. The author disclaims any intention of dealing with the optical determination of minerals, but as he makes use of the interference colours for the purpose of estimating the birefringence, he might with advantage have gone a little further and shown how easily an approximate quantitative determination of the relative retardation and birefringence may be made. Such expressions as "weak," "moderate," "very strong," "polarising in grey tints," "brilliant chromatic polarisation," though commonly employed, have very little scientific value, especially when the variation in thickness of rock-slices, even by good makers, is considered. In the same way, if the angle of extinction be employed for determinative purposes, the student should be taught to discriminate between the positive (slow) and negative (fast) directions of extinction. The statement that "between crossed nicols the rhombic pyroxenes extinguish of course straight" is too sweeping. Certain directions of section show quite an appreciable angle of extinction.

The author adopts analytical formulæ for the rock-forming minerals, a procedure which is justified by the clearness with which the composition is indicated and the ease with which it is remembered, but it may be noted that the abbreviation "Ab" for albite represents, not $Na_2O.Al_2O_3.6SiO_2$ as stated, but half that formula.

The primary classification of igneous rocks into plutonic, hypabyssal and volcanic, which is adopted, is sanctioned by almost universal usage, though it is as unreasonable as a fundamental division of the vegetable kingdom into roots, stems, and leaves. Each class of rocks is separated into families and types, with the definition of which little serious fault is, in most cases, to be found, though there may often be room for difference of opinion.

Perhaps the most valuable feature is the section which describes the distribution of igneous rocks in the British Isles, and the maps, mostly taken, by permission, from well-known papers, with which it is illustrated.

The work may be safely recommended as a text-book for students, but they should be warned against the employment of the numerous little-known and unnecessary rock-names to be found in its pages. In almost every case the same idea can be more happily expressed by prefixing a word or phrase to a well-established name. Their presence, however, undoubtedly increases the value of the book as a work of reference. J. W. E.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. vii. Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xv+709; plates cviii–cxxii; 184 text-figures. (London: Printed by Order of the Trustees, 1908.)

IN no group of animals and plants is the enormous increase in our knowledge more conspicuous than in insects. Thus, at the time of the publication of the twelfth edition of Linné's "Systema Naturæ" (1767), we find only 112 species described under Noctuæ. Sir George Hampson now divides the family Noctuidæ into fifteen families, of which the first three are Agrotinæ, Hadeninæ, and Cucullianæ, the species belonging to each being described in vols. iv.–vi. of the general "Catalogue of Moths" respectively, and vol. vii., now before us, forms the first of three volumes intended to be devoted to the fourth subfamily of Noctuidæ, the Acronyctinæ, and includes descriptions of species numbered from 2748 to 3590, a considerable number of which (and also many genera) are described as new by the author.

It is possible that all the remaining families of Noctuidæ may not require a whole volume apiece, and it would be difficult to estimate the total number of Noctuidæ which the present work is likely to contain when completed, but it can scarcely be less than 20,000 species, and may well be 30,000, or even more, as against the 112 species which were all that were known to Linné, the most learned entomologist of his time, in 1767.

We notice no alteration in the general arrangement of the work, and the usual high standard of letter-press and illustrations is fully maintained in the present volume.

Physikalische Musiklehre. Eine Einführung in das Wesen und die Bildung der Töne in der Instrumentalmusik und im Gesang. By Dr. Hermann Starke. Pp. viii+232. (Leipzig: Quelle and Meyer, 1908.) Price 3.80 marks.

THIS little work on the physical theory of the nature and production of musical sounds is almost entirely free from mathematics, and may be regarded for the most part as an abstract of the simpler portions of Helmholtz's great classic, "The Sensations of Tone." The text is, however, freely illustrated by cuts, many of which, the author acknowledges, are borrowed from other books; thus at every few pages may be found an old and familiar figure.[1]

The treatment is divided into five parts or chapters. Of these the first and second are occupied with the origin and propagation of waves and sound, while the third describes musical tones, intervals, and scales. The fourth chapter consists of four parts, dealing respectively with (i.) stringed instruments, (ii.) wind instruments, (iii.) vibrating bodies with inharmonic overtones, and (iv.) human speech and song. The last chapter is devoted to consonance and dissonance, and after giving Helmholtz's theory concludes with a *résumé* of more recent work on the subject. This part includes notices of intermittence and variation tones, and of the work and theories of C. Stumpf.

To those who wish for a bright, readable treatment of this borderland between music and physics, free from mathematics, but with the opportunity of improving their conversance with German, this book is heartily recommended. E. H. B.

[1] Perhaps it is this practice which has led to the representation of a metal *strip* vibrating like a *string* (p. 22), for the same error occurs in Tyndall's "Sound" (p. 128), 1895.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Electrons and the Absorption of Light.

ON the theories of dispersion given by Drude and Lorentz, an absorption band in the spectrum corresponds to the free period of an electron, and, if we assume that only one electron in each molecule is concerned with an absorption band, it is theoretically possible to calculate e/m for this electron from the values of the coefficient of extinction throughout the band. I have made this calculation, apparently for the first time, using the formula

$$\frac{e}{m} = 1 \cdot 297\ \nu\kappa \frac{\lambda_1 - \lambda_0}{\lambda_0^3},$$

which may be derived on both the above theories. κ is the maximum value of the coefficient of extinction, λ_0 the position of the maximum, λ_1 the wave-length, for which the coefficient of extinction has a value equal to half its maximum, and ν the index of refraction. The following table gives some results:—

Substance	λ_0	e/m	Source of data
	$\mu\mu$		
Fuchsin in alcohol...	550	1·8 10^7	
Phloxin in water	515	1·4 10^7	Stanislaw Kalandek
Crystal violet in alcohol ...	575	4·9 10^7	*Phys. Zeit.*, 9 Jahr., s. 128–35.
Corallin in alcohol	465	1·6 10^6	
Methylene blue in water ...	665	5·4 10^6	
Water blue in water	575	8·1 10^6	
Eosin in water	515	6·9 10^6	
Eosin in water	516	9·2 10^6	Georg. J. Katz
Cyanine in alcohol	587	5·8 10^6	Inaug. diss., Erlangen, 1898
Cobalt chloride in water ...	504	2·5 10^3	Houstoun and Russell
Uranyl nitrate in water ...	486	34	Proc. Roy. Soc. Edin., vol. xxix., part ii., p. 68
	473	75?	
Three glasses coloured with CoO	644	5·0 10^4	R. Zsigmondy, *Ann. d. Phys.* (4), 4, 1901, s. 60
	631	3·0 10^4	Figures taken from curves
	640	3·0 10^4	
Two glasses coloured with Cr_2O_3	620	3·2 10^4	
	655	1·2 10^4	
Three glasses coloured with NiO	640	1·3 10^4	
	640	1·0 10^4	
	610	1·1 10^4	

For the anilin colouring matters e/m is of the order 10^7, whereas for the glasses and inorganic salts it is of the order 10^4 and under, showing that in the one case we are dealing with electrons and in the other with ions. A calculation made by Drude from the dispersion of solid cyanine in the neighbourhood of its band gave $e/m = 8 \cdot 5 \times 10^6$. If there are two electrons for each of the original molecules of the colouring matter the values of e/m should be halved, or if there is only one electron for two molecules the value of e/m should be doubled. According to Kalandek, corallin probably undergoes some change in solution. This may account for the low value of e/m.

These results cannot be obtained on Planck's theory.

I hope shortly to publish a full account of the assumptions involved in this calculation, together with additional results.

R. A. HOUSTOUN.

Physical Laboratory, University, Glasgow, May 14.

Dimensional Changes produced in Iron and Steel Bars by Magnetism.

WHILE engaged on research work of an engineering nature, I came upon some facts with regard to the behaviour of magnetism on iron and steel bars in the semi-plastic state beyond the yield point that I am unaware have been noted before. I propose, therefore, to give a brief account of the experiments carried out and the results obtained, on the chance that they may prove of interest to others who have time to pursue the matter further.

A specimen of mild-steel about 18 inches long, ¾-inch diameter, and 8 inches between gauge points, having been fixed in the jaws of the testing machine, was surrounded by a solenoid, and a current supplied sufficient to cause magnetic saturation. The specimen had then a tensile load applied to it in the usual way until it ruptured, the magnetism being kept at the saturation point all the time. Other bars were then tested, with and without magnetism, and in the result it was found that the magnetised bars were distinctly less in length between gauge points than the unmagnetised—in other words, that the elongation was less in the first case than in the second.

In order to make the comparison as fair as possible, and to eliminate the effects of difference of composition and of manufacture, the specimens for each experiment (consisting of the rupturing of one unmagnetised and one magnetised specimen) were each cut from the same bar. A few of the results are given in the table below. These were taken at random from a large number of examples, and will serve to give some idea of the nature of the changes. The material in each case (with the exception of experiment No. 10, in which it was wrought iron) was ordinary mild-steel taken from bars about 12 feet long, just as they were delivered to the laboratory.

No. of experiment	Diameter of specimen (inches)	Extension on 8″ length bar Unmagnetised	Extension on 8″ length bar Magnetised	Decrease in extension	Percentage decrease in extension	Breaking load (a) Unmagnetised (b) Magnetised	Maximum load (a) Unmagnetised (b) Magnetised
1	¾	2.6	2.19	0.41	15.8	(a) 18,680 (b) 18,845	(a) 26,185 (b) 25,910
2	¾	2.5	2.25	0.25	10.0	(a) 18,080 (b) 18,800	(a) 26,115 (b) 26,040
3	¾	2.5	2.25	0.25	10.0	(a) 18,960 (b) 18,970	(a) 26,170 (b) 25,930
4	¾	2.5	2.25	0.25	10.0		(a) 26,240 (b) 26,100
5	¾	2.65	2.35	0.30	11.9	(a) 20,030 (b) 20,130	(a) 26,580 (b) 25,400
6	¾	2.45	2.25	0.20	8.2	(a) 18,630 (b) 18,120	(a) 26,770 (b) 26,290
7	⅞	2.55	2.43	0.12	4.7	(a) 23,030 (b) 23,000	(a) 33,300 (b) 33,000
8	⅝	2.5	2.35	0.15	6.0	(a) 12,950 (b) 13,010	(a) 18,500 (b) 18,400
9	1	2.5	2.25	0.25	10.0	(a) 38,680 (b) 36,210	(a) 51,360 (b) 50,515
10	⅞	2.2	2.15	0.05	2.3		(a) 30,900 (b) 30,900
11	1	2.5	2.31	0.19	7.6		
12	¾	2.4	2.25	0.15	6.2		
13	¾	2.38	2.28	0.10	4.2		
14	1	2.63	2.35	0.28	10.6		

Units = inches and pounds.

The results may be summarised as follows:—

(*a*) The amount of the decrease of elongation caused by the magnetism varies from about 3 per cent. to 16 per cent.

(*b*) The composition of the steel, its hardness, &c., affect the amount of the decrease of elongation.

(*c*) The average maximum load without magnetism seems higher than the average maximum load with magnetism.

(*d*) The average breaking load without magnetism seems lower than the average breaking load with magnetism.

(With regard to (*c*) and (*d*), nothing definite can be put forward, as it is an extremely difficult matter to gauge the maximum and breaking points to a hundred pounds or so on a 70-ton testing machine.)

(*e*) Careful measurement shows that, after rupture, the magnetised specimen is thicker all over its length than the unmagnetised, but that the greatest difference is at the place of local extension. This points to the likelihood that the magnetism hinders the flow of the metal, and that this hindering action begins just after the yield point is reached, and attains its maximum value at local extension. This is also brought out in the case of the experiment with wrought iron (No. 10), which shows on fracture numerous planes of cleavage that no doubt hindered the formation of "waist," and caused the relatively small decrease of elongation.

The following are readings, taken inch by inch, between 8-inch gauge points on ¾-inch mild-steel specimens cut from the same bar:—

After Rupture.

	1st inch	2nd inch	3rd inch	4th inch	5th inch	6th inch	7th inch	8th inch
Unmagnetised ...	1.24″	1.26″	1.30″	1.38″	1.70″	1.36″	1.24″	1.20″
Magnetised	1.20″	1.23″	1.28″	1.50″	1.50″	1.26″	1.24″	1.20″

The unmagnetised specimen broke almost exactly between the fourth and fifth inches, and the magnetised at the end of the fourth inch.

It was thought possible that if the diminution in elongation were due to the magnetism hindering the flow of the metal, tests on a Brinell hardness testing machine might give some results, but though many were carried out, nothing decisive was obtained. A few compression tests were also made, but insufficient to give trustworthy data.

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"Blowing" Wells.

IN a village about three miles from Norwich, and situated about 140 feet above sea-level, there are three of these "blowing" wells. They are, roughly, about 100 yards apart, and each is 3 feet in diameter and from 70 feet to 80 feet in depth. When last opened, some years back, they were found to be empty of water. One of them was then domed over with an iron dome, which after a time blew off owing to the pressure of air (or other gases) within the well. The other two wells have since been domed over in a similar manner, but it was necessary to insert a 3-inch ventilation pipe into the dome in each case because of the great pressure of air that sometimes accumulates within.

Observation shows that this pressure is sometimes positive for several consecutive days, and that the air then comes out of the ventilation pipe with considerable force, so much so that, in the case of one well which has a grating over the end of the pipe, the well "roars" so loudly that it can be heard for a distance of several yards. At other times the pressure in the well is negative, and then leaves and other débris get sucked into the grating. There is a strong belief, locally, that an accurate forecast of the weather can be gauged by the intensity of the "blowing." I have never heard or read of similar "blowing" wells, and it is difficult to assign an adequate explanation for this alternating positive and negative pressure in the well. Can there be any connection between the blowing and changes in atmospheric pressure, as is locally supposed, or do the rise and fall of the level of the water in the river Yare (which is about two miles distant, and is at this point only about 4 feet above sea-level) have any possible effect on this curious phenomenon?

Norwich, May 3.

SYDNEY H. LONG.

THE USES AND DATES OF ANCIENT TEMPLES.

I PROPOSE in the present article to make some very general statements concerning the work so far done on the orientation of ancient temples, and to bring together some of the chief conclusions to which it has led.

I may begin by stating that the inquiry has been carried on at intervals during the last nineteen years—that is, since March, 1890—when I observed the magnetic bearing of the temple axis of the Parthenon. From 1891 to 1894 the research was almost entirely limited to Egypt. "The Dawn of Astronomy," published in 1894, gives the result.

The first definite conclusion arrived at deals with the use of the temples; why they were built, and for what purpose. It was found that the Egyptians carefully built their temples so that the rising and the setting of certain stars, and of the sun at certain times of the year, could be watched along the temple axis by the priest in the sanctuary.

It was not until after my first winter in Egypt that I learned that Nissen, of Bonn, had anticipated me in suggesting that this might have been so, and that several references to the practice which I had made out occur in the inscriptions.

One of the chief difficulties in the Egyptian work arose from the fact that in most cases the date of the foundation of the temples was unknown. There were, however, some notable exceptions where the results of the orientation theory could be compared with records, and in these there was a perfect agreement, which also enlightened us on the method employed by the Egyptian astronomer-priests for reducing to a minimum the disadvantageous effects of the change of the places of stars brought about by the precessional movement.[1]

The next conclusion dealt with the actual astronomical observations made by the ancient Egyptians. They were of three classes:—(1) To determine the time at night. The stars used for this purpose I have called "clock-stars." (2) To observe a star rising or setting "heliacally"—that is, about an hour before sunrise on the chief festivals. (3) To determine when the sun had reached a certain part of its yearly path at which the festivals occurred.

For (1), as they had no instruments, they used a star rising near the north point of the horizon, and watched its movement round the pole; one quarter of its path would, of course, represent six hours, and so on. The stars so used were the brightest ones in the Great Bear and the Dragon. Stars rising near the south point of the horizon were also observed, and, doubtless, for the same purpose. For (2) any bright star rising or setting at the proper time between the north and south points would do; as a matter of fact, they used Capella, Spica, the Pleiades, Sirius, α Centauri, Canopus, and others. For (3) they commenced with a year beginning in May—the "May year," the first used in Britain, and still determining the quarter-days in Scotland; later they passed to the "solstitial" year, June 21, the beginning of the Nile rise and the longest day, being the *new* new year's day. This is the origin of our present English year.

The inquiry thus begun in Egypt was subsequently carried on in Greece by Mr. Penrose with admirable results, because there he was able to deal with temples the foundation dates of which are known within narrow limits.

The first attempt to apply the orientation theory to British monuments was made by Mr. Penrose and myself in 1901 at Stonehenge.

At the first blush there appears to be no resemblance between the Egyptian and Greek temples and the British stone monuments, but a careful study of both shows that this view is an erroneous one.

The study of the British monuments from the astronomical point of view has enabled us to grasp one object which, in spite of their varied forms and complexities, they all had to fulfil. It also enables us to *classify* them, and this classification not only suggests the order of their evolution, but shows their strict relationship to the Egyptian temples. This was the next advance. The demonstration is as follows.

The simplest of our ancient British stone monuments is represented by what is called a stone-row or avenue; good examples of these are to be seen at Merrivale; one is a single line of stones; the other is a compound avenue consisting of two double lines of stones running parallel with each other at some distance apart. The most famous compound avenue in our own country is that of Challacombe, on Dartmoor, which consisted once of eight rows of stones. I am sorry to say only two or three rows now remain.

Avenues were in some cases built of earth instead of stones; one at Stonehenge can still be studied; it extends towards the north-east from the centre of the temple and naos.

The next form we have to consider after the avenue is the cromlech or dolmen—that is, the skeleton of an old barrow. Here again we get the gradual elaboration from a single cromlech to compound ones. A good example of the former is that at Trevethy, in Cornwall. In this, which consists of very large stones, the only entrance into the chamber is provided by a small portion cut out at the bottom corner of one of the stones. There is another very good example called the Devil's Den, near Avebury, which is rather more simple than the cromlech at Trevethy. It consists of one big stone supported by three others.

Another kind of monument called a cove must be regarded as an uncovered cromlech. It consists of three stones occupying three sides of a square, the open side indicating the direction; the finest example is at Avebury.

Cromlechs do not always occur singly. At times they are compounded into pairs or triplets, as at Plas Newydd.

We next find a combination of the avenue and cromlech. In this form the direction of the opening of the cromlech is defined by marking and extending it with a double line of stones. We thus get a creep or alley-way, or *allée*, as the French archæologists call it, and this may be either open or covered—*allée ouverte* or *allée couverte*; fougou is the Cornish term for the latter form.

The best example that I have seen of this combination of avenue and cromlech in Britain is that at Bryn Celli Ddu. This, like the avenue at Stonehenge, looks out to the north-east of the horizon; in fact, it is practically parallel to that avenue. The most perfect example of a barrow containing a cromlech with an alley-way is at Maeshowe, in the Orkneys. The cromlech is in the centre of a still existing mound; it is a very elaborate one, with side

[1] In two instances of the dedication of the same temple to different stars at widely different epochs, the orientation theory tells us that the temple of Denderah was built either to observe the rise of the principal star in the Great Bear in 4950 B.C. or the principal star of Draco in 3100 B.C. or both; the inscriptions tell us that the temple was founded in the times of the Shemsu Heru before Mena, whose date, according to Budge's "History of Egypt," was 4400 B.C., and was afterwards restored by Pepi, whose date, according to the same authority, was 3233 B.C.

At Annu there was a restoration of an old temple by Usertsen (2433 B.C.). The story is told in a roll still extant. The theory tells us thar, as at Denderah, this restoration was undertaken to watch the rise of the principal star of the Dragon in 2500 B.C., the restored temple having been originally founded to watch the rise of the principal star of the Great Bear in 5200 B.C.

(sleeping) chambers and a small chamber at the end, and a long alley-way which points to a menhir not far away called the "Barn Stone," and to the place of sunset in December, twenty days from the winter solstice.

The most compound example of avenues and cromlechs that I know of as yet is one of which photographs and particulars have recently been sent to me by Captain Devoir, of the French Navy; in it we have three cromlechs and three alley-ways, using the same outlook, and, doubtless, once covered by one barrow.

One alley-way is directed to the sunrise in May, another to sunrise at the winter solstice, and there is another directed to a "clock-star" rising near the north point, so that, in association with one barrow, we have three distinct and well-marked alleys in directions with which we are perfectly familiar.

This oneness of aim which the orientation theory enables us to discover leads us further.

In the avenues, alley-ways, and cromlechs we are absolutely face to face with the ground-plan of Egyptian temples, so much so that there can be no question that those who built those magnificent monuments in Egypt some 2000, 3000, or 4000 years B.C. got their ideas of the buildings they wished to erect from the traditions of people who built cromlechs and who had lived in and used them.

A general plan of Thebes shows how in Egyptian architecture, in a country of wonderful civilisation, large population, and infinite wealth, we get a tremendous elaboration of the avenue; each temple is provided with one, long or short, leading outwards from the pylon.

The avenue, which in our case is built of rough stone, is elaborated into long lines of beautifully carved sphinxes, and, further, if we study the most elaborate Egyptian temples, we see there are, in the temple itself, very many openings in one straight line in various walls; in some places we have an *allée ouverte,* and in others an *allée couverte.*

These all lead to a closed chamber at the end, a darkened chamber, the naos or the holy of holies, which is nothing but a glorified cromlech.

The temple access never pierces the end of the closed chamber any more than the wall was pierced at the back of the cromlech, but it led to a darkened chamber, so that here we have the closest possible relationship from the architectural point of view between the British cromlech and the most elaborate temples at Thebes, while from the astronomical point of view the similarity of use is obvious.

So much, then, for the intimate connection between the avenue and the cromlech, however simple or complicated either may be, and the strict relationship of both to the Egyptian temples.

But there is another and completely different set of ancient monuments still to be classified. I refer to circles, which, like the avenues and cromlechs, may be simple or compound. Archæologists so far have not noticed the close relationship of circles with avenues and cromlechs, for the reason that the circles to which their attention has been almost entirely confined only represent one part of the apparatus. When we consider a circle *and its outstanding stone indicating a certain direction,* the strongest astronomical resemblance to the alignments of avenues and cromlechs is at once apparent.

There is no doubt that the circle represents an enormous advance in astronomical knowledge, possibly, to a certain extent, connected with the building conditions brought about by the poverty or the economical ideas of the people who constructed them. In densely populated and rich Egypt a temple was devoted to the rising or setting of one heavenly body, whether star or sun, the place of rising or setting being indicated by the long temple axis, and each sacred place contained many such temples, because there were many heavenly bodies to be watched. The temple of Amen-Ra, if contracted for now, could not, I fancy, be built for less than 5,000,000*l.* sterling, and it might take ten or fifteen years to erect. But it simply had one outlook, one use.

Now, to carry on this method of observation and worship where the population was scarce, the best and cheapest thing to do would be to build a bank or set up a line of stones to represent a temple axis, or to build a circle to represent a sanctuary, and from its centre to imitate various temple axes by sight-lines marked out by a stone or barrow at some distance outside the circle. Six such outstanding marks, each of stone set up in a day or two, would then replace, and quite effectually from the astronomical point of view, six majestic temples taking tens of years to build, and the elaborate system of avenues and cromlechs represented by all the temples at Thebes or in any other locality, however numerous.

Only the holy of holies as a dark chamber would have to go; the centre of the circle would replace it as the priest's place. That was a matter for the priests, and had nothing to do with astronomy. In any case, *from the astronomical point of view,* what was done by the Theban priests by building all these majestic temples could be done by one circle with properly arranged outstanding stones, so that the circle represents a distinct advance over the idea connected with the avenues and the cromlechs.

We shall not, then, be far wrong in supposing circle building to represent a later development, and this view is strengthened by the fact that there are no circles in Egypt, where the avenue-cromlech system is most developed.

The next upshot of the inquiries arrived at, soon after I had measured several stone monuments in Cornwall and on Dartmoor, was that the directions indicated by the avenues, cromlechs, and circles with outstanding stones were certainly not helter-skelter. When they were classified it was found that only a small number of directions was used—that is to say, directions embracing sunrise and sunset throughout the year, and directions to the north or south parts of the horizon which the sun never reaches.

Next it was found that these directions were practically the same, and had the same uses, as those I had previously studied in Egypt—in short, that the British avenues and stone circles bear precisely the relationship to the Egyptian temples indicated above. The "clock-stars" used in the British monuments were the precise equivalents of the stars in Ursa Major and Draco used by the ancient Egyptians, when we take the difference of latitude between Egypt and Britain (25°) and the effect of the precessional movement on the declination of the star into account. The same may be said of the "morning stars" they employed.

These "morning stars" were of very great importance. We are familiar with them from Bible references. These were stars which rose about an hour before the sun itself rose. In the earliest times there were sacrifices, and the morning sacrifice was a very elaborate affair, which required about an hour for its preparation, so that unless the priest could get some idea of the time of the actual sunrise some hour or so before the sun itself rose, he might go very wrong, and be either too early or too late at the moment of the rise of the great luminary. When the alignments to the places of the sun at different periods of the year were investigated, another conclusion of first-rate importance was arrived at.

At first the all-important positions of the sun, as indicated by the alignments, were not the solstices or the equinoxes, but at intermediate points when the sun occupied the declinations 16° 20′ N. and S. The year was thus defined by the sun's stations in May, August, November, and February.

This I have called the "May year," a vegetation year. I think it must be acknowledged that one of the most important results of the new method of looking at monuments has been the demonstration of the existence in early times in Britain of a year which began in May or November and ended in November or May; and this, one of the teachings of the monuments touching our early history, will in the future greatly help folklorists and others interested in antiquity and the dawn of the so-called Celtic literature. There is now no doubt, after the researches of the Rev. J. Griffith, that the Welsh Gorsedd circle brings before us, in stone, traditions of a time when the May year was in vogue.

The reason that we had that year before we had the real astronomical year, which works from the solstices in June and December to the equinoxes in March and September, is that the worship and *use* of the sun began before the length of the year had been made out, and that the worship was at its highest in Babylonia and Egypt at the time the sun was giving to us the most that it could give—that is to say, the harvests of the fruits of the earth.

The earliest temple that I know of directed to the May sun is at Memphis, which must date from some 4000 years B.C., and it may well be that at that time little was known about the length of the year, because it looks very much as though the Theban cult was established at Thebes as opposed to Memphis some 2000 years after the date I have mentioned, simply because the Egyptian astronomers had then found out the length of the year and had begun to use it.

One reason why they reckoned their year from solstice to solstice, which is what we do now, was probably because at the solstice the sun rises at the same place on the horizon for three days, whereas the determination of the exact position of the sun on May 6 or March 21 is a matter of difficulty as compared with the determination of the solstice. When Mr. Penrose and myself were making observations, we were led to the belief that the present Stonehenge, with its complete sarsen stone circles, is relatively a modern affair, and that there had been at Stonehenge, long before the sarsen circles were erected, an old temple directed to the "May year." I have since found in many cases traces of the "May year" anticipating the solstitial year. The solstitial cult in Britain followed the "May year" cult, just in the same way as in Egypt the solstitial cult at Thebes followed the "May year" cult at Memphis and Heliopolis.

In relation to the sun's seasonal times, then, we find temple axes, avenues, and circles with outstanding stones indicating the direction in which sunrise or sunset was to be looked for at the critical times of the year—that is, the beginning of May, August, November, and February, dealing with the May year, and the longest and shortest days of the solstitial year.

In connection with these solar alignments, evidence is forthcoming that in some cases warning was given of the chief festivals by erecting stones marking the sun's sunrise place from some twenty-one days before they occurred. It is thus possible that the structure of the Roman calendar with the 21 *dies ante calendas* and the ecclesiastical period of Lent, which was originally of three weeks' duration, may have had their origin in the stone-circle practices.

The next main conclusion derived from the work has to do with the dates of erection of the various monuments. With regard to these, I limit myself now to Britain.

The determination of dates is rendered possible by the change of the declination of the sun at the solstices and of stars, brought about by astronomical causes into which we need not now enter. This declination, indeed, is constantly changing, but we have, thanks to the researches of Stockwell and Dr. Lockyer, tables of the declinations of the solstitial sun and of the principal stars, century by century, as far back as 4000 B.C. It is fortunate that, to determine the declination to which the direction of each monument corresponds, very simple observations alone are required. It is as well to recapitulate them here. First, the exact direction of the temple axis or avenue, or of the outstanding stones or barrows, as seen from the circle, in astronomical terminology their azimuth, is obtained by measurements made at the actual monument or on the 25-inch Ordnance map. The angular height of the horizon on this line has next to be measured. With these *data* and the latitude, the declination (that is the distance from the equator) of the body observed along the sight-line indicated can be calculated. The solar group of monuments practically does not help us with regard to dates, for the reason that the change in the position of the sun every succeeding 1000 years is very small, but the change in the position of the stars every 1000 years, or even 300 years in some cases, is considerable, so that in the matter of dates we are thrown back almost entirely upon the stars. Still, there is one solar temple so perfectly arranged at Stonehenge that it has been possible to suggest the date for it within something like 200 years; the measures of that, quite independently of any view determined from other considerations, gave us about 1680 B.C. for the erection of the solstitial sarsen stones at Stonehenge.

Observations have been made at a large number of monuments in Britain during the course of the last three or four years, by the help of a great many friends in different regions, who find it a very pleasant occupation for their holidays. Already something like 140 or 150 alignments of avenues or of cromlechs, or of outstanding stones, have been measured, and 113 results have already been tabulated. These are as follows:—

SUN	May	15
	November...	9
	Summer solstice	17
	Winter solstice	11
STARS	North clock-stars Arcturus	24
	,, ,, Capella	13
	South clock-star α Centauri	6
	Warning stars Pleiades	16
	,, ,, Antares	2
	Total ...	113

It will be seen how overwhelming the evidence is becoming that blind chance had nothing to do with the setting out of the various alignments, how they all fall into a few definite groups, and how the large mass of evidence now accumulated entirely justifies the conclusions derived from those first placed on record.

With regard to the dates given later on, all are approximate only; there is nothing perfect about them. The Welsh Commission and the other commissions will, I hope, make measures, using solar instead of magnetic methods, and determine the height of hills in minutes instead of half degrees, and if they do that these dates will certainly be changed, though they cannot be changed very much.

I have already shown that the May year and the solstitial year had temples sacred to them in Egypt. I may now add that in the Egyptian temples we found one set for the northern stars, the equivalents of Arcturus and Capella, and another set for the southern stars, among them α Centauri. One of the most recent results of this inquiry has been that we have found a number of avenues, *not circles*, in Brittany and in different parts of Britain, *not in Cornwall*, the equivalents of the Egyptian temples aligned to the southern stars. The probable alignment corresponds with the southern star α Centauri. There is the Challacombe avenue on Dartmoor, the Borobridge avenue near Harrogate, and others at Avebury and Shap.

Now if we deal with the "clock-stars" in order of date, α Centauri comes first, B.C. 3600–2700. This is followed a thousand years later by Arcturus, B.C. 2600–1350, and Capella, B.C. 2250–1250. In all these cases there is a complete series of dates from one end to the other. Now these are the "clock-stars."

Coming to the warning stars, it will be noted that the Pleiades were observed rising, and Antares setting, heliacally—that is, about an hour before sunrise. The dates are:—Pleiades, B.C. 2120–1000; Antares, B.C. 1720–1310.

We see that about the same dates are involved as those found in connection with the northern "clock-stars," and this, of course, strengthens the view that we are really dealing with alignments set out for a definite purpose at a definite time. The story, then, is that astronomer-priests familiar with Egyptian methods began work here by building avenues in different parts of Britain about 3600 B.C.

The star employed as a "clock-star," then, was α Centauri, one of the stars used in Egypt. This cult was succeeded by another, in connection with which circles were introduced and northern "clock-stars" were used. This was the chief cult in Cornwall from 2600 B.C. onwards.

If we accept the dates thus astronomically revealed by the stellar alignments, several interesting consequences follow. The British circles were in full work more than a thousand years before the Aryans or Celts came upon the scene, if the time of their arrival favoured by archæologists is anything like correct. Stonehenge began as a May temple—a British Memphis—and ended as a solstitial one like that of Amen-Ra at Thebes. Another conclusion is that, whatever else went on some four thousand years ago in the British circles, there must have been much astronomical observation and a great deal of preparation for it. Some of the outstanding stones must have been illuminated at night, so that we have not only to consider that the priests and deacons must have had a place to live in, but that a sacred fire must have been kept going perpetually, or that there must have been much dry wood available. The question, then, is raised whether dolmens, chambered barrows and the like were places for the living rather than for the dead, and, therefore, whether the burials found in some do not belong to a later time.

The determination of dates, in conjunction with the conclusions arrived at concerning the various kinds of monuments, opens up another point of view which possibly in the future may lead to fruitful inquiries.

Why have we in different temple regions such great differences in the relative numbers of avenues, cromlechs, and circles, the extreme case being that only one class is represented?

When the order of the evolution of the different classes of structure is settled, the geographical distribution of them may lead us to further conclusions. The tremendous development of avenues in Brittany and in some parts of Britain where circles are almost entirely absent suggests that a people came here who knew nothing about circles, but did know much about avenues. These in Britain to which I refer were on a scale almost rivalling that of the Brittany avenues. The avenue at Shap was more than a mile long, that at Borobridge was nearly a mile long, and some of the stones were more than 20 feet high. The avenue at Challacombe must, when complete, have been a most stupendous monument. Further, the builders of all these worshipped a southern star; they were not miners, they did not go to Cornwall, and there is a difference of more than 1000 years in the dates derived from these avenue-builders and from the circle-builders of Cornwall and South Wales.

It may be worth while to refer briefly to some of the objections still urged against the orientation theory by those who are either unwilling or incompetent to test it by actual observations.

One is that there are so many stars that any alignment is certain to hit the rising- or setting-place of one of them. The fact that, with all the host of heaven to choose from, only six stars were used, and those among the brightest visible in these latitudes, and, further, that a good reason has been found for using those particular stars, is a strong argument against this objection.

Another objection made is that the theory demands a much greater knowledge of astronomy than the early temple-builders were likely to possess.

Those who put forward this objection entirely forget the conditions under which early man lived and moved and had his being. The conditions now are so different that we must not be astonished at the early peoples apparently behaving like astronomers; they could not behave like any other kind of men. The movements of the sun by day and the movements of the stars by night were the only things they could learn about, and it was imperative that they should learn about them.

People without almanacks and without any idea of the length of a year would find life absolutely impossible, at all events from the agricultural operations point of view, unless they could get, somehow or other, a general means of telling when they should plough and sow and reap. That depends upon the time of the year, and the time of year is written out very large indeed to anybody who will take the trouble to note where the sun rises. Similarly, if these people wanted to know about the flow of time at night, they would be under very great difficulties. In the first place, they had no clocks, so that unless they could get some idea of the time at night by observing the stars they would be entirely out of it so far as the lapse of time during the obscured part of their lives was concerned.

It no doubt is difficult for the average Englishman of the present day, unless he happens to be a sailor, to picture to himself a townless world without artificial light and any useful purpose served by looking at the sun by day or the stars at night. Calendars, almanacks, clocks, and watches have done away with the necessity of using his eyes in this direction, and the modern priest, like the modern layman, though he prates about the heavens declaring the glory of God and the firmament showing His handiwork, too often does not know that the sun rises to the eastward, and, if he does, he imagines that it rises in the same place all the year round; *natura rerum* does not interest him.

The ancient priest need not have been a profound astronomer to build the monuments, which were simply calendars. I do not mean to say they were calendars and nothing more, but they were, from an astronomical point of view, simply calendars, enabling people to know and recognise from past experience the different parts of the year by the place of sunrise or sunset, and they were also night-dials, enabling them to differentiate between the early and the late hours of the night.

In my inquiry I have not confined myself to the astronomical side of the question. I have tried to dip into the folklore and tradition already garnered in relation, not only to the sacred stones, but to the sacred wells and sacred trees.

From what I have learned I am convinced that much light will be thrown on both when an attempt shall have been made to picture what the lives of the first British astronomer-priests must necessarily have been.

It is interesting to note that, while the astronomical side of the inquiry suggests a close connection with Egyptian thought, the folklore and traditions, when studied in relation with the monuments, indicate a close connection between the ancient British and the Semitic civilisations.

I do not wish for one moment to suggest that the work in all these various kinds of monuments was limited to practical astronomical purposes. Our traditions render that view impossible. There was worship in its highest forms, perhaps in its lowest forms; there was magic, there were all sorts of things going on in relation to the wants of the people, and it was because there were some people who did know all that was required to meet general and special needs, including their agricultural wants, that they eventually became priests, because they were the *men who knew*, and that I believe to be the origin of priestly power throughout the world.

This work, if subsequently confirmed by other investigators, has the double advantage of supplying us pretty accurately with the date of erection of the monuments and of indicating the methods of observing the movements of the sun and stars employed in Britain in prehistoric times; and if risings and settings were so abundantly utilised—for utility as well as priestcraft was certainly at the bottom of it—in Britain four thousand years ago, the remarkable testimony to the knowledge and wisdom of the "Druids" given by Cæsar and Pomponius Mela two thousand years nearer their time is now seen to be amply justified.

Multa praeterea de sideribus et eorum motu, de mundi magnitudine, de rerum natura, de deorum immortalium vi ac potestate disputant et juventuti tradunt.—Caes. De Bello Gallico, VI., c. 14.

Hi terrae mundique magnitudinem et formam, motus coeli ac siderum, ac quod dii velunt scire, profitentur.—Pomp. Mela, II., c. 2.

The "Druids" of Cæsar's time were undoubtedly the descendants of the astronomer-priests some of whose daily work has now perhaps at last been revealed.

NORMAN LOCKYER.

RECENT STUDIES ON ANIMAL AND PLANT LIFE.[1]

(1) THE second volume of "Nature-study" consists of three parts. The first of these is composed of chapters by Mr. O. H. Latter on sundry disconnected topics—some insects, centipedes, spiders, a mussel, and a snail. The second, written by Miss Newbigin, treats of fresh-water and marine aquaria. The last describes the haunts of animals and methods of field observation. It is due to Prof. Arthur Thomson. With such able coadjutors, the editor could hardly fail to produce a work of permanent value and of practical suggestiveness. The articles, taken singly, are excellent. The subjects are treated with accuracy and first-hand knowledge; practical difficulties are faced and often solved; lines of thought are suggested from a single fact. The only thing lacking is a better coordination between the topics, and the want of it has led, in this volume, to a regrettable amount of repetition. Mr. Latter describes, for example, the water-beetle and its life-history. Miss Newbigin repeats the story in connection with aquaria, and Prof. Thomson refers to it again in dealing with fresh-water faunas. Thus we have five figures of the same beetle and four of its larva (not always consistent). It is called Dyticus at first and Dytiscus afterwards. Repetition also occurs in text and figure as regards the gnat, the pond-mussel, certain fish and hydroids. The text in other respects is not edited with care. Thus, with respect to the keeping of the pond-mussel, two of the contributors make contrary statements. These blemishes apart, the work is one that will give much pleasure and information to students of animal life, and stimulate to closer observation. The illustrations are of unequal merit, and many might have been saved or greater variety employed by a keener editor. The anatomical diagram at the commencement represents the structure of the pond-mussel.

(2) Prof. Kellogg, following in the footsteps of Fabre, gives a delightful series of episodes in the life of American insects. These have been told so well by his predecessors that it is difficult to introduce any novelty or charm to the description. But the visitations of insect pests in America give the author an opportunity for some new matter on scale-bugs and locusts. We can heartily recommend this little book for reading aloud to children.

(3) Mr. Farrer's rock-garden in Yorkshire is famous, and his advice will be most welcome to all who pursue this attractive form of imitating nature. In the present volume, a continuation of his former work, his experience and zeal are continually manifested, for Mr. Farrer has travelled far to watch and gather his alpines. Most amateur gardeners know too little of the principles on which rock- and bog-gardens are best planned, or of the natural habitats of the plants employed for stocking them. One of the great charms of this work is the way in which Mr. Farrer takes his readers into the resorts of his favourites, and describes the varying fortunes that have followed his attempts at acclimatisation. There is, for example, a description of the alpines near Arolla. The author's experience should be of great assistance to those who wish to know the best sites and conditions under which this class of plants can

[1] (1) "The Book of Nature-study." Edited by Prof. J. Bretland Farmer, F.R.S. Vol. ii Pp. viii+202. (London: Caxton Publishing Co., n.d.) Price 7s. 6d.
(2) "Insect Stories." By Vernon L. Kellogg. Pp. vii+298. (London: G. Bell and Sons; New York: Holt and Co., 1908.) Price 5s.
(3) Alpines and Bog Plants." By Reginald Farrer. Pp. xii+288. (London: Edward Arnold, 1908.) Price 7s. 6d. net.
(4) "Life-histories of Familiar Plants" By John J. Ward. Pp xx+204 (London: Cassell and Co., Ltd., 1908) Price 6s.

be cultivated. Those who possess his earlier volume will require the supplementary one, and those who do not will, on reading this one, be anxious to possess it. The illustrations are very well executed, but have, as a rule, little connection with the text. The latter part of the book (dealing with bog-plants) is of especial value to those who are attracted to the practice of this frequently misunderstood style of decorative work. Among the alpines most heartily commended are *Saxifraga peltata, Oxalis enneaphylla, Hypericum reptans,* and *Hypericum coris.* The index contains several misprints.

(4) This book is a series of detached simple essays on problems presented and solved by familiar plants. In matter and plan, the book compares somewhat closely with the delightful essays by Prof. Miall. The constitutional advantages of such weeds as camomile

Hairs from Body of a Bee, showing Pollen Grains entangled. From "Life-histories of Familiar Plants."

and coltsfoot, the relation between insect fertilisation and floral adaptations, the markings of leaves and the fertilisation of grasses, the evolution of the buttercup order, and the movements of sensitive leaves are some of the topics which Mr. Ward discourses upon pleasantly and illustrates clearly. On some points, indeed, he offers new hypotheses, and it is with them that we shall chiefly deal, premising that the whole volume is full of suggestion, and is based upon close observation.

Among the problems of diverse form and detail with which the book deals, the diverse behaviour of certain composites at nightfall is one to strike the most casual observer. Daisies mark the oncoming of night by closing, camomile by opening more widely. The explanation here given is the protection of the nectaries from dew- and rain-depletion of their store. The outer florets only successfully protect the disc of the flower from rain if they can cover it. If this is beyond their span, the method of acting as spouts to carry off the surplus moisture is an alternative rendered effective by the more horizontal position of the central florets on a raised disc. It is this adaptation which camomile effects, and such an explanation, whether new or not, is eminently a feature of the educational value of this work.

The relative evolutionary order and efficacy of colour and scent in relation to insect pollination of flowers is a point still in dispute; indeed, the dictum about cross-fertilisation being so eminently superior as a racial stimulus over self-fertilisation is coming up again for consideration. Most entomologists would, we think, consider scent of primary importance, and floral decoration as a means of directing the attracted insects to the right spot. The author, we notice, takes the view that the eye of the insect is caught first. It is, of course, almost impossible to write popularly on this subject without assuming a broad general conclusion as to its efficiency, which is, perhaps, hardly warranted. At least, the tendency to become dogmatic may blind us to a further explanation of these intricate associations between insects and plants that is as yet unknown. In this connection, we notice that, without stating definitely what insect pollinates the primrose, the author refers to the bee or the moth as doing it, in a misleading way. He would have been wiser to ask readers to notice what insect is really effective in the case of this plant. Neither honey-bees nor moths are known to be so. An interesting chapter is given to the markings of spotted orchis-leaves.

"The exposed part of the olive body of the viper, striped and spotted with dark markings . . . was almost identical with the appearance of some of the leaves of the orchis when similarly placed."

This resemblance is said in a footnote to be borne out by the occurrence of unspotted leaves of the plant in Ireland, where, of course, the viper is absent. But at present the suggestion, instead of throwing light on the subject, makes it more mysterious than ever, for it is surely more to the point to regard the viper as assimilating to the spotted leaves than *vice-versâ*, and for that there is as yet no particle of evidence. We could have wished for more information on grasses. We notice also the strange word "trinary." The illustrations are very good.

REFORM AT CAMBRIDGE.

FOR the last eighteen months the University has been inquiring into its management and constitution with the view of reform. At the end of his first year of office in October, 1907, the then Vice-Chancellor, the Rev. E. S. Roberts, the Master of Gonville and Caius College, spoke these words to the Senate :—

"I venture to touch now on dangerous ground. It is a matter of common knowledge that in a recent debate of the House of Lords some of the speakers urged His Majesty's Government to appoint a Royal Commission to inquire into the endowment, government, administration, and teaching of the Universities of Oxford and Cambridge and of their constituent colleges, in order to secure the best use of their resources for the benefit of all classes of the community. The Government, through their spokesman the Earl of Crewe, held that the moment was not opportune for appointing such a Commission, nor did he encourage the idea that a Royal Commission should be appointed in the immediate future.

"The attitude of neutrality incumbent by a wholesome tradition on my office forbids that I should in any way prejudice or anticipate any opinion to which the University, or any part or parts of our body, may give expression formally or informally during what may be called years of grace. But I think I may hazard one observation. I believe that there is hardly a single suggested change which could not be effected by existing statutory powers, by internal reorganisation, and by cooperation of colleges. The opportunity is a unique one; shall we miss it?"

Since this address a considerable number of the members of the Senate who take an interest in the affairs of the University have been periodically meeting to consider how far a common basis can be arrived at for reform in the Constitution and Government of the University.

Cambridge has thus proceeded on different lines from Oxford. Within the last six months the Hebdomadal Council has from time to time brought forward Graces suggesting alterations in the Constitution of Oxford University. These have in almost all cases been thrown out. Now they are confronted with a comprehensive scheme, due to the energy and statesmanlike thought of a single mind, that of their Chancellor. The Council has accepted nine-tenths of his suggestions, and it now rests with Convocation and Congregation to see how many of these will be carried into effect.

Cambridge, on the other hand, has sought to find a point of reform which would be accepted by what we might term the moderate conservative. The leaders of both parties are agreed on certain questions, and it may be that, as the *Times* of May 10 says, "We are much mistaken nevertheless if at the present time the Cambridge method has not made more real and more substantial progress than that" of Oxford. Some reforms which Lord Curzon's "scarlet letter" suggests were long ago effected at the sister University, but in many of the most important features there is still a large margin for change at Cambridge, and we cannot but regret that the suggestions now put forward, however likely to be carried into effect, do not go a little farther.

The first of the three committees which has had these matters under consideration had as its duty the consideration of the Constitution and the Government of the University, and it has limited its report to two questions, (1) the reconstruction of the Electoral Roll, and (2) the functions of the Senate and of the Electoral Roll as reconstituted. Its object was to suggest a scheme which would give to the body of residents engaged in teaching, research, and administration a larger share than it at present possesses in the legislative action of the University. It is proposed that two houses should be established, one a body of residents, the other the Senate as at present constituted. Excepting in certain formal matters, and matters of wide and great importance, all kinds of business would come, in the first instance, before the residents; but in every case an appeal would lie to the Senate as a whole, provided that a sufficient number of the opponents of the proposal submitted were prepared to take the necessary steps. Should this reconstruction of the Electoral Roll be carried into effect, it is suggested that the smaller body should be termed "Congregation," and its decisions should be entitled "Graces," whereas the decisions of the larger body, the Senate, should be termed "Decrees."

Elaborate and careful regulations have been drawn up for the suggested alterations. They are full of detail, and need not be considered here. The main feature of the proposal is entrusting much greater powers to the resident members of the University actually engaged in teaching than his hitherto been the case.

The second committee dealt with the question of scholarships, both of the colleges and the University. But as, at the present time, the question of college scholarships is under consideration by an inter-collegiate body in conference with the Oxford colleges, Committee No. 2 confined itself to the question of university scholarships, and its resolutions are now being considered by the Special Board for Classics.

The third committee was appointed to consider the relation of the colleges to the University and to one another. It has dealt with the following questions:—(A) The teaching for honours examinations. On this subject its suggestions involve (1) The reconstitution of the Special Boards of Studies so as to make them more fully representative of the teachers. (2) More detailed and careful consideration of the list of lectures in order to prevent overlapping. (3) An attempt to grade lectures so as to adapt them to students of different ability and attainment. (4) Some closer agreement than at present obtains as to the date of the students' return at the beginning of each term and the commencement of lectures.

Although at the present there is much cooperation between certain groups of colleges, the committee feels that this might be rendered more effective without interfering with the legitimate freedom of the colleges in arranging their own teaching. It also suggests that combination between colleges might be rendered more effective if the governing bodies informally consulted each other in making elections to fellowships or lectureships. In this way the needs of the different subjects might be more frequently and more fully taken into account.

In the last twenty years the number of professors in the University has risen from thirty-nine to forty-seven, of readers from six to twelve, of university lecturers from thirty-two to fifty-six. The number of demonstrators and teachers has also largely increased. In spite of this several wants remain unsatisfied, and others will certainly arise, and the committee refers to methods which it has discussed of raising money for further endowment.

The same committee has also (B) before it the question relating to the contribution of colleges to the common University fund. It is of opinion that colleges which contribute money for university purposes should be entitled to deduct from their taxable income any sum voluntarily so paid. It also holds that colleges in which fellowships are held by professors who are not professorial fellows, or by ex-professors, or by readers, or by certain university lecturers, should be entitled to deduct from their taxable income the sum of 200*l*. in respect of the fellowship held by each of such officers; and it makes other suggestions which would lighten the tax on colleges which are directly supporting University work. The committee is further of opinion that it is desirable that colleges should have power under their statutes to attach conditions to fellowships, such conditions to be defined within a specified time from the date of election; that in general a fellow should in the first instance be elected for a term of three years, and should be eligible for re-election for a further term of three years.

The same committee has also considered the necessary expense incurred by a student at Cambridge, and, after prolonged investigation, is of the opinion that the expenses of a careful student need not exceed 120*l*. for the academic year. This, of course, does not include expenses incurred in the vacation, for travelling, or for clothes. If this calculation errs, it is on the side of under-estimating. The amount must be somewhat increased for students of medicine and engineering, and for a non-collegiate student somewhat lowered, say to 80*l*.–90*l*. per annum.

Finally, although, perhaps, not carrying the weight of a document which has been considered by a representative committee, a circular issued by the Bursar of Trinity is regarded by many of the members of the Senate as one of the most important and valuable contributions to reform in the University. The matter with which it deals is difficult to explain shortly, but roughly it amounts to this:—A graduate, in taking his degree, pays high fees for the degree of B.A. and M.A.: after graduating, if he wishes to continue a member of the University and the college in which he was educated, he has to pay an annual sum to keep his name on the boards of the University or the college. It has always been a little difficult to explain to the young B.A. to what purposes this latter sum is devoted, and what, beyond a vote for the University Members of Parliament, advantages accrue to the graduate who remains a member of the University. There is thus a slight sense of irritation amongst those who keep their names on the boards, and in the case of those who do not compound this irritation recurs annually. On the other hand, those (and they are a large majority) who do not remain officially connected with Cambridge have the feeling that they have been "shown the door," and that no longer are they officially and technically members of the institution in which many of them spent the happiest years of their lives.

Mr. Innes's proposal is to reduce the degree fees to a nominal amount, and to abolish the fees for keeping names on the boards. If this were done, there would undoubtedly be a large increase in the numbers of graduates proceeding to the M.A. degree, and every graduate would remain a member of his college and of the University. To compensate for the loss of the fees which would thus be lowered or abolished, it is proposed that an additional charge should be imposed upon the student whilst in residence. If this could be effected, the whole body of graduates would become, and would remain, members of the Senate, and would, one cannot help believing, be more loyal and enthusiastic members of the University than is the case with those who have technically ceased to belong to their *Alma Mater*.

THE ROYAL SOCIETY'S CONVERSAZIONE.

A LARGE company assembled in the rooms of the Royal Society at Burlington House on Wednesday, May 12, on the occasion of the first of the two conversaziones given annually by the society. The visitors were received by the president, Sir Archibald Geikie, K.C.B., and great interest was shown in the exhibits of apparatus and results of recent scientific investigations. During the evening short demonstrations were given by Dr. A. E. H. Tutton, F.R.S., and Dr. Hans Gadow, F.R.S. Dr. Tutton's subject was crystals and colour: the revelation of crystal structure by polarised light. He gave a demonstration of the use of a new form of lantern polariscope to illustrate recent progress in knowledge of the internal structure of crystals. Magnificent colours were projected upon the lantern screen, though no coloured materials whatever were used to produce them, all the crystals employed being colourless. A new method of performing the Mitscherlich experiment with gypsum, without any extraneous heating of the crystal, was also shown. Dr. Gadow gave an account of the fauna, flora, and native races of Mexico.

The subjoined notes on the exhibits have been summarised from the official catalogue, and are here classified according to related subjects:—

Dr. G. E. Hale, For.Mem.R.S.: Photographs illustrative of work at the Mount Wilson Solar Observatory. (1) Three photographs of the sun, taken at the Mount Wilson Solar Observatory, April 30, 1908, showing (*a*) the photosphere, with sun-spots and faculæ; (*b*) the flocculi of calcium vapour; (*c*) the flocculi of hydrogen, at a higher level in the solar atmosphere. The hydrogen photographs, which are made with the spectroheliograph, reveal the existence of cyclonic storms or vortices associated with sun-spots. (2) Photograph of the sun, taken on Mount Wilson, October 7, 1908, with the red line of hydrogen. The vortices surrounding two large spots in the northern and southern hemispheres appear to rotate in opposite directions. (3) Six photographs, showing the mounting of the 60-inch reflector of the Mount Wilson Solar Observatory and the mode of transporting the tube to the summit on a motor-truck. (4) Blue print, showing design for tower telescope, of 150 feet focal length, now under construction for use on Mount Wilson. An image of the sun, 16 inches in diameter, will be formed in a laboratory at the base of the tower. The spectrograph for studying this image will have a focal length of 75 feet, and will be mounted in a well beneath the laboratory.—*Solar Physics Observatory, South Kensington*: (1) Photographs and diagrams illustrating researches in solar physics and its relations with terrestrial meteorology. (2) Astrophysics. (i.) Spectrum of ϵ Ursæ Majoris; (ii.) spectra demonstrating temperature differences, or similarities, of typical stars; (iii.) laboratory spectra—(*a*) oxygen (vacuum tube); (*b*) erbium (arc); and (*c*) tungsten (spark); (iv.) spectra showing identification of hitherto unknown lines in the spectrum of ϵ Orionis.—*Mr. A. Fowler*: Spectroscopic comparison of the star Mira Ceti with titanium oxide; to illustrate the origin of the characteristic bands of the Antarian or third-type stars.—*Mr. C. P. Butler*: Thorp-Butler concave replica-grating spectroscope. Some years ago several applications of the Thorp plane replica diffraction gratings were exhibited, notably their use with an opera-glass for eclipse work. Recent experiments have shown that concave replica gratings can be made to give very satisfactory results, and by slight modifications of the design of mounting, this form of spectroscope may be employed for any investigation for which the ordinary spectroscope is fitted.—*The Astronomer Royal*: (1) Photographs and diagrams of the observations of the distant satellites of Jupiter and Saturn. (2) Photographs of comet *c*, 1908 (Morehouse), taken with the 30-inch reflector at the Royal Observatory, Greenwich. (3) Tabular diagram showing the number and distribution of stars in the Greenwich section of the Astrographic Chart and Catalogue. The Greenwich section covers 2088 square degrees from the Pole to 26° N.P.D. Two series, each of 1149 photographic plates, were taken, one for the chart, with an exposure of forty minutes, and the other for the catalogue, with exposure of six minutes and twenty seconds, and the number of stars shown with each exposure has been counted. The total numbers are:—(*a*) with forty minutes, 719,000; (*b*) with six minutes, 178,600; (*c*) with twenty seconds, 38,373. The diagram shows the distribution of these stars in different parts of the area photographed, and the resulting star density.

Dr. W. J. S. Lockyer: Cloud photographs taken from balloon.—*Dr. Chree, F.R.S.*: Antarctic magnetic records and results.—*Prof. J. Milne, F.R.S.*: Seismograms of the Messina earthquake of December 28, 1908. These records were obtained at Shide, in the Isle of Wight, from two Milne horizontal pendulums. One of these recorded north-south motion and the other east-west motion.—*Prof. E. Hull, F.R.S.*: Admiralty charts along the coast of Europe and the British Isles, showing the continuation of the river-valleys under the ocean to depths of about 1000 fathoms (6000 feet).

Prof. J. Norman Collie, F.R.S.: A curious property of neon. Perfectly pure neon, when enclosed in a glass tube with mercury and shaken, glows with a bright orange-red colour. As neon does this at ordinary pressures, it appears to be different from other gases.—*Sir William Ramsay, K.C.B., F.R.S.*: Liquid radium emanation.

Radium emanation, produced in a week from about half a gram of radium bromide, is frozen with liquid air, freed from hydrogen by pumping, and introduced into a fine capillary tube. This is connected with an apparatus for compressing the gas; at ordinary temperature the gas liquefies to a colourless liquid of high density, which phosphoresces strongly—more strongly than the gas. At about 70° the liquid freezes to a solid, which, when further cooled, phosphoresces with remarkable brilliancy. *The Rev. H. V. Gill, S.J.:* A new kind of glow in vacuum tubes (see p. 358).—*The National Physical Laboratory:* (1) Electrically heated laboratory muffle furnace (*Mr. W. Rosenhain*). The special feature of the furnace is the high degree of heat insulation aimed at, together with ready access to the working parts. The muffle attains a temperature of 920° C. with a current consumption of 9 amperes at 105 volts, and the platinum winding shows no signs of deterioration after months of continuous use. (2) Quadrant electrometer for alternating current power measurements of high precision (*Mr. C. C. Paterson and Mr. E. H. Rayner*). (3) Standard non-inductive water-cooled manganin tube resistances of 0·001, 0·002, and 0·04 ohms respectively, to operate with currents of 2500, 1000, and 100 amperes respectively (*Mr. C. C. Paterson and Mr. E. H. Rayner*). (4) Metallic filament electric glow-lamp for photometric substandard (*Mr. C. C. Paterson and Mr. E. H. Rayner*). (5) Apparatus for testing definition and for determining the variation of light intensity in an image due to diffraction (*Mr. J. de Graaff Hunter*).

Prof. W. F. Barrett, F.R.S.: (1) Apparatus (*a*) for determining the light-threshold of the eye, and (*b*) for measuring the amount of light irregularly reflected from rough surfaces. (2) New form of optometer for the examination and measurement of defects in vision. Optometers have hitherto been defective owing to the impossibility of preventing involuntary accommodation of the observer's eye. In the present instrument this difficulty is overcome by the use of an inclined semi-transparent mirror in the eye-piece. By changing the attachment both pupillometric and entoptic examination of the eye can readily be carried out.—*Prof. Silvanus P. Thompson, F.R.S.:* (1) Experiments on the contraction, by heat, of india-rubber. India-rubber, under tensile stress, contracts strongly when its temperature is raised. Work is done by its contraction at the expense of the energy of the heat. Hence, it would be possible to construct a thermal engine in which the working substance is india-rubber, instead of steam or hot air, and operating by contraction, instead of expansion, of the working substance. (2) Standard magnets for quantometric work.

Mr. T. H. Laby and Mr. Horace Darwin, F.R.S.: A string electrometer, used to measure minute quantities of electricity, and as an oscillograph.—*Mr. T. H. Laby:* The counting of α particles (electrically charged helium atoms) by Prof. E. Rutherford's method. By an electrical method a deflection of an electrometer is obtained as each α particle passes into a cylinder. A wire is supported in the axis of this narrow metal cylinder, from which it is electrically separated by a guard-ring insulator. This ionisation chamber is enclosed in a sealed glass tube, and the air exhausted to a small pressure (4 mm.). A tap admits α particles from uranium, which pass into the cylinder and ionise the air in it. To detect these ions, Prof. Rutherford multiplied them by producing others from them by collision. The field between the cylinder (−) and the wire (connected to the electrometer) is adjusted of such intensity that the first-formed negative ions travelling to the wire produce others by collision with the air molecules. Thus, when an α particle travels through the cylinder lengthwise, many negative ions reach the wire, and so the electrometer, the string of which is suddenly deflected, but returns, as it is connected to earth through a high resistance of thin rubber.—*Mr. A. W. Porter:* Electric splashes on photographic plates. A photographic plate is backed by a plate-electrode, and a single spark discharge is allowed to pass over the plate from a second electrode in front; the plate is then developed. The new effects exhibited are brought about (1) by diminishing the pressure of the surrounding atmosphere; (2) by replacing it with other gases; (3) by placing the plate in a magnetic field.—*Dr. C. V. Drysdale:* (1) Vacuum tube model, showing the propagation of alternate currents in a helix (see *Phil. Mag.*, November, 1908); (2) stroboscopic apparatus for measuring speed, frequency, slip, and other periodic phenomena.—*Mr. A. Wright:* An electrical device for evaluating algebraical formulæ and equations. The device consists in the combination of special rheostats attached to slide rules and a Wheatstone bridge, by which quantities can be multiplied, divided, added, or subtracted simultaneously, and by which complicated algebraical expressions or equations can be evaluated or solved with an accuracy comparable with that attainable by ordinary slide rules.

Mr. C. E. S. Phillips: The flow of sand through tubes. The rate at which the free surface of a column of sand descends in a vertical tube, owing to the escape of powder from an orifice at the lower end, is independent of the head of sand above the opening.—*Mr. A. Mallock, F.R.S.:* Engine worked by stretched india-rubber. The model illustrates a method whereby a long stretched india-rubber cord can be made to produce mechanical work (see p. 358).—*The Daimler Company, Coventry:* A 38-horse-power Daimler engine. A sectional "valveless" engine, bore 124 mm., stroke 130 mm., showing action of piston, sliding sleeves, and other working parts.

Mr. S. Cowper Coles: (1) Specimens of metallic parabolic reflectors, made by electro-deposition, and specimens of electro-deposited metals showing their crystalline structure; (2) working model of an apparatus for uniting aluminium by means of the formation of a flexible skin of oxide.—*Messrs. Strange and Graham, Ltd.:* A process of making ribbon metals. The molten metal is caused to flow through one or more nozzles in a thin stream upon the periphery of a rapidly rotating water-cooled drum. The metal solidifies immediately, and is thrown off from the surface of the drum in the form of a continuous and uniform ribbon. It is possible to obtain metal as thin as 1/1000 inch, and half a mile to a mile of ribbon can readily be obtained from each nozzle per minute. Ribbons of aluminium, lead, zinc, tin, copper, silver, gold, &c., were shown.—*Mr. C. E. Larard:* Cylindrical specimens twisted to destruction. These specimens (principally of mild steel and a 3 per cent. nickel steel) were before testing divided into unit distances by circular divisions, and in addition six generating lines were painted and scribed at equal distances along the surfaces. The final configuration of the cylindrical surfaces after fracture, as revealed by these division lines, shows clearly the surface flow of the material during the plastic stage of the test.—*Sir Robert Hadfield, F.R.S., and Messrs. Hadfield, Ltd.:* Elements and alloys used in steel manufacture; high-speed tool steel, caps for projectiles, &c.

Prof. Threlfall, F.R.S.: Curves, showing that the spontaneous combustion of cargoes of coal loaded in English, Scotch, and Welsh ports practically occurs only with summer loadings. It was shown by the New South Wales Royal Commission on the Spontaneous Combustion of Coal Cargoes (1897) that ships the cargoes of which took fire had mostly been loaded in summer. In view of the high summer temperature of Newcastle, New South Wales, this was only what might have been expected, but it does not seem to have been noticed that a similar relation might obtain for cargoes loaded in the temperate climate of the United Kingdom. An analysis of 4898 long voyage shipments in the years 1873, 1874, and 1875—presented to the English Royal Commission of 1876—shows unmistakably that it is only cargoes loaded in summer which are liable to spontaneous combustion.—*Prof. H. B. Dixon, F.R.S.:* Photographs showing the generation and nature of "explosion-waves" in gases. The photographs were taken on films moving with a uniform downward velocity (between 50 metres and 80 metres per second). The explosions, started by electric sparks, travelled along horizontal glass tubes. The photographs obtained are thus compounded of the horizontal movements of the flame and the vertical movement of the film. This analysis reveals (i.) the slow initial movements of the flame; (ii.) the sudden setting up of the "explosion-wave"; and (iii.) the remarkable effects of "reflected waves." Explosive gas mixtures were also fired by rapid compression with a steel piston. The photographs show that the gases are fired at a point, and are not fired instantaneously throughout.—*Dr. F. D. Chattaway, F.R.S.:* Ammonium perhalides. Although derivatives of ammonia in which hydrogen attached to trivalent nitrogen is replaced by halogen, such as nitrogen chloride, NCl_3, and nitrogen iodide, $NI_3=NH_3$, are violently explosive, the ammonium perhalides, which contain complexes of three halogen atoms attached to pentavalent nitrogen, are perfectly stable. They are highly coloured substances, which crystallise well from water, in which they are very soluble.—*Mr. Francis Fox:* Pitchblende, or radium ore, from Trenwith Mine, Cornwall (St. Ives Consolidated Mines, Cornwall). In 1843 Prof. Henwood, F.R.S., drew up a report on the Trenwith Mine with reference to its unproductiveness as a copper mine. He reported that the mine contained large quantities of pitchblende, at that time considered to be valueless. Records exist describing the position of the pitchblende in the mine, and vigorous steps are now being taken for clearing the mine of water and working it for pitchblende. The richer specimens contain 33 per cent. of uranium oxide (U_3O_x), and from 150 to 200 milligrams of radium per ton of ore.

The Director, Royal Gardens, Kew: (1) Experiments with Cyclamen seedlings. Cyclamen seedlings normally have only one cotyledon; if this be entirely removed the second cotyledon will develop. If only the lamina be cut off a new lamina will bud out from the side of the leaf-stalk near the apex, and on the removal of this second lamina a third can be induced to grow out from its stalk just below the apex. If the lamina be mutilated, and not wholly removed, new growths will also be formed. (2) Flowers of Sebæa (Gentianaceæ) with two stigmas. The flowers of the genus Sebæa (Gentianaceæ) from South Africa have been found to have two stigmatic surfaces on the same style, one above and one below the position of the anthers. The lower stigma has been fertilised after removal of the normal one, and from the seeds thereby formed seedlings have been raised at Kew.—*Prof. J. W. H. Trail, F.R.S.:* Preparations to illustrate the retention of colours, especially of green, in botanical specimens exposed to light. The method employed is described in the *Kew Bulletin*, 1908, No. 2.—*Dr. G. H. Rodman:* A series of photomicrographic transparencies of pollen cells.—*Mr. C. E. C. Fischer:* A parasitic fungus on beech (*Armillaria mucida*, Schrad).—*Mr. W. Fawcett:* Drawings of Jamaica orchids.—*Mr. R. A. Robertson:* Photographs for identification purposes of the transverse surface of timbers.

Marine Biological Association of the United Kingdom: The bottom deposits of the southern part of the North Sea. The charts and sections illustrate the great predominance of fine sand in most parts of the area, and the marked contrast between the broad stretches of sand off the Continental shores and the irregular but coarse ground along the English coast. They also show that the finest materials increase towards the north.—*Mr. W. Bagshaw:* (1) Photomicrograph showing abnormal striation of the diatom, *Navicula lyra*; (2) Frustule of diatom, exhibited under the microscope with 1/12 oil-immersion lens.—*Dr H. Gadow, F.R.S., and Mrs. Gadow:* Rare specimens of natural history from Mexico.—*Mr. L. Doncaster:* Case of *Abraxas grossulariata* (currant moth) illustrating sex-inheritance.—*Dr. E. F. Bashford:* Recent advances in knowledge of cancer (see NATURE, December 31, 1908).—*Lieut.-Colonel W. B. Leishman:* The transmission of tick fever. This relapsing fever of man, widespread in Africa, is due to the *Spirochaeta duttoni*, which is inoculated by the bite of a tick, the *Ornithodorus moubata*. Infected ticks may transmit the virus through the eggs to the second and even to the third generations, which, in their turn, may infect man by their bites. The mechanism of this hereditary transmission is not certain, but it appears possible that spirochætes ingested by a tick undergo a change of form, and, in this altered form, penetrate the young ova and infect the next generation, developing anew into spirochæte form under certain conditions of temperature.—*Dr. A. F. Bilderbeck Gomess:* *Cheyletus eruditus* as an entozoon in man.—*Dr. A. D. Waller, F.R.S.:* Demonstration of the electrical variations of the human heart and of the dog's heart on Einthoven's string galvanometer.—*Mr. S. G. Shattock:* A microscopic section of the aorta of King Menephtah, traditionally regarded as the Pharaoh of the Exodus, showing senile calcification. The mummy was found in 1898 by M. Loret in the tomb of Amenhotep II., at Biban el Muluk, Thebes. It was unwrapped in 1907 by Dr. G. Elliot Smith (acting on the instructions of M. Maspero). The mummy was wrapped in a sheet of fine linen, on which the name was written in hieratic characters. The microscopic sections show the presence of calcareous particles in the middle coat of the artery, such as are met with in senile degeneration.

Mr. H. R. Knipe: Drawings of extinct animals, by Miss Alice B. Woodward.—*Dr. A. Smith Woodward, F.R.S.:* Ramus of mandible and teeth of a herbivorous dinosaur, Trachodon, from the Upper Cretaceous of Wyoming, U.S.A.—*Dr. H. Gadow, F.R.S., and Mrs. Gadow:* Ethnological specimens from Mexico. (1) Prehistoric implements from the States of Chihuahua and Michoacan; (2) throwing sticks, used by the Tarasco Indians of Lake Patzcuaro.—*Dr. C. G. Seligmann:* Photographs of the Veddas of Ceylon and of their ceremonial dances. The Veddas are now limited to the sparsely settled country between the central hill *massif* and the eastern coast. A few still subsist on game, yams, and honey, and live in rock shelters, but the majority build huts and practise a little rude cultivation. Their ceremonial dances are essentially religious, and are performed to obtain the assistance of the spirits of their dead, who are called the Nae Yaku, or of certain long dead Vedda heroes, of whom the most important is the great hunter, Kande Yaka, who is also Lord of the Dead.—*Prof. Karl Pearson, F.R.S., Mr. E. Nettleship, and Mr. C. H. Usher:* Illustrative plates to a forthcoming monograph on albinism (Drapers' Company research memoirs).—*University of London, Francis Galton Laboratory for National Eugenics:* Pedigree work in man.—*Sir Benjamin Stone, M.P.:* Photographic studies of Constantinople and neighbourhood.

NOTES.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 5.

PROFS. YVES DELAGE and M. G. Retzius have been elected foreign members of the Linnean Society.

THE Bessemer medal of the Iron and Steel Institute was presented to M. A. Pourcel at the meeting of the institute last week.

THE Wolcott Gibbs memorial lecture of the Chemical Society will be delivered by Prof. F. W. Clarke at the meeting of the society on Thursday, June 3.

THE annual conversazione of the Royal Society of Arts this year will be held at the Natural History Museum, South Kensington, on Tuesday, June 29.

A *Times* correspondent at Winnipeg reports that an earthquake shock, lasting from thirty seconds to a minute, was felt there and for 500 miles to the west at 10.17 p.m. on May 16.

THE Royal Scottish Geographical Society has decided to award the Livingstone gold medal of the society for the current year to Lieut. Shackleton, for his work in the Antarctic.

DR. G. A. GIBSON, 3 Drumsheugh Gardens, Edinburgh, who has undertaken to edit the medical and scientific papers and articles of the late Sir William Tennant Gairdner, and to preface the collection with a biography, will be glad to know of any letters or other literary remains possessed by friends of the late professor.

THE central committee of the Austrian Alpine Club, we learn from *La Nature*, has, by the liberality of the authorities of Munich, just been put in possession of a large building with excellent accommodation, and well situated on the banks of the Isar. The club proposes to inaugurate an Alpine museum in its new building specially concerned with everything related to the study of the Alps from every point of view.

WE learn from the *British Medical Journal* that the Harben lectures of the Royal Institute of Public Health will be delivered this year by Prof. R. Pfeiffer, director of the Hygiene Institute, Breslau. The first lecture, on the importance of bacteriolysins in immunity, will be given on Monday, June 21; the second, on endotoxins and anti-endotoxins, on June 23; and the third, on the problem of virulence, on June 25.

THE ninety-second annual meeting of the Société helvétique des Sciences naturelles will be held at Lausanne on September 5–8, under the presidency of M. Henri Blanc. On September 6 and 8 the subjects and openers of discussions will be:—the Jura, E. de Margerie; aërodynamic foundations of aviation, S. Finsterwalder; comparative psychology: determinism and theory of memory, A. Forel; history of the animal life of Ceylon, F. Sarasin; some recent results of astronomical photography, R. Gautier; and natural history impressions of Greenland, M. Rikli. The secretaries of the congress are MM. H. Faes and P. L. Mercanton, Lausanne.

AT the last annual meeting of the Royal Institution of Cornwall, held at Truro, it was announced that fitting accommodation has now been secured for the valuable collections in its charge. The scheme of adding to the existing museum has been abandoned, and a new building standing in its own grounds, free from the danger of fire, and occupying a conspicuous and accessible position, has been secured. The work of adapting this to form one of the best scientific museums in the west of England is now in progress; of a total estimated cost of 5000*l.*, sufficient has been collected to warrant the council in proceeding with the scheme, and there is every reason to believe that the appeal for the balance will meet with a gratifying response.

THE Nature Study Society has organised an exhibition of aquaria, vivaria, and other means of observing animals, with photographic and microscopic illustrations, to be held at the Royal Botanic Gardens, Regent's Park, on Friday and Saturday, June 4 and 5. Exhibits of the following character will be acceptable:—aquaria, fresh water and salt water; vivaria containing reptiles, Amphibia, snails, caterpillars, and other animals; flight cages containing butterflies, dragon-flies, and other insects; ants' nests, wormeries, means of keeping minute forms of life; microscopic exhibits illustrating minute forms of life; photographs bearing directly upon any of the above matters. Intending exhibitors should communicate before May 25 with the honorary secretary of the exhibition, Miss Winifred de Lisle, 58 Tyrwhitt Road, Brockley, S.E.

WE notice with regret the death, on May 12, in Munich, of Prof. Heinrich von Ranke. Prof. von Ranke was born on May 8, 1830, and was educated in the universities of Erlangen, Berlin, Leipzig, and Tübingen. From the obituary notice in the *Times* we learn that he acted for a year as assistant to the biologist Johannes Müller, and later worked at Tübingen with Hugo Mohl. He took his M.D. degree in 1851. Prof. von Ranke gained much experience in various branches of medical science from his army work under the English Government during the Crimean War, and in later years on the battlefield of Bohemia during the Austro-Prussian War of 1866. In 1874 he was appointed to an extraordinary professorship, dealing with the treatment of children, in the University of Munich. In addition to much work in public hygiene, von Ranke devoted his attention to scientific agriculture, making a model farm of a portion of his estate near Munich. He served as vice-president of the Agricultural Society of Bavaria. His literary work included many pamphlets on his scientific researches and practical experience in medicine; he also wrote on archæological subjects.

AT the invitation of the Mayor and Corporation of Winchester, the annual congress of the South-Eastern Union of Scientific Societies will be held at that town on June 9–12 inclusive, under the presidency of Dr. Dukinfield H. Scott, F.R.S. The following papers will be read:—prehistoric memorials of Hampshire, W. Dale; leaf-mining insects, A. Sich; the evolution of our southern rivers, W. F. Gwinnell; fungus-hunting in Hants, J. F. Rayner; local Lepidoptera, Rev. G. M. A. Hewett; and nature-study for teachers, Prof. Cavers. Messrs. Griffin and Lowne will give a demonstration of plant-pressing and mounting. Dr. Burge, headmaster of Winchester College, has invited members to a conversazione, at which Mr. R. W. Hooley will lecture on the age of reptiles in Hants and the Isle of Wight. The Mayor and Corporation of Southampton have invited the members to visit that city, on which occasion Prof. Hearnshaw will show and explain the corporation documents and regalia. Various visits to noteworthy spots will be conducted by Sir W. Portal, Bart., Mr. W. Whitaker, F.R.S., Mr. N. H. Nisbett, Alderman W. H. Jacob, and Canon Valpy, the Vice-Dean. There will be a loan museum as usual, under the management of Mr. E. W. Swanton. The local secretary is Mr. W. Norris, 4 Upper High Street, Winchester, and the general secretary is the Rev. R. Ashington Bullen, "Englemoor," Woking, from either of whom further information may be obtained.

THE April number of the *Museums Journal* opens with an article, by Dr. A. H. Millar, on the removal of the Scottish Hunterian Museum from the old college in High Street, Glasgow, to Gilmorehill University, in the same city. In the course of the article, which was originally delivered in the form of an address to the Ipswich Museums' Conference, the author gives an account of the career of William Hunter, and a *résumé* of the history and formation of his museum. The transference of the collection to its present home took place in the early 'seventies.

BIOGRAPHY occupies a prominent position in the May issue of *British Birds*, to which Mr. W. H. Mullens contributes an interesting sketch of the lives and works of William Macgillivray and William Yarrell, together with portraits of both these distinguished ornithologists. Macgillivray's "History of British Birds" has, in the author's opinion, met with unmerited neglect, although it is one of the most valuable treatises on its subject in existence. This neglect is attributed to the supposed extreme technicality of the work, to the long interval between its commencement and its completion, and, lastly, although by no means leastly, to the dominating influence of Yarrell's volumes, which appeared about the same time, but in quicker succession.

To vol. xxi., part ii., of the Proceedings of the Royal Society of Victoria, Prof. Baldwin Spencer contributes an illustrated account of a problematical organism, of which several examples were thrown up during a storm in Bass Strait. At first sight the general appearance of these jelly-like organisms, for which the name *Hologlaea dubia* has been proposed, suggested affinity with the Ctenophora, but such a relationship is negatived by the fact that what appear on superficial examination to be ctenophoral bands present no trace of the distinctive features of such structures. At one time its describer was of opinion that these organisms might be detached portions of some larger creatures, but he now considers that they probably represent a stage in the life-history, possibly a nursing-stock, of some type at present unknown to naturalists.

It is argued by Prof. E. L. Greene, with considerable reason, in a paper published in the Proceedings of the Washington Academy of Sciences (vol. xi., No. 1), that Linnæus was not a dogmatic believer in the doctrine of fixed species. This opinion is based on the notes affixed to certain plants in the "Species Plantarum." Thus it is remarked with regard to *Thalictrum lucidum* that the plant is not very distinct from *Thalictrum flavum*, and seems to be the product of its environment. Again, with reference to *Achillea alpina*, it is suggested that the Siberian mountain soil and climate have moulded it out of *Achillea Ptarmica*. A few other similar examples are cited.

An interesting epitome of the lines of classification adopted by Dr. T. Wolf in his monograph of the genus Potentilla, and communicated by the author, is published in the *Sitzungsberichte und Abhandlungen der naturwissenschaftlichen Gesellschaft Isis* for 1908. The pistil provides the primary characters of distinction for the sections and subsections. The author also discusses the distribution of the genus, which is in accord with the morphological classification, and concludes with the following enunciation. If it is possible to classify a group of plants so that the morphological relationship of the species coincides with a definite geographical distribution, then the classification is certain to be phylogenetic, and therefore natural.

The rate of growth of palms forms the subject of an article, by Mr. A. W. Lushington, published in the *Indian Forester* (March). The author observed that a fresh leaf-bud was formed every month in the case of all palms, whether betel, date, palmyra, &c., so that the development of twelve leaves a year appeared to be constant. Reckoned on this basis, a palmyra palm would attain a height of about 28 feet in a century, and would not reach maturity for 300 years. Palms develop the full thickness of the stem below ground before they throw up the aërial shoot; the time required for the palmyra appears to vary from about four to twenty years. It is suggested that increase in thickness, being caused by the expansion of the soft central tissue, continues so long as the vascular tissue of the leaf-sheaths can extend, and this varies with the nature of the soil.

The greater portion of the *Kew Bulletin* (No. 3) is devoted to the flora of Ngamiland as exemplified by the collections of Major and Mrs. E. J. Lugard. Major Lugard furnishes an introductory sketch of the physical and natural features of the country that is peopled by the Batawana, and includes the northern portion of the Kalahari desert. The flora is subtropical; the trees, which are confined to the river banks, consist of several species of Acacia, notably *Acacia giraffae*, *Copaifera mopane*, *Terminalia pruinoides*, and *Kigelia pinnata*. The collections yielded no fewer than ninety-three new species out of a total of 373. The Leguminosæ, the dominant family, provides three new species of Acacia, an Albizzia, and others. Out of eight species of Grewia, five supply new types. *Habenaria Lugardii* and *Crinum rhodanthum* are two new plants with brilliant flowers.

Prof. Schwendener, of Berlin, is well known as a leader in the investigation of the numerous mechanical problems which arise in the study of plants. Botanists will therefore be indebted to Prof. Holtermann for the publication of Schwendener's lectures in an easily accessible form ("Vorlesungen ueber mechanische Probleme der Botanik," Leipzig, Engelmann). The principal topics, treated rather in sketchy outline, consist of the mechanical system of tissues, theory of leaf arrangement, ascent of sap, stomata, and the various mechanisms connected with motile structures. Prof. Holtermann adds critical notes of his own, dealing with some of the points raised in modern controversy. The booklet is well worth reading, though we cannot help wishing that it had been expanded into a larger work. "Lectures," when published in book form, have often been employed as the means of a full discussion by their author of the subjects on which he is specially qualified to speak. So far as the lecturer himself is concerned, the latter sentence would have eminently applied to Schwendener, but these "lectures" stop a long way short of full discussion.

The habit of using ancient sarcophagi in modern interments is familiar in the case of Charlemagne, who, after his canonisation in 1165, was interred in a sarcophagus which he himself had brought from Ravenna, and Nelson was buried in a stone coffin which legend says was prepared for Henry VIII. by Cardinal Wolsey. The finest existing examples of sarcophagi used in this way in Roman Churches, that of Cardinal Fieschi in the Church of St. Lorenzo fuori le Mura, and that of the Savelli family in Sta. Maria in Ara Coeli, are described by Mr. J. Tavernor-Perry in the April number of the *Reliquary*. That of Cardinal Fieschi, which probably belongs to the second century of our era, is decorated with a Roman marriage in high relief, a frieze representing the story of Phæton, the angles forming two great masks, unfortunately somewhat injured. The more artistic Savelli monument was probably intended for Luca, Senator of Rome, who died in 1266, and was nephew of Pope Honorius III. This sarcophagus is carved with Bacchic figures, holding festoons, from which rise portrait busts, doubtless intended for the original occupants of the tomb. To this the Savelli family added a beautiful superstructure bearing the inscriptions and family arms, the decoration being of the Sienese school, and the lovely glass mosaic the work of the famous Comati family, who were engaged for six successive generations in the churches of southern Italy. Other examples of their work are described, with fine illustrations, in the same number by Miss E. Stacey.

The May number of the *Geographical Journal* contains an important article, by Prof. Dr. Eugen Oberhummer, of Vienna, on Leonardo da Vinci and the art of the Renaissance in its relations to geography. From the fresh information now available the reputation for scientific knowledge enjoyed by the great painter is still further enhanced. It is not quite certain that the remarkable map of the world now at Windsor, and dating from the beginning of the sixteenth century, is really his work; but much material of a similar kind was discovered by Jean Paul Richter. It is known that in 1502 Leonardo, then in the service of Cesare Borgia as a military engineer, made a tour through Urbino, Pesaro, Rimini, and other places, where he carried out a survey and constructed maps. The most interesting of these represent Tuscany and the Pontine Marshes, while he made an accurate plan of the town of Imola in the Romagna, of Milan, and other cities. Besides being a topographical he was also an eminent physical geographer and astronomer. He held that the earth was a planet, and denied that it occupied a privileged position in the universe, thus being one of the forerunners of Copernicus. He must also be regarded as the founder of the modern theory of wave motion, and his investigations of the question of currents and of other hydraulic problems are remarkable. He believed that rocks were of sedimentary origin, and that mountains were accumulations of river alluvium. He held, for his time, advanced views on the subject of the Deluge, and as he laid much stress on the influence of erosion he anticipated much of the modern doctrine of valley formation. He did good service for meteorology by his study of winds, and he was one of the pioneers of Alpine exploration. Dr. Oberhummer follows his account of the scientific work of Leonardo by a description of the world and star maps constructed by Albert Dürer. He gives interesting reproductions of the work of these artistic and scientific men from the originals in the collections at Windsor, the British Museum, and other places.

The prospect of a short water supply during the coming summer is predicted by the Rev. F. C. Clutterbuck, of Abingdon, in *Symons's Meteorological Magazine* for April. Speaking particularly of the Thames Valley, Mr. Clutterbuck bases his prediction on the measurements of a well in the Upper Greensand of which he has a daily record for the last forty years, this well having always been considered a good test as regards water supply. Only on two occasions has the well been so low as it is now, viz. in the autumn of 1898 and in the spring of 1905, which was a year of very short water supply in the Thames Valley. In the six months October–March inclusive, 1904–5, the rainfall at Abingdon was 9·24 inches; in 1908–9 it was 9·13 inches, almost similar conditions. Therefore, Mr. Clutterbuck concludes, we may expect the same deficiency this year as was experienced in 1905. In an editorial article on the rainfall of the winter half-year it is pointed out that for England and Wales there was a deficiency of more than one-quarter of the normal rainfall. The dry autumn may produce an exceptionally good wheat harvest this year, but, the editor observes, the general dryness of the whole winter half-year cannot fail to cause anxiety as to the yield of wells and the replenishment of reservoirs.

Under the title of "Bibliographia Botanica," Messrs. W. Junk, of Berlin, have issued a classified catalogue of nearly 7000 books, journals, and pamphlets dealing with all branches of botany.

In the *Atti dei Lincei*, xviii. (1), 7, Dr. G. Agamennone describes certain remarkable long waves that were recorded by the seismographs at Rocca di Papa on the occasion of the recent earthquakes of December 28, 1908, and also in the Calabrian earthquake of September 8, 1905. The same slow waves were observed at Göttingen in 1905 by Angenheister.

In the *Annals of Mathematics* (April), x., 3, Prof. E. B. Wilson gives an exposition of the applications of probability to mechanics. The discussion is presented in the form of an introduction to the study of statistical mechanics. It is illustrated by the consideration of simple examples, and well shows how "mean value" and probability for a continuous function depend on the distribution, or, in other words, on the variable with respect to which the function is assumed to be uniformly distributed.

Messrs. W. Cramp and B. Hoyle, in a paper on the electric discharge and the production of nitric acid by means of it, which appears in the April number of the Journal of the Institution of Electrical Engineers, give a *résumé* of the various methods which have been used in the attempt to produce nitric acid direct from the nitrogen of the atmosphere, and criticise them in the light of their own researches. They have investigated the relative efficiencies of various forms of electric discharge, and of different methods of introducing and withdrawing the gases, and have found that a considerable number of the results obtained are in agreement with the ionisation theory. It is unfortunate that the authors were unable to proceed far enough with their researches to enable them to state definitely the yield of acid per kilowatt hour under the best conditions, and on a commercial scale.

In the April number of the *Journal de Physique* M. A. Dufour gives a detailed account of the examination of the Zeeman effect for certain bands in the emission spectra of gases, on which he has been engaged for the last two years, and of which he has given short accounts in the *Comptes rendus*. He finds that the bands of the emission spectra of the chlorides and fluorides of the alkaline earths examined, and of the second or molecular spectrum of hydrogen, may be divided into three classes, the first of which show the normal Zeeman effect in the direction of the magnetic field, *i.e.* that component of the doublet which has the shorter wave-length is circularly polarised, the direction of rotation agreeing with that of the electric current producing the field. The second class show no appreciable effect, while the third are abnormal, the direction of rotation being reversed, and the polarisation incomplete. M. Dufour is inclined to attribute this abnormal behaviour to negative electrons moving in complicated paths determined by the whole of the atoms constituting the molecule of the gas, while the normal effect is due to the negative electrons moving in comparatively simple paths in the atoms.

From Messrs. Adam Hilger, Ltd., we have received an eight-page catalogue giving illustrated descriptions, and prices, of several of the spectroscopes specially designed for the observation of stellar and solar spectra. For amateur observers the Zöllner star spectroscope, supplied for fifty shillings, is a useful and adaptable instrument. Spectroscopes for prominence and other solar observations range from 4*l.* for a small direct-vision, grating instrument, to the 35*l.* to 60*l.* "Evershed" protuberance spectroscope, which is a most efficient instrument for the observation of sun-spot spectra and prominences. For laboratory researches the Littrow type spectrograph is now largely employed, and a specially designed instrument of this type, having an achromatic objective of $2\frac{1}{2}$ inches aperture and 8 feet focal length, and a $2\frac{1}{2}$-inch Rowland or Michelson grating, costs about 65*l.*

We have received from Messrs. John J. Griffin and Sons, Ltd., a description of "The York Air Tester," an apparatus for the rapid estimation of carbon dioxide in air. The advantages claimed for this apparatus are that it is simple enough to be placed in unskilled hands and sufficiently accurate for controlling ventilation. It is a minimetric method, resembling in principle the apparatus described by Lunge and Zeckendorf about fifteen years ago. In the latter apparatus a measured volume of a weak solution of sodium carbonate, coloured with phenolphthalein, was decolorised by a measured volume of the air under examination, the quantity of air being determined by the number of fillings of a rubber pump. In the York apparatus the rubber ball is replaced with advantage by a metallic pump, and the sodium carbonate solution by baryta solution. With the latter solution the absorption is quantitative under the conditions of use prescribed in the instructions. As to the disadvantages of the York apparatus, the quantity of carbon dioxide measured is based on a preliminary calibration with atmospheric air, assumed in the table as 3·6 parts per 10,000. As in towns the amount may be as much as 4·5, the results may be uncertain by 25 per cent. The stock bottle for the weak baryta solution carries sufficient solution for eighty tests, or two litres. This amount seems too large, and makes the whole apparatus unnecessarily heavy. The mode of working is simple, and should give good results in unskilled hands.

THE claims of reinforced concrete as a suitable material for buildings likely to be subjected to earthquakes are advanced in *Concrete and Constructional Engineering* for May. For such buildings either the very lightest form of wood construction should be applied, as in Japan, or, if permanence and architectural effect are desired, some form of monolithic construction as is obtainable in reinforced concrete. Masonry and brickwork are entirely out of place, and steel frames covered with concrete do not seem to have the advantages possessed by reinforced concrete in its simplest forms. In the opinion of the writer, steel-frame construction has been adopted too freely in San Francisco and elsewhere. Reinforced concrete buildings need not necessarily be eyesores; this is altogether a question of good design, and there are sufficient examples of such buildings now in existence to show that the reproach of the older generation of architects cannot be directed at the productions of a really good designer. The article is of interest in view of the now well-known disastrous effects of the recent earthquake in Messina.

A CATALOGUE of new books and new editions added to Mr. H. K. Lewis's medical and scientific circulating library (136 Gower Street, W.C.) during the first quarter of this year provides a concise summary of the chief works of scientific interest issued in recent months.

THE fifth revised edition of Prof. Max Verworn's "Allgemeine Physiologie" has been published by Mr. Gustav Fischer, Jena. The price of this work, which now occupies 742 pages, is sixteen marks.

THE Bulletin of the Pasteur Institute of Southern India (No. 1, 1908) contains details of several researches carried out by Major Cornwall and Dr. Kesava Pai on rabies, *e.g.* diagnosis of the disease, the Negri bodies, histology of the blood, toxins, &c.

THE commemorative address on Darwin and his work, delivered by Prof. August Weismann at Freiburg in Baden on February 12, has been published in pamphlet form by Mr. Gustav Fischer, Jena. A note upon the address appeared in NATURE of March 18 (p. 75).

PROF. W. JAMES's "Principles of Psychology" has been translated into German by Dr. Marie Dürr, and published by the firm of Quelle and Meyer, Leipzig, with notes by Prof. E. Dürr. The same publishers have just issued a translation into German, by Prof. A. Kalähne, of M. L. Poincaré's work on "Electricity," already translated into English.

THE report of the sixth meeting of the South African Association for the Advancement of Science, held last year at Grahamstown, has now been published. An account of the proceedings of the meeting appeared in NATURE of August 27, 1908 (vol. lxxviii., p. 395), to which reference may be made for the chief subjects discussed in the volume. The amount of work recorded in the 408 pages of the report is a very creditable record for an association founded so recently, and the officers are to be congratulated upon the success of their efforts to arouse and maintain an interest in scientific work in the South African colonies.

THE Smithsonian Institution of Washington has issued a classified list of Smithsonian publications available for distribution in March, 1909. These publications are supplied by the institution either gratuitously or at a nominal cost as an aid to research. Of the many activities of the Smithsonian Institution, this wide distribution of papers, scientific and otherwise, among original workers for the extension of knowledge is one of the most useful. The list has been prepared in such a way as to conform as closely as possible with the classification methods used by the International Catalogue of Scientific Literature, and will be found convenient for reference.

MR. L. F. COGLIATI, 17 Corso di Porta Romana, Milan, has made arrangements to publish the manuscript of Leonardo da Vinci in the library of the Earl of Leicester at Holkham Hall. The volume will contain a double Italian transcription of the text, be printed on hand-made paper, and contain seventy-two heliotype plates, comprising the entire reproduction of the original manuscript and of its numerous illustrations; it will contain an introduction and index, and include a biography of Leonardo da Vinci by Dr. G. Calvi, the editor of the volume. It may be mentioned that the compilation obtained the Tomasoni prize from the R. Istituto Lombardo di Scienze e Lettere. The manuscript contains the material Leonardo gathered for his treatise on hydraulics, and many of his opinions on questions in cosmography and geology are also to be found in it. Only 160 copies of the volume will be published; the first 100 are offered to subscribers at 3*l*. 4*s*. net (postage, &c., 4*s*. additional), and the remaining volumes will be 4*l*. net.

OUR ASTRONOMICAL COLUMN.

MARS.—A telegram from Prof. Lowell, communicated by Circular No. 108 of the Kiel Centralstelle (May 11), announces that two rifts have appeared in the snow-cap of Mars in longitudes 350° and 240°.

JUPITER.—In Bulletin No. 38 of the Lowell Observatory Prof. Lowell describes the different features of Jupiter observed at Flagstaff during the period March 28 to June 4, 1907. The most interesting feature was the system of wisps, or lacings, between the north and south equatorial belts. These festoons were detected by Mr. Scriven Bolton (see NATURE, No. 2000, vol. lxxvii., February 27, 1908, p. 401), and they form a curious network across the equatorial region of the planet. The individual wisps leave caret-shaped markings in the belts, generally at an angle of 45°, and show increased curvature throughout their length. Mr. Lampland has succeeded in obtaining faint photographic images of these peculiar features.

All the dark belts observed were of a cherry-red colour of varying depths, and even the polar hoods at times showed tints of the same hue. The Great Red Spot was but dimly visible, but many dazzling white spots were, from time to time, made out. The equatorial and tropical belts of each hemisphere were seen to be connected by wisps similar to those described above, and the bright equatorial belt was divided into two parts by a longitudinal belt practically encircling the planet.

On March 30, at 5h. 55m. (standard mountain time), the shadow of satellite I. was seen to be nearly twice as broad as it was high, and at 6h. 13m. a penumbra to it was observed. Markings were seen on satellite III. on April 2.

The Upper Layers of the Solar Atmosphere.—In a paper published in No. 16 (April 19) of the *Comptes rendus* M. Deslandres describes some results obtained with his new spectroheliograph. Photographs obtained previously showed long dark streaks of calcium vapours when the secondary slit was set on the centre of the "K" line; these streaks were named "filaments."

By employing a larger dispersion and an additional slit of an improved form, M. Deslandres succeeded in isolating entirely the K_3 line, and found that these filaments were shown much more definitely than on the earlier negatives, when the light employed was a mixture of the K_2 and K_3 lines. A similar result follows if the $H\alpha$ line of hydrogen be employed. These dark filaments, then, are the characteristic feature of the sun's upper atmosphere, and differ from Hale's "dark flocculi" in that they are black on both the K_1 and $H\alpha$ (centre of line) photographs.

In the same number of the *Comptes rendus* Prof. Hale makes some remarks relative to Deslandres's paper, and states that on employing the large spectroscope he found that the relative intensity of the bright and dark flocculi depends upon the part of the line ($H\alpha$) employed. With the slit set on the central part of the line the bright flocculi are very intense, but if the light from the edge of the line is exclusively used, the dark flocculi are shown strongly, whilst the bright flocculi are faint or even invisible.

Spectra of some Spiral Nebulæ and Globular Star Clusters.—With a specially designed spectrograph attached to the Crossley reflector, Mr. E. A. Fath has succeeded in photographing the spectra of a number of spiral nebulæ and globular clusters, the investigation having been undertaken in order to test the statement that the spectra of the former are continuous. The collimator of the spectrograph has an aperture of 54 mm. and a focal length of 315 mm., and the prism is of light flint glass and 30° angle, whilst the camera objective is composed of two plano-convex lenses of 51 mm. aperture and 155 mm. equivalent focal length. The scale of the spectrum is such that the distance from λ 3727 to λ 5007 on the plate is approximately 3·3 mm.; exposures varying from 3h. 19m. to 18h. 11m.—for the Andromeda nebula—were found necessary.

There is not space here to reproduce the detailed discussion given in Lick Observatory Bulletin No. 149, but the general conclusions are of great interest. No spiral nebula investigated has a truly continuous spectrum, although this is the fundamental feature of all their spectra, which range from those having principally bright lines to those containing only absorption lines of the solar type. The great nebula in Andromeda comes in the latter category, and fourteen absorption lines were measured.

The spectra of the spiral nebulæ are best interpreted by the hypothesis that these bodies are unresolved star clusters with varying conditions of gaseous envelopes. Thus, if the Andromeda nebula were such a cluster in which stars of the solar type preponderated, its spectrum would be sufficiently explained. The exposures on globular clusters showed that clusters in which one spectral type of star predominates do exist. But this question needs a great deal more investigation before the theory can be accepted, and, as Mr. Fath points out, Bohlin's parallax for the Andromeda nebula, 0·17″, would require that, if this object is an unresolved star cluster, the size of the components is, with reasonable assumptions, of the order of that of the asteroids. The difficulty of the investigation lies in the extreme faintness of the objects to be observed. While two minutes' exposure on Arcturus, with the Mills spectrograph attached to the 36-inch refractor, gives a measurable spectrum, it would require about 500 hours to give a satisfactory spectrum of the Andromeda nebula, one of the brightest of the spiral nebulæ.

THE INTERNATIONAL COMMISSION FOR SCIENTIFIC AËRONAUTICS.

The sixth Congress of the International Commission for Scientific Aëronautics commenced at Monaco on April 1. Thirty-three members were present, representing fourteen countries. The Prince of Monaco, by whose invitation the meeting was held at Monaco, placed the rooms of the new Oceanographical Museum at the service of the commission. Among the members present were Prof. Hergesell (the president), Profs. Assmann, Berson, and Captain Hildebrandt from Germany, M. Teisserenc de Bort from France, Prof. Hildebrandsson from Sweden, Prof. A. L. Rotch from the United States, Generals Rykatcheff and Kowanko from Russia, Colonel Vives y Vich from Spain, Prof. Bjerknes from Norway, Prof. Palazzo and Dr. Oddone from Italy, Hofrat von Konkoly from Hungary, M. Vincent from Belgium, Captain Ryder from Denmark, and Messrs. P. Alexander and C. J. P. Cave from this country.

Prof. Hergesell, in opening the congress, spoke of the extent of the observations now made by members of the commission, and of the work that had been done since the last meeting at Milan. He mentioned particularly the series of ascents made in July, 1907, the full results of which had just been published, and which included a network of observations extending over a great part of the northern hemisphere. The instruments used were very satisfactory, but Prof. Hergesell warned observers to make frequent calibrations to ensure accuracy in the observations. He also mentioned the important work on wind direction and velocity by means of theodolite observations on *ballons sondes* and pilot balloons.

The Prince of Monaco, in welcoming the congress, spoke of the work that had been done by Prof. Hergesell and himself on his yacht the *Princesse Alice*, and of the finding of *ballons sondes* at sea. By means of observations to determine the trajectory, Prof. Hergesell was able to determine the point of fall with such accuracy that balloons are now found at sea more easily than on land.

At the morning meeting on April 2 Prof. Assmann read a paper on rubber balloons, and spoke of the improvement that had lately been made in their manufacture; it had been found possible to eliminate small foreign particles in the rubber, which consequently could be stretched far more before bursting occurred. M. Teisserenc de Bort spoke of goldbeater's skin for captive balloons, and mentioned that, by a system of elastic lacing, expansion could be secured during the ascent and "pocketing" avoided during the descent. Prof. Hergesell spoke of the rapid deterioration of rubber balloons owing to the effect of light, especially in the tropics; to guard against this Prof. Assmann uses a yellow covering for captive rubber balloons.

Prof. Assmann then read a paper on a method of ventilating the instrument for a short time during an ascent, when, owing to decrease of vertical velocity, insolation might cause too high a temperature to be recorded; the apparatus consists of a polished metal sphere containing compressed air, which can be opened by an electric contact actuated by the barometer at any desired height. He spoke of the doubts that had been expressed, particularly in England, on the reality of the isothermal layer, or "stratosphere" as it has been named by M. Teisserenc de Bort, and hopes that his apparatus may definitely set these doubts at rest. Mr. Cave said that no one in England who is working at the study of the upper air has any doubts as to the reality of the stratosphere; Prof. Hergesell cited cases of rapid descents of instruments, and M. Teisserenc de Bort mentioned night ascents as proving the real existence of the phenomenon. Prof. Hergesell noticed that no member present doubted the fact, and asked the secretaries particularly to note this agreement of opinion.

Prof. Hergesell showed a new meteorograph for use with manned and captive balloons, Prof. Palazzo an apparatus for detaching balloons, and similar instruments were shown by Prof. Hergesell and General Rykatcheff. M. Teisserenc de Bort deprecated the idea of limiting the ascent of a *ballon sonde*.

Prof. Rotch urged that all kite ascents should be tabulated on a uniform plan, and that temperatures on the ground-level should be given at intervals during the flight; he also spoke of the confusion that existed with regard to the sign of the temperature gradient.

Prof. Hergesell announced that a communication had been received by Prof. Köppen, who was unable to attend the congress; he proposed that all measurements of atmospheric pressure should in future be given in absolute C.G.S. units.

At the afternoon meeting on April 2 Prof. Bjerknes read a paper on the theoretical applications of upper-air observations, and spoke of the necessity for further cooperation. He advocated a series of strictly simultaneous ascents at all the stations, and suggested that on certain days observations should be made at 7 a.m., 1 p.m., and 7 p.m. Greenwich mean time. At 1 p.m. ascents of *ballons sondes* and kites should be made, and at the other hours, besides the ordinary barometer and thermometer readings at the ground-level, there should be as many observations of pilot balloons as possible; if possible, *ballons sondes* might be sent up at the other hours, but the mid-day ascent should be the principal one. He also strongly supported Prof. Köppen's proposition, and said that the use of dynamical units for atmospheric pressure would greatly facilitate theoretical work. M. Teisserenc de Bort said that he saw no difficulty in changing the units if there were any real advantage to be gained by the change. Mr. Cave said that the practice had already been introduced in England in the official publication of the upper-air observations in the Weekly Weather Report, and that Dr. Shaw was strongly in favour of the change being generally made.[1] Prof. Bjerknes said that he would publish tables to enable observers to change the old units into the new ones. In regard to the series of simultaneous observations advocated by Prof. Bjerknes, M. Teisserenc de Bort proposed that one of the smaller series of ascents should be set apart to be made on Prof. Bjerknes's plan, and General Rykatcheff suggested that the time of the ascents should remain as at present, but that they should be made strictly simultaneously, and that additional pilot balloon ascents should be made.

M. de Massani then read a paper on the proposed upper-air observations in Hungary, and Mr. Alexander one on the instruction in aërodynamics in the United Services College, Windsor.

M. Teisserenc de Bort read a paper on the results of theodolite observations on *ballons sondes* at Trappes, and the importance of this method in the verification of heights as determined by the barometer. As a result of his observations, he finds that the cyclonic circulation of the air in low-pressure systems does not extend to great heights in the atmosphere, but that the balloon sooner or later gets into a general wind current, mostly from west to south-west in these latitudes; over high-pressure areas the wind is light, and great irregularities in direction are found; there are often several entirely different currents superposed one above the other; this condition had also been observed in the tropics. With regard to the wind in the stratosphere, M. Teisserenc de Bort has often found a small change in direction at its lower limit, but the changes are neither so regular nor so great as might have been expected. In the discussion that followed Prof. Hildebrandsson said that the observations of M. Teisserenc de Bort in low-pressure areas confirmed his own observations of clouds; it was clear that at 3000 metres or so the isobars over a low-pressure area were no longer closed on the polar side. Mr. Cave said that his observations showed only a small change of direction when a balloon entered the stratosphere, but there had generally been a considerable decrease of velocity; his observations had been made at times when the wind velocities in the lower layers were considerably higher than in most of the cases mentioned by M. Teisserenc de Bort. Prof. Hergesell said that he had not found any regular change of wind direction in the upper layer, but he had in general found a diminution of velocity; but this diminution often occurred at some distance above the lower limit of the stratosphere.

Prof. Hergesell gave an account of the experiments he had made to determine the rate of ascent of rubber balloons in still air. From these experiments he has deduced a formula from which, within certain limits, the rate of ascent of a balloon may be calculated from its weight and from its free lift when inflated with hydrogen. Both he and M. Teisserenc de Bort consider that the vertical velocity is constant up to moderate heights; the theoretical increase of velocity due to decreased density of the air is probably more or less balanced by loss of gas from the balloon. If we know the rate of ascent, and determine the heights trigonometrically, we are able to measure vertical currents in the atmosphere. From his own observations Prof. Hergesell concludes that there is almost always some vertical motion, and sometimes he has observed a vertical current downward of as much as 1 metre per second, or even more; but in general a downward movement at one time is more or less counterbalanced by an upward movement at another, and therefore the one theodolite method, when the height of the balloon is taken as a function of the time, gives the wind velocities with very fair accuracy. Some discussion ensued about the theodolites used for the observations, and it was agreed that for accurate work with a base line the theodolites should read to five minutes of arc, but for the one theodolite method less accuracy was needed. A triangular base with three observers was also strongly recommended.

M. Teisserenc de Bort read a paper on the theory of the isothermal layer, which formed the subject of Mr. Gold's recent theoretical investigations (Proceedings of the Royal Society, vol. lxxxii., 1909). Prof. Hergesell said that he had not seen the original paper, but he thought from the account that M. Teisserenc de Bort had given that the theory had much to recommend it. M. Teisserenc de Bort said he thought the adiabatic distribution of temperature in the lower layers was due entirely to the vertical circulation of air in this part of the atmosphere.

On the afternoon of April 5 the Prince of Monaco was present, and Prof. Berson gave an account (which has appeared in Nature, April 8, p. 171) of his observations on the Victoria Nyanza and off the east coast of Africa. Prof. Palazzo gave an account, illustrated by numerous lantern-slides, of his expedition to Zanzibar and its neighbourhood.

At the meeting on Tuesday morning Prof. Hergesell said that he had received a gift from the Kaiser to the commission in the shape of two portable houses, which could be used as a temporary observatory at any place where an extended series of observations might be useful; it had been proposed to erect them for a year or two on the Peak of Teneriffe, but the Spanish Government had now decided to establish a permanent observatory there. Colonel Vives y Vich gave an account of what it is proposed to do, and said that kite and pilot-balloon ascents would be made; to hasten on the commencement of the meteorological work, the Spanish Government would be willing to accept the temporary loan of the houses under certain conditions until the permanent buildings are ready. It was resolved to send a telegram to the Kaiser thanking him for his gift to the commission and for the interest he had taken in the work, and one to the Spanish Government accepting the conditions as to the houses.

Dr. Assmann spoke of the importance of the study of the upper air for aërial navigation, and thought that the cooperation of aëro clubs and others interested might be obtained, and that by this means a wider study of the subject might be possible. He looked forward to the establishment of more observatories where daily ascents should be made as at Lindenberg, and hoped that in time it might be possible to publish daily synoptic charts giving the isobars at different heights above the surface.

At the last meeting, in the afternoon of April 6, the following resolutions were carried:—

(1) Prof. Köppen's proposal to adopt absolute measures for atmospheric pressure was referred to the International Meteorological Committee.

(2) The July series of observations to be made at 7 a.m. Greenwich mean time, and pilot balloons to be sent up three times a day in accordance with the proposals of Prof. Bjerknes.

(3) M. Vincent's proposal that frequent observations of

[1] See introduction to the Weekly Weather Report, 1909.

the state of the sky should be made on international days was recommended.

(4) The importance of observatories for the study of the upper air to be urged on all countries which do not possess them.

(5) M. de Massani's project to establish an upper-air observatory on the plains of Hungary, near Kecskemét, was endorsed.

(6) It was resolved to bring to the notice of aëro clubs the importance of observations during ascents of manned balloons for sport, &c.

(7) Copies of traces of registering instruments are to be exchanged between members of the commission if required.

(8) Titles of new publications to be sent to Prof. Assmann for publication and analysis in *Fortschritte der Physik*, or to the U.S. Weather Bureau for the *Monthly Weather Review.*

(9) Prof. Rotch's proposition to express the temperature gradient as positive when the temperature decreases with altitude was adopted.

(10) Prof. Rotch's proposal that in the published observations of kite ascents simultaneous observations at ground-level be given was adopted.

(11) The thanks of the commission to be sent to the Austrian Minister of War and to the Vienna Aëro Club for their assistance, and to other Governments which have encouraged the study of the upper air.

(12) The thanks of the commission to be sent to the Spanish Government for its promise to establish an observatory on the Peak of Teneriffe, and to the Spanish military aëronauts and to the German Government for aiding the project.

(13) Various new members were elected—MM. Trabert, Vincent, Kleinschmidt, Bjerknes, Ryder, and Bamler; the directors of the observatories of Irkutsk, Tiflis, and Ekaterinburg; and several military aëronauts, including Colonel Capper.

(14) It was resolved that the next meeting of the commission should be held in Vienna in the autumn of 1912.

Besides the formal meetings of the congress, the members were entertained on several occasions by the Prince of Monaco. A lecture was given by M. Bourée on the oceanographical work that has been done by the Prince on his yacht the *Princesse Alice*, and on April 4 the members were taken by motor to the Nice Observatory by the Corniche Road.

PROBLEMS OF APICULTURE.

ABOUT four years ago a mysterious disease appeared among the bees of the Isle of Wight, and caused great mortality. The most characteristic features were disinclination to work, some distension of the abdomen, frequent dislocation of the wings, and, later, inability to fly. At this stage the bees could only fly a few feet from the hive, and then dropped and crawled about aimlessly on the ground. They could often be seen crawling up grass stems or up the supports of the hive, where they remained until they fell back to the earth from sheer weakness, and soon afterwards died. An investigation was begun by Mr. A. D. Imms, but, as he was unable to continue the work, the Board of Agriculture secured the services of Dr. W. Malden, whose report is issued in the February number of the *Journal of the Board of Agriculture.* He finds that the only organ affected is the chyle stomach, all other organs being normal; there is no paralysis of the wing muscles. The disease is almost certainly infectious, and a plague-like bacillus was frequently found in the chyle stomachs of diseased bees, but not in those of healthy bees. Owing to difficulties of manipulation, it was impossible to establish definitely any causal connection between the disease and the presence of the organism, although the experiments strongly suggest that there is such a connection. It is to be hoped that the investigation may be completed; it promises to be of general importance for the solution of problems connected with infectious diseases of bees.

The whole question of bee diseases needs working out more fully, for little is as yet known with any degree of certainty about the causes of some of them, and few of the disease-producing bacteria have been investigated. An important administrative question is also raised: if a diseased hive is not at once destroyed it becomes a source of infection for surrounding hives, and one careless bee-keeper can in this way do serious harm to others round about him without becoming liable to compensate them for their loss. In a recent Bulletin issued from the United States Department of Agriculture Bureau of Entomology (No. 75), discussing the status of apiculture in the United States, it is urged that bee-keeping should not be popularised, but should be confined, so far as possible, to competent men having a sufficient financial stake in the business to ensure that the bees should have proper attention. "No question in apiculture," says the writer, "at all compares in importance with the control of bee diseases." Two contagious brood diseases already cause serious loss, and there is reason to believe that they are spreading at a rapid rate. The bee industry of the States is quite important enough to deserve consideration; the value of the honey is put at 20,000,000 dollars annually, but the work of the bees in fertilising the blossoms of fruit trees is valued at a still higher figure.

Among other bee problems that are still obscure, few are more interesting than the mating of bees. A host of questions suggest themselves as one watches the wonderful flight of the virgin queens and the drones, but investigation is rendered difficult by the absence of methods. It is no easy matter to arrange that only selected drones shall mate with the queens. Only few cases are on record where mating took place when the bees were caged, even though all the conditions were normal and the cages used were very large—Mr. Davitte's was 30 feet high and of the same diameter. Mr. Miller recently made some experiments, with negative results, at the Rhode Island Agricultural Experiment Station on this subject, and his paper, in the current annual report, affords a good illustration of the difficulties that the investigator meets.

METEOROLOGY OF THE DUTCH EAST INDIES.

WE are indebted to the Royal Observatory of Batavia for the following valuable publications:—(1) meteorological, magnetical, and seismometric observations for 1906, and (2) rainfall observations made at the Netherlands East Indian stations for 1907. It may not be generally known that the establishment of this important observatory was primarily due to a suggestion made by Baron A. v. Humboldt to the Governor-General of Netherlands' India in 1856 (Bayard, Presidential Address to the Royal Meteorological Society, January, 1899). Humboldt pointed out the great value that a magnetical and meteorological observatory at Batavia would be for the promotion of knowledge concerning those phenomena between the tropics. The Amsterdam Academy strongly supported the suggestion, and invited Prof. Buys Ballot to draw up a plan. The proposal of the latter, in 1857, included the organisation of hourly observations at Batavia and the establishment of secondary stations at some places in the East Indian Archipelago, and Dr. P. A. Bergsma was subsequently appointed director of the proposed system. Hourly observations were commenced at Batavia in 1866, and have been continued without interruption down to the present time, with summaries after each five-yearly period, but the establishment of second-order stations was not carried out on account of expense. Wind observations are, however, made at many places by non-official observers, and are collected by the observatory. In 1879 Dr. Bergsma organised a system of rainfall observations throughout the archipelago which has since been regularly continued.

The data for 1907 are published in two volumes, giving (1) daily and monthly amounts, and (2) monthly and yearly amounts and the number of rain-days, together with the results for 1879–1907, at all stations having observations for five years and upwards. At the end of the year the official stations numbered 292, and included Java, Sumatra, Borneo, North Guinea, and the many islands lying between them, some of the principal places being provided with self-recording gauges. The rainfall over this vast area varies very greatly, according to position and altitude and the strength of the monsoons. On the whole, the amounts for 1907 differed little from the average; in Java the extreme yearly values were about 29 inches and 196½ inches (both in the eastern part), and at outlying stations about 21 inches to 197½ inches (both in Celebes). The results at more than 700 stations in Java, including the observations at non-official stations, for the period 1879–1905, have recently been separately published by Dr. W. van Bemmelen. In addition to the above-mentioned publications, the observatory has issued the results of several valuable investigations relating to seismology, tides, &c., and has completed a magnetic survey of the whole archipelago. Papers have also been published bearing upon the moon's influence on meteorological and magnetical phenomena.

RECENT PAPERS ON FISHES.

A REVIEW, by Mr. E. W. L. Holt, of recent contributions to our knowledge of the life-history of the eel, forms the subject of No. 8 of Irish Fisheries Scientific Investigations for 1907 (1909). After a survey of the development and migration of the species, the author is of opinion that the breeding-resort of the eels of northern Europe is in the deep water outside the 500-fathom line to the south-west of Ireland, where alone their leptocephali have been taken in abundance. It by no means follows from this that all north European eels which reach the sea succeed in arriving at the breeding-area, and possibly Finnish eels never breed at all. If this be so, it becomes a practical certainty that elvers—unlike salmon—do not return to the rivers from which their parents started, as, indeed, is improbable on other grounds, seeing that eels—unlike salmon—are hatched in the sea.

In the second part of vol. xxxi. of Notes from the Leyden Museum, Prof. Max Weber, of Amsterdam, describes a large number of new species of fishes collected by the members of the *Siboga* Expedition in Austro-Malaya. A large proportion of these were taken in littoral or sublittoral waters, but others were captured on coral-reefs or in deep water with nets. Many of the new forms are blennies and gobies, no fewer than seven new species of the type-genus (Gobio) of the latter group being described. The present preliminary notice is published on account of the interest attaching to these fishes from a distributional point of view.

To vol. vii., part i., of *Annotationes Zoologicae Japonenses*, Mr. S. Tanaka contributes two papers on Japanese fishes, one dealing with those inhabiting rock-pools at Misaki, and including descriptions of two new species, while the second is devoted to eight new species from Japan generally, two of these being gobies and one a blenny.

Finally, three new species of cisco, or lake-herrings, of the genus Argyrosomus from the great lakes of North America are described by Messrs. Jordan and Evermann in No. 1662 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 165–172), where a note is appended on the species of white fish (Coregonus) inhabiting the same region.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Sir E. Ray Lankester, K.C.B., has resigned his appointment as Huxley lecturer for the coming session, and Mr. W. Bateson, F.R.S., has accepted an invitation to fill the vacancy thereby caused.

On July 7 the King is to perform the opening ceremony of the new buildings of the University. These buildings, which are situate in the south-west corner of Edgbaston, are about three miles from the centre of the town. They comprise the Great Hall, an imposing structure about 160 feet in length, 80 feet in width, and 60 feet high; two separate blocks devoted to engineering in its various branches, civil, mechanical, and electrical; another block for mining and metallurgy, with additional buildings for the manufacture and working of iron and steel; and a power-station for the generation of electrical power, which is distributed to the different blocks for driving machinery and for lighting purposes. These sections have all been in working order for two or three years; and at the present time there are approaching completion two blocks for the departments of physics and chemistry respectively, and a third structure which will serve the function of a central library. Rising high above all these is the Chamberlain Tower, with its clock and bells, measuring from base to summit about 325 feet, the gift of a local donor as a tribute to the Chancellor of the University.

CAMBRIDGE.—In connection with the Darwin centenary, it is proposed to confer the degree of Doctor of Science, *honoris causa*, upon:—E. van Beneden, professor of zoology in the University of Liège; Robert Chodat, professor of botany in the University of Geneva; Francis Darwin, F.R.S., of Christ's College; Karl F. von Goebel, professor of botany in the University of Munich; L. von Graff, professor of zoology in the University of Gratz; H. Höffding, professor of philosophy in the University of Copenhagen; J. Loeb, professor of physiology in the University of California, Berkeley; E. Perrier, director of the Natural History Museum, Paris; G. A. Schwalbe, professor of anatomy in the University of Strassburg; H. von Vöchting, professor of botany in the University of Tübingen; H. de Vries, professor of botany in the University of Amsterdam; C. D. Walcott, secretary of the Smithsonian Institution, Washington; E. B. Wilson, professor of zoology in the Columbia University of New York; and C. R. Zeiller, professor of palæobotany in the École Nationale Supérieure des Mines, Paris.

The special board for biology and geology has approved a grant of 25*l.* from the Balfour fund made by the managers to Mr. R. C. Punnett, in furtherance of his experiments to investigate the inheritance of certain features in rabbits.

The syndicate on alternatives for the general examination, after consultation with the special boards affected, recommends that the schedules for the first examination for the M.B. degree be adopted for the proposed preliminary examination in science, and that the examinations be conducted by the same examiners and on the same papers. It is proposed to allow that the three subjects of the examination—chemistry, physics, and elementary biology—be taken separately, but all candidates must pass in each subject. Detailed regulations have been issued as regards the amendment of the ordinances which the various suggestions will involve.

The new agricultural buildings are now well advanced, and it is hoped they will be ready for occupation by October. The amount of expenditure already incurred is 14,000*l.*, and it is now necessary to obtain specifications and estimates for furniture and fittings. It is estimated that these, together with the architect's commission and incidental expenses, will amount to 3500*l.* At the present time the building fund amounts to 17,000*l.*, and there is thus a balance of 3000*l.* in hand. A further sum of 2000*l.* has been promised as soon as 18,000*l.* has been subscribed. Strenuous efforts are therefore being made to obtain the 1000*l.* required to reach this amount.

LONDON.—Wednesday, May 12, was Presentation Day at the University. In the absence of the Chancellor (Lord Rosebery), the Vice-Chancellor (Sir Wm. Collins, M.P.) presided. Before the proceedings in the Great Hall commenced, the first general parade of the University contingent of the Officers' Training Corps, which mustered more than 400 strong, was held in front of the University. Addresses were delivered by the Vice-Chancellor and by Sir Henry Mackinnon, Director-General of the Territorial Force. The first report of the new principal, Dr. H. A. Miers, F.R.S., showed continued progress, the number of matriculants having risen from 3277 in 1907–8 to 3856 in 1908–9. A corresponding increase was also reported in the number of first degrees granted (from 1192 to 1336) and of higher degrees (from 64 to 78). In concluding his report, the principal directed attention to the great progress which had been made in the organisation of higher education in London since the re-constitution of the University, and the "appalling deficiencies" which still existed in certain particulars. "I found a university," he said, "housed in the half of a building which, though splendid, is entirely inadequate and bears another name, without any proper accommodation for its examinations, without even sufficient room for its normal business or for the meetings of its Senate, councils, and committees; a university which sorely needs endowments and buildings for advanced teaching and research; which has no place that can become a centre for the intellectual and social life of the teachers and students belonging to its numerous schools; a university mainly dependent upon examination fees for its existence, while compelled to consume one-half of these fees in the expenses of the examinations themselves." The presentees included 13 Doctors of Science and 261 Bachelors of Science. It is remarkable that the number of B.Sc.'s presented slightly exceeds the number of B.A.'s (254). In addition, 86 B.Sc.'s in engineering were presented.

The new physiology institute at University College, funds for the building of which were provided by the generosity of Mr. Ludwig Mond and Dr. Aders Plimmer and by the bequest of the late Mr. T. Webb, will be opened on June 18 by Mr. Haldane, Secretary of State for War.

The King has signed the warrant for granting a charter establishing the University of Bristol.

Lord Reay will open the new buildings of the Merchant Venturers' Technical College, Bristol, on June 24.

Mr. R. A. Chisolm has been appointed Greville research student for research in connection with the subject of cancer at Guy's Hospital Medical School.

The old Galway students of Prof. Senier have just presented him with an address encased in a silver casket, expressing their pleasure at the recent action of the Royal University in conferring upon him the honorary degree of Doctor of Science in recognition of his services to science and to university education in Ireland.

We learn from *Science* that subscriptions to the C. W. Eliot fund have been received from about 2050 graduates of Harvard University and others, and amount at this time to about 26,000*l*. The committee hoped that the fund would amount to more than 30,000*l*. by May 19, when President Eliot retired. The subscriptions have been placed in the hands of trustees, to invest and hold for the benefit of President and Mrs. Eliot. The fund will eventually pass to Harvard University.

The Goldsmiths' Company recently offered a gift of 50,000*l*. to the governors of the Imperial College of Science and Technology towards the cost of the proposed extension of the engineering department of the college, and on May 14 the offer was gratefully accepted by the governors. Writing to Lord Crewe, as chairman of the governors, Sir Walter Prideaux, on behalf of the Goldsmiths' Company, pointed out that the gift was irrespective of the company's support to the City and Guilds Institute, and that their subscriptions in the latter direction would not be curtailed. The letter reminded Lord Crewe that the whole of the engineering department of the Imperial College is to be called "The City and Guilds College." The Goldsmiths' Company has expressed the hope that the company will be given separate representation on the delegacy which it is proposed shall administer the entire department of engineering, and the governors of the college have promised that the wishes of the company shall receive immediate attention. The Goldsmiths' Company will pay 10,000*l*. on the day whereon the contract for the work is signed, and the remainder by instalments spread over a period of not fewer than three years.

In his annual address as president of the Royal Institution of Cornwall, Dr. R. Pearce discussed the attempts made by the society to provide instruction for miners in the subjects connected with their occupation. One of the objects of the institution, founded in 1818, was to establish a mining school, the first of the kind in England. The results were at first unsatisfactory; but in 1859 the school was re-organised with the advice and assistance of Mr. R. Hunt, and at a later date by Sir C. Le Neve Foster. The result has been, not so much to improve the methods of Cornish mining, as to provide students qualified for work in other places. Out of 221 students at the Camborne School only forty-one are Cornishmen, the balance being made up from natives of other parts of the country and several foreigners. The school has supplied mining engineers for the colonies and foreign countries, and the president, summing up the results, remarks:—"We may, I think, congratulate ourselves on the fact that, although Cornwall is not deriving any very important benefit by the application of scientific instruction to its mining industry, our colonies and our colonial mining and metallurgical enterprises are being built up from material furnished from our Cornish mining schools."

SOCIETIES AND ACADEMIES.

London.

Royal Society, May 13.—Sir Archibald Geikie, K.C.B., president, in the chair.—Recent solar research; Dr. G. E. **Hale**.—Utilisation of energy stored in springs: A. **Mallock**, F.R.S. The "dynamic worth" of a substance is the work which can be elastically stored in it, divided by its mass. It may be expressed either as the square of the velocity which the stored work could impart to the mass, or, in gravity measure, as the height to which the stored work could raise the weight of the mass. The dynamic worth of india-rubber is more than ten times as great as for any other known substance, and for this reason india-rubber may be used with advantage in certain cases as a source of motive power. It is pointed out in the paper that if the potential energy in the strained material is to be efficiently converted into mechanical work, no frictional contact must occur while the strained material is returning to its original shape. Thus, if the strained material is in the form of a long cord wound on a reel (as the most convenient method of storage), the condition as to the absence of friction during contraction makes it necessary to develop the stored energy in cycles. In the first place, keeping the tension of the cord constant, a certain length must be unwound from the reel and the reel clamped. The cord also must be clamped in two places, first, near the place where it leaves the reel, and again at the extremity of the strained part, to some moving piece of the mechanism. If the part of the cord included between these points is then allowed to contract, the whole elastic work it contained is transferred to the machine. The above cycle may be repeated as long as any stretched cord remains on the reel. Any change of tension, however, in the process of unwinding involves loss of efficiency, due to the sliding of the cord on the reel or on the underlying coils, which must occur if the tension in the wound and unwound parts differs.—A new kind of glow in vacuum tubes: Rev. H. V. **Gill**. The experiments described in the paper were made with the object of investigating the nature and causes of a phenomenon observed by the writer when occupied with a research connected with palladium foil. A piece of palladium foil, or platinum foil coated with palladium black, is heated to a white heat in air at a pressure of about 0·15 mm. A purple-blue glow is seen to surround the hot metal. Between the glow and the palladium there is a dark space. The thickness of the dark space varies with the temperature of the foil. The glow disappears when the tube is heated to a high temperature, and returns when it is cooled. It is shown that the presence of the glow depends on a reaction between the gases introduced into the tube when the palladium is heated and the disintegrated particles of palladium. Water vapour is required to be present in the tube, and the glow can be made to disappear by freezing out the vapour by means of a few drops of liquid air applied to the outside of the tube, or by introducing some phosphorous pentoxide into the tube. The spectrum of the glow shows certain regions which correspond to portions of the spectrum of carbon monoxide gas. It is also shown that carbon monoxide is present in the tube which shows the glow. No effect was observed when electric and magnetic fields were applied to the glow. The probable cause of the luminosity is the luminous union of carbon monoxide and oxygen brought about by palladium charged with hydrogen in the presence of water vapour. A second effect is also briefly described, which appears to be due to the causes which give rise to thermo-luminosity.—The elastic limits of iron and steel under cyclical variations of stress: L. **Bairstow.** An explanation of the fatigue of materials due to the repetition of stresses of sufficiently great magnitude has been investigated experimentally, and found to agree completely with experiments to destruction. The theory was proposed by Bauschinger in 1886, and states that fatigue occurs when the cycle of stress is so great that the extensions produced thereby are not wholly within the limits of elasticity of the material. For this to be true for the whole of Wöhler's well-known experiments, the inferior and superior elastic limits must be variable, but it must not be possible to vary one limit independently of the other. The experiments dealing with this question have been made in a specially constructed testing machine, the repetitions being produced so slowly that the extensions of the specimen at the extreme loads in the cycle could be observed under the normal conditions of test. This new feature in experiments on fatigue has led to the discovery that iron and steel can be made to yield by the repeated application of a cycle of stress in which the maximum stress is considerably less than the static yield stress. Such yielding accompanies any change in the position of the elastic limits, the change being greater as the amount of the yielding is greater. The position of the elastic limits has been found for a number of ratios of maximum to minimum stress, and the relationship of the results to Wöhler's experiments shown. The well-known Gerber parabola is shown to be only a rough approximation.—Functions of positive and negative type: J. **Mercer.**

Geological Society, April 28.—Prof. W. J. Sollas, F.R.S., president, and afterwards Prof. W. W. Watts, F.R.S., vice-president, in the chair.—The boulders of the Cambridge drift: R. H. **Rastall** and J. **Romanes.** For several years past a large number of boulders have been collected from the Glacial drifts of Cambridgeshire, and from the post-Glacial gravels which have been derived from the drifts. These specimens have been classified geographically, and then subjected to a careful petrological examination, with a view to the determination of their origin. Rocks of Scandinavian origin, and especially those of the Christiania province, are abundant throughout the whole area. Rocks from the Cheviots and central Scotland are more abundant than was formerly believed, and specimens have also been identified from the Old Red Sandstone conglomerates of Forfarshire and from Buchan Ness (Aberdeenshire). Lake District rocks probably also occur in small quantity. Much of the Chalk and flints appear to be of northern origin. It is concluded that an older Boulder-clay, containing foreign erratics, the equivalent of the Cromer Till, once extended over the whole district, but was subsequently incorporated with the Great Chalky Boulder-clay. The Scandinavian ice advanced from the direction of the Wash, bringing with it Red Chalk and bored Gryphæas from the bed of the North Sea, and carrying them as far west as Bedford. Rocks from the north of the British Isles become progressively scarcer from west to east, and the distinctive types are absent to the east of Cambridge. They appear to have been brought by an ice-stream coming from a northerly direction, which probably to a certain extent replaced the Scandinavian ice towards the east.—The nephrite and magnesian rocks of the South Island of New Zealand: A. M. **Finlayson.** The magnesian rocks described in this paper are a disconnected series of intrusive peridotites, forming a more or less defined belt along the western portion of the South Island, parallel to the trend of the island and to the structural and geographic axes of the main Alpine range. The course taken by these rocks apparently follows one of the main Pacific trend-lines, the nature of which will be more fully understood with the further elucidation of the structural geology of the region. The rocks are intrusive into sedimentary strata of ages varying from Ordovician to Jura-Trias, and, so far as can yet be determined, all the exposures appear to be of approximately contemporaneous origin.

Royal Anthropological Institute, May 4.—Mr. J. Gray, treasurer, in the chair.—Some stone circles in Ireland: A. L. **Lewis.** The author described several large circles in the neighbourhood of Lough Gur, co. Limerick. These differ from the British circles, being thick banks of earth faced on each side by large stones, but they are furnished with outlying single stones in a manner similar to that found at many of the circles in England and Scotland; these outlying stones are apparently in the direction of the rising of some star at a very early date. One of the largest circles was "restored" shortly after 1860, and now consists of a wall, 150 feet in diameter and 5 feet high, of stones, backed outside by a bank of earth 30 feet wide, through which there is but one entrance, a passage 3 feet wide, lined with stones on each side; this entrance is in the direction of the rising sun in May. The author suggested that, assuming the restoration of this circle to be correct, it differed in construction from the others, and possibly also in its purpose, and that it might have been used as a pound for wild animals driven into it from outside over the sloping bank, and kept inside to be killed as required. There were also circles of stones without earthen banks, remains of cromlechs or dolmens, locally called "giants' graves," and many other interesting ruins belonging to various ages, and there was also the usual melancholy tale of monuments of all sorts destroyed. In another short note Mr. Lewis directed attention to some concentric circular markings, similar to those found at New Grange and other prehistoric places, faintly incised on a stone on the Rock of Cashel, on which the early kings of Munster were said to have been crowned, and which now serves as a pedestal for a very ancient cross.

Linnean Society, May 6.—Dr. D. H. Scott, F.R.S., president, in the chair.—Some Zoantheæ from Queensland and the New Hebrides: Mrs. L. J. **Wilsmore.**—Two new genera of Thysanoptera from Venezuela: R. S. **Bagnall.**

Mathematical Society, May 13.—Sir W. D. Niven, president, in the chair.—Ternary quadratic types: H. W. **Turnbull.**—Gauss's theorem, and on the semi-convergence of certain force integrals in the theory of attractions: Dr. J. G. **Leathem.**—The continuity or discontinuity of a function defined by an infinite product: J. E. **Littlewood.**

MANCHESTER.

Literary and Philosophical Society, April 20.—Prof. H. B. Dixon, F.R.S., president, and later Mr. F. Jones, in the chair.—The Guatemalan earthquakes and eruption of 1902: W. S. **Ascoli.** The earthquake occurred on April 18, 1902, at about 8.25 p.m., the intensity being greatest in western Guatemala, where the second and richest city of the country, Quezaltenango, was completely destroyed. Many other places suffered greatly, and about 1400 of the 20,000 people living in the disturbed region lost their lives. Six months later, on October 24, 1902, there followed the eruption of the neighbouring volcano, Santa Maria, the ash of which covered an area of more than 125,000 square miles. The region, over which nearly 8 inches of ashes and pumice-stone fell, extended to about 2000 square miles, and within it most of the houses and farm buildings fell in under the weight of the ejectamenta, and in some places were totally destroyed. It is estimated that 6000 persons were killed. The cloud from the volcano was eighteen miles in height, and the detonation was audible at Costa Rica, 500 miles away. The whole of the side of the mountain was blown out, exposing a perpendicular cliff 7000 feet high, and forming a crater seven-eighths of a mile long, three-quarters of a mile wide, and 1500 feet deep.—Apical pigment-spots in the pluteus of *Echinus miliaris*: F. H. **Gravely.** In advanced living plutei of *Echinus miliaris* from the plankton of Port Erin Bay there are present in close association with the apical plate two pairs of pigment-spots, and one pair of tufts of stiff cilia. The anterior pair of pigment-spots is small, and of a transparent red colour. The posterior pair are smaller, and of an opaque yellow. They are situated in the general cavity, closely applied to the inner surface of the apical plate, and are probably composed of the same substance as that of similar cells described by MacBride as being found in other parts of the body—especially in large masses beneath the four epaulettes—of the pluteus of *Echinus esculentus*. This substance occurs, with a similar distribution, in the pluteus of *E. miliaris*.

CAPE TOWN.

Royal Society of South Africa, March 17.—Dr. Wm. Flint in the chair.—The spectrum of the ruby: J. **Moir.** On placing a ruby before the slit of a spectroscope, using strong illumination, preferably sunlight, a very remarkable absorption spectrum is obtained, which differs from all others in resembling an ordinary *emission* spectrum. The light is cut off except for a sharp narrow red band situated just beyond the B line of the solar spectrum, and this band bears the closest resemblance to the potassium or lithium line as commonly seen in the Bunsen flame when a rather wide slit is used. The limiting wave-lengths of the band are about 6915 and 6945 tenthmetres. Its width is therefore about half its distance from the B line in the solar spectrum. The phenomenon is most easily seen in pale rubies; corundum with even the faintest pink shade generally shows the characteristic line; but even the darkest true rubies show it if the illumination be strong enough. No other pink or red stone—pyrope, almandine, spinel, or tourmaline, for example—shows this line, which would therefore appear to be characteristic of the colouring of the true ruby. In addition to the red line the spectrum contains wide green and orange bands, which are, however, not characteristic.—Remarks on some experiments with the venom of South African snakes: W. **Frei.** The author contends that, from a toxicological point of view, the classification of the snakes in (1) Oglypha, (2) Opistoglypha, (3) Proteroglypha, (4) Solenoglypha, is the most satisfactory.—An upper limit for the value of a determinant. Note on a theorem regarding a sum of differential coefficients of principal minors of a Jacobian: Dr. T. **Muir.**—Note on a Cœnurus of the Duiker bok: L. H. **Gough.** The parasite was found imbedded in the muscles between the scapula and the vertebral column of a Duiker Bok (*Cephalophus Grimmi*).—The evolution of the river system of Griqualand West: A. L. **Du Toit.** The drainage system in the area dealt with consists of the Orange River with its tributaries, the Vaal, Harts, Riet, and Brak rivers, sections of the first three forming the continuous valley facing the edge of the Kaap Plateau from Vryburg almost to Prieska.

DIARY OF SOCIETIES.

THURSDAY, MAY 20.

ROYAL SOCIETY, at 4.30.—Observations on the Urine in Chronic Disease of the Pancreas: Dr. P. J. Cammidge. *Trypanosoma ingens*, n.sp.: Colonel Sir David Bruce, C.B., F.R.S., and Captains A. Hamerton, H. R. Bateman and F. P. Mackie.—The Incidence of Cancer in Mice of Known Age: Drs. E. F. Pashford and J. A. Murray.—A Method of Investigating the Total Volume of Blood contained in the Living Body: Drs. J. O. Wakelin Barratt and W. Yorke.

ROYAL INSTITUTION, at 3.—Newfoundland: J. G. Millais.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.—Some Tests and Uses of Condensers: W. M. Mordey.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on the Zangezour Copper Mines: A. L. Simon.—The Determination of Tungstic Acid in Low-grade Wolfram Ores: H. W. Hutchin and F. J. Tonks.—Cupellation Experiments: the Thermal Properties of Cupels: C. O. Bannister and W. N. Stanley.—The Bessemerising of Hardhead: Donald M. Levy and D. Ewen.—The Use of Standards in Reading Gold Pannings: Stephen J. Lett.—Notes on the Scaling and Sweating of Copper Battery Plates: Sydney F. Goddard.

FRIDAY, MAY 21.

ROYAL INSTITUTION, at 9.—Afforestation: Hon. Ivor C. Guest, M.P.

SATURDAY, MAY 22.

ROYAL INSTITUTION, at 3.—The Secret Societies of the Banks' Islands: Dr. W. H. R. Rivers, F.R.S.

MONDAY, MAY 24.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

TUESDAY, MAY 25.

ROYAL INSTITUTION, at 3.—The Hittites: (2) Recent Discoveries in Asia Minor and Northern Syria: Prof. John Garstang.

ZOOLOGICAL SOCIETY, at 8.30.—Description of a New Species of the Genus Alpheus, Fabr., from the Bay of Batavia: Dr. J. G. De Man.—On the Skull of a Black Bear from Eastern Tibet, with a Note on the Formosan Bear: R. Lydekker.—The Anatomy of the Olfactory Organ of Teleostean Fishes: R. H. Burne.

WEDNESDAY, MAY 26.

GEOLOGICAL SOCIETY, at 8.—The Cauldron Subsidence of Glencoe, and the Associated Igneous Phenomena: C. T. Clough, H. B. Muff, and E. B. Bailey.—The Pitting of Flint Surfaces: C. Carus-Wilson.

ROYAL SOCIETY OF ARTS, at 8.—The Manufacture of Nitrates from the Atmosphere by the Electric Arc: S. Eyde.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—Chinese Astronomy: E. B. Knobel.

THURSDAY, MAY 27.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Notes concerning Tidal Oscillations upon a Rotating Globe: Lord Rayleigh, O.M., F.R.S.—The Absolute Value of the Mechanical Equivalent of Heat in Terms of the International Electrical Units: Prof. H. T. Barnes.—An Approximate Determination of the Boiling Points of Metals: H. C. Greenwood.—Some Results in the Theory of Elimination: A. L. Dixon.—The Liquidus Curves of the Ternary System, Aluminium-Copper-Tin: J. H. Andrew and C. A. Edwards.

ROYAL INSTITUTION, at 3.—Newfoundland: J. G. Millais.

INSTITUTION OF MINING ENGINEERS, at 11.—Presidential address: Dr. R. T. Moore.—Electricity in Coal-mines: R. Nelson.—Comparison between the Value of Surplus Gas from Regenerator Bye-product Coke-ovens and Steam produced by the Waste Heat from Bye-product Coke-ovens, with Special Reference to the Evence Coppée new Bye-product Ovens: M. H. Mills.

FRIDAY, MAY 28.

ROYAL INSTITUTION, at 9.—Advances in our Knowledge of Silicon as an Organic Element: Dr. J. Emerson Reynolds, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 10.30.—The Use of Concrete for Mine Support: Prof. W. R. Crane.—Mining in British Columbia: Mrs. Rosalind Young.

SATURDAY, MAY 29.

ROYAL INSTITUTION, at 3.—The Secret Societies of the Banks' Islands: Dr. W. H. R. Rivers, F.R.S.

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THURSDAY, MAY 27, 1909.

TWO STANDARD WORKS ON ZOOLOGY.

(1) *A Student's Text-book of Zoology*. By Prof. Adam Sedgwick, F.R.S. Vol. iii. The Introduction to Arthropoda, the Crustacea, and Xiphosura. By J. J. Lister, F.R.S. The Insecta and Arachnida. By Dr. A. E. Shipley, F.R.S. Pp. xii+906. (London: Swan Sonnenschein and Co., Ltd., 1909.) Price 24*s*.

(2) *A Treatise on Zoology*. Edited by Sir Ray Lankester, K.C.B., F.R.S. Part vii. Appendiculata. Third Fascicle, Crustacea. By Dr. W. T. Calman. Pp. viii+346. (London: A. and C. Black, 1909.) Price 15*s*. net.

THESE two ample volumes suggest that a comprehensive text-book on the whole animal kingdom can no more be written by a single zoologist. The advanced student needs an encyclopædic work in which several naturalists with wide general and deep special knowledge have united their labours. The great "Treatise" which is slowly taking shape under the editorship of Sir Ray Lankester has been planned from the outset on these lines, and Dr. Calman's volume is worthy of the best of its predecessors. Prof. Sedgwick now issues the third volume of his text-book, eleven years after the appearance of the first, and he tells us in his preface that, but for the help of his colleagues, Messrs. Lister and Shipley, this present volume would still be far from completion.

(1) When Prof. Sedgwick's second volume was reviewed in NATURE (November, 1905), the arrangement by which the Chordata were placed in the middle of the series, and the Arthropoda widely separated from the Annelida, was naturally criticised. The author, in his preface, now briefly replies to this criticism, pointing out that he followed "the clue given by the cœlom," and postponed the section on the Arthropoda until after that on the "enterocœlic" phyla. In defending this separation of the Arthropoda from the Annelida Prof. Sedgwick differs from Sir Ray Lankester, who adopts a single phylum—the "Appendiculata"—to include Arthropoda, Annelida, and Rotifera. Prof. Sedgwick is fully justified in regarding the Arthropoda as an independent phylum, as they "differ so fundamentally from the Annelida in their cœlomic arrangements," but in separating the two groups so widely in his system he surely puts too great a strain on the fascinating cœlomic theory.

To the volume before us Prof. Sedgwick himself contributes the chapters on the Tunicata, Enteropneusta, Echinodermata, Onychophora, and Myriapoda. His account of the Tunicata, which occupies sixty-five pages, is a masterly summary of the complex details of structure and life-history which characterise that interesting and puzzling class. The author's scepticism as to many current morphological ideas is shown by his remark that the ascidian subneural gland is "in its origin actually a part of the embryonic brain which the pituitary body never is." Nearly fifty pages are devoted to the Enteropneusta, a testimony to the great advances lately made in our knowledge of the group and to its zoological importance.

While upholding the vertebrate affinities of the Enteropneusta, Prof. Sedgwick insists that several fundamental features clearly indicate relationship to the Echinodermata, and his account of that great phylum, occupying nearly 200 pages, comes next in the volume. His discussion on the relationship between echinoderms and chordates is especially valuable and suggestive. Besides the well-known correspondences in the cœlomic spaces, the central nervous system, and the mesodermal limy skeleton, and the likeness of the tornaria to the echinoderm type of larva, attention is directed to the left-hand position of the mouth, both in the developing echinoderm and in the larval Amphioxus. This character is considered of the greater importance because no adaptational explanation of it, at least in the latter instance, is forthcoming. Incidentally, the author discusses the Dipleurula theory as elaborated by Bather, and gives reasons for doubting the existence of bilateral symmetry among the ancestors of echinoderms, though he has no other explanation of the free-swimming larvæ to offer. He further differs from most special students of the Echinodermata in his rejection of the association of the Crinoidea with the Palæozoic Blastoidea and Cystidea in a sub-phylum Pelmatozoa, holding our knowledge of the structure of the two latter classes to be too incomplete for any certain estimation of their affinities, while "Holothurians stand further from Asteroids and Echinoids than do the Crinoids." The value of the chapter on echinoderms is much enhanced by a remarkably well-chosen series of illustrations, including some hitherto unpublished drawings by Prof. E. W. MacBride.

The remainder of the volume (about 550 pages) is devoted to the Arthropoda. Mr. J. J. Lister contributes a short but admirable introduction on the phylum as a whole. On the disputed question of the segmentation of the crustacean and insectan head, Mr. Lister follows in the main the views of Hansen and Folsom, accepting the maxillulæ of the Apterygota as true appendages; but he ranges the arachnidan chelicerae with the insectan feelers, and thus makes the whole cephalothorax of a scorpion equivalent to the head of a cockroach. There is a remarkably good account of arthropodan eyes and vision.

(2) Mr. Lister has also written the chapter on the Crustacea, which occupies some 200 pages, and this section can be appropriately compared with Dr. Calman's volume of Lankester's "Treatise." In the former work the Trilobita are included among the Crustacea, while in the latter they are relegated to the Arachnida. Both writers agree that this ancient group of arthropods has affinities with the Arachnida and with the typical Crustacea, but, in view of their feelers and biramous limbs, their actual inclusion among the Arachnida can hardly be defended. In the classification of the Crustacea Mr. Lister is conservative, preserving the Entomostraca as a subclass, and holding to the long-recognised and familiar orders. Dr. Calman, on the other hand, rejects the Entomostraca as a natural group, and raises the Copepoda, Ostracoda, Cirripedia, &c., to the rank of "subclasses," dividing each into two or more "orders."

In this matter Mr. Lister's caution may, perhaps, be commended. In his arrangement of the Malacostraca, Dr. Calman adheres to his published views, in agreement with Boas and Hansen, splitting up the old order Schizopoda, so that the Mysidacea, with their reduced carapace, developed brood-pouches, and elongate tubular heart, are grouped with the Cumacea, Isopoda, Amphipoda, &c., in a division Peracarida, while the Euphausiacea are associated with the Decapoda to form the division Eucarida, characterised by an extensive carapace, a condensed heart, and the absence of brood-pouches. Mr. Lister, on the other hand, retains the order Schizopoda in its familiar signification. Here he clings to a position that must ultimately be abandoned, and he has little, except the opinion of Claus, to offer in its defence.

As might have been expected by those who have followed his excellent work, Dr. Calman's volume is especially strong in the morphological and systematic aspects of carcinology, while Mr. Lister deals more fully with development and bionomics. For example, we find in the latter author's chapter a summary of Keeble and Gamble's recent important work on colour-changes in the Decapoda, which has no place in Dr. Calman's volume. In both accounts of the Crustacea due regard is given to palæontology, and Mr. Lister appreciates no less than Dr. Calman the great importance of the Tasmanian Anaspides and its Palæozoic allies. By a judicious use of the two works, no student can fail to gain an admirable introduction to the study of the Crustacea.

Prof. Sedgwick has himself written the chapters on the Onychophora and the Myriapoda included in his volume. His epoch-making work on the structure and development of the Cape species of the former class might have prepared us for the excellence of his descriptions. In spite of Goodrich and Lankester's recent teaching on cœlomoducts, he still calls the peripatid excretory tubes "nephridia," a piece of conservatism in which he may find support from some zoologists; but it is hard to understand his rejection of the generic distinctions in the group, introduced by Pocock, and supported and extended by Bouvier, Dendy, and other recent workers. Except for Evans's Eoperipatus, he refuses to use the terms of these authors even in a subgeneric sense, needlessly coining a series of uncouth zoogeographical compounds such as "Chilio-peripatus," "Congo-peripatus," and "Capo-peripatus."

The unattractive yet interesting groups of Arthropoda known as "Myriapods" are dismissed in thirty pages. It is a matter for regret that the unnatural "Class Myriapoda" is retained, and in the discussion wherein the author defends this arrangement he does not even mention the natural solution of the difficulty —to treat the Chilopoda, Symphyla, and Diplopoda as independent classes—though he rightly insists on the insectan affinities of the Symphyla.

Mr. A. E. Shipley contributes a good chapter on the Insecta to Prof. Sedgwick's volume, giving a trustworthy account of the main structural features, and a clear, if brief, introduction to insect embryology, though the general discussion of metamorphosis is disappointingly curtailed. The denial of evidence for pre-Carboniferous insects ignores the ephemeroid and other remains described by Scudder from the American Devonian. Mr. Shipley's classification of insects is modified from Sharp's recent scheme; its only serious fault is the presence of the unnatural group "Anapterygota," including the Mallophaga, Anoplura, and Siphonaptera. In the account of the Apterygota, the two very remarkable genera, Anajapyx and Acerentomon (the latter regarded as the type of a new order), recently described by Silvestri, and the systematic work of Börner on the Collembola, should not have been neglected. In the description of the Lepidoptera, attention should have been directed to the importance of larval and pupal stages in the classification of the order, as pointed out by Chapman and others; from the statement on p. 710 it might be inferred that no lepidopterous pupa emerges partially from its cocoon.

The last chapter of the volume, occupying 90 pages, is devoted to the Arachnida. For this also, except a section on the Xiphosura by Mr. Lister, we are indebted to Mr. Shipley. The Pycnogonida, which appear as a subclass of the Arachnida, are too briefly dismissed; no reference is given to the works of Sars, Meinert, and Cole, nor is there any allusion to the puzzling ten-legged Antarctic genera; but the account of the Xiphosura and Eurypterida is especially good. The scorpions, spiders, and mites are excellently described, while the fairly full accounts of the Phalangidea and Palpigradi are welcome. The Tardigrada and Pentastomida appear as "appendices" to the Arachnida.

It is easy in reviewing such volumes to point out omissions, if not errors, and to suggest how this or that feature might be better otherwise. But the leading thought with which one lays them down is of gratitude to the authors for the labour expended on them and on the other volumes of the series to which they belong. With the yearly increasing output of research, the trustworthy text-book becomes more than ever necessary, and the modern English student is fortunate with sets of "Lankester" and "Sedgwick" on his shelves.

G. H. Carpenter.

THE FLORA OF THE PRESIDENCY OF BOMBAY.

The Flora of the Presidency of Bombay. By Dr. Theodore Cooke. Vol. ii., parts ii. to v. (London: Taylor and Francis, 1907–8.)

THE appearance of the last part of the second volume of the above completes the first instalment of the series of local floras projected to carry on the task of which "The Flora of British India," by Sir Joseph Hooker, aided by other eminent botanists, forms the foundation. The object of these "local" (or, as they might well be styled, provincial) floras is to amplify and, where necessary, to revise for a particular area the taxonomic information set out in the more general publication, and the present volume, judged in this light, must be held to have attained a high standard both in fulness and precision.

The descriptions, although answering the severest technical requirements, are sufficient to guide even a beginner, and this is attained, among other means, by the inclusion of the whole account in a single paragraph, in place of the old plan of subjoining to an often curt diagnosis, sometimes barely intelligible without special study of the family or genus, a more or less loosely constructed note, usually in small print, on sundry features of the species, which might or might not, as things fall out, fulfil the end of a detailed description.

Another commendable feature of the work is presented in the analytical keys that are prefixed to the larger or more difficult genera. There is nothing easier, in a way, for a systematic writer than to make such a key on paper, and the more easily it has been made the more likely is it to be found in practice unworkable, or worse than useless; but the keys in this instance have been manifestly framed with some regard to the natural groupings of the species, and are clearly the result of personal and accurate examination of the material. As illustrations we may mention the synopsis at pp. 98–9 of the Bombay species of Diospyros, of Cordia (p. 199), Strobilanthes (pp. 365–6), and of the often almost hopeless genera of grasses (in the stricter sense). For the last-named very important family—the despair almost of taxonomists—Dr. Cooke has followed rather closely the arrangement made by Dr. Otto Stapf in the "Flora Capensis," which is that most generally now adopted, and, whatever may be thought of this as a comprehensive scheme for this difficult family, it must be admitted that Dr. Cooke's treatment of such genera as Panicum and Eragrostis, to say nought of Andropogon, has been fitted to it in a very workmanlike and skilful manner, without sacrificing detailed observations of the actual structure of the species, that are palpably the fruit of indefatigable work with the lens, by the author.

A like scrupulous accuracy pervades the nomenclature throughout the volume, though in some cases whole-hearted disciples of the Vienna Congress will miss sundry emendations that have doubtless been avoided purposely, for reasons analogous to those that have dictated, in the preparation of these Indian and colonial floras, adherence to the "Genera Plantarum" of Bentham and Hooker, as against the more recent work of Engler and Prantl. In the case of compendia founded, as the present is expressly, on the "Flora of British India," this is practically unavoidable, but in the analysis of families, and in some minuter matters, Dr. Cooke has shown, if anything, a shade too much deference to those monumental authorities. Take, for example, the arrangement of the tribes and subtribes in Compositæ (pp. 1–6). Assuming that Astereæ can be kept up as a tribe apart from Inuleæ, and that both should continue, even in a linear arrangement, to stand far apart from Senecionideæ through the intercalation of Helianthoideæ, Helenoideæ, and Anthemideæ, surely it is time to revise the subtribes of Astereæ. No doubt the solitary representative of the genus Erigeron found in Dr. Cooke's area, if it should be kept as an Erigeron at all, conforms to the definition of the subtribe "Heterochromeæ" by G. Bentham; but discoveries by the Abbé Delavay, by Wilson, and others in the Indo-Chinese region have shown that there are true Asters, and perhaps members of the allied genus Erigeron, that have the disk florets of the same bluish tint as the ligules, though of deeper intensity. In the "Genera Plantarum" it was admitted that in several genera all the florets are yellow, but now that the converse exception is known to affect the type-genus of the tribe, the division into Heterochromeæ and Homochromeæ seems to call for reconsideration.

A minor case suggests itself at pp. 1030–31, where the careful work of Jaubert and Spach on the actual forms of Melanocenchris has been swamped for the sake of resuscitating Koenig's practically barren title for the genus (Gracilea). This, of course, is a debatable example, but the same can hardly be said for the citation of Linnæus at p. 479 for the genus Boerhaavia, which Linné himself was most careful to attribute to its real author, Vaillant. In restoring *B. diffusa*, Linn., to the rank of a variety, Sir Joseph Hooker had, in fact, given the clue, because one or other of the two forms put under *B. repens* in the "Species Plantarum" was the type of Vaillant's genus. Whether either of those be identical with the *B. diffusa* of Linné can be decided only by inspection of the authentic types collected in Abyssinia by Lippi.

Dr. Cooke's "Flora" was commenced in 1900, and the first part appeared in July, 1901. On May 1, 1902, the Bombay herbarium at the Poona College of Science was destroyed by fire, and he has since had to depend largely on his own collections and those of Woodrow to supplement the classical material at Kew. He has examined and described 2502 indigenous species, and dealt with more than 500 introduced or cultivated plants known to the Presidency, distributed among 1029 genera and 148 families, embracing types of widely divergent affinities, and belonging to such diverse phytogeographical regions as the Oriental, East African, and Indo-Malayan. It is no mean achievement in itself to have completed such a task successfully. The final part is accompanied by a carefully prepared index to the book as a whole, and this is in two parts, the vernacular names being indexed by themselves, which, for most purposes, is the most convenient arrangement.

THE TEACHING OF PHYSICAL CHEMISTRY.

(1) *The Elements of Physical Chemistry.* By Prof. J. Livingston R. Morgan. Fourth edition, revised and enlarged. Pp. xiv+539. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 12*s.* 6*d.* net.

(2) *Outlines of Physical Chemistry.* By Dr. George Senter. Pp. xvii+369. (London: Methuen and Co., n.d.) Price 3*s.* 6*d.*

(1) THE fact that the former of the above-mentioned text-books has, in the space of a single decade, passed into its fourth edition, is sufficient evidence that the work has met with a large share of approval, and has shown it to be adapted to the requirements

of a large number of students of physical chemistry. Within the limits which the author has allowed himself, a very large amount of experimental work has been collected and discussed, and in this connection even the most recent work has received attention. In the initial chapters, however, dealing with the physical properties of substances, the author has been somewhat niggardly, and one is struck by a want of balance. Thus, whereas twenty pages have been allotted to the discussion of surface tension and the molecular weight in the liquid state, together with an excellent account of the author's drop method, barely a page has been devoted to refraction of light, and no mention at all is made of the rotation of the plane of polarised light. It must be confessed, also, that at times the condensation of language makes the reading of the book somewhat of a strain, and is productive of want of lucidity; so that the book, in parts, assumes the character of lecture notes rather than that of a self-explanatory text-book. In many cases, however, the author has been successful in minimising this evil by the insertion of tables of experimental results, and by the working out of numerical examples. This last feature of the book is indeed one to be greatly commended. No one can obtain a useful grip of physical chemistry without the study and actual working out of numerical problems. The collection of such problems inserted at the end of the book will therefore be of great value, both to the teacher and to the student.

The author has not been afraid to employ the methods of the calculus or to introduce the student at an early point to the study of thermodynamics. We can only wish that such a method might be adopted with some prospect of success in this country.

During the period which has elapsed since the appearance of the first edition, change has taken place in the attitude of mind of the author. Before the appearance of the third edition, the author states that he had come under the influence of Ostwald's "Naturphilosophie," and as a result he sets before himself the aim "to distinguish sharply between hypothesis and fact, avoiding the former as far as is possible."

Now, it cannot be denied that among students of science too little attention is usually paid to the philosophical side of the subject, so that the true meaning of a law, an hypothesis, and a theory is insufficiently appreciated, leading as a result to the confusion of hypotheses and theory with fact. Still, it cannot be said that the cure for this is to discard hypotheses altogether. Hypotheses are most valuable for the development of a science, so long as they are recognised as such, and are kept in their place. But the author himself is apparently none too sure of his ground here. It is, of course, perfectly competent for him, if he thinks it good, to eliminate hypotheses and theories, and to confine himself to what is experimentally determinable, and to generalisations of such observed facts, but when he states (p. 187): "By the word theory, then, we do not mean a hypothesis in which something not observed is added to the facts to 'explain' them, but only a generalisation of observed facts," surely he is taking undue liberties with language which can be productive only of confusion. Such a standpoint is to be regretted, for it greatly reduces the value of a book which has otherwise very much to recommend it.

(2) The second of the two books mentioned above can be heartily welcomed. It is put forward by the author as "an elementary introduction to physical chemistry," and as such the reviewer believes that it will, on the whole, be found very satisfactory. It cannot, and does not pretend to, treat in detail the whole subject of physical chemistry, but it does attempt, and this successfully, to introduce the student to the more important parts of the subject, special stress being laid on the modern theory of solutions, the principles of chemical equilibrium, electrical conductivity, and electromotive force.

The order in which the author treats his subject is as follows:—Fundamental principles of chemistry; the atomic theory; gases; liquid solutions; dilute solutions; thermochemistry; equilibrium in homogeneous systems; law of mass action; heterogeneous equilibrium; the phase rule; velocity of reaction; catalysis; electrical conductivity; equilibrium in electrolytes; strength of acids and bases; hydrolysis; theories of solution; electromotive force.

In the above treatment the author intentionally devotes comparatively little space to the discussion of physical properties and their relation to chemical constitution. In this, doubtless, he was wise; and yet one cannot help feeling that the addition of twenty, or even of ten, pages devoted to experimental results would not have greatly added to the bulk of the volume, and would certainly have been of great value in giving the student some idea of the utility of physical methods for the elucidation of chemical constitution.

In connection with the subject of dilute solutions, the treatment is not altogether satisfactory, insufficient emphasis being laid on the probability that solutions are essentially different from gases. Some indication might have been given that there is not only an experimental, but also a theoretical reason for substituting the mass of the solvent for the volume of the solution in the general osmotic equation; also the unsatisfactory character of the kinetic explanation of the mechanism of osmotic pressure should have been pointed out. Further, rather more definite guidance might have been given to the student than merely to say, "other views are that it (*i.e.* osmotic pressure) is connected with attraction between solvent and solute, or perhaps with surface tension effects," especially as the reviewer has pointed out that the surface-tension theory is untenable. It is true that the author inserts, as a saving clause, the sentence "It may be pointed out that the equivalence of osmotic pressure and gas pressure in great dilution is no evidence that they arise from the same cause," but the student will still probably continue to believe that the kinetic explanation is the best one.

The discussion of electrical conductivity and of electromotive force, two very important subjects, is very well done.

The book is wonderfully free from misprints, at least of a serious character, and on the whole the book is one which can be highly recommended to all students who wish to obtain a first acquaintance with the subject of physical chemistry. In language it is clear and well-expressed, and the practical illustrations which are appended to most of the chapters will be found very useful for laboratory work. The cost of the book, also, is extraordinarily low. A grave omission on the part of the publishers is the date of publication on the title-page. A. F.

ELECTRICAL ENGINEERING.

(1) *Transformers, for Single and Multiphase Currents. A Treatise on their Theory, Construction, and Use.* By Prof. Gisbert Kapp. Second, revised and enlarged edition. Pp. ix+363. (London: Whittaker and Co., 1908.) Price 10*s*. 6*d*. net.

(2) *Electrical Engineer's Pocket Book. A Handbook of Useful Data for Electricians and Electrical Engineers.* By Horatio A. Foster, with the Collaboration of Eminent Specialists. Fifth edition, completely revised and enlarged. Pp. xxxvi+1599. (London: A. Constable and Co., Ltd., 1908.) Price 21*s*. net.

(1) A NEW edition of Prof. Kapp's well-known book on transformers is bound to be interesting to all electrical engineers. Moreover, when the new edition is so much enlarged as to become practically a new book, the publication is of still greater importance.

The first two chapters are introductory in character, and deal respectively with general principles and with the losses in transformers. We cannot but feel some regret that the constants for hysteresis loss are not given in the form $K \times B^{1.5}$. This form gives practically the same result as the $B^{1.6}$ formula if a suitable value of K is chosen (as Prof. Kapp states on p. 17), and the calculation of the loss if the index is 1·5 can be much more readily made. The second chapter includes some valuable results of tests on the newer alloyed irons.

One of the best of the new chapters is chapter iii., where the subject of heating of transformers is dealt with very completely. The method of estimating temperature rise graphically for intermittent loads by combining the heating and cooling curves is very clearly given. Chapter v. is a very interesting one, dealing with the much neglected subject of the design of choking coils; the method of determining the necessary volume of the air-gap to give a certain amount of wattless current is both novel and useful.

In chapter vi. the design of the core of a transformer is considered, and a good deal of space is devoted to the discussion of the distribution of losses in a transformer. Some exception must be taken to the statement on p. 123:—

"The law of equal losses gives the maximum efficiency of a transformer which is the right size for the load. Arnold's law[1] gives it for a transformer which is slightly too large for the load."

[1] Copper loss = 0·8 hysteresis loss + eddy current loss.

Arnold's law and the law of equal loss are obtained on totally different premises, and both laws are correct for the given premises. It is true also that for a transformer designed on Arnold's law a higher efficiency can be obtained by increasing the load until the copper loss is equal to the iron loss, but this load may be more than the transformer can stand, and it is no more accurate to say that Arnold's law gives maximum efficiency for a transformer that is slightly too large for its load than it would be to say that the law of equal losses gives the maximum efficiency for a transformer that is slightly too small for its load.

In chapter vii. the design of a shell transformer is worked out in detail. One must enter a protest against the introduction of "Fill Factor." This is a literal translation of the German "Füllfaktor," but the English "Space Factor," introduced by Thompson, is now so well recognised that it seems a pity to use another term.

In chapter viii. the transformer theory is worked out in the same clear way as is done in the earlier edition. Prof. Kapp's well-known diagrams are described in detail, as well as the simplified drop diagram now so largely used. In the next chapter the calculation of magnetic leakage is considered, and some useful formulæ are given for calculating it in specific cases.

Chapter x. deals with the measurement of power; the usual methods of measuring power are described, including the three amperemeter and three voltmeter methods. Students might perhaps have been warned of the great accuracy of measurement in voltage and current which is necessary to obtain good results with these two methods. Chapter xi. deals with the testing of transformers, and includes also a description of most of the modern iron-testers, including the Epstein tester for total loss, the Grassot fluxometer, and Prof. Kapp's device for measuring magnetic quality.

The next chapter deals with a number of subjects, including safety appliances for transformers, three-wire transformers, auto-transformers, series working, and Scott's system of transformation from two-phase to three-phase working. It is similar to the corresponding one in the earlier edition, though the matter is greatly increased and brought up to date.

The last chapter gives some examples of modern single-phase and three-phase transformers, and is one of the most valuable in the book, both for the student and the designer. Not only are many plates and drawings included, but the details of the designs are worked out in many cases.

This book is likely to remain a standard treatise on the subject in English for some time.

(2) The "Electrical Engineer's Pocket Book" is similar to many other pocket books of the same class already on the market. It aims, however, at giving more complete and comprehensive information than most of these compilations, and deals with such subjects as electrochemistry, illuminating engineering, electrolytic action, firing mechanism for guns, electrometallurgy and X-rays, while more than 250 pages

are devoted to electric railways. The method of giving two tables for the same constant in two separate parts of the book is open to much criticism, and there are one or two obvious mistakes. In the description of the Weston cadmium cell, for example, the elements are stated to be cadmium and mercury instead of cadmium amalgam and mercury, while in the table of specific inductive capacities on p. 227 the specific inductive capacity of gutta-percha is given as 2·5, whereas on p. 36 we have the proper value of from 3·3–4·9. The whole of the table on p. 227 might well be omitted. Apart from a few minor defects, which it is very difficult to avoid in a compilation of this kind, the tables appear to be trustworthy, and are readily referred to by the aid of an excellent and complete index. E. W. M.

FOOD AND NUTRITION.

Human Foods and their Nutritive Value. By H. Snyder. Pp. xvi+362. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 5*s*. net.

OUR author remarks that the study of foods is "the oldest, most important, most neglected, and least understood of any that have a direct bearing upon the welfare of man."

No doubt there has been, and still is, neglect of systematic and coordinated scientific investigation into the many problems which arise in connection with the task of nourishing the human body. Yet a vast amount of work has been done on the subject. The list of books referred to in the present volume reaches the respectable total of one hundred. True, many of them—as, for example, the "Bulletins" of the United States Department of Agriculture—are only short studies of isolated points, but, on the other hand, the list is chiefly confined to American works, and is not intended to be a complete bibliography. Perhaps the indications point not so much to general neglect as to the present stage being one of accumulating evidence. By and by, it may be, some dietetic Kepler will discover laws of nutrition which will coordinate the facts better than can yet be done. Meanwhile, distinct progress is being made.

The opening chapter of the volume is devoted to expounding the general composition of foods. It describes how they are made up of water, inorganic salts, and organic compounds, and how the latter may consist of proteids and fats, starches, sugars, pectose, cellulose, and so on. After explaining the changes which foods undergo during cooking, the author passes to a consideration of the various classes of foods—*e.g.* vegetables, fruits and flavourings, milk and other dairy products, meat-foods, cereals, condiments, and beverages. In each case a short description of the article is given, indicating its composition as regards nutrient substances and, generally, its value as a food. Tables are appended which show, for ordinary American foodstuffs, the proportion of non-edible refuse, water, protein, fat, carbohydrates, and ash, together with the heat-equivalents of the foods.

Naturally in so small a book the information is often meagre, but it appears to be generally trustworthy. The treatment, though elementary, should serve to make the work a good introduction to the study of dietetics.

Probably the sections dealing with the digestibility of foods and with dietary studies will be found the most interesting. The author distinguishes between the completeness and the ease of digestion, and summarises the factors which influence the two as (1) combination of foods, (2) amount, (3) method of preparation, (4) mechanical condition of the food, (5) its palatability, (6) its physiological properties, such as astringency and laxativeness, (7) the individuality of the consumer, and (8) psychological influences—*e.g.* preconceived ideas as to the wholesomeness or otherwise of the food. On such questions as vegetarianism, the use of "whole-meal" bread, and heavy meat diets, Mr. Snyder takes a moderate and reasoned attitude. As regards the last, he maintains that at present the available results are too meagre to justify the formulation of other than tentative standards. "In the matter of diet," he says, quoting Hutchison's "Food and Dietetics," "every man must, in the last resort, be a law unto himself . . . . giving due heed to the warnings which nature is sure to address to him should he at any time transgress."

C. SIMMONDS.

THE BODY AT WORK.

The Body at Work. A Treatise on the Principles of Physiology. By Dr. Alex. Hill. Pp. xi+448. (London: Edward Arnold, 1908.) Price 16*s*. net.

DR. HILL has given us a book at once instructive and attractive. He writes for the amateur in science, but men deeply versed in physiology will find much to interest and to learn in his work. There is not a sentence in the book that could be spared, yet, although the reading commands close attention, it never fails to attract and to please. After a preliminary review of the subject of physiology, the second chapter, on the basis of life, reminds one of the great man whose name appears in the first line of the chapter, for "The Body at Work" is quite in the style of Huxley at his best.

The subject is approached from the unit of structure—the cell—through its groupings and specialising of structure and function to form the higher tissues and organs. The importance of the leucocytes, their manner of travelling, of multiplying, and of grouping, is graphically told, and the sections devoted to the blood and circulation in chapters iv. and ix. are simply but most explicitly handled. Amateurs in science can peruse with understanding the abstruse subjects of the functions of the thyroid gland, the suprarenal capsules, and the pituitary body. Digestion and dietetics, respiration in all its bearings, absorption and excretion are given in language that reads almost like a fairy-tale, yet with a scientific accuracy and bearing wholly trustworthy.

Throughout the book the meaning of vital processes is brought out in a fashion which leaves its impress.

The relationship of "vital action" to "physical phenomena" is carefully discussed, for the expressions "physical" and "vital" point a contrast constantly present to the physiologist's mind, and lead to much confusion. He is apt to regard as physical whatever he can test and measure in his laboratory, but cannot, however, make a model of a living cell or isolate it from the "vital" process which surrounds its existence in the living body. The technicalities of the nervous system are relieved by applied side-issues, often in the form of conversations, which enliven what are apt to be mere dry details.

The chapters on the special senses which close the book are fraught with information useful to physiologists, to musicians, and to teachers of singing and voice production. There is a message in the book to men and women of almost every calling, and everyone will find the text to be a model of writing and of how to convey information in a manner which commends itself to a teacher.

Scientific writings are, as a rule, mere catalogues of facts, put together in a manner more or less irrelevant. There is no reason for this except the absence of literary ability, a factor which obtains all too widely in medical and scientific writings generally. Huxley's works on scientific subjects, Sir Thomas Watson's on medicine, and Druitt's on surgery are exceptions to the rule, but they belong to a past generation, and seem to have left behind them no writers of their literary capacities. Dr. Hill, however, appears to have caught something of their inspiration, and we can only hope that he will deal with other subjects within his ken in a manner similar to that which he has given us in "The Body at Work."

OUR BOOK SHELF.

British and American Customary and Metric Legal Measures for Commercial and Technical Purposes. (Forming the Measure Section of Part i. of "The Mechanical Engineer's Reference Book.") By N. Foley. Pp. 25. (London: Crosby Lockwood and Son.) Price 7*s*. 6*d*. net.

The necessity for these tables reminds us what an immense amount of time is wasted by the retention of the barbarous and cumbersome English system of measures. In two nations with more than 100 million people, not a small proportion of the school-time of every child is wasted in learning, and those engaged in industry and commerce in using, a system of measures which could not be less adapted to rapid and easy calculation. Yet we seem little nearer the time when our measures will be decimal and efficient, even though most of the opposition to the decimal system merits no respect.

The tables before us are for commercial and industrial use. All ordinary lengths, areas, volumes, weights, &c., in English measure can be converted, with their aid, at a minimum of calculation, to the metric equivalent. The range and arrangement of the equivalents have been thoughtfully chosen, and the printing is excellent, so the book lends itself to rapid use, and fits its purpose admirably.

We have only noted two serious misprints ("Tonne 2 = 1 ton, 1 qr., 9 lb.," and the equivalent of 3 tonnes); there is also an unimportant slip in the equivalent of 15 c.c. in cubic inches on p. 10; in many other places where we have tested the tables they are correct. Page 6 is reprinted on p. 7, and p. 10 on p. 11 with only the decimal point moved, which seems a waste of space.

In defining the ohm, volt, and ampere, the last is confused with 1/10 of the electromagnetic C.G.S. unit of current, while each of the former is "defined" in terms of the other and the ampere. The correct definitions, however, are mentioned by the author, but not as such. It would prevent confusion if the larger unit of heat were called in these tables a "kg.-calorie" instead of merely a "calorie."

It increases considerably the simplicity of the metric system if C.G.S. units are uniformly used in it. It is hoped that the author will help, as he well can, to attain this end by giving wherever possible in future editions of these conversion factors, the C.G.S. equivalent as the metric equivalent.

The units of pressure used in these tables are the engineer's lb. per square inch or kg. per square cm. Though they are thoroughly bad units, as they vary in magnitude from place to place and lead to confusion, they have, however, the advantage of conciseness over the physicist's "760 mm. of mercury at 0° C. in latitude 45° C. and at sea-level." The megadyne per sq. cm., which is nearly the average barometric pressure, deserves to be more generally used.

T. H. L.

(1) *Leitfaden der Tierkunde für höhere Lehranstalten.* By K. Smalian. Erster Teil, pp. iv+40, price 1.20 marks; Zweiter Teil, pp. iii+41–100, price 1.50 marks; Dritter Teil, pp. 101–208, price 2 marks. (Leipzig: G. Freytag; Vienna: F. Tempsky, 1908.)
(2) *Bau und Geschichte der Erde.* By O. Abel. Pp. viii+220. (Same publishers, 1909.) Price 4·50 marks.

(1) In response, we are told, to a widely expressed wish, the author of the first of these works decided to condense and simplify his "Grundzuge der Tierkunde" (reviewed on a previous occasion in Nature) so as to make a text-book. The result is the "Leitfaden," which is issued in three separate fasciculi, respectively suited (beginning with the last) to the requirements of the fourth, fifth, and six forms. The general plan of the work is to take a series of typical animals, and to make them texts for dissertations on the groups they represent. Despite the fact that some of the text-figures are of a somewhat ancient and obselete type, the work seems well adapted for its purpose.

We cannot, however, congratulate the author on the coloured plates. In the first part, for instance, we see a fox crawling over a slab of blue limestone or slate on which its red coat stands out so conspicuously that the presence of the marauder would be at once detected. In the third part the plate of African animals wherein Grant's bonte-quagga (*Equus burchelli granti*) does duty for the zebra (*E. zebra*) reappears in spite of attention having been directed to the error in our notice of the "Grundzuge."

(2) The appearance of the second of the two works is due to a reform which has been made in science-teaching in the middle schools of Austria. To put such reform in action, a suitable and up-to-date text-book was, of course, a *sine quâ non*; and Dr. Abel was accordingly entrusted with the compilation of such a work. No better man could have been chosen, as is demonstrated by the volume before us, which is practically all that such a text-book should be. It is not overladen with detail, each of the different sections of the subject receives its proper amount of space, and the illustrations, if not in the highest style, are at all events numerous. The volume commences

with a short account of the universe generally; this is followed by a short *précis* of dynamical geology, and the rest is devoted to stratigraphy and palæontology. A map of the geology of the Vienna basin directs the attention of the scholar to the importance of studying the strata of his own neighbourhood.

Goethe und Pestalozzi. By Karl Muthesius. Pp. vii+275. (Leipzig: Durr'schen Buchhandlung, 1908.) Price 4.50 marks.

When all Europe was keenly excited by the social and educational work of a schoolmaster in a Swiss country town, Goethe held aloof. Pestalozzi's biographers have not hesitated to ascribe this to want of sympathy with the common people. Goethe, Minister of State and intellectual aristocrat, despised the poor and ignorant, and the *Schwärmerei* of early-nineteenth-century philanthropy seemed to him exaggerated, if not foolish. Such, at least, is a commonly received account of the matter, and the author of this interesting little book has shown what a libel upon the great man's memory it is. There can be little doubt, however, that Goethe made no effort to cultivate Pestalozzi, and still less that he distrusted Pestalozzian educational doctrine as it came under his notice. It was his misfortune to be acquainted with its weakest points. Goethe had no patience with an educational system which left out of its purview literature and history—everything, in fact, which could not be reduced to an A B C. In his view, geometry and geography, nature-study and language could never be made to fill up this gap, no matter how carefully they were systematised and ordered for school use.

Even the religious instruction of the traditional primary school was dropped by many of the new schoolmasters who had brought their inspiration from the shores of Lake Neuchatel. The tendency was to give up everything that would not fall into the Pestalozzian plan of beginning with concrete examples and ending with a definition. This was poison to Goethe. It had all the vices of current naturalism. Everything great that men had done and thought might remain unknown. The school youth was not brought into touch with types of human greatness—moral, poetic, or artistic. He was taken out of his historical connections and set afresh in an environment of things that could be defined! Small wonder the poet was distrustful. We have learned to know Pestalozzi better than Goethe did.

La France et ses Colonies au Début du XXe Siècle. By M. Fallex and A. Mairey. Pp. vi+660. (Paris: Ch. Delagrave, n.d.) Price 5 francs.

This is one volume of an excellent series of regional studies "at the beginning of the twentieth century," throughout which M. M. Fallex's has been the principal hand. We find here a proper conception of geographical study thoroughly well applied. In the first part of the work a general survey of France is provided—its position, area, configuration, structure, climate, hydrography, and population. In the second and most important part the country is divided into natural regions, each one of which is considered in succession on the same lines as those of the general survey. The division itself is worthy of commendation and notice—(i.) the Central *Massif*, subdivided between the east and centre and the west and south, (ii.) the Pyrenean region, (iii.) the basin of Aquitaine, (iv.) the Alps of Savoy, (v.) the Alps of Dauphiné and Haute-Provence, (vi.) the Jura, (vii.) the Saône-Rhone valley, (viii.) the Midi, (ix.) the north-east, (x.) the north, (xi.) the basin of Paris in three subdivisions, (xii.) Brittany. Next follows political and economic geography, worked out no less satisfactorily than the regional. France itself occupies nearly five-sixths of the volume; the colonies, therefore, come in for what is perhaps disproportionately scanty treatment.

It is of no little interest to gather the French point of view as to the prospects of some of the colonies, for the authors are not content merely to make statements of fact and leave their readers to make inferences; here the inferences are found ready drawn, even if they are unflattering. Of the French establishments in Oceania we read ". . . ils ont toujours végété. C'est qu'ils sont trop loin de la France; en France on les connaît à peine." If this is so, the French student has an excellent opportunity of repairing his ignorance from this book and of extending the knowledge he gets from it, for excellent bibliographies are provided. There is also a full topographical index, a feature worthy of remark in a French work of this type. The illustrations are numerous and good.

The Interpretation of Radium. Being the Substance of Six Free Popular Lectures delivered at the University of Glasgow. By Frederick Soddy. Pp. xviii+256. (London: John Murray, 1909.) Price 6s net.

This book is based on popular experimental lectures delivered by Mr. Soddy at the University of Glasgow last year. The lecture form of address is retained, most of the experiments described being illustrated by photographs and diagrams. The book is intended chiefly for the lay reader, the author's object being rather to show the bearing of the new discoveries on our general outlook on nature than to give a detailed treatment of the subject.

The author gives a very clear and interesting account (in non-technical language) of radio-active phenomena and the light which the disintegration theory throws on them. The important work which Mr. Soddy has done in helping to establish this theory is a guarantee of the accuracy of his treatment. He confines his account mainly to the uranium-radium disintegration series.

The book will be found quite up-to-date, containing as it does reference to such recent work as Rutherford's proof that the α particle is an atom of helium, the experiments by Rutherford and Geiger in counting the number of α particles expelled by radium, and the author's own experiments on the production of helium from uranium and thorium. Many members of the general public, and workers in various departments of science, will find the book rich in interest.

Flower and Grass Calendars for Children. By Agnes Fry. Pp. 31. (Clifton: J. Baker and Son; London: Simpkin, Marshall and Co., Ltd., n.d.) Price 3*d*. net.

The idea of making use of children's ability for committing verse to memory to introduce a few facts regarding the time of flowering and habits of plants, and thereby to stimulate their interest in botany, is commendable. The stanzas are short, and each is prefaced by a heading. There are four objects to be sought in such a calendar—the first to get true measure and cadence, the second to give good rhyme, the third to choose the correct month of flowering, and the fourth to introduce any striking facts regarding the character or habitats of the plants. The weakness of Miss Fry's verses lies chiefly in the measure, which is apt to be halt or forced; in this respect the grass calendar is more pleasing. As pointed out, the stanzas may and should be altered to suit the flowers in different localities.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Baskets used in Repelling Demons.

UNTIL about the end of the Japanese *ancien régime*, *i.e.* 1867, it was an invariable annual usage with the people of Yedo (now Tokyo), on the eighth of the second moon, to erect high before every house a bamboo pole with a basket on its top (Kawakita, "Morisada Mankô," ed. 1908, vol. ii., p. 251). However, from Tanehiko's "Yôshabako" (Yedo, 1841, bk. i., ch. ix.), it appears that about the seventeenth century a basket or a sieve was displayed on a tall pole or above the main doorway, not only on this so-called Work-start Day (*Koto-hajime*), but also on the eighth of the twelfth moon, named *Koto-osame*, or Work-finish Day—both these appellations primarily of agricultural concern, indicating to us a bygone age, when the New Year holidays of the Japanese husbandmen, with their preliminaries and after-games, covered some thirty days besides the whole first moon.

Citing many an old authority, and, among others, a stranger's statement, that in his native island nobody would stir out of doors on certain dark nights without carrying a basket to ward off the roving spirits, Tanehiko clearly shows the usage we are describing to have originally been meant for repelling demons. He argues, also, that this Work-start Day usage in Yedo had been first introduced—though with a manifest deviation as to the day of its performance—from certain provinces, whence the founders of its governing families had mostly sprung, and where, even so late as in Tanehiko's time, the inhabitants customarily displayed baskets, neither on the Work-start nor on the Work-finish, but only on the *Setsubun*, or Last Winter Day. Indeed, the Last Winter Day seems to have proved the fittest occasion for repelling or expelling malevolent souls, for, in its evening, apparently from time out of memory, it has been a universal custom in Japan to eject demons with baked beans forcibly thrown just before shutting all the doors and windows, and to stick upon the door-case a branch of the tree *Osmanthus aquifolium* and a half-roasted sardine, the strongly spined leaves of the former, with the unpleasant odour of the latter, sufficing to put to flight the spirits that try to intrude into any human dwellings.[1]

Whether or not Tanehiko's view is correct in tracing the Work-start Day usage of the past Yedo folks into an earlier provincial practice on the Last Winter Day, it is very significant in this connection that a Jesuit missionary of the seventeenth century observed every native of Tonquin to plant before his house a pole topped with a basket on the Final Night of the year, in order to scare away the intrusive demons. He relates it thus:—

"Gionti all'ultimo giorno dell'anno nel farsi sera, ciascuno dinanzi sua casa vi pianta 'un albero secco, o una longa pertica, nella cui cima, in vece di bandiera legano una cesterella, con attorno appesovi carte dorate, a modo di oro stridente, persuasi, che come ne'seminati, e negli horti sì mettono i spauracchi, per tenerne lontani gli uccelli, così quella cesta con quell'oro insù la pertica vaglia a fugare i Demonij, e non farli accostare alle loro case: che se in quell'ultima sera dell'anno, non ritrovassero quel riparo dinanzi l'uscio, senz'altro entrerebbero loro in casa a fargli sfortunati tutto l'anno. E se avviene, che alcuno tralasci di far questa cerimonia, e non curi di esporre la detta insegna, ne è mostrato à dito, e si dice: Ecco la casa del Demonio" (Filippo de Marini, "Historia et Relatione del Tunchino e del Giappone," Roma, 1665, p. 133).

I fully know that I am exposing my great ignorance in asking the following questions upon the subject. Are there any other people than the Japanese and the Tonquinese who used, or still use, baskets in frightening the demons? How has the origin of the custom been scientifically described? Also I have a note, taken from Waitz, "Anthropologie der Naturvölker," i., s. 347, Leipzig, 1872, to the effect that some Polynesians often apply, to mark a tabooed place, a basket-work moulded into shark or lizard. Why has basket-work been particularly chosen for this purpose?

The reason Tanehiko (*loc. cit.*) adduces to account for the Japanese use of baskets in repelling demons is that the basket originally employed in the rite had some of its openings shaped in star pentagon—the figure formerly held as specifically efficacious in averting evil influences, and termed Seimei's signature, after the greatest soothsayer Japan has ever produced (921–1005 A.D.). Someone opines that the star pentagon terrifies demons extremely, because it much resembles the eye of Fang-Shang, the principal demon-hunter in the Chinese ceremony of *Na* (see footnote), whom the "Ritual of the Chau Dynasty" (written *c.* 1100 B.C.) prescribes for this occasion to wear red trousers and black coat, a headdress of bearskin, and a mask with four golden eyes. Yet another opinion has been advanced which states that some wicker-works, *e.g.* the sieves, are so fabricated as forcibly to put the spirits in mind of the Taoist, and thence Buddhist, emblem named *Kuji* (lit., Nine Letters), formed lattice-like by intercrossing five vertical and four horizontal lines, and said to represent the nine Chinese characters, that make up a charm most powerful against all manner of demons. In this exposition I see the order of cause and effect quite inverted, it being obvious that the very *raison d'être* of the symbol *Kuji* is the assumed efficacy of the wicker- or lattice-work in keeping all within it in complete safety and well-being. This will be well understood should one inspect an old-fashioned Shinto shrine with its front strongly defended by a lattice, or should he peruse this subjoined passage:—

"The generality of the huts used as dwelling-houses [in Kordofan] are furnished with a flat-roofed shed of some twelve feet square immediately in front of them, which, in the dry season, forms the usual sitting-room. . . . It has a spacious doorway in front, through which light is admitted in sufficient abundance to dispense with windows, and is never closed when any of the family are at home. When they are absent, a piece of wicker-work, placed against it and sustained in its position by a piece of wood, serves to keep out dogs, fowls, and cattle; and being a sufficient indication that the inmates are absent, no one will approach it. Locks are dispensed with, and, as housebreaking is unknown, they are not required" (John Petherick, "Egypt, the Soudan and Central Africa," Edinburgh and London, 1861, pp. 213–4.

KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, April 4.

[1] This Last Winter Eve rite of the Japanese reminds us of the Australians annually driving from their midst the accumulated ghosts of the last year's dead; of the modern Bohemians at Pentecost, and the Tyrolese on Walpurgisnacht, hunting the witches, invisible and imaginary, out of house and stall (Tylor, "Primitive Culture," New York, 1888, vol. ii., p. 199); and of the archaic Chinese ceremony of *Na*, which was to force the demons away from the imperial palace on the Final Night of the lunar year (*Chû-ye*), and which, since its adoption into the Japanese court ritual, 706 A.D., has become gradually confused in vulgar minds with the native observance of the Last Winter Eve, in spite of the but very rare coincidence of these two nights (Yashiro, "Kokon Yôran Kô," ed. 1905, vol. i., p. 931). *Cf.* the Tonquinese custom given in the text.

Vapour-density and Smell.

IN NATURE of May 13 (p. 308) Dr. Hill states that "no volatile body, the density of which is not greater than that of air, is a stimulant of our olfactory membrane." I venture to suggest some important exceptions to this rule, if, indeed, it is a rule, viz. ammonia, density 8·5; hydrocyanic acid, 13·5; and hydrofluoric acid, 10. Although the last-named consists mostly of molecules H_2F_2 at the ordinary temperature of the air, it contains a considerable proportion of HF molecules at 40° C. I have never heard of any of these (or, indeed, of formaldehyde) being prepared in such a way as to have no smell, and it does not seem probable that it could be done. I have myself prepared ammonia with the greatest possible care, and in several different ways; the product obtained has certainly a different smell from the commercial article, but it is still very pungent. It seems to me that the reason for this rule of smells is simply that the atomic weights of the large majority of the elements have a much greater numerical value than the density of air, putting hydrogen equal 1 in both cases; and to this may be added that the vast array of organic compounds are mostly of complicated constitution, and must necessarily have high vapour densities. E. P. Perman.

University College, Cardiff, May 15.

"Blowing" Wells.

Mr. S. H. Long, the writer of the letter on "blowing" wells in Nature of May 20, should refer to an article on "The Movement of Air in Fissures and the Barometer" (Nature, vol. xxvii., 1883, p. 375), in which phenomena similar to those observed by him are described in the case of several wells in different parts of England.

12 Marloes Road, W., May 21. A. Strahan.

NATURAL HISTORY IN INDIA.

The annual report of the natural history section of the Indian Museum for 1907–8 repeats the usual complaint that "lack of trained officers has again retarded progress," and the complaint is justified by the information that the trained staff—for a section that includes zoology, archæology, and numismatics—consisted of one permanent officer and one assistant engaged for a term, with a few casual assistants and humbly remunerated clerks, and a couple of Bengali students to help them. In plain language, this big assemblance of a staff, when measured by European standards, comes to but one man with life-interest at stake.

From this statement of the case it might be thought that a museum of natural history situated in the capital of the Indian Empire must be one of the many blessings of western civilisation that the oriental mind regards with pious indifference. But no; when we turn to an interesting appendix we learn that the "number of visitors to the museum during the 237 days on which the institution was open to the public was 580,161, or a daily average of 2447."

Or it might be supposed that zoology is a subject of little or no consequence to the welfare of our Indian Empire. Again, no. If it be called to mind that the majority of our fellow-subjects in India are *directly* dependent for their very lives upon crops that are ravaged by every sort of insect-pest, and that diseases carried by animals of many kinds, and diseases caused by divers parasitic animals and animalcules—not to speak of death by snake and beast of prey—account for about 75 per cent. of the mortality of the population, and for no one knows what percentage of the mortality of stock, it can hardly be said that the study of zoology is a matter with which India has no concern. No; the only possible conclusion is that the Indian Government, humane, just, and intelligent as it undoubtedly is, resembles all other administrations of the British pattern in its stolid indifference, not merely to natural science in the abstract, but even—and that is, indeed, hard to comprehend—to the pocket value of natural science.

But what it lacks in official thews and sinews the museum—thanks to the moving energy, the trained ability, and the wonderful versatility of its superintendent, Dr. Annandale—makes up in spirit, and nowhere is this more clearly shown than in its published output of research.

Publications now before us include parts ii. to iv. of the second volume of the "Records" and the third part of the "Memoirs," these containing papers by twenty-six authors, many of whom are European specialists.

One of the most striking and original features of these museum records is that, besides paying the attention justly due to such orthodox museum topics as vertebrates, mollusca, insects, crustacea, &c., they take thought of many small things that in many museums are regarded as somewhat off the beaten track—such as fresh-water polyps and polyzoa and plankton.

The series of reports on the fauna of brackish ponds is of great interest, for we are here on that plastic ground whence the fresh water receives its recruits from the stragglers of the sea. Solutions of several little problems depend upon careful observations, continued through the whole round of seasons, of the fauna of a definite delta station, such as are now being carried on and recorded by Dr. Annandale. An interesting item in this latest series of reports is Mr. T. R. R. Stebbing's account of an amphipod, a species of Grandidierella, the only congener of which inhabits a closed lagoon six miles from the west coast of Madagascar; here we get a peep at one of the pitfalls which this kind of study fences off.

Equally interesting are Dr. Annandale's reports upon the fresh-water fauna of the Indian continent—a subject which, outside vertebrate limits, has hitherto hardly been touched.

A paper upon the fresh-water fauna of a district of Tibet has also the charm of novelty, and Captain F. H. Stewart, who, in the course of other (official) duties, collected the material for it, deserves much credit for making such good use of an exceptional opportunity. The collection includes *Hydra fusca* from an altitude of 15,000 feet, and much lake-plankton which, as would be expected, is practically identical with that of northern Europe, except in the case of the ostracods.

Among other papers, that of Captain W. S. Patton, upon the differential diagnosis of *Cimex lectularius* and *Cimex rotundatus*, must be mentioned, by reason of the part played by the latter species in the dissemination of the microparasite of the insidious disease, *kála azár*.

The part of the memoirs in review is devoted to the earthworms of India, and consists of a systematic monograph by Dr. W. Michaelsen, and anatomical descriptions of certain aquatic forms by Major Stephenson. The value of Dr. Michaelsen's monograph is somewhat difficult to estimate. The systematic part of it, which includes a concise index of all the Indian species of oligochætes known, is undoubtedly a most useful piece of work, although in some places it is marred by an unfortunate controversial tone. But that part of it which deals with geographical distribution can scarcely be meant to be taken seriously, especially as it completely ignores the comprehensive and critical work accomplished in this field by that eminently judicial and preeminently qualified naturalist, the late Dr. W. T. Blanford.

To say that well-established facts relating to the present geographical distribution of animals must be taken into consideration in reconstructing the configuration of the land in former geological epochs is to state a proposition to which no reasonable geologist will object. But to make the unqualified assertions, as Dr. Michaelsen does, that the "endemic terrestrial oligochætes give us one of the best documents for the geological history of a country," and that "the recent geographical distribution and the relations between the different groups" (of land oligochætes) "enable us to determine the different paths of the former migrations, and thence the configuration of land and sea in former periods" is to put oneself out of court. It is unprofitable to criticise conclusions deduced from such a sweeping major premise.

A PERSIAN TREATISE ON FALCONRY.[1]

ALTHOUGH the ancient sport of falconry is still upheld to a limited extent in western Europe, it is to the East that we must turn at the present day if we would see "the pride and pomp and circumstance" that continues to attend a diversion practised from the remotest ages. The Arabs probably learnt the art from the Persians; for not only do many Arabic MSS. state that the first falconer was a Persian, but many of their technical terms relating to the sport are borrowed from the Persian language. In India, too, where hawking has always been popular with the native princes, the textbooks (MS. or lithographed) are not in Hindustani, as might be supposed, but in Persian, although very corrupt, and disfigured by Punjabi and Sindhi idioms and technical terms. It is probably for this reason that these MSS. have remained so long untranslated; for it is certain that no one but a Persian scholar, who is likewise a proficient falconer, could attempt the task of translation with any chance of making himself understood.

Col. Phillott, in his preface to another work, the "Qawānīnu 's-Sayyād," published last year in the "Bibliotheca Indica," says, "Had I not been a practical falconer of more than twenty years' experience of falconry in the East, I would not have ventured to edit the present text." This admission applies with even greater force to the "Bāz-Nāma-yi-Nāsirī," of which his translation is now before us; for treating, as it does, of the art of hawking, it is full of technical terms inseparable from the sport, with descriptions of the Persian method of capturing and training hawks, and treating their ailments, which no one but a falconer would properly understand. Thus it would be difficult to find a more competent translator and editor for such a work than Col. Phillott.

We learn from his introduction that the present work is of no antiquity, having been composed in 1868, when the author was sixty-four. It was originally lithographed in Teheran, and a second (and perhaps a third) edition was lithographed in Bombay. The present translation has been made from the Teheran text.

The author was Taymūr Mirzā, a Persian prince of some celebrity, who, in 1836, accompanied by two of his brothers, paid a visit to the court of William the Fourth on a political mission, in which they succeeded, through the good offices of Lord Palmerston, eventually returning to Baghdad. Devoted from his youth to field sports, the author was well received by the Shāh (Nāsir 'd Dīn Shāh), and became a constant companion in his sporting expeditions. In Persia and around Baghdad the name of Taymūr Mirzā is still "a household word." It was not until quite late in life that he began to think of writing down his experiences as a falconer, to leave "as a memento for all lovers of the sport, whether tyros or experts." "Sixty-four years of my life," he writes, "have now passed, all spent in hunting and shooting. I have had no hobby but sport, no recreation but it." He died in 1874 at the age of seventy.

His work, relating as it does to a special branch of sport, naturally appeals most strongly to those for whom it was designedly written; but, putting aside

FIG. 1.—From an Old Persian Painting, probably of the Mughal Period. From "The Bāz-Nāma-yi-Nāsirī: a Persian Treatise on Falconry."

technicalities, the general reader cannot fail to be amused with the anecdotes which are told of sport in Persia, as well as with the quaintness of oriental diction. Thus, speaking of a worthless hawk that defied his best efforts as a trainer, the author says (p. 39), "What could be the cause of her extraordinary behaviour? Puzzled and perplexed, I buried my head in the collar of reflection determined to unravel the tangled skein of the difficulty," &c.

To criticise any of the methods or devices of Persian falconers would here be out of place, though there are many passages which suggest comment. The

[1] "The Bāz-Nāma-yi-Nāsirī, a Persian Treatise on Falconry." Translated by Lieut.-Col. D. C. Phillott. Pp. xxiv+195. (London: Bernard Quaritch, 1908.) Price 21s. net.

Persian fowlers, like their Indian confrères, are adepts in the art of snaring, and it is curious to note that one of their devices for capturing a wild hawk at night by means of a lantern (p. 75) is, with slight variation, to be found in the "Book of St. Albans, 1486." Similarly a recipe for a slow-moulting hawk (p. 151) is also prescribed in that famous work of Julyana Berners. To explain such unexpected coincidences would take us now too far afield.

A valuable feature in the present translation is the number of footnotes which Col. Phillott has supplied, to explain and illustrate the Persian writer's meaning, to reconcile apparent discrepancies, or to confirm his statements from his own experience. To English readers interested in the literature of falconry, these footnotes will prove very instructive. The illustrations which accompany the text are of two kinds—reproductions of Persian drawings of hawking scenes, and

FIG. 2.—Young Passage Saker (Dark Variety). From "The Bāz-Nāma-yi-Nāsirī: a Persian Treatise on Falconry."

photographs from life of hawks employed by Persian falconers. The reader is here presented with a sample of each. J. E. H.

DR. SVEN HEDIN ON CENTRAL ASIA.

THE April number of the *Geographical Journal* contains two papers by Dr. Sven Hedin descriptive of his journeys through Tibet in 1906–8. The first of these is a narrative of his travels, which is necessarily so much abridged that it barely does more than give an idea of the extent and difficulties of his exploration; the other is a summary of the most important, or, rather, what Dr. Hedin regards as the most important, of his discoveries. The two are not necessarily identical, and it may be that when we have the full account of his travels the discoveries to which he now attaches greatest importance may prove of minor interest. For the present, however, we have only this summary, in which he enumerates the four most important results of his journey as the discovery of (1) the true source of the Brahmaputra, (2) the source of the Indus, (3) the "genetic" source of the Sutlej, and (4) the discovery of a continuous mountain chain, to which he applies the name Trans-Himalaya.

Of these the two first are of interest, especially the fact that no part of the drainage of the Kailas mountain finds its way into the Indus river; the third is a doubtful discovery, for though Dr. Hedin has discovered and visited the source of the largest of the feeders of the Manasarowar lake, it cannot in any proper sense of the word be regarded as belonging any longer to the drainage area of the Sutlej river. At one time there was continuous flow from Manasarowar to Rakas Tul, and again from that to the Sutlej, but this latter has been dry for at least half a century, while the former seems to have become intermittent and likely to cease in the near future; except for a possible escape by underground percolation, no part of the water of these lakes now finds its way into the river, and even this supposititious communication would not justify us any longer in describing a tributary of either of the lakes as the source of the Sutlej, nor does the matter seem much bettered by the addition of the adjective genetic.

The most important, in his own view, of Dr. Hedin's discoveries, and the one around which controversy has settled, is that of a great continuous mountain range, coextensive with and parallel to the Himalayas, to which he has given the name Trans-Himalaya, a name to which exception has been taken, and which seems to require greater justification than Dr. Hedin has given. We may ignore the objection that the term was applied by Cunningham to the mountains lying between the Sutlej and the Indus, but we cannot accept the quotations from other authors cited as justification for the use of the term. A writer from the Indian side may use, with perfect correctness, the expression Trans-Himalayan, as applied to the country, or to explorations carried out, on the further side of the Himalayas, but it is a different matter when we are asked to accept the words as a definite geographical term, and once this proposal is brought forward the two questions arise as to whether the word is either justifiable in itself, or necessary. Of these two questions the first is a literary one, and it must be confessed that some real objections may be urged against the word adopted by Dr. Hedin, and accepted by Lord Curzon of Kedleston; but the second is the important one, for, unless the supposed range of mountains to which it is applied has a real individuality and independent existence, no special term is required or can be justified.

From earliest times it has been recognised that the great system of mountains which rises to the north of the Indo-Gangetic plain has an individuality of its own which deserves and requires a name, and the word Himalaya, originally applied to a part, has been extended to the whole chain of snowy peaks together with their dependent mountains of lower elevation. It has not, however, been so generally recognised that this unity belongs less to the mountains than to the plain at their foot, and some modern geographers, not content with merely recognising the individuality of the great chain, have attempted to trace the individual ranges of which it is composed along the whole length of the system, and thereby have retarded a proper appreciation of the true nature of this system of mountains. A simile proves nothing, but is often useful as an illustration, and, without pressing the resemblance too far, the organisation of the Himalayan mountains may be compared to that of a great army, composed of many thousands of individual soldiers, grouped in regiments, these, again, in brigades and divisions, each having a separate individuality; but the individuality of the soldier differs from that of the regiment to which he belongs; this, again, merges in the individuality of the brigade, and the whole in that of the army. So with mountains, the peaks may be grouped into *massifs*, these into ranges, a series of which may form a great chain or system like that of the Himalayas or the Andes; but just as the brigades of an army are not each extended along the whole front, so the ranges do not extend along the whole length of the system. Each in turn comes to an end, and the chain is taken up by another, not as a direct continuation, but overlapping the end, so that the direction of the individual ranges is oblique to that of the system as a whole. Any other arrangement would probably be as physically impossible, with material such as that of which the earth's crust is composed, as the marshalling of an army in brigades or divisions drawn up in lines extending along the whole length of the front would be militarily impracticable.

This interpretation of the orography of the Himalayas is borne out by such maps as we possess, and especially by those maps attached to Messrs. Burrard and Hayden's valuable sketch of the Himalayas, which exhibit the facts, rather than Colonel Burrard's interpretation. In these it will be seen that the high peaks of the Himalayas do not form a single range, but rather a band crossed obliquely by a series of ranges, and if we are to group these individual ranges into a single system, and to include in it the lesser ranges lying to the north and south, there is no reason, geographical or geological, for separating it from the mountains of southern Tibet and the northern territories of Cashmere. Structurally and orographically, the whole of the mountains between the Indian plains and the lake region of central Tibet belong to one great system, and the term which Dr. Hedin wishes to introduce is either unnecessary or misleading; needless if it merely indicates the country north of the first belt of lofty, snow-clad peaks, misleading if meant as a name of a mountain range or system. Range it is not, for Dr. Hedin is clear enough on this point, as he repeatedly speaks of the separate ranges of which it is composed, and gives their number as no less than ten; mountain system it equally is not, having no separate existence. If a new name is required at all, it must be one which will unite these ranges with the Himalayas, not one which suggests a separation, for the valleys of the Sanpo and Indus no more separate the mountains on either side of them than, on a smaller scale, are the analogous valleys of the Rhone and the Rhine a reason for splitting up the unity of the Alps.

This criticism must not be taken as in any way a disparagement of Dr. Hedin's achievements; there can be but one opinion of the brilliance of his exploration and of the courage and determination with which he overcame the obstacles in his way. The publication of a detailed account of his travels will necessarily form an important addition to our knowledge of central Asia, but the fullest recognition of its importance does not involve an acceptance of Dr. Hedin's deductions, nor does a difference of opinion in regard to them imply any question of the accuracy of his observations.

Kailas from the south-west From the *Geographical Journal.*

THE TEACHING OF GEOMETRY.

THE circular recently issued by the Board of Education on "The Teaching of Geometry and Graphic Algebra" is an important document from at least two points of view. First, it has a very considerable educational value in indicating the successive steps or stages which it is proper for a teacher to take, and, secondly, it supplies information as to the way in which the changes, introduced mainly by the Mathematical Association, have worked out. Those who have advocated the reformation of the teaching of geometry will be glad to know that the verdict of the Board of Education is favourable. "It should be stated at the outset that the general effect has been beneficial."

The reformers had most serious difficulties to face, the greatest, perhaps, being the almost divine authority attributed in England to Euclid's definitions, postulates, axioms, and propositions. Euclid's system was here regarded as the highest, and an infallible, type of logical accuracy. That it is still so regarded by some people is evident from the somewhat flippant and jesting comments made on the circular of the Board of Education in some of the daily papers. It may not be hopeless to point out to the writers of such comments that Euclid in at least one instance contradicts himself. His definition of a circle, for example, makes it to be, not a *curve*, but a *surface* : "a circle is a plane figure bounded by one line which is called the circumference." This clearly makes a circle to be a surface, and, moreover, it is lacking in definiteness, because it does not say whether the plane-bounded figure is that which is contained within the circumference, or that infinite external space which lies outside. Again, if a circle is a plane surface, what becomes of the proposition that two circles can intersect in only two points? Further, Euclid made the mistake of supposing that every geometrical concept can be *defined*, whereas there are some that can be only *described* : witness his attempted definition of a straight line, which merely encourages a pupil to deceive himself with a vague word.

The imperfections of Euclid are an old controversy which need not be enlarged upon. His merit as a logician is very great, and his logic is, on the whole, a type of accurate reasoning. Those who took part in reforming his system sought at once to preserve his logical excellence and to improve the subject-matter on which it was to be exercised. This they tried to do by familiarising the beginner with the main concepts of geometry in ways more natural and more easy than those adopted by Euclid—by an early use of rule and compass, for example, which dispensed with that somewhat complicated and ridiculous problem which forms the very second proposition of Book i., "through a given point to draw a right line equal to a given finite right line," a most gratuitous stumbling-block to the beginner. They assumed the potent Baconian principle that "examples give a quicker impression than arguments." There is no doubt that the new system has made geometry much more easy in its initial stages for the young pupil, but it contains one great element of danger—it may, to a great extent, replace strict logic by rule of thumb, and accurate expression by slipshod language. Those who have to examine papers on geometry sent by pupils from scores of different schools must admit that this danger has not been averted, and the reason is easily found. *We are at present teaching geometry on syllabuses.* So long as this plan is adhered to, there will be most perplexing diversities in the sequence of assumptions and propositions in school teaching, not unmixed with inaccuracy of expression. The present writer knows from experience that it is necessary for an examiner to keep before him several books on geometry when dealing with the work of various schools, owing to the fact that a proposition which one pupil thinks it necessary to prove another assumes as an axiom. Moreover, the whole of the pupils of a school are sometimes found to speak of a circle as *touching* a triangle at its three vertices. This is a matter dependent on the individual teacher, and it cannot be cured by any syllabus.

There are, of course, several excellent text-books on geometry, with little difference in the order of propositions, but no one of them is universally adopted. The successful reformation of the teaching of geometry seems to require an authoritative text-book which will serve as a definite guide to all teachers—such as that sanctioned by the Minister of Education in France. In the absence of such a definite guide, the present somewhat chaotic system will continue.

The writer of this article suggested, in the columns of Nature, in the early days of the reformed system, that such an authoritative book should be issued conjointly by the universities, but the university authorities felt difficulties. Why should not the Board of Education issue such a work? Its recent circular is in itself an excellent syllabus, but the practical teacher will regard it simply as one more added to the bundle which he already possesses.

There is one recommendation in the circular with which it is impossible to agree :—"Axioms and postulates should not be learnt or even mentioned"—that is to say, they are to be treated as suppressed premises. Now every mathematical physicist encounters occasionally what seems to be a fundamental contradiction of some proved result with other known results, and it is only after it is pointed out to him that his reasoning contains a suppressed premise that the difficulty is removed. The neglect of the explicit recognition of an axiom is the same in kind as the suppressing of an important premise.

Two excellent sentences, containing a fundamental truth, must be quoted from the circular :—"It should be frankly recognised that unless the power of doing riders has been developed, the study of the subject is a failure. Although examining bodies may continue to pass candidates who merely reproduce proofs they have learnt, eked out by definitions or other matter, masters should not be satisfied with this; *the only proof of knowledge worth having is the power of applying it to new matter.*" (The italics are ours.) This is, indeed, a great truth, the importance of which in the teaching of applied mathematics is still greater than it is in the teaching of geometry, and one which every teacher should lay to heart.

George M. Minchin.

PHOTOMETRIC UNITS.

An important announcement with regard to the photometric units maintained at the Bureau of Standards, America, the Laboratoire Central d'Électricité, Paris, and the National Physical Laboratory, Teddington, has been issued by the Bureau of Standards in its Circular, No. 15, dated April 1, 1909.

It was at first intended to make this announcement simultaneously in America, France, and Great Britain, but circumstances prevented this. It is desirable, however, to state authoritatively that the agreement described in the subjoined memorandum has been arrived at, and has the approval of the gas referees; and that the photometric standards of the National Physical Laboratory are being maintained in accordance with it.

R. T. Glazebrook.

Memorandum as to Photometric Units.

In order to determine as accurately as possible the relations between the photometric units of America, France, Germany, and Great Britain, comparisons have been made at different times during the past few years between the unit of light maintained at the Bureau of Standards, Washington; at the Laboratoire Central d'Électricité, Paris; at the Physikalisch-Technische Reichsanstalt, Berlin; and at the National Physical Laboratory, London.

The unit of length at the Bureau of Standards has been maintained through the medium of a series of incandescent electric lamps, the values of which were originally intended to be in agreement with the British unit, being made 100/88 times the Hefner unit.

The unit of light at the Laboratoire Central is the bougie decimale, which is the twentieth part of the standard defined by the International Conference on Units of 1884.

and which is taken, in accordance with the experiments of Violle, as 0·104 of the Carcel lamp.

The unit of light at the Physikalisch-Technische Reichsanstalt is that given by the Hefner lamp burning at normal barometric pressure (76 cm.) in an atmosphere containing 8·8 litres of water vapour per cubic metre.

The unit of light at the National Physical Laboratory is that given by the 10-candle-power Harcourt pentane lamp, which has been prescribed for use by the Metropolitan Gas Referees, burning at normal barometric pressure (76 cm.) in an atmosphere containing 8 litres of water vapour per cubic metre.

In addition to the direct intercomparison of flame standards carried out recently by the national loboratories in Europe, one comparison was made in 1906 and two in 1908 between the American and European units by means of carefully seasoned carbon filament electric standards, and as a result of all the comparisons the following relationships are established between the above units:—

The pentane unit has the same value within the errors of experiment as the bougie decimale. It is 1·6 per cent. less than the standard candle of the United States of America, and 11 per cent. greater than the Hefner unit.

In order to come into agreement with Great Britain and France, the Bureau of Standards of America proposed to reduce its standard candle by 1·6 per cent., provided that France and Great Britain would unite with America in maintaining the common value constant, and with the approval of other countries would call it the international candle. The National Physical Laboratory, London, and the Laboratoire Central d'Électricité, Paris, have agreed to adopt this proposal in respect to the photometric standardisation which they undertake, and the date agreed upon for the adoption of the common unit and the change of unit in America is April 1, 1909.

The following simple relations will therefore hold after that date:—

Proposed new unit = 1 pentane candle.
= 1 bougie decimale.
= 1 American candle.
= 1·11 Hefner unit.
= 0·104 Carcel unit.

Therefore 1 Hefner unit = 0·90 of the proposed new unit.

The pentane and other photometric standards in use in America will hereafter be standardised by the Bureau of Standards in terms of the new unit. This, within the limits of experimental error, will bring the photometric units for both gas and electrical industries in America and Great Britain, and for the electrical industry in France, to a single value, and the Hefner unit will be in the simple ratio of 9/10 to this international unit.

The proposal to call the common unit of light to be maintained jointly by the national standardising laboratories of America, France, and Great Britain the "international candle" has been submitted to the International Electrotechnical Commission, and through it to all the countries of the world which are represented on that commission.

It is hoped that general approval will be secured, and that in the near future the term "international candle" for the new unit will have official international sanction.

NOTES.

AT the anniversary meeting of the Linnean Society on Monday, the gold medal of the society was presented to Dr. F. O. Bower, F.R.S., regius professor of botany in the University of Glasgow.

WE regret to announce that Dr. G. von Neumayer, Foreign Member of the Royal Society, and for many years director of the marine observatory at Hamburg, has died at Neustadt, at eighty-four years of age.

EDMOND HALLEY, the second Astronomer Royal, died on January 14, 1742, and was buried in the churchyard of St. Margaret's, Lee by Blackheath, in the same grave as his wife, who had died five years previously. In 1854 the memorial stone being much out of repair, the Commissioners of the Admiralty, who by that time had the Royal Observatory in their control, evidently considered the tomb as a national monument, and replaced the stone by a new one, the old stone being removed to Greenwich Observatory, where it is now to be seen attached to a wall. By lapse of time the second stone now requires renovation, and we are glad to know that the Commissioners of the Admiralty have under consideration the question of the repairs to be done.

AN International Congress of Applied Photography is to be held from July 8–10 next at Dresden, in connection with a photographic exhibition. Particulars may be obtained from the secretary, Dr. Veisz, Winchelmannstrass, 27, Dresden.

WE regret to see the announcement, from the Berlin correspondent of the *Times*, that Prof. Wilh. Engelmann, professor of physiology in the University of Berlin, died on May 20, at sixty-five years of age. Prof. Engelmann, who held a professorship at Utrecht for many years before his removal to Berlin in 1897, was an eminent authority upon muscular and nervous, especially cardiac, anatomy.

PROF. C. D. PERRINE, of the Lick Observatory, has been appointed director of the Argentine National Observatory, Cordoba. His work with the Crossley reflector is to be taken over by Dr. H. D. Curtis, now in charge of the D. O. Mills expedition at Santiago, and the latter will be succeeded by Mr. J. H. Moore, of the Lick Observatory. Prof. Perrine will arrive at Cordoba at the end of this month, and he asks that all correspondence shall be directed to him there.

PROF. DAVID TODD, of Amherst College, Massachusetts, is about to undertake an experiment for determining the composition of the air at high levels, and the cause of mountain sickness. He intends to make several balloon ascents in a closed car from Canton, Ohio, the interior of the country being considered preferable owing to freedom from seaward air currents. Rarefied air will be pumped into the car to keep the pressure at normal. The Aëro Club of New England has offered Prof. Todd the use of its new balloon, the *Massachusetts*, of 56,000 cubic feet capacity, for the purpose of his experiments.

THE Blue Hills Meteorological Observatory, near Boston, is about to lose, by his resignation, the services of Mr. Henry Helm Clayton, who has been in charge of it since 1894, and has made it one of the most important weather stations in America. He is to be succeeded by Mr. A. H. Palmer, now at Harvard. Mr. Clayton intends to attempt shortly a balloon trip from San Francisco to the Atlantic coast, as a preliminary test of the possibilities of an air voyage over the Atlantic. He believes that he can accomplish these feats by taking advantage of an upper air current which appears to flow constantly eastward at a height of about two miles above the earth's surface.

AN incident reported from Wisconsin suggests something of the possibilities latent in "Christian science" and allied notions as a menace to public health. In the Legislature of that State there was recently introduced a Bill providing that, in connection with lessons in elementary hygiene, the pupils in the "public schools" should be taught how to avoid contagion and the commoner ailments. There immediately poured in hundreds of letters and petitions protesting against such a policy, as it would give children the impression that disease was real. The opposition was so strong that the Assembly Committee on Public Health, in spite of the efforts of three physician members, was intimidated into killing the proposal at its first hearing.

A director will be appointed shortly for the Australian Institute of Tropical Medicine, which has been founded to further the scientific study of the diseases peculiar to tropical Australia, and to afford opportunities for the training of medical men in this department of medicine. The institute will be situated in Townsville, Queensland, where a large and well-equipped general hospital exists. The general control of the institute is vested in a committee appointed by the Universities of Sydney, Melbourne, and Adelaide, and one representative of the Government of Queensland. The director will be required to organise and administer the institute, to conduct investigations into the tropical diseases of Australia, and to give such instruction in tropical diseases as may be determined upon, and superintend research work undertaken in the laboratories of the institute. The appointment will be, in the first instance, for five years at a salary of 600*l.* per annum. The selection of the director will be made by a committee of three representing the Royal Society, the London School of Tropical Medicine, and the Liverpool School of Tropical Medicine.

Last week we referred to the new museum, at Truro, of the Royal Institution of Cornwall. At a meeting of the institution held on May 25 it was announced that the following letter had been received from the Duchy of Cornwall Office:—"The Prince of Wales has been pleased to sanction a donation of 200 guineas from the Duchy revenue to the fund for a new county museum at Truro. His Royal Highness directs that the donation may be given in memory of Sir Humphry Davy and Richard Trevithick, two great Cornishmen who commenced their careers with few advantages and left names which can never be forgotten. His Royal Highness hopes that with increased facilities for the study of science and art the great traditions of the Duchy may be more than maintained."

In his article on "The Government and Aëronautical Research" in Nature of May 13 Prof. Bryan remarked:—"The Aëronautical Society mainly exists for the purpose of promoting discussions on aëronautical matters." Mr. Eric S. Bruce, late honorary secretary of the society, writes to say that, from the days of its foundation in 1866, the society has had wider objects and aims than merely debate. Experiments have been encouraged, a "well-illustrated" journal has been published, and it is hoped that a well-equipped aëronautical laboratory may before long be established. "Another special object has been the establishment of a comprehensive aëronautical library, and many of the important works on aëronautics in various languages have already been collected." Prof. Bryan has favoured us with the following remarks upon the subject of Mr. Bruce's letter:—"No difference of opinion can possibly exist as to the value of libraries, laboratories, practising grounds, and properly conducted experiments in furthering the progress of aëronautics. But while the Aëronautical Society deserves full credit for all that it has done in the right direction, it would be invidious to single it out without referring in equal detail to claims of a similar or different kind possessed by the other two bodies under discussion. The Aëro Club also has its experimental ground, while the Aërial League attaches the greatest importance to scientific research, which it proposes to further by founding and endowing a college. If this movement receives the support which it deserves, that institution should certainly become the leading authority on all scientific developments of aëronautics. In the accounts of the amalgamation given in the daily papers a claim to that position was put forward on behalf of the Aëronautical Society. But the right of a society to rank among the leading scientific bodies must necessarily depend largely on the maintenance of a uniformly high standard of scientific value and accuracy in the communications published in its Proceedings, and an examination of the Journal shows that such a claim could not be admitted unchallenged in the columns of Nature any more than the description of the Journal as 'well illustrated' could be allowed to pass without referring to the figures on pp. 52, 53, of the April number. For this reason the sentence quoted by the energetic and enterprising ex-secretary was chosen after careful consideration as indicating the special and distinguishing characteristics of the society better than any statement of a more ambitious character."

What is perhaps the largest prehistoric relic found in England has just been secured for the Hull Municipal Museum. This is the well-known "dug-out" boat found during excavations at Brigg, Lincs, in 1886. The boat is cut from a single piece of oak, more than 48 feet in length and 6 feet in width—a much larger size than any oak tree living in Britain to-day. With the boat were found many interesting relics, and these have also been presented by Mr. V. Cary-Elwes. Mr. T. Sheppard, the curator of the museum, has successfully removed the boat to its new quarters, where it forms a welcome addition to the already large series of Lincolnshire antiquities.

A magnetic storm of some size was recorded at Kew during May 14 and 15. It commenced suddenly at about 5.0 a.m. on May 14, the initial change of horizontal force —about 70γ in five minutes—being unusually large. The total range was about 400γ in horizontal force and 54′ in declination. The largest and most rapid changes took place between 4 p.m. and 6 p.m. on May 14. Westerly declination diminished by about 48′ between 5.12 p.m. and 5.18 p.m. The vertical force was continuously in excess of its normal value between 2 p.m. and 10 p.m. on May 14, the excess not falling short of 100γ between 2.40 p.m. and 8.40 p.m. There were no large movements after 4 a.m. on May 15, but the curves remained somewhat disturbed until the evening. There was a marked appearance at times of continuous oscillatory movements of the type which usually accompany aurora.

In his recent discourse at the Royal Institution, which we hope to publish in an early issue, Prof. Ronald Ross referred to the neglect of malaria prevention for ten years in many British possessions. In answer to a question upon the subject asked by Mr. Ramsay MacDonald in the House of Commons a few days ago, Colonel Seely referred him to the report of the advisory committee for the Tropical Diseases Research Fund for the year 1907 (Cd. 3992) containing reports relating to malaria. He added:—"These reports show, I regret to say, that nothing of any consequence had been done in the direction indicated at that time. The reports in question have, with the rest of the matter contained in the Blue-book, been brought to the notice of the schools of tropical medicine, but action to be effective must needs be taken by the Governments concerned, with the cooperation of the general community."

In the House of Commons on May 20 Mr. Balfour asked the Prime Minister whether he could state the nature of the duties entrusted to the scientific committee on aërial navigation, and explain the relation of the committee to the executive officers who were understood to be designing balloons and aëroplanes for naval and military purposes. In answer to the question Mr. Asquith said:—"It is no part of the general duty of the advisory committee for aëronautics either to construct or to invent. Its function is not to initiate, but to consider what is initiated elsewhere, and is referred to it by the executive officers of the Navy and Army construction departments. The problems which are likely to arise in this way for solution are numerous, and it will be the work of the committee to advise on these problems, and to seek their solution by the application of both theoretical and experimental methods of research."

On Tuesday next, June 1, Dr. F. Gowland Hopkins will begin a course of two lectures at the Royal Institution on "Biological Chemistry"; on June 3 Prof. W. E. Dalby will commence a course of two lectures on "A Modern Railway Problem: Steam *v.* Electricity"; and on Saturday, June 5, Dr. F. F. Blackman will deliver the first of two lectures on "The Vitality of Seeds and Plants," (1) "A Vindication of the Vitality of Plants," (2) "The Life and Death of Seeds." The Friday evening discourse on June 4 will be delivered by Prof. J. A. Fleming, on "Researches in Radio-telegraphy," and on June 11 by Sir James Dewar, on "Problems of Helium and Radium." An extra discourse will be delivered on June 18 by Mr. A. Henry Savage Landor, on "A Recent Visit to the Panama Canal."

We have received a copy of a special report on the establishment and organisation of a research laboratory at the Crichton Royal Institution, Dumfries, which has been submitted to the board of direction by Dr. C. C. Easterbrook, the physician superintendent. It is suggested that the laboratory shall be devoted to study and research in nervous and mental disorders. Dr. Easterbrook proposes that three Crichton fellowships be established for the promotion of psychiatrical research, one in clinical neurology and psychology, one in pathology and chemistry, and one in pathology and bacteriology. Each fellowship should be, he maintains, of the value of 250*l.* a year with residence in the institution, or 50*l.* additional in lieu thereof. Particulars are given of what might well be the general qualifications and previous training of candidates, and indications are supplied of how such fellows could, by working in a research laboratory, benefit the institution as well as medical science.

In a note upon changes in the staff and administration of the London Zoological Gardens which appeared in Nature of May 13, it was announced that the curators will have to devote their whole attention and time to the care of the animals under their charge, and therefore "will have no time to spend on scientific zoology." Dr. Chalmers Mitchell, secretary of the society, writes to say that while it is certainly intended that the first duty of the curators shall be the care of the living animals in their charge, "such work opens as wide a field for research in 'scientific zoology' as the anatomical and systematic investigations to which, by implication, the writer of your note would seem to restrict the phrase." He is convinced that "the council will welcome the scientific work of the staff in whatever direction that may be, so long as it is compatible with the discharge of their duties." In the *Times* announcement of the changes it was stated that the curators were expected to devote all their energies to "curating," an expression which the writer of the note took (and still takes) to mean that they were not to spend time on scientific work.

The British Fire Prevention Committee, which was founded on the occasion of the great Cripplegate fire of 1897 and incorporated in 1899, is celebrating the tenth anniversary of its incorporation this week. The greater knowledge of building materials and appliances obtained by scientific independent tests at the committee's testing station has done much to obtain a better understanding of the value and also the limitations of different methods of construction and equipment, whilst considerable influence has also been exerted by the committee in guiding building and fire service legislation in directions where it is most effective to prevent loss of life and loss of property. The objects tested by the committee since its formation numbered 160 to the end of last year, and it should be understood that the investigation into any one object sometimes requires as many as twenty or thirty testing operations. Notable tests have been those with large reinforced concrete floors, a series of fifty fire-resisting doors, fire-resisting glazing, and latterly also with safety devices. Perhaps a final feature that claims remark is that the whole of the funds required for the establishment of the committee's testing station and the execution of its work have been raised voluntarily, that more than 20,000*l.* have been expended in ten years on the work of the committee, and that the whole of the services rendered by the committee and its officers are voluntary.

Some interesting details of the scientific achievements of the British Antarctic Expedition under Lieut. Shackleton are given in Monday's *Times*. The communication is from the New Zealand correspondent of the *Times*, and is based upon information provided by Prof. Edgeworth David. From the article we learn that a number of the rotifers found in the lake muds were of the same variety as those already described by the biologist of the expedition (Murray) in Spitsbergen and Franz Josef Land. This was especially the case in regard to the species *Macrobiotus arcticus*. A point of special interest in regard to the marine fauna near Cape Royds is that it may provisionally be concluded that it bears some distant resemblance to the types of animal life of the Coal-measure series of Australia and Tasmania. The possibilities of the Antarctic having been an archipelago can no longer be entertained. There is a high continental plateau extending from the new mountains recently discovered by the *Nimrod* expedition forty-five miles west of Cape North to the magnetic pole across the plateau traversed by Captain Scott of the *Discovery*, and over the portion traversed by Lieut. Shackleton in his furthest south journey to beyond the South Pole itself—probably for a distance of 1800 miles. The most interesting geological discovery was that of Coal-measures at least 1500 feet thick in latitude 85° S. There were at least seven seams of outcrop in the cliff face of the great nunatak where the discovery was made; they varied in thickness from 1 foot to 7 feet. Abundant small fossil root impressions were present in the fire-clay found with some of the seams. The general geological results of the expedition show that there is a very ancient series of crystalline rocks similar to those already described by Ferrar, of the *Discovery*, forming the foundation platform from near the South Pole to Cape North. The whole of this basal series gives every promise of minerals of the rare earths in more or less abundance. Superimposed upon these basal beds is the sandstone formation already described by Ferrar as the "Beacon" sandstone. Above the sandstones, on a series of volcanic rocks, occur immense lava sheets more or less horizontally bedded. As regards volcanic eruptions, it is interesting to note that

Erebus, like Stromboli in the Mediterranean, formed a good barometer, for as the mercury fell in the barometers of the expedition so did the steam cloud over Erebus rise higher and higher. Nearly all the principal steam eruptions took place when the barometer was at its lowest.

We have to acknowledge the receipt of vol. v., part ii., of the *Boletim do Museu Goeldi* (*Museu Paraense*), the greater portion of which is devoted to botanical subjects, although there is one paper, by Dr. Emilia Snethlage, on new Amazonian birds in the collection of the museum, and a second by the same author on certain new fishes from the Amazon and its tributaries, recently described by Dr. Steindachner.

The categories of variation form the subject of the first and longer article, by Prof. S. J. Holmes, in the May number of the *American Naturalist*. After directing special attention to mutations, the author concludes as follows:—"If sudden mutations have been a not uncommon source of varieties of domesticated animals and cultivated plants, it does not follow that the selection of comparatively small variations has not been the predominant method of species-forming in a state of nature. After fifty years from the publication of Darwin's 'Origin of Species' we are still debating, and more lively than ever, the central problem of that epoch-making book; but it is not improbable the views of its sagacious author will prove more nearly correct than those of most of his modern critics."

In describing, under the name of *Isocrinus knighti*, a new crinoid from the Upper Jurassic of Wyoming, we are glad to see that Mr. F. Springer, in No. 1664 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 179–90), decides not to replace the well-known name *Encrinus liliiformis* or to transfer it to another species, although, according to strict interpretation of rules, there may be grounds for so doing. "I shall maintain," he writes, "that, irrespective of the merits of their original titles to priority, the names of Encrinus and Millericrinus have become valid simply by the lapse of time, by long usage in the sense in which they are now generally understood; and that by reason of universal acquiescence in such use for nearly a century, zoologists are now estopped from disputing them." These are golden words, and it is most satisfactory to find that Mr. Boulenger's revolt against the priority-fetish has spread to America, where the fetish is most highly worshipped. We trust the revolt will continue to spread.

Brown-bear hunting in Alaska forms the subject of a very fully illustrated article, by Mr. G. Mixter, in the April number of the *National Geographic Magazine*, the article concluding with an extract of a report on these bears by Mr. W. H. Osgood. After mentioning that Alaska is unrivalled in regard to the number and variety of its bears, and that the brown bears are the largest in the world, with the exception of the Polar species and their own relations in Kamchatka, the latter author considers that the days of these bears are numbered, and that these animals will ere long be exterminated except in the more remote districts. The brown bears vary greatly in colour, ranging from dark seal-brown to buffish-brown, with the legs and under-parts generally darker than the back. Although the ends of the hairs are often paler than the bases, the silver-tipped fur of the grislies is never seen, while the front claws are shorter, thicker, and more sharply curved than those of the latter.

The osteology and affinities of the Jurassic American iguanodont reptiles of the genus Camptosaurus form the subject of a long paper, by Mr. C. W. Gilmore, published as No. 1666 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 197–332). As the result of additional materials, the author is enabled to give a new definition of the genus, while special attention is also directed to the three English reptiles which have been assigned to the genus by Mr. Lydekker. All three are admittedly very nearly allied to the American genus, and the author at present sees no reason for separating the Kimeridgian *C. prestwichi*, although in certain points it comes closer to Iguanodon than to the typical Camptosaurus. On the other hand, the femur from the Oxfordian on which *C. leedsi* was founded appears to come nearer to the corresponding bone of the American Dryosaurus, and the species may therefore be distinct from Camptosaurus, the same remark applying to the still more imperfectly known *C. valdensis* of the Wealden of the Isle of Wight.

We have been favoured with parts of the *Journal botanique de la Société impériale des Naturalistes* of St. Petersburg (Nos. 2 to 6, 1908). Papers on the algæ of the Black Sea are contributed by Mr. K. N. von Deckenbach and Mr. N. N. Woronichin. The former provides new records for species and localities; the latter, a more extensive paper, deals with the identification of green algæ from several collections, and supplies a list of nearly fifty species, but none of them is endemic. Two articles on the distribution of plants are contributed, the one, by Mr. J. Perfiliew, on the government of Wologda, the other, by Miss H. Poplavska, on the government of Pskov. A genus, Luenovia, is created by Mr. W. Sukatscheff for a new blue-green alga under the order Hormogoneæ.

Additional notes on the economic aspects of the oil palm, *Elaeis guineensis*, are given in the current issue (No. 4) of the *Kew Bulletin*, compiled from information supplied by officers in Nigeria, Sierra Leone, Gambia, and the Gold Coast. The chief factors affecting habitat are a rainfall of more than 70 inches and a soil rich in humus but well drained. Plantations are only occasionally met with, as among the Krobos of the Gold Coast, but there is no difficulty in raising young plants. The method of tapping the palms for "wine," which tends to the destruction of numbers of trees, is described. At the present time, and until transport facilities are improved the sources of supply are more than adequate.

Prof. C. F. Chamberlain has supplemented his paper on the female gametophyte of the cycad *Dioon edule* by an account, published in the *Botanical Gazette* (March), of spermatogenesis in the same plant. The staminate cones measure 10 cm. to 20 cm. in length; the numerous sporophylls bear about 250 sporangia, and the average output of a sporangium is placed at 30,000 spores. One persistent prothallial cell is developed. The sperms, produced in pairs in a mother-cell, are only slightly smaller than the sperms of Zamia, and, like them, are just visible to the naked eye, as they measure about 1/40-inch. The movement of cilia is accompanied by pulsating and amœboid movements. Two blepharoplasts are formed which eventually break up into granules from which the spiral ciliated band of the sperm is developed.

An account of trees on the Dawyck estate, in Peebles, by Mr. W. B. Gourlay, is published in the latest number (vol. xxiii., part iv.) of the Transactions and Proceedings of the Botanical Society of Edinburgh, in which it is stated that larches were planted on this estate in 1725, or thirteen years before the first introduction to Dunkeld; the survivors are much weather-beaten, but the estate lies in an extremely cold region. Silver fir, *Abies pectinata*, grows well, and some large trees, one of which reaches a height of 115 feet, date back to the year 1735. Two horse-chestnuts, said to be the first planted in Scotland, probably date back a few years earlier. Plantations of the common larch are subject to disease, but the Japanese larch is healthy, and the Douglas fir thrives in sheltered situations.

The classic experiments by Moll concerning the absorption of carbon dioxide from the air will be familiar to most botanists, more especially as illustrations are given in Vines's "Physiology of Plants." The experiment where a leaf was inserted between two glass dishes has been further investigated by Dr. V. Zijlstra, who has embodied his results in a brochure on the transport of carbon dioxide in leaves. He finds that when part of a leaf is placed in an atmosphere devoid of carbon dioxide, and the adjacent part of the leaf is covered, then the carbon dioxide formed in this part of the leaf in respiration diffuses through the leaf, and a band of starch is formed beyond the screen. The band varies from 5 mm. in the dahlia to 2·5 cm. in wheat, while through the leaves of Eichhornia and Pontederia the gas can diffuse much more readily.

In the May number of *Man* Dr. F. C. Shrubsall describes two crania and some long bones from ancient ruins in Rhodesia. The skulls seem to be of the Bantu, not of the Bushman, type; in other words, they belong to a negro race similar to the inhabitants of Rhodesia at the present day. The position in which these remains were found seems to indicate that they were coeval with the buildings near which they were discovered. While this does not, of course, prove that negroes were the builders of the famous ruins, it is significant to note that the remains do not belong to any of the more northern races. The fact that the bones were associated with valuable gold ornaments precludes the supposition that these negroes had been enslaved by the foreigners, who, according to one theory, were the builders of these remarkable structures.

We have received copies of two fasciculi, one dealing with Oligochæta and Hirudinea, and the other with Nematodes, Gordiidæ, &c., of *Die Susswasserfauna Deutschlands, eine Exkursionsfauna* (Jena: G. Fischer). The parts (of which those before us are respectively numbered 13 and 15) are sold separately, at a price varying between one and two shillings each, and they are issued in narrow duodecimo form, so as to be convenient for carrying in the pocket. Each part is, moreover, written by a specialist, and sufficiently, although diagrammatically, illustrated, and the whole work appears, therefore, to be admirably adapted for the purpose for which it is intended, namely, as a companion for the field-naturalist.

The report of the Bombay and Alibag observatories for the year 1908 has been received. White ants cause much damage at the Colaba (Bombay) Observatory; glass insulators filled with kerosene have been provided for the presses containing the records, but it is doubtful if they will prove efficacious. The rainfall for the year amounted to 53·54 inches, being 21·62 inches below the average for 1873–96; of that amount, 52·70 inches fell between June and September inclusive, the period of the south-west monsoon. Milne's seismograph registered forty-eight earthquakes, besides several small movements; great disturbances occurred on January 11, February 9, August 20, and November 2. A table prepared in accordance with the suggestion of the International Commission for Terrestrial Magnetism, representing the magnetic character of each day, shows that there were 135 calm days, the remaining days of the year showing small or larger disturbances; six of the latter were days of great disturbance. The mean declination was 1° 2′ east.

The ballistic galvanometer method of measuring quantities of electricity has proved so convenient and flexible that it has been used to determine changes of magnetic induction in cases to which it was not strictly applicable. According to the simple theory of the instrument, the whole of the electricity must have passed through it before the moving part of the instrument has had time to move appreciably from its position of rest. Prof. O. B. Pierce, of Harvard, has investigated the behaviour of a d'Arsonval galvanometer the period of swing of which was raised to ten minutes by attaching to the coil a circular disc with a weighted rim. He finds that the simple theory is still applicable to such an instrument, and has by means of it measured the changes of magnetic induction through large electromagnets. His memoir forms No. 11 of vol. xliv. of the Proceedings of the American Academy of Arts and Sciences.

Some comparison tests between the new Féry spiral pyrometer and a standardised thermoelectric Féry radiation pyrometer are recorded in *Engineering* for May 14. The spiral pyrometer has the advantage over other types of radiation pyrometers in that it is self-contained. The instrument consists essentially of a very small spiral made of a strip of two metals having very different coefficients of expansion, and having a pointer attached. The spiral unrolls when heated, and the pointer travels over a scale indicating the temperature of the furnace. Rays coming from the furnace are reflected by a concave mirror and sent to the spiral, any radiation passing through the spiral being reflected back to it by means of a second small mirror. The whole is contained in a tube furnished with a focussing arrangement by means of which the observer directs the instrument towards the furnace and obtains an image of it. Adjustment of the zero of the instrument is easily effected. The tests were conducted by Mr. G. C. Pearson in the retort-house of the Birmingham Gas Works, and ranged between 845° C. and 1260° C. The greatest difference between the readings of the two instruments amounted to 10° C. at 930° C.; the mean of twelve readings shows the spiral pyrometer to be reading about 1° C. in excess of the thermoelectric pyrometer. The maker's claim of an accuracy within 1 per cent. or 2 per cent. is thus amply justified. The instrument is being constructed in this country by the Cambridge Scientific Instrument Company.

A series of special demonstrations on the use of microscopes, and various microscopic appliances and accessories, has been held during the past week or so at the London depôt, 9–15 Oxford Street, of Mr. Ernest Leitz, of Wetzlar. It is generally known that this firm was practically the pioneer in the production of cheap microscopes and objectives of Continental make, and an inspection of the apparatus now shown clearly indicates that, though a low standard of price is maintained, the apparatus produced is of a very high class. It is interesting to note that in the production of the new types of microscope stands the firm is being largely influenced by English ideas of design; the result is a type of instrument which combines to a considerable extent the Continental horseshoe foot and the much more stable English tripod foot. Could Mr. Leitz carry this innovation somewhat further, he would be in a position to produce an instrument which in point of design and for general stability and convenience in use would have few equals and probably no superiors. The episcopic and diascopic projection apparatus is of a very complete order, and admits of being used for photomicrographic work as well. The dark ground illuminators, and also some recently introduced appliances for metallurgical work, are of special interest. An entirely new design of apparatus, adapted for both visual and photographic purposes in metallurgy, is also exhibited, and in this a definite departure from existing methods is to be seen. The microtomes are also of new design, and are of very substantial construction. A visit to the premises of Mr. Leitz at the present moment cannot fail to be of interest to microscopists, or to those to whom the microscope may be of either practical or scientific value.

Mr. John Murray has just issued the fourth edition of Mr. W. C. D. Whetham's book on "The Recent Development of Physical Science." The book was published first in 1904, and was noticed in Nature of January 26, 1905 (vol. lxxi., p. 291). The present issue is fundamentally the same as the third edition published four years ago, though a few additions have been made.

No. 168 of Ostwald's *Klassiker der exakten Wissenschaften*, published by Mr. W. Engelmann, Leipzig, contains papers on the stereoscope by Wheatstone, Brewster, Riddell, Helmholtz, Wenham, d'Almeida, and Harmer, edited and annotated by Mr. M. von Rohr. The volume makes an interesting contribution to the history of the stereoscope for German readers.

The thirteenth revised and enlarged edition of "Prantls Lehrbuch der Botanik," edited by Prof. F. Pax, has been published by Mr. W. Engelmann, Leipzig. The text has been extended, and now occupies nearly five hundred pages. The price—six marks—for a volume of this number of pages, and almost the same number of figures, is remarkably low.

Prof. R. Zsigmondy's valuable work upon the application of the method of ultramicroscopy to the study of solutions of colloids has been translated into English by Mr. T. Alexander, and published by Messrs. J. Wiley and Sons (London: Chapman and Hall, Ltd.) under the title "Colloids and the Ultramicroscope." An appreciative notice of the original German work appeared in Nature of March 1, 1906 (vol. lxxiii., p. 410). The price of the English edition is 12*s*. 6*d*. net.

OUR ASTRONOMICAL COLUMN.

A General Solution of the Spectroheliograph.—A paper by M. Deslandres, published in No. 15 of the *Comptes rendus*, describes a "general purposes" spectroheliograph recently set up at Meudon in which are combined four distinct instruments for the photographic registration of the phenomena of the solar atmosphere. All these instruments are fed by the same cœlostat and objective.

The first is an ordinary spectroheliograph giving the forms of the flocculi in Hα light, the dispersion and reflection being performed by a reflection grating. If the grating be removed from the path of the collimated ray the latter falls on a train of prisms, which deviates it into a second camera of 3 m. focal length giving K_3 and K_2 images, for comparison with the Hα images, of 80 mm. diameter.

If it is desirable to isolate a special line the camera objective of the second instrument is replaced by a plane mirror, so that the ray is reflected into the third spectroheliograph arranged for the easy isolation of any special radiation, whilst if this instrument be removed the ray passes into the fourth instrument, of much greater length and having three slits, so that very fine lines, or definite portions of broad lines, may easily be isolated. It is with the latter form that M. Deslandres has recently obtained the fine images, with K_3 and Hα radiations, showing the dark filaments.

The requisite motions are imparted to the objective forming the primary image, and to the photographic plate, by synchronised electric motors and speed transformers, and M. Deslandres states that the change from one instrument to another is a simple matter; the complications are more apparent than real.

The Brightness of the Corona.—Lick Observatory Bulletin No. 153 contains a brief review, by Prof. Perrine, of the results obtained from the attempts to measure the total brightnesses of the corona during the total solar eclipses of 1905 and 1908.

Among other things, it is shown that the ratio of the intrinsic actinic brilliancy of the brightest parts of the corona to that of the surrounding sky is 744/1, whilst the ratio of total coronal, to full moon, light is 0·111. The results also indicate that there are sufficient differences of brightness of the corona at successive eclipses to be detected by the methods employed at Flint Island in 1908.

A Standard Scale of Photographic Magnitudes.—In Circular No. 150 of the Harvard College Observatory Prof. Pickering points out the urgent importance of fixing upon some standard scale of photographic magnitudes for international adoption, and describes the work already done in this connection at Harvard. The method of polar sequences, in which the region to be investigated is photographed on the same plate and under the same conditions as the polar region, has been found to give satisfactory results, and the absolute magnitudes of a sequence of forty-seven stars in the latter region have been determined. Other sequences are being prepared, and Prof. Pickering states that the Harvard College Observatory is prepared to devote a large part of its resources to the work if a satisfactory scale can be universally adopted.

The Origins of Satellites.—In a telegram to the *Astronomische Nachrichten* (No. 4323, May 17), Prof. See announces that he has rigorously demonstrated that satellites were all captured, and states that he is sending a paper setting forth his demonstration.

The Spectrum of Morehouse's Comet.—With a quartz spectrograph attached to the 80-cm. refractor of the Potsdam Observatory, Prof. Hartmann obtained a spectrum of comet 1908*c* on October 27, 1908; the exposure was 140 minutes, and the slit width 0·1 mm. Three faint pairs of lines are shown at wave-lengths 3874·2, 3908·6; 4001·1, 4020·0; and 4252·8, 4275·8. The first of these is very broad, and corresponds to the head of the third cyanogen band, whilst the origins of the other pairs are as yet unknown (*Astronomische Nachrichten*, No. 4322).

The Orbit of ξ Boötis.—An orbit for ξ Boötis, previously published by Prof. Doberck, was determined by aid of Sir Wm. Herschel's position angles, and no longer represents the observations. Consequently, Prof. Doberck has determined a new orbit, using only the measures made since 1830, and publishes it, together with an ephemeris until 1915·5, in No. 4322 of the *Astronomische Nachrichten*; the following are the elements:— $\Omega = 171° 37'$, $\lambda = 346° 52'$, $\gamma = 32° 54'$, $e = 0·5061$, $P = 179·60$ years, $T = 1907·84$, $a = 5·015''$, retrograde. The hypothetical parallax of this system is $0·158''$.

The Birth of Worlds.—In *Cosmophysics*, "an international journal of astrophysics," described as the organ of the Wainoni Park Astrophysical Society, Christchurch, New Zealand, Prof. A. W. Bickerton sets forth his complete theory of stellar creation. Numerous recent observations of stars, novæ and their spectra are introduced into this summary in order to demonstrate that lucid stars are formed by the collision of two cosmical masses. The new body, however, is not the combined mass, but, according to Prof. Bickerton's theory, is a third body formed by the masses detached from the colliding bodies by the force of the impact; the latter, after their impact, go on their respective journeys as variable stars.

SELECTIVE WIRELESS TELEGRAPHY.

A PAPER by Dr. Alex. Muirhead and myself, on some experiments and measurements in accurate wireless tuning with open-circuit radiators, and the conditions under which perfect selection is possible, was read to the Royal Society in January of this year, and will appear in a forthcoming issue of the Proceedings.

The essence of it is that in signalling across land both radiator and receiver must be completely insulated from, and elevated above, the earth, if they are to be persistent oscillators such as are capable of accurate tuning. Earth connection damps out the vibration and spoils tuning: and to get the best effect the lower capacity area must be not only insulated, but must be elevated above the earth until its capacity with respect to the upper aërial is a minimum.

To prove this, the received energy was measured at a distant station by a Duddell hot-wire meter; and several series of measurements were taken with the lower capacity at different heights above the earth, and also when connected with the earth.

The sensitiveness of a thoroughly tuned Lodge-Muirhead system is extreme; small power is sufficient, and the inductive connection of the collector to the receiving instrument may be separated by a surprising interval without stopping communication.

Under these non-earthed conditions every other station, even near and powerful ones, can be tuned out and their disturbance eliminated.

Directly earth connection is made, tuning of the radiator and collector is nearly gone, for they no longer have any persistent free vibration period. Samples of a large number of measurements are recorded in the paper.

But from the paper as originally sent in an account of the most striking experiment to illustrate the facility and perfection of tuning on this system, when insulated capacity areas are employed without any earth connection, was accidentally omitted, though it has since been communicated to the society. The experiment was made on May 14, 1907, and may be briefly described.

Preliminary Information.

Each aërial of the Lodge-Muirhead system consists of a pair of capacity areas in the form of a couple of very open "Maltese crosses" or squares of wire suspended horizontally from four posts like the framework of a carpet, one above the other, and both well insulated from the earth. Connection with each is made in the middle by a special elaborately stranded cable to the instruments, but no earth connection is made at all.

A wheel coherer—revolving steel disc dipping into oiled mercury—is employed as detector under the conditions of accurate tuning; or sometimes a point coherer, similarly treated with oil. An electrolytic coherer is even more sensitive, but its leakage damps vibrations out and prevents the accumulation of impulses necessary for accurate tuning, whereas the film of oil on the wheel coherer insulates until the oscillations in the receiving tuned condenser circuit have mounted up sufficiently to break it down and overflow through the detector.

That is in brief summary the way signalling works, and the following account has reference to signalling across Kent between Elmer's End and Downe.

Experiment in Diplex Telegraphy.

At two stations, Downe and Elmer's End respectively, the upper capacity area of each aërial was bisected diagonally, the two triangular halves being insulated from each other, and each connected to its own independent receiving or sending arrangement. The lower aërial was not bisected, but was doubled, an additional insulated area being placed a few feet below the ordinary one. By this means each station was practically doubled, and the two halves at each station made to correspond to a different wave-length.

Two senders at Elmer's End were then set to work simultaneously, one to transmit the word "Liverpool" continuously for a long time, the other the word "steamships" continuously in the same way. Two independent receivers at the Downe station—one of them a siphon recorder and one a telephone, though both might easily have been automatic recorders—each of them inductively connected with one half of the aërial there, now received simultaneously, one of them a succession of "Liverpools," the other a succession of "steamships," without the slightest confusion or interference or overlapping of any kind.

In other words, diplex telegraphy (as distinct from duplex) was found quite easy on this system of tuning, which was specified by one of us in 1897.

Experiment in Selection or Tuning Out.

Another experiment more recently tried is the following. Two stations were arranged at Downe, 1200 feet apart, either of which could speak with great ease to Elmer's End, and was strong enough to speak to a station thirty miles away. One of the Downe stations was then switched on to "receiving," and both Elmer's End and the other station at Downe were set speaking to it.

The wave-length of one was 300 metres, of the other 660 metres, so as to compare Civil with Admiralty conditions.

By the mere motion of a handle the frequency of the receiving station could be altered at will so as to correspond either with the neighbouring sending station 1200 feet off, or with the distant sending station seven miles off—which distance might, however, have been increased immensely without any difficulty. A few trees intervened between the neighbouring stations.

In these circumstances, when properly adjusted, each station could be heard separately; that is to say, messages could be received first from one tuned-in station and then from the other, without any disturbance from the station tuned-out, although both stations were sending all the time strongly and simultaneously. The ease and large margin with which selection could be achieved shows that the two neighbouring stations could have been put still nearer, while still retaining the power of complete tuning-out.

Testing of Margin of Selection.

Further experiments in the same direction were conducted as follows:—

The two stations at Downe, 400 yards apart, were rearranged so that there were no trees between, only a few low hedges, thus making the test manifestly more severe. A given power was then employed for sending at one of these neighbouring stations, and the same power at the distant Elmer's End station, while the other neighbouring station was arranged for receiving from either of these two at pleasure. Experiment was now directed to determine the conditions under which the neighbouring station could be completely cut out, while still the distant one could be clearly heard. In other words, to determine the amount of separation between the primary and secondary of the inductive connection which would eliminate all disturbance from the neighbouring station adjusted to ordinary commercial wave-length, while it would permit perfect signals to be received on the siphon recorder from the distant tuned station of longer or more nearly naval wave-length.

Case 1.—Elmer's End sending with a wave-length of 580 metres. Neighbouring Downe sending with a wave-length of 300 metres. The receiving Downe station was attuned so as to cover a range of wave-length about 580 metres on the average, but extending more than 20 metres above and below. Under these conditions it was possible completely to cut out the local station on a coupling of $3\frac{1}{2}$ inches, that is, with $3\frac{1}{2}$ inches separating primary and secondary coil of the inductive connection; whereas from Elmer's End perfect signals could be obtained without disturbance on any coupling between $3\frac{1}{2}$ inches and 7 inches. Indeed, as the exact pitch was reached at the receiving adjustment, the signals received boomed out, as it were, very strongly.

Case 2.—The Elmer's End wave-length was shortened to 510 metres, the local Downe station remaining at 300 metres, and again a series of readings was taken at the receiving Downe station adjusted to an average of 510 metres wave-length.

The coupling separation, which now just managed to cut out the local station, was 4 inches. Anything above

4 inches gave perfect signals from Elmer's End, and no disturbance.

Case 3.—On shortening the distant wave-length still more, so as to make it 450 metres, the neighbouring station could not be completely cut out without at the same time introducing a trace of superposed disturbance into the messages received from the distant station.

Case 4.—The difference of wave-length between the two stations was now, therefore, again slightly increased, the Elmer's End wave-length being adjusted to 480 metres, with the local station still remaining at 300.

In this case perfect and strong signals could be received from Elmer's End again, but the separation of the inductive connection had to be as much as 6 inches in order completely to cut out the local signals from the neighbouring station.

It follows, therefore, that when two powerful stations are so excessively near each other as they were in this case—namely, in adjoining fields—a distant signal can be heard with perfect clearness, *i.e.* without any trace of disturbance, only when its wave-length is more than half as great again as that of the neighbouring station; but that undisturbed signalling is much more easy when it approaches double that magnitude, or, of course, when the neighbouring stations are not quite so close together.

In no case was any trace of harmonic detected; *e.g.* when a station was sending 300 metres, and the neighbouring receiving station was attuned to 600 metres, it did not necessarily feel any disturbance. The waves emitted and received by these radiators appear to be practically pure.

OLIVER LODGE.

MARINE BIOLOGY IN THE TORTUGAS.[1]

THE volumes referred to below contain a series of nineteen papers based on work done or material collected at the Marine Biological Laboratory of the Carnegie Institution, situated on Loggerhead Key, off the southwest coast of Florida. The observations recorded bear ample testimony to the exceptionally favourable situation of the laboratory for the prosecution of marine biological research, and also to the facilities afforded on a liberal scale for work on a wide variety of subjects.

Dr. A. G. Mayer, the director of the laboratory, describes the annual breeding swarm of the Atlantic palolo (*Eunice fucata*, Ehlers), which occurs within three days of the day of the last quarter of the moon between June 29 and July 28. The worm when mature (and immature worms take no part in the swarming) is about 10 inches long, and its sexual products are limited to its posterior half. Before sunrise on the day of the annual breeding swarm the worm crawls out backwards from its burrow in the coral or limestone rock until the whole of the sexual portion is protruded. By means of vigorous twisting movements this portion is detached, swims vertically upwards to the surface of the water, and there continues to swim about with its posterior end in front. These sexual portions of the worms, which show no tendency to congregate, are present in great abundance at Tortugas, scarcely a square foot of the surface above the coral reefs being free from them. At sunrise the worms undergo violent contractions, which cause the expulsion of the sexual products through rents or tears which are formed in the body wall; the torn and shrivelled remains of the body wall then sink down to the bottom and die. Although light is probably a contributory cause, it is not the sole cause of this spasm of contraction, which takes place, though it is somewhat delayed, in swimming worms which have been removed to a dark room. After casting off its posterior sexual segments the anterior part of the worm crawls back into its burrow, and regenerates a new sexual end. The author has attempted to determine the nature of the stimulus to which the worm responds when it swarms, and he shows that the worms never swarm when moonlight is prevented from falling upon the rocks in which they are ensconced. The paper is a most interesting contribution to the study of this remarkable phenomenon.

[1] Papers from the Tortugas Laboratory of the Carnegie Institution of Washington. Vol. i., pp. v+191; vol. ii., pp. v+325. (Washington: Carnegie Institution, 1908.)

Dr. Mayer describes a series of experiments on the scyphomedusan *Cassiopea xamachana*, from which he concludes that the stimulus which causes pulsation is due to the constant formation of sodium oxalate in the terminal endoderm cells of the marginal sense organs. The sodium oxalate precipitates calcium as calcium oxalate, thus setting free sodium chloride, which he shows acts as a nervous and muscular stimulant. Pulsation is thus caused by the constant maintenance at the nervous centres in the sense organs of a slight excess of sodium over and above that found in the surrounding sea-water.

The late Prof. W. K. Brooks and Mr. B. McGlone have studied the origin of the lung of Ampullaria. They find that the gills, the lung, and the osphradium arise simultaneously, or nearly so, that they are developed from a ridge or thickening of the mantle, and that they should therefore be regarded as a series of homologous organs specialised among themselves in different directions. The lung becomes functional before the gill, as is shown by the fact that the newly hatched young quickly die if they are prevented from leaving the water, while adults can survive an immersion of a month or more. Other papers, the last productions of the late Prof. Brooks, contain a discussion of the subgenus Cyclosalpa, a description of the rare *Salpa floridana* (Apstein), and of a new appendicularian—*Oikopleura tortugensis*—to the tail of some of which a new species of Gromia was found attached.

Prof. Reighard discusses the significance of the conspicuousness of the coral-reef fishes of the Tortugas. He concludes, as the result of a long series of ingenious experiments, that the coral-reef fishes do not possess that combination of conspicuousness, with unpleasant attributes, necessary to the theory of warning coloration. The conspicuousness of these fishes, since it is not a secondary sexual character and has no necessary meaning for protection, aggression, or as warning, is without biological significance. These fishes have no need of either aggressive inconspicuousness, because they feed chiefly on fixed invertebrates, or of protective inconspicuousness, for they are afforded abundant protection by the reefs and their own agility. Selection has therefore not acted on their colours or other conspicuous characters, but these have developed, unchecked by selection, through internal forces. An attempt is made to apply this conclusion to the "warning coloration" of conspicuous insects.

There are other memoirs on the formation of chromosomes in various echinoderm ova; on the spermatogenesis of the "walking-stick" phasmid, *Aplopus mayeri*, in which the history of the accessory chromosome is traced and its probable significance as a sex determinant discussed; on the habits and reactions of the crab *Ocypoda arenaria*, of Aplopus, and of the woody and sooty terns; on the early development of the scyphozoon Linerges, on actinian larvæ referable to the genera Zoanthella and Zoanthina; on the rate of regeneration in Cassiopea; on regeneration of the chelæ of Portunus, on the life-history of the booby and man-o'-war bird, and on the cestodes of the Tortugas.

THE RELEVANCE OF MATHEMATICS.

ONE of the most important achievements of the thought of the last fifty years has been the conclusive proof of the logical nature of all mathematical conceptions and methods, in opposition to Kant's view that mathematical reasoning is not strictly formal, but always uses *a priori* intuitions of space and time. This does not, of course, imply that the methods of investigation followed by individual mathematicians are essentially different from those followed by other inquirers, the objects of whose researches are not purely logical; it is well known, in fact, that, though a proposition A may logically imply a proposition B, yet B may be deduced from A by considerations quite outside those of logic. Thus the existence of the solution of a certain important and famous mathematical problem—known as "Dirichlet's principle"—was, we may say, *felt*, and actually applied in domains of pure mathematics, for certain physical reasons connected with the equilibrium of statical electricity long before rigorous logical methods were discovered for proving the existence in question. The fact that propositions are connected logically by no means implies that this connection is obvious, nor does it preclude their being discovered, even in a correct form, by the exercise of what is popularly called "intuition."

By the side of this ever-deepening investigation into the principles of mathematics went on an inquiry, carried on by entirely different men, into the nature and purposes of our conceptions in physics. Through the work of these men, the true relation of mathematics to physical science, which had been a subject on which there had been until then much confusion of thought, appeared clearly. We will glance at the history of mathematics and of the application of mathematics to physics.

From the earliest times until the seventeenth century mathematicians were chiefly occupied with particular questions—the properties of particular numbers and the geometrical properties of particular figures, together with simple mechanical questions concerning centres of gravity, the lever, and so on. The only exception to this was afforded by *algebra*, in which symbols (like our present x and y) took the place of numbers, so that, what is a great advance in economy of thought and other labour,[1] a part of calculation could be done with symbols instead of numbers, so that the *one* result stated a proposition valid for a whole class (often an infinity) of different numbers. Such a result is that which we now write:—

$$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3,$$

which remains valid when we substitute any particular numbers for a and b, and labour in calculation is often saved by the formula, even in this very simple case.

The great revolution in mathematical thought brought about by Descartes in 1637[2] consists in the application of this general algebra to geometry by the very natural thought of substituting the numbers expressing the lengths of straight lines for those lines. Thus a point in a plane (for instance) is determined in position by two "co-ordinates" or numbers denoted by x and y, x denoting the distance from a fixed point along a fixed straight line (the abscissa) to a certain point, and y denoting the distance from this last point along a perpendicular (an "ordinate") to the abscissa to the point in question determined by x and y. As the point in question varies in position, x and y both vary; to every x belongs, in general, one or more y's, and we arrive at the most beautiful idea of a single algebraical equation between x and y representing the whole of a curve—the one equation, called the "equation of the curve," expressing the general law by which, given any particular x out of an infinity of them, the corresponding y or y's can be found. Thus $y=3x+2$ gives *one* y for each x, $y^2=3x+2$, or, more generally, $y^2=mx+n$, where m and n stand for any fixed numbers, gives *two* y's, one positive and one negative (above and below the abscissa respectively), for each x, except when x is zero.

The problem of drawing a tangent—the limiting position of a secant, when the two meeting points approach indefinitely close to one another—at any point of a curve came into prominence as a result of Descartes's work, and this, together with the allied conceptions of velocity and acceleration "at an instant"[1] which appeared in Galilei's classical investigation, published in 1638, of the law according to which freely falling bodies move, gave rise at length to the powerful and convenient "infinitesimal calculus of Leibniz and the "calculus of fluxions" of Newton. It is now clearly established that those two methods, which are theoretically—but not practically—the same, were discovered independently; Newton discovered his first, and Leibniz published his first, in 1684. The finding of the areas of curves and of the shapes of the curves which moving particles describe under given forces showed themselves, in this calculus, as results of the inverse process to that of the direct process which serves to find tangents and the law of attraction to a given point from the datum of the path described by a particle. The direct process is called "differentiation," the inverse process "integration."

Newton's fame is chiefly owing to his application of this method to the solution, which, in its broad outlines, he gave, of the problem of the motion of the bodies in the solar system, which includes his discovery of the law according to which all matter gravitates towards (is attracted by) other matter. This was given in his "Principia" of 1687; and, for more than a century afterwards, mathematicians were occupied in extending and applying the calculus.

Of the great mathematicians of this time—the brothers Bernoulli, Euler, Clairaut, d'Alembert, Maclaurin, Lagrange, Laplace, Legendre, Fourier, Poisson, and others—most were Frenchmen; and the successful application of mathematics to celestial and molecular mechanics, to hydrodynamics, to the theory of the conduction of heat, and to electricity and magnetism, brought about, in a great measure, that enthusiastic trust in science, that faith that the whole mystery of life and of our lives was about to be uncovered by it, and that waning of faith in religion, which are so characteristic of France in the eighteenth century, and which are met with in the highest degree in Laplace.

Whether or not it was due to the indirect influence of Kant, whose "Critique of the Pure Reason" first appeared in 1781, an increasing tendency towards critical examination into the validity and the limits of validity of mathematical conceptions and methods appeared in the mathematics of the nineteenth century. First of all we must mention Gauss, who, in an unexampled degree, combined the power of discovery and profound critical insight, so that in the seven volumes of his publications, in the collected edition of his works, there is hardly a page which is not both important in the history of mathematics and free from error. But perhaps of still greater influence was the work of the French mathematician Cauchy; it is he who must be regarded as the chief inspirer—perhaps indirect—of Weierstrass; it is Weierstrass who was the chief inspirer of Georg Cantor, and it is to the influence of Cantor and Dedekind, most of all, that we owe that trend of thought which, with modern mathematical logicians, has resulted in the great discovery of the logical nature of mathematics.

Of course, in this short description there is no implication that the nineteenth century has been poor in the more technical achievements or physical applications of mathematics; in England alone the names of Stokes, Thomson

[1] In *The New Quarterly* for October, 1908 (vol. i., p. 498), Mr. N. R. Campbell has objected to the idea of Mach that "economy of thought" is the end for which scientific theories are formed, for reasons based, it seems to me, on a misunderstanding of what Mach really meant. Perhaps the phrase "economy of thought" is not well chosen, and may lead to such misunderstandings; for the principle directs attention to a rule of scientific method which can be readily admitted, and certainly the goal of science, as guided by this principle, will not "have been attained when its students have ceased to think." This rule may be thus described. As science advances, besides actually overcoming an obstacle, it, consciously or unconsciously, leaves marks of guidance for those who come after; so that those obstacles which required great genius to overcome in the first instance af erwards became quite easily so. This is necessary in order that our energies may not be spent by the time that we reach a new obstacle not hitherto surmounted; and "economy of thought" means that we are to be spared waste of the energy of thought whilst treading the path already trodden by our predecessors, so that we may keep it for the really important new problems—not that we may cease to think about problems, new or old.

And thus we have legacies left by great men, such as Lagrange's analytical mechanics and Fourier's theory of the conduction of heat, which are merely inventories of extensive classes of facts, arranged with wonderful compactness. In this description of an *infinity*, perhaps, of facts by a *few* formulæ, there is undoubtedly an æsthetic motive and value; but, apart from this, there is this important economical aspect, that a multitude of particular facts and "laws," which we had hitherto to remember, actually or artificially (in a note-book or library), is, in the theory, comprised in a few symbolical formulæ, which only require *logical* development to get at the particular cases. From this point of view we get the apparent paradox that "economy of thought" leads to the replacing of memory by reason. The solution of the paradox is that logical development can be made more mechanical even than memory, and that thus thought is spared, so that we can concentrate it on the unsolved problems which are always coming into our field of vision as we advance.

The tendency to economy of thought, which is shown in the growth of physics—for example, in the inclusion of the particular Biot's law of the distribution of temperatures in Fourier's theory—may also be seen in the symbolism of pure mathematics.

[2] We need hardly point out that this change was not sudden—that Descartes's "Géométrie" was not a "proles sine matre creata," but that here, as everywhere, the development of mathematics has followed the principle of continuity.

[1] Mathematically, the finding of the tangent at a point of a curve, and finding the velocity of a particle describing this curve when it gets to that point, are identical problems. They are expressed as finding the "differential coefficient," or the "fluxion" at the point.

(Lord Kelvin), and Maxwell, and those of many living show this; and in Germany one of the greatest influences in pure mathematics was Riemann, who is usually contrasted with Weierstrass as a type of the creative, as opposed to the critical, genius.[1] But in this article we are only concerned with questions in the theory of knowledge, with the principles of mathematics, and the basis of their application to physics, and, through these questions, with the relevance of mathematics to our whole civilisation and, what is still more important, to our whole lives.[2]

The critical inquiries into the nature and purposes of our conceptions in physics, which have been mentioned above, have put in a clear light the fact, which seems to have been overlooked by Laplace in that flush of enthusiasm which a mathematician can so readily understand, and which, without the excuse of the sudden illumination brought about in the eighteenth century by the development of mathematics, is still overlooked by the cruder physicists, that the "world" with which we have to deal in theoretical (mathematical) mechanics, for example, is but a mathematical scheme the function of which it is to imitate by logical consequences of the properties assigned to it by definition certain processes of nature as closely as possible. Thus our "dynamical world" may be called a model of reality, and must not be confused with the reality itself.

That this model of reality is constructed solely out of logical conceptions results from our conclusion that mathematics is based on logic, and on logic alone; that such a model is possible is indeed surprising, and the surprise only goes when we follow up in history the growth of the application of mathematics to physics. The need for completing facts of nature in thought was, no doubt, first felt as a *practical* need—the need that arises because we feel it convenient to be able to predict certain kinds of future events. Thus, with a purely mathematical model of the solar system, we can tell, with an approximation which depends upon the completeness of the model, the relative positions of the sun, stars, and planets several years ahead of time; this enables us to publish the "Nautical Almanac," which is so useful to sailors, and makes up to us, in some degree, for our inability "to grasp this sorry scheme of things entire . . . and re-mould it nearer to the heart's desire."

The need of the completion of facts in thought is not merely practical; it is also intellectual. The striving after logical completeness, whether in generality of results or consistency of its own premisses or those of its models of reality,[3] is accompanied by a feeling of æsthetic pleasure or of intellectual honesty, or of both. We may say that mathematics has an æsthetic and a moral value.

Mathematics is relevant to those who go down to the sea in ships, to those who stay on dry land and build bridges or locomotives, and to those who observe the sun's corona during a total eclipse to find out what the sun is made of. Mathematics is relevant to the philosopher, for not only has it investigated and does it investigate its own foundations, but also it explains what is meant by the philosophers' own phrases, such as "the postulate of the comprehensibility of nature" (which seems to be the postulate that a purely logical model is possible), and the "laws of uniformity, continuity, and causality." And lastly, mathematics, besides being relevant to æsthetics and morals in the above sense, is of moral significance in another respect. Since the basis of mathematics is logic, and logic alone,[1] all those personal, national, and historical questions which are from time to time mixed up with mathematics—however essential some of them may be to the understanding of certain points and to education—show themselves, when looked at from a higher plane of truth, to be irrelevant.

Philip E. B. Jourdain.

[1] On a closer consideration, this distinction breaks down almost entirely. Apart from the numerous instances which can be quoted of particularly critical work by Riemann and particularly creative work by Weierstrass, surely it is always true both that there should be no creation without criticism (otherwise we run the risk of building castles in the air) and that there cannot be any relevant criticism which does not add to our knowledge, and is in so far creative.

[2] *Cf.* A. Voss, "Über das Wesen der Mathematik." Pp. 3–4. (Leipzig and Berlin: B. G. Teubner, 1908.)

[3] I have tried to show by some examples that we can and ought to examine the details of our models with the aid of the most refined conceptions of modern mathematics, in order to be certain that the models are logically consistent ("On some Points in the Foundation of Mathematical Physics," *The Monist*, April, 1908, vol. xviii., pp. 217–26; *cf.* Voss, *op. cit.*, pp. 71–2). An example of the results of critical investigation into applied mathematics is the discovery—which has also obvious practical results in the avoidance of labour doomed to unfruitfulness—by Poincaré of limits of validity for certain of Laplace's formulæ.

[1] Mathematics is a wonderfully refined *symbolic* (for the importance of this character, see Voss, *op. cit.*, pp. 25–26) logic, the product of thousands of minds, and so adapted as to spare all waste of thought on unessentials.

THE IRON AND STEEL INSTITUTE.

The fortieth annual general meeting of the Iron and Steel Institute was held at the Institution of Civil Engineers on May 13 and 14, under the chairmanship of Sir Hugh Bell, who retains the office of president for another year, and will be succeeded next May by his Grace the Duke of Devonshire. The report of the council for the past year shows that the affairs of the institute are in a prosperous condition. Five Carnegie research scholarships had been awarded, and Mr. Carnegie had presented 11,000 dollars, the income of which would assist in meeting clerical expenses and those incurred in issuing special memoirs.

The proceedings on May 13 opened with three papers, taken together for discussion, dealing with corrosion and protection of iron and steel. The paper by Mr. W. H. Walker, of Boston, U.S.A., contains the fundamental conceptions involved in the modern electrolytic theory of the corrosion of iron, develops this theory from the facts now known, and shows that the older carbonic-acid theory can be, and is, included therein, and points out some of the practical applications of this theory to the problem of corrosion. Mr. Allerton S. Cushman, of the United States Department of Agriculture, contributed a paper on the preservation of iron and steel. The author favours the view of corrosion as an electrochemical phenomenon, and deals with the questions of the production of a metal highly resistant to corrosion, of protective coatings, and of the passive condition which iron is capable of assuming. It seems to be a fact that carefully made open-hearth metal, in which the ordinary impurities are cut down to mere traces, and in which the heat treatment has been carefully controlled, is much more resistant to corrosion than the ordinary types of metal with a comparatively high percentage of impurities. The preservation of iron and steel by application of other metals to the surface, and of paint and other coatings, is fully discussed, and certain experiments having the object of determining their relative values under ordinary weathering conditions, which are now being carried out in America, are described and illustrated with photographs. Mr. J. Cruickshank Smith, of London, contributed a paper on physical tests for protective coatings for iron and steel. Tests are described for examining the following points:—that the proper proportion of pigment and vehicle has been obtained with the minimum of free oil space in the dry film; the smallness and uniformity of size of the pigmentary particles; the possession of the property of minimum tendency of the pigment and vehicle to separate; the determination of the thickness and uniformity of the film and its strength and elasticity; the permeability and hardness of the film.

An important paper on the solubility of steel in sulphuric acid was contributed by Messrs. E. Heyn and O. Bauer, of Gross-Lichterfelde. This paper contains 120 pages of matter, together with plates, and can only be briefly noticed here. The authors' researches show that the transition from the martensite of hardened steel to pearlite of annealed steel is not continuous through the intermediate stage of tempering as has been hitherto supposed. There is an intermediate metastable form to which the authors have given the name of "osmondite," in honour of Osmond. The fact is shown by the curve of solubility in dilute sulphuric acid attaining a sharply defined maximum at 400° C. The researches dealt with the influences of the quenching and tempering of steel on its solubility, of quenching and re-heating soft mild steel, and of the quenching temperature; the influence of cold working and annealing on the solubility of mild steel, and of the chemical composition of iron on its susceptibility to attack by dilute sulphuric acid; the influence of the nature of the sulphuric acid employed on the solubility of iron. The regularity and trustworthy character of the results obtained prove the great utility of this method of deducing the nature of the previous treatment of the metal under examination.

A paper on the chemical physics involved in the decarburisation of iron-carbon alloys was read by Mr. W. H. Hatfield, of Sheffield. In this the author refutes the view of Dr. Wüst that it is necessary that the temper-carbon be precipitated before elimination. There generally remained at least 1 per cent. temper-carbon in so-called decarburised malleable cast iron.

The proceedings on May 14 opened with the presentation of the Bessemer gold medal to Mr. A. Pourcel, who first manufactured ferro-manganese and silico-spiegel in the blast furnace. A paper was then taken on the electric furnace and the electrical process of steel-making, by W. Rodenhauser, of Saarbrücken. Such furnaces can be divided into two groups, electric arc furnaces and those in which the arc is avoided. The paper contains working drawings and photographs of many furnaces of these types, and notes of their working and defects.

A paper on fuel from peat was read by Dr. M. Ekenberg, of London, dealing with the author's researches for finding a suitable process for converting peat into fuel without air-drying. An experimental apparatus for wet-carbonising peat-pulp and a peat briquette factory are described and illustrated.

A heat-treatment study of Bessemer steels was contributed by Prof. M'William and Mr. E. J. Barnes, of Sheffield University. This paper gives a large number of tests carried out by the authors on commercial English steels of varying carbon content. Many tables of results are appended.

The Bristol recording pyrometer was described by Messrs. P. Longmuir and T. Swinden, of Sheffield, together with notes of tests made with this low-resistance "shop-tool" at the works of the Sheepbridge Coal and Iron Company. Mr. C. E. Stromeyer, of Manchester, added another paper to his previous work on the ageing of mild steel and the influence of nitrogen. The net result of the experiments may be summarised as follows:—(a) the usual tensile and bending tests do not detect those treacherous steels which, after behaving well under the steel-works' tests, fail in the workshop; (b) the test strips which have been injured on their edges by chisel nicks and then bent clearly indicate that mild steel does change some of its qualities with time, and these changes can be accelerated by heating the samples to the temperature of boiling water.

Papers were contributed on high-tension steels, by Mr. P. Longmuir; on tests for hardness, by Prof. Turner, of Birmingham; and on the determination of carbon and phosphorus in steel, by Mr. A. A. Blair, of Philadelphia, U.S.A. Papers from the Carnegie research scholars dealt with the special steels in theory and practice, the strength of nickel-steel riveted joints, the preparation of carbon-free ferro-manganese, steels suitable for gears, and gases occluded in steel.

SCIENTIFIC WORK IN THE ENGLISH POTTERIES.[1]

THE English Ceramic Society, founded in 1900, has just issued the seventh volume of its annual Transactions. The membership report shows a steady growth from thirty members in the first two years to a little more than 200 during 1907 and 1908. Ten meetings were held during the session 1907–8, at Tunstall, Longton, Hanley, and Fenton. For the current session the president is Mr. F. H. Wedgwood, and the secretary Dr. J. W. Mellor.

Special attention appears to have been directed to the question of gas-firing, which formed the subject of a paper read by Dr. Seligman in December, 1907; of a second paper, by Mr. Schmatolle, read in January, 1908; and of a discussion in March, 1908; as the former speaker dealt with Continental types of furnace, and the latter came over from Berlin, it is evident that those who control the English potteries have something to learn from their Continental colleagues. The advantages claimed for gas-firing are economy of fuel (especially when a battery of kilns is arranged to work in series, using the same gas-current to cool one furnace and heat the next), a great reduction in breakages and in wear and tear, and, finally, the complete abolition of the smoke nuisance, which has made the "Potteries" and the "Black Country" synonymous terms.

An important paper is contributed by Messrs. Moore and Mellor on the adsorption and dissolution of gases by silicates, a question that derives great commercial importance from the tendency which some glazes show to "spit-out" by the liberation of bubbles of gas; the conclusion is drawn that, although the glaze itself may sometimes be responsible for the spitting, the trouble is usually due to the presence of moisture or of organic matter in the "body," and that the nature of the glaze is usually of secondary importance. The uninitiated may well wonder at the nature of the topics referred to in the discussions on "blungers" and on "pugging," but the address on "Porcelain," by the retiring president, at least is free from this obscurity of nomenclature.

In addition to arranging for scientific meetings, the society has appointed a committee for the purpose of adopting, in conjunction with workers in other countries, a standard method of clay analysis. The volume under review affords the fullest confirmation of the statement of the incoming president that, whilst "the society can easily make a president, it is the secretary who makes the society," his contribution including a share in the authorship of six of the seventeen papers now published.

[1] Transactions of the English Ceramic Society, vol. vii., Session 1907–8. Pp. xii+170. (Published by the Society, County Pottery Laboratory, Stoke-on-Trent, Staffordshire.) Price, Non-members, 21s.; Members, 10s. 6d.

THE CULTIVATION OF TEA.[1]

THIS little pamphlet of sixty-eight pages deals with the cultivation, and particularly with the manuring, of tea. A considerable amount of information on the subject has been gained through the experiments of Dr. Mann and others, and has been drawn on freely by the author. Tea requires a heavy rainfall—100 inches is mentioned as a suitable amount—and rather special conditions of cultivation obtain in consequence. Many of the plantations are situated on very sloping ground, and the soil is liable to be washed away; the difficulty is met by several devices, among others by growing plants with big leaves alternately with the tea plants, and thus covering the ground so far as possible. Leguminous plants like crotalaria, ground-nuts, dadaps, &c., are commonly used, and when they die or are cut down they supply both nitrogen and organic matter to the soil. Other nitrogenous manures are, however, in use, including oil cake (rape or castor), which is one of the cheapest, and ammonium sulphate. Potash manuring has been found to be very effective, and also phosphates, but lime is not popular among tea-growers.

The question of quality is dealt with at some length. As a rule, the higher the position of the plantation the better the quality of the tea, but the yield per acre is less; probably the lower temperature of the high ground is the determining factor. Heavy dressings of manure are prejudicial to quality, but Dr. Mann's experiments are quoted to show that light dressings frequently applied will increase the crop without injuring its quality.

The results of the manurial trials on the Pitakande Estate, Ceylon, are discussed in detail, and a very useful little chapter is given on the way to conduct such trials. "It is of paramount importance," says the author, "that every owner of a tea plantation should be in a position to experiment for himself and ascertain the most profitable way to manure his crops." This is a very sound position to take. The manures found most profitable at Pitakande would not necessarily be most profitable elsewhere; the real lesson for the tea-planter is to make his own experiments, and so to discover the fertiliser or mixture of fertilisers giving the best results on his own plantations.

[1] "The Fertilisation of Tea." By George A. Cowie. (*Tropical Life* Publishing Office.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following have been appointed members of the board of electors to the professorship of astrophysics:—Sir George Darwin, K.C.B., Sir Robert Ball, Sir William Huggins, K.C.B., O.M., hon. LL.D., Mr. Fitzpatrick (president of Queens' College), Dr. Hobson, Dr. Liveing, Sir J. J. Thomson, and Dr. R. T. Glazebrook.

The Rede lecture will be delivered on Thursday, June 24, at 12 noon, in the Senate House, by Sir Archibald Geikie, K.C.B., P.R.S. The subject will be "Darwin as Geologist."

The special board for biology and geology has reappointed Mr. J. J. Lister to be a manager of the Balfour fund for five years to June, 1914.

LONDON.—The governors of the Imperial College of Science and Technology, following on the appointment of Prof. Adam Sedgwick as professor of zoology at the college, and of Prof. McBride as his special assistant, have lost no time in making their intentions known with regard to the work of next session. Provision has been made, quite apart from the general work of the department, for a series of special courses of lectures. These include marine biology and fishery science with practical work at the college, and, during the summer vacation, at the Plymouth station of the Marine Biological Association by Dr. E. J. Allen, director; an advanced course of vertebrate embryology, by Mr. Richard Assheton; and, in addition, courses of entomology and the physiology of development, the lecturers for which have still to be appointed. In addition to the above, the governors have appointed Mr. Dobell as special lecturer in cytology and protistology, subjects of rapidly growing importance so intimately concerned with the phenomena and the causes that underlie the conditions of heredity, health, and disease.

At the meeting of the Senate of the University on May 19, the degree of D.Sc. in physiology was granted to Dr. N. H. Alcock, an internal student of the physiological laboratory, for a thesis entitled "The Physiology of the Peripheral Nerves, especially with regard to their Electrical Phenomena," and other papers. The degree of D.Sc. was also granted to the following external students:—in chemical physiology, to Mr. Charles Dorée, for a thesis on "Cholesterol," and other papers; and in geology, to Mr. John Ball, for a thesis entitled "A Description of the First or Aswan Cataract of the Nile," and other papers.

Mr. F. W. Twort has been appointed superintendent of the Brown Animal Sanatory Institution in succession to Dr. Gregor Brodie, resigned.

Mr. A. R. Brown has been appointed university lecturer in ethnology for the session 1909–10, under the Martin White benefaction.

The principal of the University (Dr. H. A. Miers, F.R.S.) has been appointed a member of the governing body of the Imperial College of Science and Technology in succession to Prof. D. S. Capper, resigned.

The certificates of the joint matriculation examination of the northern universities have been recognised under certain conditions as exempting from the London matriculation examination.

MR. C. A. EALAND, staff instructor in biology at the Essex County Laboratories, Chelmsford, has been appointed principal of the laboratories.

PROF. G. ELLIOT SMITH, F.R.S., professor of anatomy in the Government School of Medicine, Cairo, has been appointed to the chair of anatomy in the University of Manchester.

LORD CURZON OF KEDLESTON, Chancellor of the University of Oxford, was the principal guest at the summer dinner of the Oxford Graduates' Medical Club on May 20. Replying to the toast of "The Visitors," Lord Curzon said that to most people Oxford is identified with the study of what is properly known as humane culture. Very few people outside the colleges are aware of the fact that Oxford was once the home of the school of medicine, and that it has turned out some of the most distinguished physicians who have cast lustre upon the English name. After eulogising the achievements of Linacre, Sydenham, Wren, Harvey, and Radcliffe, the Chancellor went on to remark that about the middle of the last century the condition of science at Oxford might almost be compared to that of the Dark Ages, and the attitude towards medical science in particular, and to science in general, was one of suspicion if not of active hostility. "In 1850, when the first commission was about to commence its labours at Oxford, there was not a single scientific laboratory in that University, and had the whole of the medical students in Oxford at that time been sent down, they could have been taken to the station, if station there was, in a single four-wheeled cab. But even when the night was darkest, the dawn was nigh; and there has been no more dramatic, more inspiring, or more creditable page in the history of learning than the steps by which science fought its way back into Oxford until, at the present moment, it sits enthroned alongside the humanities and has a crown of equal authority and prestige upon its brow."

THE Department of Agriculture and Technical Instruction for Ireland has published the results of an inquiry, by Mr. F. C. Forth, director of technical instruction for Belfast, into the number of students of each age enrolled in the classes of the Belfast Municipal Technical Institute, together with notes on the increase in attendance that is possible at technical classes. The statistics published in the report are rendered more intelligible when it is remembered that the population of Belfast in 1901 was 349,180, and that about one-fifth of the population, or 63,870, were from five to fourteen years of age, of whom 50,000 were on the rolls of national schools; 7000 were fourteen years of age, of whom only 730 were attending national schools. A satisfactory feature of the statistics is the great increase they show in the number of students at each age during the seven years of the institute's existence. It is clear, too, that the students now begin their evening studies at an earlier age after leaving the day school than was formerly the case. In 1901 there were more students at seventeen than any other age; in 1907 the largest number were sixteen years of age. Another outstanding fact is the large increase in the number of women students as compared with the men. Mr. Forth discusses what he calls "ideal" conditions of education, and arrives at some interesting results. He takes one-sixth of the population to be of elementary-school age and about 2 per cent. as of fourteen years of age—which he thinks might be taken as the age for leaving the day school and entering evening classes. If half the number of children of fourteen years of age joined the evening classes and followed up their studies, that would mean 1 per cent. of the population, and if certain other "ideal" conditions prevailed $5\frac{1}{2}$ per cent. of the population would be undergoing technical instruction, and this in the case of Belfast would raise the total number of students' scientific and technological subjects from about 5000 to 20,000 students.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 20.—Sir Archibald Geikie, K.C.B., president, in the chair.—Observations on the urine in diseases of the pancreas: P. J. **Cammidge.** In the course of a series of observations on the metabolic changes associated with diseases of the pancreas it was found that if the urine of a patient suffering from an inflammatory affection of the gland were boiled with hydrochloric acid, the excess neutralised with lead carbonate, and the freed glycuronic acid precipitated out with tri-basic lead acetate, treatment of the filtrate with phenylhydrazine, after the excess of lead had been removed with sulphuretted hydrogen, yielded a crystalline product which varied in amount with the intensity and stage of the disease. Normal urines, and specimens from patients suffering from diseases in which there was no reason to think that the pancreas was involved, gave no reaction. Twenty-eight cases in which the urine had been examined during life were investigated *post-mortem*, and the results of the urinary examination confirmed. The urines of three dogs with experimentally induced acute or chronic pancreatitis were found to give a characteristic reaction. A detailed examination of a large quantity of urine from each of eight patients giving a well-marked reaction showed that it was due to a sugar having the reactions of a pentose, and yielding an osazone with a melting point of 178° C. to 180° C. Attempts to isolate the mother-substance were not successful; it would appear to be derived from the pancreas, and is probably set free as the result of degenerative changes in the gland, passing into the blood, and being excreted in the urine.—*Trypanosoma ingens*, n.sp.: Sir David **Bruce** and Captains A. E. **Hamerton**, H. R. **Bateman**, and F. P. **Mackie**.—The incidence of cancer in mice of known age: Dr. E. F. **Bashford** and Dr. J. A. **Murray**. The relative frequency of cancer at different age periods in female mice has been determined on animals bred for the purpose, the ages, sex, and parentage being carefully recorded. The diagnoses have been made by combining clinical observation with microscopical examination and transplantation of the tumours, and with *post-mortem* examination of the animals. Following Jensen, the authors demonstrated in 1903–4 that cancer can be transmitted artificially from one individual to another of the same species by the implantation and continued growth of living cancer-cells, and have shown that this form of transmission is not responsible for the great frequency of the disease. Other authors have since described "epidemics" of cancer in animals, especially mice. In the course of a year the present authors observed nineteen cases of cancer in their mice. This aggregation of cases corresponds to the "epidemics" adduced as evidence that the disease is infective. The cases have been analysed with reference to the age at which the tumours were first observed. The following table gives the liability to cancer at different age-periods:—

Age	6–9 months	–12 months	–15 months	–18 months	–21 months	–24 months and over
Total ...	135	110	94	21	6	—
Cancer ...	3	4	7	3	2	—
Per cent. ...	2·2	3·5	7·4	14·2	33·3	—

The progressive increase shown in the table presents a remarkable parallel with the age-incidence of cancer in the human subject, and confirms the earlier statements (Proc. Roy. Soc., January, 1904, &c.) that in animals, whatever their length of life, the recorded frequency of cancer varies, as in man, with the opportunity for examining a sufficiently large number of adult and aged individuals. The observations also add a statistical confirmation to the results of the comparative histological and biological studies of the Imperial Cancer Research Fund, which have shown the close parallel, amounting in many particulars to complete identity, between malignant new growths in man and other vertebrates. They demonstrate that the law of the age-incidence of the disease holds for the shortest-lived mammals as it holds for man. Since the facts agree with the less perfect data for other vertebrates, the general application of the law of age-incidence is probable, and, therefore, any explanation of the etiology of cancer must accord with the circumstance that, when considered *statistically* cancer is a function of age, and when considered *biologically* a function of senescence.—A method of estimating the total volume of blood contained in the living body: Dr. J. O. W. **Barratt** and Dr. W. **Yorke**. The principle employed in this method is that of injecting into the blood stream a known amount of dissolved hæmoglobin, and then determining the degree of the resulting hæmoglobinæmia. This enables the volume of the blood plasma to be calculated, and, with the aid of a hæmocrit determination of the composition, by volume, of the blood, the total amount of blood present in the living body is ascertained. The hæmoglobin employed is obtained from the red blood cells of the subject of observation. No ill-effect has been observed after injection of dissolved hæmoglobin. The estimation of hæmoglobin is generally made with von Fleischl's hæmoglobinometer, the scale of the instrument having been previously standardised by means of solutions containing known amounts of red blood cells. When the depth of the natural colour of the blood plasma, before injection, is markedly increased, as sometimes happens, it is difficult to obtain hæmoglobinometer readings of the amount of dissolved hæmoglobin present after injection. In such cases the blood plasma, suitably diluted, is matched, by means of a comparison spectroscope, with solutions containing known amounts of dissolved hæmoglobin.

Zoological Society, May 11.—Prof. E. A. Minchin, vice-president, in the chair.—(i.) Hitherto unrecorded specimens of *Equus quagga*; (ii.) differentiation of the three species of zebras; (iii.) a portion of a fossil jaw of one of the Equidæ: Prof. W. **Ridgeway**.—The batrachians and reptiles of Matabeleland: E. C. **Chubb**.

Royal Astronomical Society, May 14.—Sir David Gill, K.C.B., F.R.S., president, in the chair.—Spectroscopic comparison of *o* Ceti with titanium oxide: A. **Fowler**. The spectrum of the star had been taken by Mr. Slipher at the Lowell Observatory, and that of titanium oxide at South Kensington. The two spectra were, for the most part, identical, and their comparison forms a contribution to the analysis of the third type of spectra, showing the titanium oxide origin of many bands in the red, the details of which are not given by Vogel and Dunér.—Solar parallax papers, No. 7: A. R. **Hinks**. The present paper gives the details of the general solution from the photographic right ascensions of Eros at the opposition of 1900, the resulting parallax being about 8·807″. A further communication, giving results from micrometric observations, will shortly be presented.—An easily constructed sun-dial: W. E. **Cooke**. The sun-dial shown was of wood; it could be made by an ordinary carpenter, and was being introduced among the planters and farmers of Western Australia. An adjustment, to be made once for all, reduced local to standard time, and a further adjustment for the equation of time enabled the dial to be read to within about half a minute without the necessity of consulting tables.—Researches on the solar atmosphere: H. **Deslandres**. M. Deslandres gave an account of his spectrographic work at Meudon Observatory, illustrated by photographs showing the faculæ, &c., in monochromatic light.

Royal Anthropological Institute, May 18.—Prof. W. Ridgeway, president, in the chair.—Tibetan and Burmese amulets: Dr. W. L. **Hildburgh**. The author first referred briefly to the general principles underlying the employment of amulets. He touched on the beliefs in demons or evil spirits as producers of certain diseases, and on the use of protections against such diseases and against others not necessarily caused by similar influences. He also outlined the principal reasons guiding primitive peoples in their choice of amulets. Passing to Tibetan amulets, the author divided them, for convenience of reference, into religious, secular, and natural amulets. The religious amulets consist principally of the well-known printed paper charms, of which a considerable number were exhibited, small images of deities or the like, and relics and other articles with which religious ideas are associated. The secular amulets are such as are formed artificially, but in which the intercession of supernatural beings is not immediately concerned. Such are twisted metal bracelets against strains in the arms, or charms of plaited cords. The natural amulets consist of natural substances in which the protective or curative virtues are inherent, frequently so because of supposed sympathetic connection. Such are parts of the tiger, the elephant, the musk-deer, and other animals, particularly such parts as the teeth, claws, bones, or hairs. The medicinal use of such objects was also mentioned. The paper on Burmese amulets covered the ground in much the same manner. Amongst the principal Burmese amulets referred to by the author were rings made of genuine or imitation elephant hair, ornaments of elephant-nail, parts of various animals, coral, amber ornaments, representations of animals, and objects which had been subjected to magical ceremonies.

Royal Meteorological Society, May 19.—Mr. H. Mellish, president, in the chair.—The anticyclonic belt of the northern hemisphere: Colonel H. E. **Rawson**. In a previous communication the author brought forward some facts regarding the anticyclonic belt of the southern hemisphere, derived from an examination of the South

African records from the year 1841 to 1906. He found that the indications of a cyclical oscillation of the belt to and from the equator over South Africa were strong enough to encourage the belief that an analysis of Australian records on the one side, and of Argentine on the other, would prove that all the action centres of the atmosphere were moving together over this wide area, and that a similar oscillation existed in the northern hemisphere. He subsequently found that investigations of Mr. H. C. Russell and Dr. W. J. S. Lockyer supported his conclusion that there is a period of about 9·5 years between the greatest north and greatest south position of the anticyclonic belt in the southern hemisphere, the double oscillation thus taking nineteen years. He has since extended the inquiry into the movements of the action-centres in the northern hemisphere with the view of ascertaining whether they show any similar oscillation to and from the equator, which is not to be explained by seasonal changes of position. Dealing with the Nile floods, he draws the inference that the high-pressure systems which affect North-east Africa are farther north when the floods are in excess and nearer to Egypt when they are deficient. He also made an analysis of the tracks of the hurricanes which passed north and south of Manila Observatory, and found that these throw an interesting light upon the oscillations of the action-centres of the atmosphere.—Errors of estimation in thermometric observations: A. **Walter.** In examining the returns from a newly inaugurated series of second-order meteorological stations in Mauritius, it was noticed that a large percentage of the thermometer readings was in whole or half divisions. This led the author to analyse the returns, and he gave in the paper the frequency curves of the "tenths of estimation."

Institution of Mining and Metallurgy, May 20.—Mr. Edgar Taylor, president, in the chair.—Notes on the Zangezour copper mines: Dr. A. L. **Simon.** A brief description of the geology, mines, and mining conditions and costs of mining, reduction and production of copper in this district of the Little Caucasus.—The determination of tungstic acid in low-grade wolfram ores: H. W. **Hutchin** and F. J. **Tonks.** A description of a new method introduced by the authors, for which it is claimed that it combines the accuracy of the mercurous nitrate method with an improvement in the attack of the mineral, fusion with alkalis being replaced by digestion with caustic soda solution. The preliminary treatment with hydrofluoric acid becomes unnecessary, and the charge of ore can be much larger than is customary. The paper consists of two parts, section i. dealing with the working details of the assays employed, with a tabulation of results for comparison, whilst section ii. is supplementary, and consists mainly of an investigation of conditions affecting the aqua regia method and that here brought to notice.—Cupellation experiments; the thermal properties of cupels: C. O. **Bannister** and W. N. **Stanley.** The authors here record a series of careful experiments made for the purpose of comparing patent cupels (*i.e.* cupels made with a magnesite base) with bone-ash cupels, as regards their relative diffusivity of heat, specific heat, and rate of cooling, &c., and the result of their tests was to establish the existence of great differences in the thermal properties of the two classes of cupel mentioned, notably as follows:—the diffusivity of heat and specific heat of patent cupels are greater, and the actual temperature of the cupelling button is much lower, at the same temperature of muffle, in patent cupels than in those made of bone-ash, and silver beads take longer to solidify and spit, and are, indeed, much less likely to spit, on patent than on bone-ash cupels.—The bessemerising of hardhead: D. M. **Levy** and D. **Ewen.** The authors found, in the course of researches conducted to that end, that it is possible by bessemerising to convert hardhead, which is one of the waste products of tin smelting, into a highly ferruginous slag, and a fume consisting to a large extent of arsenic oxide with some tin oxide, whilst nickel and cobalt gradually concentrate in the diminishing button. The heat evolved by the operation is sufficient to keep the products molten and the process self-supporting. It remains to be ascertained, however, whether the slags can be obtained of sufficiently low tin contents to make the process a commercial success.—The use of standards in reading gold pannings: S. J. **Lett.** Having procured for his own use weighed standards of gold dust for comparison when reading pannings, the author submitted a description of these for the benefit of others requiring a handy and portable apparatus by means of which it is, the author claims, possible to gauge accurately a much smaller quantity than 1 dwt.—Notes on the scaling and sweating of copper battery plates: S. F. **Goddard.** This is a brief account of the results of cleaning two copper plates after fifty months' running, during which period 33,000 tons of quartz ore were crushed. It was found subsequently, by melting the plates, that only an exceedingly small percentage of gold was actually absorbed by the copper, and that only in the upper portion.

MANCHESTER.

Literary and Philosophical Society. May 4.—Mr. F. Jones, president, in the chair.—The tent-building habits of the ant *Lasius niger*, Linn., in Japan: Dr. Marie **Stopes** and C. G. **Hewitt.** The species of ant constructing the nests, which were cylindrical in shape, is *Lasius niger*, the common brownish-black ant occurring in our English gardens. In this particular district of Hayama, within fifty miles of Tokyo, it constructs shelters of minute grains of sand cemented together on the twigs of the Ilex as axes. The object of these nests is to afford shelter for aphides or "plant-bugs" which live upon the plant and are looked after by the ants for the sake of the "honey-dew" which they secrete. The shelters not only keep the aphides warm, and so increase their yield of "honey-dew," but also prevent them from escaping and protect them from their enemies and other ants. For their own convenience the ants also construct covered galleries of the sand detritus, which wind round the trunk of the tree and communicate with the tents in which the aphides are confined and with their own nest on the ground. This is the only case described of *L. niger*, which has a world-wide distribution, constructing tents of this kind.—The permanent change of volume effected in cast irons by repeated heatings: Prof. H. F. **Rugan** and Prof. H. C. H. **Carpenter.**

DUBLIN.

Royal Dublin Society, April 20.—Mr. J. E. Gore in the chair.—Mechanical stress and magnetisation of iron: W. **Brown.** Results have been obtained with iron wires in a perfectly uniform magnetic field throughout their entire length by varying the magnetic field, the load, the size of wire, and the magnitude of the current through the wire.—Methods of determining the amount of light irregularly reflected from rough surfaces: Prof. W. F. **Barrett.** The amount of light irregularly reflected from rough surfaces is a matter of considerable practical importance, especially in the case of large surfaces, such as walls and buildings, but no satisfactory data appear to be obtainable. The law of inverse square being inapplicable to such surfaces, the author has employed two methods, which yield satisfactory results. A Lummer-Brodhun or other similar type of photometer is employed, and the intensity of the stronger light reduced by (1) a rapidly revolving opaque disc having a sector cut out, the size of which can be accurately adjusted until a photometric balance is obtained, or (2) by an adaptation of the author's instrument for determining the "light-threshhold" of the eye. In this case the stronger light is reduced by absorption through a column of liquid of neutral tint, the length of the column being capable of easy and accurate adjustment. By this means measurements can be made of the light diffused at various angles from small surfaces, which are used to replace the silvered mirror that reflects the standard light through the liquid column. This arrangement also affords a convenient method of testing different systems of lighthouse illuminants.—A new form of polarimeter for the measurement of the indices of refraction of opaque bodies: Prof. W. F. **Barrett.** By means of Brewster's law the index of refraction of opaque non-metallic bodies can be found if the angle of maximum polarisation by reflection can de determined. In the instrument devised by the author this angle is expeditiously found by causing the telescope, which projects a parallel incident beam on to the reflecting surface, and the collimator which carries the analyser, to move simultaneously through equal angles by means of a simple form of link motion. A source of monochromatic light (a small glow-lamp in a coloured globe) is rigidly attached to, and moves with, the telescope. To enable opaque liquids to be examined, the graduated circle over which the telescope and collimator move is fixed in a vertical plane. Fusible substances are contained in a porcelain capsule, which can be heated by steam or by an electric current, so that a reflecting liquid surface is thus obtained.—Further observations on the powdery scab of the potato, *Spongospora subterranea* (Wallroth): Prof. T. **Johnson.** The author brought forward evidence in favour of the view that the organism responsible for the scab is a true slime-fungus identical with the *Erysibe subterranea* described by Wallroth in 1842. He also gave an account of experiments conducted last year to prevent the scab.

PARIS.

Academy of Sciences, May 10.—M. Émile Picard in the chair.—Critical examination of the monochromatic images of the sun with the hydrogen lines: H. **Deslandres** and L. **d'Azambuja.** A further instalment of the results obtained with the large spectroheliograph at Meudon, a description of which instrument is given in an earlier paper. For the red hydrogen line, the first-order spectrum with a grating gave sufficient dispersion. With this arrangement, not only has the entire line been isolated, but also separately the centre of the dark line and its edges. The image of the centre, representing the upper layer of hydrogen, has been compared with the corresponding layer K_3 of calcium, and was found to present the same characters, although somewhat weakened. Some of the phenomena previously observed are shown to be due, not to peculiarities in the emissive or absorptive power of hydrogen, but to an instrumental cause, a defect of the spectroheliograph.—The unsymmetrical enlargement of the lines of the arc spectrum and their comparison with those of the solar spectrum: Ch. **Fabry** and H. **Buisson.** When the arc is produced between iron poles in a vacuum it is less luminous than when produced at atmospheric pressure and all the lines are much finer. Certain lines, which in the air arc are distinctly thickened, in a vacuum cannot be distinguished from the others. The observations form a complete confirmation of the explanation given by the authors of the anomalies observed in the comparison of the sun and arc spectra.—A recent note of M. Stekloff: E. **Goursat.** A claim for priority.—Problems of elasticity in two dimensions: C. **Kolossoff.**—The nomographic representation of equations with four variables: Maurice **d'Ocagne.**—An arrangement of a carrying surface for an aëroplane: Maurice **Caron.**—An apparently abnormal fact which occasionally occurs in commercial transformers: M. **Gacogne** and A. **Léauté.** The anomaly described is due to the capacity of the transformer.—An influence of radium on the velocity of crystallisation: Louis **Frischauer.** Comparative measurements were taken of the rate of crystallisation of droplets of surfused sulphur, a portion of the sulphur only being exposed to the radiation from radium salt. In the latter case the velocity of crystallisation was increased. The radium emanation gave a similar result, but exposure to the Röntgen rays was without influence. It would thus appear that it is the α rays which are active in this respect.—Thermo-endosmosis: M. **Aubert.**—The charge of a negative ion of a flame: Georges **Moreau.** The charge found $e=4.3\times10^{-10}$, and may be compared with the value for the charge of an electron found by Millikan (4.06), Perrin (4.1), and Rutherford (4.65), all divided by 10^{10}.—The discharge of inductors: E. **Caudrelier.**—The teleautocopyist for the transmission of images to a distance: Laurent **Sémat.** A description is given of the apparatus and of the method of securing the necessary isosynchronism. All the operations take place in daylight, and are controlled by purely mechanical methods, neither photography nor selenium being used. About five minutes are required to transmit a plate measuring 7 cm. by 12 cm.—Wireless telephony: MM. **Colin** and **Jeance.** The special advantages of the apparatus described are the arrangements of the negative electrodes of the arcs to ensure steadiness, the utilisation of an intermediate circuit for giving a simple constant oscillation, and the arrangement of the microphones.—The radium emanation: A. **Debierne.** The volume of emanation in equilibrium with 1 gram of radium was found to be, in mean, 0.58 cubic millimetre, in close agreement with the results of Rutherford and Royds, but much smaller than the 7 cubic millimetres of Ramsay and Cameron. From the curves of decrease of the intensity of the radiation a diminution to one-half takes place in 3.81 days.—The anhydrous combinations of thorium chloride with the alkaline chlorides: Ed. **Chauvenet.** Anhydrous thorium chloride combines with the alkaline chlorides, giving compounds of the type $ThCl_4.2MCl$ with the metals Li, Na, K, Rb, and Cs, and $ThCl_4.4MCl$ with Rb and Cs only. Ammonium chloride forms the exceptional compound $ThCl_4.NH_4Cl$.—Benzoylacrylic acid. The condensation of glyoxylic acid with some ketones: J. **Bougault.** In alkaline solution glyoxylic acid readily condenses with acetophenone and analogous ketones, forming diphenylacetic acid or analogous acids. Dianisylacetic and diperacylacetic acids, prepared by this reaction, are described.—The modifications of anthesterol and its benzoate: M. T. **Klobb.**—A nephelinic syenite from the Transvaal: H. A. **Brouwer.**—The energy necessary for kneading by machinery: M. **Ringelmann.**—Observation of ovules of the rabbit with two germs, contained in a common envelope of albumen secreted by the oviduct: Cl. **Regaud** and G. **Dubreuil.**—A popular remedy for cancer: Robert **Odier.**—The regulation of the secretions by d'Arsonvalisation: Foveau **de Courmelles.** The high-frequency treatment leads to increased secretion of urea, uric acid, and chlorides, together with a diminution in the amount of phosphate eliminated.—Costiasis and its treatment in young trout: Louis **Léger.** The use of a weak solution of formalin (35 c.c. to 40 c.c. of the 40 per cent. solution in 100 litres of water) is suggested for destroying the parasite (*Costia necatrix*), the cause of the disease. The young trout are not injured by this solution. Another trout disease gyrodactylosis, is cured by the same treatment.

May 17.—M. Émile Picard in the chair.—Biaxial crystallised liquids: Fred. **Wallerant.** Liquid azoxyanisol shows the true properties of biaxial crystals. This is regarded as an argument in favour of the absolute identity of liquid and solid crystallised bodies.—A new Australian Onychophorus: E. L. **Bouvier.** The new species resembles *Peripatoides Suteri*, but this resemblance is only superficial, since many distinctive characters are different.—Surfaces of total constant curvature: C. **Guichard.**—The value of the invariants ρ and ρ_0 for surfaces of the fourth order with double isolated points: L. **Remy.**—The residues of measurable functions: Frédéric **Riesz.**—The principle of Dirichlet and the development of harmonic functions in polynomial series: Serge **Bernstein.**—Linear differential equations and uniform transcendentals of the second order: René **Garnier.**—An example of the Zeeman effect, positive and longitudinal, in the emission spectra of vapours: A. **Dufour.**—The chromatic circle according to Young's hypothesis: A. **Rosenstiehl.** The new chromatic circle designed by the author gives colours possessing the following qualities of the fundamental colours required by Young's theory:—the complementary of the orange is the first green-blue; the third yellow-green, of which the complementary is the first violet; and the third blue, having as complementary the yellow placed between the first and second yellow. The defects of the old colour circle are discussed.—Measurements of the Brownian movements in gases and the charge of particles in suspension: M. **de Broglie.** From an ultramicroscopic study of the motion of a charged particle of tobacco smoke in an electric field, followed by the application of the formulæ of Stokes and Einstein, the value for the charge e is deduced as 4.5×10^{-10}, agreeing well with the results obtained by different methods.—The lower harmonics: G. **Sizes** and G. **Massol.**—Kathodic projections: L. **Houllevigue.** It is known that a kathode placed in a vacuum projects, besides corpuscles deviable by a magnet, particles of itself. Since these are not appreciably deviated by a magnetic field, it follows that these particles have either a relatively large mass, a small electric charge, or a high velocity. The experiments here recorded accord with the first hypothesis.—The freezing point of gaseous mixtures at very low temperatures: Georges **Baume.** An apparatus is described and figured by means of which accurately measured volumes of pure gases can be mixed and frozen, and the freezing point determined. The apparatus has been applied to the cases of mixtures of methyl oxide and hydrochloric acid, methyl oxide and sulphur dioxide, and methyl oxide and methyl chloride.—The theory of organic bases according to the viscosity of their solutions: D. E. **Tsakalotos.** From measurements of the viscosity of aqueous solutions of trimethylamine, pyridine, piperidine, and nicotine, the conclusion is drawn that all these bases form molecular combinations with water.—Study of the system water, liquid ammonia. Concordance of the results with the hypothesis of ammonium hydrate: E. **Baud** and L. **Gay.** Measurements were made of the heat disengaged and the contraction accompanying the mixture of water and anhydrous ammonia. The experimental results agree with the hypothesis of the existence in aqueous solutions of ammonia of the hydrate $NH_3.H_2O$, in equilibrium with water and free ammonia.—The colouring properties of lead chromate: Léo **Vignon.** Chromate of lead in suspension is taken up by cotton, wool, and silk, the depth of dye varying with the proportion of chromate in the bath, but being nearly identical for all three materials.—Dipropargyl: magnesium derivative, octadiinedioic acid: MM. **Lespieau** and **Vavon.**—The gaseous, respiratory exchanges of the aërial vegetative organs of the vascular plants: G. **Nicolas.**—The presence of indol-producing bodies in culture broths: Ch. **Porcher** and L. **Panisset.** The use of the indol reaction as a test for certain bacteria is liable to lead in certain cases to erroneous conclusions, since the reaction may sometimes be given by the original culture fluid.—The action of the Bulgarian ferment *yoghourt* on various sugars: Gabriel **Bertrand** and F. **Duchácek.** Arabinose, xylose, sorbose, maltose, saccharose, and mannitol are not fermented by this agent, but glucose, mannose, galactose, levulose, and lactose are easily fermented. In all cases the fermentative products contain *d*- and *l*-lactic acids, a small proportion of formic and acetic acids, and succinic acid.—The influence of boric acid on diastatic actions: H. **Agulhon.**—The ichthyological fauna of Lake Tchad: J. **Pellegrin.**—The stratigraphical characters of the layers of the French and Swiss Alps: Émile **Haug.**—The tectonic of the southern slopes of the *massifs* of Canigou and Puigmal: O. **Mengel.**—The stratigraphical results of an expedition in Chaouîa, Morocco: Louis **Gentil.**—The cranial capacity of fossil men of the type known as Neanderthal: Marcellin **Boule.** Direct measurements of the capacity of the fossil skull from La Chapelle-aux-Saints gave a volume of about 1600 c.c., and it is suggested that the volume of the Neanderthal skull is of the same order, and that the 1230 c.c. attributed to it by Schaafhausen, Huxley, and Schwalbe is too small.—The bend of the Rhine at Bâle: Gabriel **Eisenmenger.**

DIARY OF SOCIETIES.

THURSDAY, MAY 27.

ROYAL SOCIETY, at 4.30.—Notes concerning Tidal Oscillations upon a Rotating Globe: Lord Rayleigh, O.M., F.R.S.—The Absolute Value of the Mechanical Equivalent of Heat in Terms of the International Electrical Units: Prof. H. T. Barnes.—An Approximate Determination of the Boiling Points of Metals: H. C. Greenwood.—Some Results in the Theory of Elimination: A. L. Dixon.—The Liquidus Curves of the Ternary System Aluminium-Copper-Tin: J. H. Andrew and C. A. Edwards.—Studies on the Structure and Affinities of Cretaceous Plants: Miss M. C. Stopes and Dr. K. Fujii.

ROYAL INSTITUTION, at 3.—Newfoundland: J. G. Millais.

INSTITUTION OF MINING ENGINEERS, at 11.—Presidential address: Dr. R. T. Moore.—Electricity in Coal-mines: R. Nelson.—Comparison between the Value of Surplus Gas from Regenerator Bye-product Coke-ovens and Steam produced by the Waste Heat from Bye-product Coke-ovens, with Special Reference to the Evence Coppée new Bye-product Ovens: M. H. Mills.

FRIDAY, MAY 28.

ROYAL INSTITUTION, at 9.—Advances in our Knowledge of Silicon as an Organic Element: Dr. J. Emerson Reynolds, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 10.30.—The Use of Concrete for Mine Support: Prof. W. R. Crane.—Mining in British Columbia: Mrs. Rosalind Young.

SATURDAY, MAY 29.

ROYAL INSTITUTION, at 3.—The Secret Societies of the Banks' Islands: Dr. W. H. R. Rivers, F.R.S.

TUESDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—Biological Chemistry: Dr. F. Gowland Hopkins, F.R.S.

WEDNESDAY, JUNE 2.

ENTOMOLOGICAL SOCIETY, at 8.—On the Colonisation of New Nests by Myrmecophilous Coleoptera: H. St. J. Donisthorpe.

SOCIETY OF PUBLIC ANALYSTS, at 8.

THURSDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—A Modern Railway Problem: Steam *v.* Electricity: Prof. W. E. Dalby.

LINNEAN SOCIETY, at 8.—On the Alcyonaria of the *Sealark* Expedition: Prof. J. A. Thomson.—On the Cephalochorda of the *Sealark* Expedition: H. A. S. Gibson.—Report on the Porifera collected by Mr. C. Crossland in the Red Sea: R. W. Harold Row.

RÖNTGEN SOCIETY, at 8.15.—Annual General Meeting.

INSTITUTE OF ACTUARIES, at 5.—Annual General Meeting.

FRIDAY, JUNE 4.

ROYAL INSTITUTION, at 9.—Researches in Radiotelegraphy: Prof. J. A. Fleming, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Fossiliferous Lower Keuper Rocks of Worcestershire: L. J. Wills.

SATURDAY, JUNE 5.

ROYAL INSTITUTION, at 3.—The Vitality of Seeds and Plants: (1) A Vindication of the Vitality of Plants: Dr. F. F. Blackman, F.R.S.

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THURSDAY, JUNE 3, 1909.

THE EVOLUTION OF THE VASCULAR SYSTEM IN FERNS.

Lectures on the Evolution of the Filicinean Vascular System. By A. G. Tansley. Pp. viii+143. *New Phytologist* Reprint, No. 2. (Cambridge: Botany School, 1908.) Price 3*s*. 6*d*.

THIS is the second "*New Phytologist* Reprint" of special courses of lectures in botany, delivered under the auspices of the University of London. The publication of these advanced lectures serves a very useful purpose, and it is to be hoped will be continued.

The present reprint differs, as regards the introductory lecture, from the original report in the *New Phytologist*, of which Mr. Tansley is editor. This lecture has been re-written, in the light of some friendly criticisms published since its first appearance, so that it is necessary to consult the reprint in order to learn the author's mature views. The first lecture is of wide interest, for it deals with the question of the origin of the Pteridophyta, involving that of the vascular plants generally. As the author says (p. 4), there is much reason to believe that the true vascular plants had a common origin—in other words, that the Pteridophyta are a monophyletic group. We have, however, no direct knowledge of any plants which suggest "Pro-Pteridophyta," and are forced to take refuge in speculation. The author first notices the well-known "antithetic theory," which traces the origin of the spore-bearing plant from a sporogonium or fruit like that of the Bryophyta (*see* NATURE, November 5, 1908, pp. 1–4). The author points out that this theory involves some tremendous morphological assumptions in the way of the origin of new organs, particularly leaves. The position has changed considerably since this book was published, and the theory is no longer maintained by its chief advocate, Prof. Bower, in its original form;[1] we have, probably, in the future to look rather for some explanation such as is here suggested by Mr. Tansley. He starts from a form like the seaweed Dictyota, "in which two morphologically identical generations, the one bearing sexual organs and the other bearing tetrasporangia, follow one another in regular alternation."

"If we imagine such a form to become subterrestrial, its spores becoming adapted to aërial distribution, its thallus-branches becoming specialised into stem and leaf, while its sexual generation is reduced in vegetative development, we have a practicable ancestor of the Pteridophyta" (p. 7).

It is probably on such lines as these that the problem of the origin of the plant in the Vasculares will be solved, if a solution is ever attainable.

The author, however, accepts the antithetic theory for the moss phylum, and therefore concludes that the alternation of generations in the two groups had a distinct origin, and that the sporogonium of a bryophyte is not homologous with the spore-bearing plant of a fern. The author suggests an ingenious view of the relation between the two forms of alternation, but the reviewer inclines rather to the belief that the sporogonium of the mosses and liverworts represents a reduction from some more plant-like type of sporophyte.

Lectures ii.–ix. treat of the main subject of the course, the evolution of the vascular system in the fern series. Lecture ii. is on the important Palæozoic group Botryopterideæ, the most ancient family of ferns of which the structure is known. In some of these plants the leaf branched in more than one plane, four series of pinnæ, instead of two, springing from the main rachis. In the opinion of the author,

"This tendency to radial organisation of the frond may perhaps be regarded as a relic of the time when, according to our basal hypothesis, the structure of the fronds of ferns was but little differentiated from the structure of their stems" (p. 23).

The radial branching of the frond, however, appears to be characteristic of the more complex members of the family, and may more probably be regarded as a specialisation (perhaps peculiar to the fertile frond) than as a vestige of primitive organisation. The known Palæozoic plants were, after all, a long way removed from primeval simplicity.

In lecture iii., the simple structure of the filmy ferns, so similar in many respects to that of the extinct Botryopterids, is considered. Lecture iv. is concerned with the Gleicheniaceæ and Lindsayeæ, families in which the solid vascular cylinder is beginning to give rise to the tubular structure which forms the transition to the more complex vascular systems. The Lindsaya type, in particular, with an internal strand of phloëm running through an otherwise solid woody axis, is of great evolutionary interest, because the same structure recurs in the early stages of development of more advanced ferns.

Lecture v. treats of the evolution of the tubular stele as shown in the Schizæaceæ, a family of small extent which presents a remarkable range of anatomical structure.

Lecture vi. is devoted to the evolution of "dictyostely" (the typical polystely of Van Tieghem), in which the vascular system opens out into an elaborate network of strands, each having in some degree the structure of the entire vascular cylinder of the lower forms. The author, however, in his glossary at the end of the book, tells us that the use of the term polystely and its variants should be discontinued altogether, at least in the fern series. As a counsel of perfection this judgment may be received with submission, but the terminology of the great French anatomist still has a descriptive value, and its use will probably not be wholly abandoned at present.

The specially complex anatomical organisation described as "polycycly," where the vascular system is built up of two or more concentric cylinders, is considered in lectures vi. and vii. In the more extreme forms of polycycly (Marattiaceæ and tree-ferns), the highest elaboration met with, either in the fern series or elsewhere, is attained.

In the next lecture (viii.) simpler types (those of the Osmundaceæ and Ophioglossales), which lie apart from the main lines of descent, are taken up. The

[1] See Discussion on "Alternation of Generations" at the Linnean Society, *New Phytologist*, March, 1909, pp. 104–16.

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Osmundaceæ have recently acquired a remarkable interest from the researches of Kidston and Gwynne-Vaughan, who have succeeded in tracing back this family, on anatomical evidence, to a common origin with the Palæozoic Botryopterideæ. The adder's tongues, on the other hand, have been separated from the ferns by some authorities. The author lays stress on the relations of this family to the Sphenophyllum-Psilotum type, as well as to the ferns and Cycadofilices.

Lecture ix. is occupied partly with the filicinean leaf-trace, partly with the development of the vascular system in the individual plant (ontogeny). In introducing the latter subject an interesting comparison is drawn between animal and vegetable embryology (p. 121).

In the final lecture the vascular system of the ferns is compared with that of other phyla of vascular plants. A valuable criticism of Prof. Jeffrey's proposed division of the higher plants into Lycopsida and Pteropsida is given in this connection. Sections on the morphological construction of Selaginella compared with that of the ferns (with which a remarkable analogy is ingeniously traced), and on the relations of ferns and seed-plants, conclude the course.

The book is an admirable example of the evolutionary treatment of the anatomical structure of plants, a line of research in which English-speaking botanists have for some time past taken the lead, the author himself being one of its best exponents.

We have only one verbal criticism to add; it is a pity that the author lends his sanction to the misuse of the word *hypothecate*, now becoming frequent among certain of the younger writers of scientific papers. He speaks of "such an ancestor as we have hypothecated" (p. 6). We have learnt from Sir W. S. Gilbert that ancestors may be bought, but it was reserved for the modern botanical author to discover that they may be *mortgaged*!

A glossary, bibliography, and index complete the volume.

D. H. S.

ELECTRICAL ENGINEERING.

Heavy Electrical Engineering. By H. M. Hobart. Pp. xxiv+338. (London: A. Constable and Co., Ltd., 1908.) Price 16s. net.

WITH so prolific an author as Mr. Hobart, the expectation of finding in any new book a good deal of old matter in a new guise is but natural, but in the present case such an expectation would be quite erroneous. This book is original from beginning to end; moreover, it is a perfect store of useful practical data and is clearly written, so that the reader always remains in touch with the author and knows what point he wishes to make. These points are not matters of little detail, but the features in a design which really count. It is this ability of Mr. Hobart to take a broad and comprehensive view of his subject which makes this book so eminently readable. But in parts it is also highly controversial, and although also these parts are interesting reading, one cannot help feeling a little anxious for the author lest he should prove a false prophet. Thus he calls the London, Brighton and South Coast electrification "this single-phase monstrosity," and devotes several pages to prove that the work could have been done for two-thirds the money on the direct-current system and in much less time. It may be that he is right, but if one remembers that the Swiss railway committee, which has been deliberating for three years, has not yet taken heart to condemn the single-phase system root and branch as Mr. Hobart does, a saying about a region where angels fear to tread comes to one's mind. Another point on which the author is equally dictatorial in his judgment concerns the transmission of power by high-pressure continuous current on the series system.

The general scope of the work is excellent. The author takes in succession all the parts of a large electricity supply undertaking, and shows us the determining factors and their relative importance in the right perspective. The metric system is used throughout, and as unit of power the kilowatt. As unit of energy the author uses the kilowatt-hour, whether the energy be mechanical or heat. Thus we find even such quantities as the specific heat and the latent heat of steam expressed, not in calories, but in kilowatt-hours. As the unit mass to which these quantities are referred he takes one metric ton of steam or water. In the first two introductory chapters are given tables on the property of steam in the new measure, evaporative power, cost and calorific value of coal, the over-all efficiency of generating stations, an analysis of the losses, the plant capacity in various stations, the demand for light, power, and traction in various towns, &c., all from actual experience and carefully tabulated. He then shows by way of example how the figures collected may be used to design an electricity works for a town of one million inhabitants, and comes to the conclusion that the immediate demand would be for 77 million kilowatt-hours per annum, and the demand in the course of the next ten years 120 million kilowatt-hours. The works should, therefore, be designed with the view of an extension up to this limit. With chapter iii. and subsequent chapters we enter into the more technical part of the subject, namely, steam-raising plant, engines and turbines, generating machinery, condensing plant, and the generating station considered as a whole. This brings us to chapter viii., which deals with overhead lines and underground cables, whilst the last two chapters are devoted to a criticism of the Thury system and to electric traction.

Most of what the author has to say on steam engines is concerned with turbines, and very little is said about piston engines. Neither does the author discuss the advantage of combining the piston engine with the turbine in the sense that the former utilises the high-pressure steam and exhausts into the latter. His ideas as to the ultimate size of turbine sets are on a grand scale. He thinks that units of 10,000 to 20,000 kw. at pressures up to 20,000 volts will come into use. Curiously enough, he says nothing about the question of how sets of this magnitude are to be kept cool. It is quite obvious that the air required for ventilation would not only have to be supplied in huge quantities by special fans, but also that it would have to be carried away in closed ducts to the outside of the engine-room.

When dealing with gas engines for alternating-current generators the author falls into a strange error. He mentions as one of the drawbacks that power is lost through the damping coils which the irregular motion of a gas engine renders necessary. Now it is well known that damping coils must not be used in such cases. His remarks on slot insulation, on which subject he is an authority, are highly interesting; he believes that eventually it will be possible to reduce this to something like 2 mm. for a 10,000-volt machine, but unfortunately he does not say in what manner this improvement is to be achieved. He is evidently an advocate of severe testing, and the subject of insulation tests gives him the opportunity of a homily on the ethics of the inspecting engineer. His suggestion that the sufficiency of the mechanical support of the winding should be tested by short-circuiting at full excitation the terminals of, say, a 5000-kw. alternator sounds rather heroic, and his anticipation that not more than six times normal current would flow at the instant of closing the switch may be doubted, although he is quite right in saying that, a moment after, the current would only be about three times the normal value.

The chapter on the design of the central station as a whole is particularly interesting and useful. Here we find an enormous mass of information collected from a variety of stations and tabulated in a convenient form. The same may be said of the chapter on transmission plant. The author gives us, not only technical details, but also the cost from actual experience, and one cannot but admire the industry with which he has collected so much really valuable information. As regards electric traction, his sympathies are all for the direct-current system, for which he predicts a rise of working pressure up to something like 1200 volts. The single-phase system he condemns entirely, but as regards the three-phase he admits a slight superiority in the matter of weight over the direct-current system. As the limits of the power of motors at the ordinary one-hour rating he takes 150 h.p. for the single-phase, 300 h.p. for the continuous, and 400 h.p. for the three-phase system. The three-phase system is a little lighter, and the single-phase system more than twice as heavy as the continuous-current system. A new and very simple formula for the tractive resistance in kg. per ton of train is given on p. 231. It is as follows:—

$$R = 2{\cdot}70 + 0{\cdot}09\,\frac{V^2}{W}$$

for railways in the open, and

$$R = 3 + 0{\cdot}3\,\frac{V^2}{W}$$

for tube railways. V is the speed in km. per hour, and W is the weight of the train in tons.

GISBERT KAPP.

WHY LEAVES ARE GREEN.

Zur Biologie des Chlorophylls, Laubfarbe und Himmelslicht, Vergilbung und Etiolement. By Ernst *Stahl.* Pp. v+153. (Jena: Gustav Fischer, 1909.) Price 4 marks.

IN this interesting and suggestive book, Prof. Stahl presents us with the results of his observations and speculations upon the ever-interesting problems of the biology of chlorophyll and its related colouring matters. One of the most interesting of these is the cause of the prevailing green colour of our vegetation. How does it arise that the various photosynthetic organs of plants are green, and not some other colour?

Engelmann has already shown that the colours of the algal vegetation of the sea are complementary to the light which falls upon them, and Gaidukov has made experiments to show that the Cyanophyceæ, or blue-green algæ, undergo a change in colour complementary to the light which falls upon them, when grown under different coloured lights. Prof. Stahl thinks that these observations may lead to an explanation of the green colour of land plants. The chlorophyll spectrum may be regarded as a combination of two absorption spectra. The absorption at the blue end of the spectrum agrees very nearly with that of etiolin and the colouring matter of yellow leaves, whilst the absorption in the red corresponds to that of the green colouring matter which is formed when etiolated plants are exposed to light, and disappears in the autumn, when the leaves again turn yellow. The yellow-green colour of the leaf may, therefore, be an adaptation to the prevailing colour of the diffuse light which falls upon it, the yellow being complementary to the blue of the heavens, and the green to the orange and red which mostly prevail when the sun is low.

The region of least absorption in the chlorophyll corresponds with that of maximum energy in the spectrum. The plant does not, therefore, depend for its assimilative work upon the rays of greatest energy. On the other hand, the possibility of using these rays is shown by the red algæ, which absorb the green as well as the blue, the maximum of their assimilative activity lying exactly in the green.

The author tries to show that the non-absorption of the green rays is not only due to the fact that the chlorophyll makes no use of those rays which usually reach it in a weakened form, but also to the fact that the absorption of these rays in direct sunlight would be dangerous to the plant, because of their great heating power. Under normal conditions an intense illumination is unnecessary. The amount of energy used up by the chlorophyll grain in carbohydrate assimilation is only a small part of the total energy it absorbs. In light of lower intensities, however, it is clear that the amount of energy absorbed by the plant becomes more nearly proportional to the amount used for assimilation, and thus a complementary colour adaptation to the light is understandable. In the red and brown seaweeds, the blue-green algæ, &c., the absorption of the green rays may be necessary to supply the plant with the energy required. A too intense illumination of the leaf, by concentration of the sun's rays upon it, destroys the chlorophyll. According to Pringsheim, this is caused by the chemical rays, but Prof. Stahl considers that the effects of the heat rays have been overlooked, and he insists on this as an important factor in the problem. The variation in the colour of foliage leaves, according to whether they are in the sun or in the shade, is partly due, he thinks, to this danger of overheating. In the special case of the red and brown seaweeds, he considers that the colours are not entirely due to an adaptation to the quality of the light, but also to its intensity.

How far the author's conclusions are justified remains to be seen, but he adduces a considerable amount of evidence in favour of them, which he discusses in a most interesting and suggestive way.

Prof. Stahl suggests that the etiolation, and the yellow coloration of leaves in autumn, may be due to the need of economy in food materials. Willstätter has shown that, in its purest form, green chlorophyll contains C, H, O, N, and Mg. The yellow colouring matters contain only C, H, and O, so that, by keeping back the green chlorophyll in the spring and re-absorbing it in the autumn, a saving would be effected in nitrogen and magnesium, which are of great value to the plant.

Some interesting experiments are described to show that this actually does take place. If leaves which are just on the point of turning yellow, but are still green, are removed from the plant and kept in a damp chamber, they retain their green colour, whilst neighbouring leaves, still attached to the plant, become yellow. So, also, if slits are cut in the leaf, so that the principal veins are severed, the portions of leaf thus cut off from the main conducting vessels remain green, whilst the other parts turn yellow. The results of experiments made by various observers, and others recently made at the author's suggestion, in the agricultural laboratory at Jena, are brought forward to show that potassium and nitrogen, phosphoric acid, iron, chlorine, and silica, are more or less reduced in amount in the yellow as compared with the green leaf. The significance of these facts, which no doubt lend considerable support to Prof. Stahl's interesting hypothesis, is fully discussed, but that the etiolation of young leaves and the yellow coloration of old leaves are so definitely associated with the plant's need for economy cannot, from the evidence before us, be said to be so clearly established as Prof. Stahl seems to think.

H. W.

THE FOUNDATIONS OF GEOMETRY.

Grundlagen der Geometrie. By D. Hilbert. Third edition. Pp. vi+280. (Leipzig and Berlin: B. G. Teubner, 1909.) Price 6 marks.

THIS fascinating work has long since attained the rank of a classic, but attention may be directed to this new edition, which has various additions, mainly bibliographical, and seven supplements, which are reprints of papers by the author on topics related to that of his famous essay. Two of these can be enjoyed by readers with no exceptional mathematical knowledge. In the one on the equality of the base angles of an isosceles triangle, Dr. Hilbert proves, *inter alia,* the remarkable fact that, even if we assume Euclid's theory of proportion, we cannot prove his propositions on equalities of area, unless we assume the truth of prop. 4, bk. i., of the "Elements" in the wider sense—that is, when one triangle has to be turned over to make it fit the other. It is also pointed out (p. 68) that two tetrahedra can be constructed with equal heights, and bases of equal area, which cannot be cut up into congruent polyhedra, and to which congruent polyhedra cannot be added in such a way that the solids thus produced can be sliced up into congruent parts. Consequently it is impossible to build up a theory of equality of volumes strictly analogous to Euclid's theory of equality of areas.

Another supplement of general interest, and easily understood, is that on the notion of number. The most noticeable thing here is the remark that the commutative law of addition $(a+b=b+a)$ can be deduced from the distributive laws of multiplication, together with the axiom $a.1=1.a=a$; thus

$$(a+b)(1+1)=(a+b).1+(a+b)1=a+b+a+b$$
$$(a+b)(1+1)=a(1+1)+b(1+1)=a+a+b+b;$$

therefore $a+b+a+b=a+a+b+b$, and hence $b+a=a+b$.

The seventh supplement, on the foundations of logic and arithmetic, deserves very careful study, both by mathematicians and by philosophers. The main feature of this is that an aggregate is defined as *any* object of thought, and the notion of "element of an aggregate" is a derived one. Dr. Hilbert objects to Dedekind's method in his well-known tract on number, because it postulates the aggregate of "all objects of thought" as a definite conception. A sort of promise is given that the author will expand the ideas of this essay in greater detail, and it is earnestly to be hoped that this intention will be carried out. In connection with these discussions there is one point that deserves attention; a finite intelligence thinks *in time,* and cannot rid itself of that idea. Now, if we take the statements (1) I am conscious; (2) I am conscious that I am conscious; (3) I am conscious that I am conscious that I am conscious; (1) is the most elementary possible thought from a metaphysical point of view, (2) is the most elementary form of reflection, and if we admit that any thought can be reflected upon, we at once get the natural scale in the form t, tr, tr^2, tr^3, &c. It is not impossible that some such reasoning was in the mind of Rowan Hamilton when he made the statement, which puzzled De Morgan, that "Algebra is the science of Pure Time." Until time is defined in terms of simpler entities, it is open to question whether any generation of the natural scale is really more fundamental than the above. Of course, there may be methods which are preferable in the eyes of a mathematician who wishes to avoid metaphysical discussion; but the fact remains that there is a metaphysical aspect of the question which must be faced before a final answer is reached.

G. B. M.

VALENCY.

The Theory of Valency. By Dr. J. Newton Friend. Pp. xiv+180. (London: Longmans, Green and Co., 1909.) Price 5s. net.

ALTHOUGH one may be inclined to criticise the inclusion of this volume in Sir William Ramsay's well-known series of text-books of physical chemistry, it is to be heartily welcomed on its own account, for there is no English treatise, and no very recent German one, dealing with the important subject of valency. The author's exposition is careful and thorough, dealing at length with the bearing of the periodic law on valency, and with the numerous, and in some cases fantastic, theories which profess to interpret the facts of chemical combination. Dr. Friend is not in a position to expound any one theory of valency which commands general acceptance; in the present state of our knowledge he can only put before the reader some half-dozen theories—Werner's, Abegg's, Ramsay's, his own, and others—to each of which exception may be taken in one respect or another.

The theory of constant valency, which had difficulty with the interpretation of the so-called "molecular" compounds, has, of course, been abandoned, and the authors of the newer theories vie with each other in postulating valencies of all sorts and conditions—"principal," "auxiliary," "normal," "contra-," and "latent." From the examples quoted in the book it will be seen that, according to the theory adopted and the particular compound under consideration, hydrogen may be regarded as mono- or di-valent, nitrogen as tri-, tetra-, or penta-valent, bismuth as di-, tri-, or tetra-valent, and chlorine as mono-, di-, tri-, or tetra-valent. Perhaps, however, the crowning example of departure from the older view of the constancy of valency is found in the suggestion, which has been brought forward in one quarter, that oxygen may have a valency of six or even twelve! The grounds on which a particular number is chosen to represent the valency of a given element are, indeed, frequently unconvincing, and after a perusal of Dr. Friend's volume one feels how much vagueness and arbitrariness there is about the whole subject.

In proportion as it is found necessary to admit the variability of valency, doubts arise as to the practical value of a doctrine of valency. It must be borne in mind that certain chemists have challenged even the contention on which is based the whole structure of modern organic chemistry, the contention, namely, that carbon is never anything else than tetravalent. The author, indeed, maintains that nothing is gained by assigning a variable valency to carbon, and prefers to attribute variability to other elements, such as oxygen, chlorine, and flunrine. But the argument that unless the valencies of carbon and hydrogen are limited to four and unity, respectively, the possibilities of formulation are indefinitely multiplied is not a weighty one. Equally unconvincing is a criticism of the interesting view that different grades of chemical union may exist; this view is characterised, not as unsound, but as "dangerous," a line of argument that generally bespeaks a certain weakness in the defence.

The author is probably right in concluding that the solution of the valency problem is to be sought for on electrical lines, but at the same time he has done well to present to the reader everything which has a bearing on the subject, as, for instance, the new theory of Barlow and Pope, who regard valency from a non-electrical standpoint. It is only by a full and faithful presentation of conflicting facts and theories that the actual state of the problem can be rightly understood.

J. C. P.

ECONOMIC GEOLOGY IN BRITISH GUIANA AND SOUTH AFRICA.

(1) *The Geology of the Goldfields of British Guiana.* By J. B. Harrison. With Historical, Geographical, and other Chapters by F. Fowler and C. W. Anderson. Pp. ix+320. (London: Dulau and Co., 1908.)

(2) *The Ore Deposits of South Africa.* By J. P. Johnson. Part i., Base Metals. Pp. iv+61. (London: Crosby Lockwood and Son, 1908.) Price 5s. net.

(1) THE history of gold mining in British Guiana dates from 1720, when an expedition was despatched to Berbice in quest of gold. Further unsuccessful attempts were made at intervals, and modern mining in the colony dates from 1863. The first important success was gained in 1886, and mining regulations were enacted. The efforts were again commercially unprofitable, but some alluvial mining has always since been carried on. Quartz mining first attracted much attention in 1890, but none of the attempts was then commercially successful, because, Mr. Harrison tells us, the work was conducted recklessly, mills being erected before the mines had been adequately prospected. At length, in 1903, more judicious management was rewarded by success, and the mines on the Puruni River added British Guiana to the profitable gold-fields of the British Empire. The greatest yield was 138,000 ounces, in 1893–4, since when the yield has been slowly falling, until the output in 1906–7 was 85,000 ounces.

The first important contribution to the geology of British Guiana was the memoir by Brown and Sawkins, published in 1875 by the British Geological Survey. Since then various additions have been made to its mining literature, and an important series of contributions to its pure geology by its Government geologist, Mr. J. B. Harrison. He has now issued a valuable handbook to the geology of the colony, to which chapters on the history and geography are contributed by Messrs. Fowler and Anderson.

Mr. Harrison's monograph includes a detailed account of the geology and petrography of the country, which consists of a foundation of Archæan rocks, with intrusive series of granites and diabases, covered by a series of sandstones apparently of Algonkian age. Intrusive diabase and other basic igneous rocks are widely distributed; they are perhaps the most interesting rocks in the country, and, according to Mr. Harrison, are the source of most of the placer gold. The origin of the gold is discussed in an interesting chapter, and the author concludes that it was derived from the basic igneous rocks themselves. De Launay, Perkins, and other mining authorities share that view, which has, however, been rejected by Prof. Louis, who considers that the gold came from quartz veins in the schists and gneisses, and also by Mr. J. A. Spurr, who thinks it is derived from the acid igneous rocks, and was introduced in solutions connected with the intrusion of dykes of the ultra-acid rock which he has called alaskite. Some of the placer gold has been derived directly from quartz veins formed in the superficial sheets of laterite that cover much of the country, but the gold in these veins is no doubt derived from the primary deposits in the underlying rocks. The gold in the secondary veins in the laterite sometimes occurs in rich pockets. It is therefore not surprising that the placer gold includes small nuggets. Mr. Brown, however, strongly supports the view that gold is present dissolved in the soil waters, and is thus carried into the drifts and there chemically deposited. As a proof of the solubility of the gold in the waters of the soil, he refers to its presence in the vegetation. The occurrence of gold in the trees growing on gold-fields has been repeatedly affirmed and denied. Mr. Harrison accordingly carefully assayed samples of wood from the interior of trees, and proved that the ashes contain gold up to several grains per ton. The establishment of this fact by Mr. Harrison is an important contribution to the problems of gold deposition; nevertheless, the information he gives as to the distribution of the alluvial gold suggests that the bulk of it is of detrital origin.

(2) Mr. Johnson's book contains less original matter. It is a short summary, in sixty-one pages of large type, of the chief facts as to the distribution of base metals in South Africa. It is prefaced by a brief theoretical introduction, and concludes with some pages of practical hints to prospectors. It is a useful guide to recent literature, and to mining work on the base metals in South Africa. The author adopts the American quantitative classification of rocks, and his short theoretical statement gives the arguments fairly for both sides of disputed questions. J. W. G.

OUR BOOK SHELF.

The Method and Scope of Genetics. An Inaugural Lecture delivered on October 23, 1908. By Prof. W. Bateson, F.R.S. Pp. iv+49. (Cambridge: University Press, 1908.) Price 1*s*. 6*d*. net.

The University of Cambridge is to be congratulated in respect of the professorship of biology, which it founded last year, with the aid of an anonymous benefactor. It is to be congratulated because it has had the wisdom to recognise the import and the promise of a kind of inquiry which is still young (though it justified itself long ago at Down, at Brünn, and elsewhere), and has hitherto had very little academic recognition; for although the professorship bears the comprehensive title "of biology," it was founded with the understanding that the holder should apply himself to a particular class of physiological problems—those of heredity and variation—the study of which is denoted by the new term "genetics." Some years ago, in the University of Edinburgh, thanks, we believe, to the energy of Prof. Cossar Ewart, whose "Penycuik Experiments" have been so important in themselves and in their incentive, there was established a lectureship on the physiology of reproduction, which has been filled by Dr. A. H. H. Marshal with conspicuous success.

But Cambridge has gone one better—we hope the equivalent Scottish step will soon follow—in instituting this professorship of biology, ear-marked to mean genetics. The University of Cambridge is not less to be congratulated on being able to secure for this new professorship an investigator like Mr. Bateson—on whom Darwin's mantle has fallen—whose critical insight, patience, ingenuity of experiment and infectious enthusiasm have won him the respect and admiration of all the biologists of to-day.

In his inaugural lecture Prof. Bateson shows that the claims put forward in the name of genetics are high, and that they are not high without reason. "Mendel's clue has shown the way into a realm of nature which for surprising novelty and adventure is hardly to be excelled." "It is no hyperbolical figure that I use when I speak of Mendelian discovery leading us into a new world, the very existence of which was unsuspected before." Let us notice some of the progressive results which warrant these enthusiastic statements. A great law of inheritance has been discovered, and a simple hypothetical *rationale* of the law has been suggested. The duality of inheritance which the cytologist had demonstrated in his own way has been likewise proved—one may almost say played with—experimentally. Curiously puzzling phenomena have been made plain. Fresh light has been thrown on reversion and on variation. A new *point d'appui* has been found for physiological chemistry, and from cases so different as cinnamon-canaries and sweet peas, currant-moths and colour-blindness, it seems as if we were on the eve of discovering something of the mystery of sex. And, besides all this, "if we want to raise mangels that will not run to seed, or to breed a cow that will give more milk in less time, or milk with more butter and less water, we can turn to genetics with every hope that something can be done in these laudable directions." Even in regard to human kind it does not seem any longer an idle dream to see an art of eugenics rising on the foundations of genetics. J. A. T.

Hydraulic Générale. By A. Boulanger. 2 Vols. Tome i., Principes et Problèmes Fondamenteaux. Pp. xvi+382. Tome ii., Problèmes à Singularités et Applications. Pp. vii+299. (Paris: Octave Doin et Fils.) Price 10 francs.

The science of hydraulics in France has long been served by distinguished and devoted adherents—to instance only a few, Bazin, St. Venant, Du Buat, Prony, and Boussinesq. The numerous contributions of this last-named exponent, during a period of nearly forty years, to the Academy of Sciences and other scientific bodies, are familiar enough to students of the subject, but, owing to their detached and voluminous character (the total publications of the eminent man of science amount to 1800 quarto pages), they have not hitherto been conveniently adapted to the requirements of systematic study, and it has long been felt that a *résumé* of their more important conclusions would be of great service. At the instance, therefore, of the director of the Bibliothèque de Mécanique, and with the concurrence of M. Boussinesq himself, the present work was undertaken with this end in view.

There are two volumes, the first being devoted to a demonstration of fundamental principles and to the statement of general phenomena, appertaining as much to the province of the physicist as to that of the engineer. Thus, after an introduction on the laws governing the pressure and deformation of a confined material element, and on the movements of fluids in general, there are three sections dealing with phenomena in which the influence of friction is negligible or sensible, and covering the motion of waves and the flow of water in pipes and channels.

The second volume is occupied with the elucidation of problems which appeal more particularly to the practical engineer, who, apart from his interest in the purely scientific aspect of an investigation, demands for his use some definite, even if empirical, quantitative solution. To arrive at such results, postulates of a more or less contestable character have oftentimes to be assumed, and the processes cannot be as rigorous as a mere theorist would desire. The questions treated in this way include the flow of water through orifices and over weirs, and in pipes possessing abrupt changes of direction and sudden restrictions of area. The influence of friction on undular movement is also expounded, and a final chapter deals with water-hammer.

The work is based on mathematical processes of a very advanced nature, and from considerations of space the calculations, many of them intricate enough, have been set forth as succinctly as possible. For further information on particular points the reader is referred to various sections of M. Boussinesq's writings which deal specially with them. There is a serviceable bibliographical index at the end of each volume.

The author manifests his keen appreciation of the *travaux pénétrants* of M. Boussinesq, and concludes his preface by stating:—"Qu'il n'est pas de question d'hydrodynamique appliquée qui ne doive à ce Maitre des progrès considérables." The tribute is just, and will be heartily endorsed by British men of science.

The Chadwick Lectures, University of London, Session 1907–8. By W. D. Scott-Moncrieff. Pp. 79. (London: St. Bride's Press, Ltd., 1909.) Price 2s. net.

THE Chadwick lectures in the University of London were established in 1907 for a period of five years, the endowment being derived from the funds of the trust created by the will of a great sanitarian, Sir Edwin Chadwick, K.C.B. The trustees have provided that two short courses of lectures shall be delivered each year, at the University, upon subjects relating to sanitary science, with special reference to recent advances in hygiene and municipal engineering. In the lectures under review, Mr. W. D. Scott-Moncrieff deals with the subject of sewerage and sewage disposal in four lectures. At the outset he deals with facts which are mainly historical, tracing the evolution of our present methods, and summarising the Acts of Parliament and the reports of Royal and other Commissions relating to sewage disposal. He then proceeds to a critical survey of the various provisions which have been made, from time to time and in different places, for purifying sewage.

The lectures will serve exceedingly well to indicate the lines upon which we are now advancing towards the solution of the sewage problem, and the lecturer is to be congratulated upon having made an interesting, instructive, and suggestive contribution to the subject of sewage disposal. He strongly emphasises the waste of manurial values involved in modern methods and the economy of ascertaining by direct experiment the conditions necessary to success, in every specific instance, before spending money in ignorance of what these conditions really are. As one of the pioneers among British workers upon the biological purification of sewage, he remains a strong advocate of that method.

After reviewing the enormous amount of study and experiment which chemists, biologists, and engineers have for many years devoted to the subject of sewage purification, the reader will find food for contemplation in the circumstance that the trend of modern scientific opinion is in favour of the methods of "mother earth." Biological agencies, "the scavengers of nature," are now generally considered to afford at once the most economical and effectual means of sewage purification. The natural disposal of fæces upon earth had always proved satisfactory so long as the soil was suitable in nature and amount, but with the growth of our towns and the introduction of the water-carriage system a new set of circumstances had to be faced. Large volumes of water polluted with fæcal matter had to be dealt with, and the disposal of this, without causing a nuisance or contaminating drinking-water supplies, became the problem which is even now but partly solved. Mr. Scott-Moncrieff shares the very general view that it is by methods in which "nature's scavengers" are placed under the best conditions for their work that we are likely to obtain the best all-round results.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Temperature of the Upper Atmosphere.

SINCE my last letter on the above subject the columns of NATURE have contained some interesting data from Mr. E. Gold, and an account of the meeting at Monaco on April 1 of the International Commission for Scientific Aeronautics. The proceedings of the commission seem to have included the enunciation of a creed in which the members expressed their individual belief in the existence of an "isothermal layer" (*aliter* "stratosphere"). This promulgation was apparently intended mainly for the benefit of heretics in England. As is not unusual with creeds, an exact definition of the essential term *stratosphere* does not seem to have been supplied, and I am thus in doubt whether I am or am not one of the elect. The term "stratosphere" can hardly have been employed in its very strictest sense, which would seem to imply that at any given instant of time temperature is a function only of the distance above the ground. This obviously could not be true at altitudes where either a diurnal or an annual variation was sensible, and I doubt whether members of the commission are yet prepared to deny the existence of these variations at the heights with which they are concerned. In the recent German balloon ascents in Central Africa temperatures were recorded which differ somewhat notably from those met with at corresponding heights in Europe, while in the polar regions temperatures are sometimes recorded at ground-levels which are lower than those usually encountered in balloon ascents here.

The term *stratosphere* is thus presumably intended merely to indicate in a general way that at high levels the rate of change of temperature in any horizontal direction is normally very small. In this sense I too am rather disposed to be a stratospherist. What has been objected to by myself, and I believe I speak for others in this country, is the application of the term "isothermal layer" to the whole of the upper atmosphere—so far as yet explored by kites and balloons—which exists above the level where fall of temperature with increase of height ceases (*cf.* Mr. W. H. Dines, NATURE, February 27, 1908, p. 390). I see no objection to the application of the term to a layer of finite thickness, if such exists, throughout which rate of change of temperature with height is vanishingly small. If t and h denote temperature and height, then, according to most Continental balloon records, dt/dh during an ascent is normally first negative and later positive. As a mathematician, I recognise, of course, that this implies either an absolute discontinuity—a rare event in nature—or else the existence of at least one surface where dt/dh is zero. In the latter event one would naturally expect dt/dh to be small for an appreciable distance on either side of the surface where it vanishes.

Coming now to Mr. Gold, if he will refer to my original letter (NATURE, March 12, 1908, p. 437) he will see that errors of $\pm 10°$ F. were not *asserted* to exist as a normal thing, but were suggested as a *possible* explanation of the following results, which had been quoted by Mr. W. H. Dines as recorded on one and the same occasion (November 11, 1907):—

Station	Height of "isothermal layer"	Temperature of "layer"
Ditcham Park ...	36,000 feet ...	$-42°$ F.
Oxfordshire ...	38,500 ,, ...	$-58°$ F.
Manchester ...	37,000 ,, ...	$-74°$ F.

If Mr. Gold can suggest any other explanation likely to carry conviction to those who are sound in the stratospheric faith, I should be much interested to know what it is.

The figures quoted by Mr. Gold in his letter show that the examples which I had given of the differences between the temperatures recorded by two thermometers of different patterns sent up in the same balloon were not exceptional. Unless I misunderstand his figures, they signify that, taking two thermometers of different types, A and B, the reading from A is the higher when temperature rises and the lower when it falls. Taking both rising and falling readings, the *average* value of $(A \sim B)$ max. in Mr. Gold's sixteen cases is 3·2° F. In one case it is 6·3° F. It must also be remembered, as explained in my last letter, that if $A - B$ represents lag, it is likely to be an underestimate of the true error in the more sluggish thermometer. If we take the range of the *algebraic* difference $A - B$ during the ascent and fall, Mr. Gold's figures give a mean of 4·6° F., the extreme value being 8·3° F.

The fact that on the average of *all* the readings, both rising and falling, $A - B$ (or is it $A \sim B$?) is small—on the mean of the sixteen cases almost exactly 1° F.—seems to be regarded by Mr. Gold as a great tribute to the accuracy of the instrument makers. This, however, does not necessarily follow, if—as I should naturally assume—the observers followed the procedure customary with meteorologists of applying to their readings before publication the corrections obtained by comparing the thermometers with some recognised standard. This, however, is perhaps hardly germane to the present discussion.

May 23. C. CHREE.

An Optical Phenomenon.

I HAVE a greenhouse facing nearly due south. In a vertical pane of glass there is an imperfection. When the sun shines on this pane no light is transmitted through the imperfection. The result is that on a board or piece of paper held at right angles to the sun's rays there is produced an intense black disc about 1 inch in diameter, the board being held about 8 inches from the glass. This black disc is margined all round by a very narrow, brilliantly white line.

I can form no explanation of the phenomenon, for, so far as I can see, interference has no chance of acting. The glass is quite transparent, and the flaw so small that I could not find the cause of the black spot for some time. The disc is not hot.

So far as I can see, the glass is in tension round a central minute imperfection. By "sighting" the pane at various angles it is possible to detect certain lines. It is difficult, however, to get at them with any accuracy. There is no perceptible difference in thickness.

I cannot find any reference in any text-book to a pane of clear glass which absolutely intercepts the sun's rays in this way.

Can anyone give me an explanation of what appears to be a very unusual phenomenon? V. P.

Crohill, Pendennis Road, Streatham, May 22.

THE OLDEST REMAINS OF MAN.[1]

THE oldest remains of Man with which, until now, we were acquainted date back to the middle Pleistocene, to the Moustier period. They are represented by the cave relics from Neanderthal, Spy, Krapina, Naulette, Malarnaud, and possibly Mentone, by the drift relics from Galley Hill and Bury St. Edmunds. In the memoir under notice, however, we have the description of the two halves of a lower jaw for which a much higher antiquity is claimed.

FIG. 1.—Mandible seen from the side.

They are attributed to the earliest Pleistocene or even to the late Pliocene.

The jaw, which, fortunately, contains its complement of teeth, was found 24·10 metres below the surface in a deposit of sand at Mauer, 10 kilometres south-east of Heidelberg. The date of the discovery was October 21, 1907.

When found, the two parts were thickly coated by the deposit in which they lay; the left half had a piece of limestone firmly cemented to it, both jaw and stone being similarly marked by dendritic deposits of iron and manganese. The sand in which the jaw

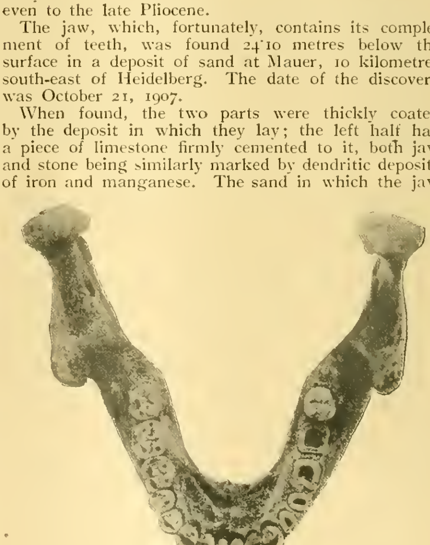


FIG. 2.—Mandible seen from above.

was found is of the same age and nature as the sand of Mosbach, and is attributed to the earliest Pleistocene, although the remains of the fauna found within it justify us to some extent in ascribing it to an epoch even more remote—the period of the Cromer Forest Bed in England, the late Pliocene of South Europe. The fauna includes, among many species distinctly diluvial, *Rhinoceros etruscus*, Falc., a horse

[1] "Der Unterkiefer des Homo Heidelbergensis aus den Sanden von Mauer bei Heidelberg." Ein beitrag zur Palaontologie des Menschen von Otto Schoetensack. Pp. iv+67; 13 plates. (Leipzig: W. Engelmann, 1908.) Price 14 marks.

intermediate between *Equus stenonis*, Cocchi, and the Taubach form, and *Elephas antiquus*.

A full description of the site and of the manner in which the discovery was made, with a careful compilation of the animals the remains of which have been found in the deposit, constitute the first portion of the book. Two other parts are concerned with the remains themselves, viz. with the jaw and with the teeth. The latter are typically human, and permit of no doubt as to the mandible being that of a man. The canines are not unduly prominent, while the dimensions of the teeth are within the variation limits of living man. The most striking features of the jaw, which, it may be said, was divided into two parts by the spade of a workman, are the absence of a chin, the thickness of the body, the width of the ascending ramus, and the low level of the coronoid process. Correlated with the absence of a chin is a well-marked incisura submentalis, the lower border of the symphysis being 50 mm. above that of the lateral portion of the body. The sulcus supramarginalis, interdigastric spine, trigonum postmolare, and præcoronoid fossa recognised by Klaatsch in Australian mandibles are also apparent in the specimen. A small tubercle lies immediately below the mental foramen; a similar excrescence has been noted by Gorjanović-Kramberger in the jaw fragment Krapina H and by Klaatsch in recent Australians. The geniohyoglossus muscle arose from a groove, the genio-hyoid from a rounded prominence.

FIG. 3.—Position in which the mandible was found, Mauer, near Heidelberg.

The width of the ascending ramus is 60 mm. The coronoid process is blunt and rounded. The condyloid process is chiefly remarkable for the large size of its articular facet.

The lower border of the mandible passes backwards and only slightly outwards from the symphysis to the junction of body and ramus, where it suddenly takes a more outward curve. The border thus has a contour not unlike that of a trefoil window.

Comparisons are made between the Heidelberg jaw, those of Spy and Krapina, and, in addition, those of recent Australians and Negroes. The author concludes that the Heidelberg specimen surpasses all in its combination of primitive characters, that it is a generalised type from which all jaws, ancient and recent, can be readily derived, that the Spy mandibles resemble it most, the Krapina examples exhibiting marked but mere individual variations.

As to the teeth, all the molars are quinquicuspid; the second molars are the largest; the first and third molars are of equal size. Certain teeth were fractured by the spade, the pulp cavity being laid open. It was possible to measure the diameters of the pulp cavity and the thickness of the wall in the case of the premolars and first two molars of the left side; these measurements were considerably in excess of those which obtain in recent Europeans. The jaw was, further, Röntgen-rayed, little additional information being, however, supplied.

The figures, which are mainly photographs, number forty-eight, and are disposed on thirteen plates. They leave nothing to be desired.

The whole volume reflects the greatest credit on Dr. Otto Schoetensack. Anthropologists are to be congratulated that the work of describing what there is every reason for thinking are the oldest remains of man fell into such capable hands.

WILLIAM WRIGHT.

A GREAT ENDOWMENT AND ITS INFLUENCE.[1]

IT was in April, 1905, that Mr. Carnegie added to his many benefactions in the interest of education by handing over to a board of trustees of his own selection a sum of 2,000,000*l.*, the revenue of which was to provide pensions for the teachers of universities, colleges, and technical schools in the United States, Canada, and Newfoundland. The trustees were nearly all presidents of universities or colleges—the few others being men of conspicuous eminence in business and finance. In 1906 the trust was incorporated by charter under the title of the Carnegie Foundation for the Advancement of Teaching. In his deed of gift the donor stated that the fund was to be applied without regard to race, sex, creed, or colour. He did not "presume to include," among the institutions which were to benefit, State-supported universities or colleges on the ground that "they might prefer that their relations should remain exclusively with the State." In response, however, to the desire of the professors in State universities, expressed through their National Association, Mr. Carnegie in March, 1908, increased his original gift by 1,000,000*l.* in

[1] The Carnegie Foundation for the Advancement of Teaching. Third Annual Report of the President and Treasurer, October, 1908.

order that State institutions of the requisite academic grade which "apply through their governing boards, with the sanction of the legislature," might also participate in the benefits of the foundation.

The annual reports of this foundation show how far-reaching may be the effects of a wisely administered, wealthy trust, even though it has been established for what may seem a narrow and special purpose. These effects will be all the more important now that the State institutions may be admitted to share in the grants. In Scotland, the Carnegie Trust, which devotes part of its income to the payment of fees at the universities, has exercised a considerable influence in raising the standard of university, professional, and technical education by granting its favours only to those who reach a high preliminary standard of attainment, and who show fair ability and sufficient industry in their university studies. So there are already clear proofs that the Foundation for the Advancement of Teaching is quickening the movement in America for improved secondary education, raising the standard of entrance to college and university, and thereby uplifting the whole of higher education to a worthier plane. The foundation is making good the claim of its president that it should be considered not "as a charity, but an educational agency," which is making for "educational coherence and educational unity," and is taking into account "the interests not alone of a community or of a section, but of a continent." The trustees came to the conclusion that their true task is to consider the merits, not of individuals, but of colleges; to decide upon fair and wise standards, and then to admit to the system of retiring allowances such institutions as comply with the standards, and come within the provisions of the charter. To accomplish this, it was necessary to collect facts concerning the various institutions, such as "their method of government, their denominational relations, their value as centres of moral and intellectual influence, their financial resources, and, most important of all, their academic standards of work."

It was found that there are more than 950 institutions in the United States and Canada calling themselves colleges and universities. Of these some 850 are in the United States. An examination of the curricula, the income, and the work of these institutions showed that these names had in a large majority of cases been assumed with little regard to the meaning of the names, and little consideration of the difference between the work of a high school, a college, and a university. The trustees had to recognise that the pioneer stage of education had passed, and that it was necessary to standardise the higher institutions of learning.

They saw clearly that the nature of the requirements for admission to a college or university affects fundamentally the character of that institution. It was essential to enforce a reasonable standard—a standard which could be articulated with the work of the high schools, and enforced with care and judgment. The Carnegie Foundation, recognising that entrance requirements form the sole feasible means of securing a fair degree of unity in an educational system, had to reduce to a common method of expression the various systems in these 950 institutions, and to "define the amount of preparation which a college ought to demand of its matriculants." This definition had to rest upon the actual practice, and had to be formulated after a study of the curricula of the standard high schools. These schools require at least four subjects to be studied daily five times a week. Counting as a unit a study pursued in this way for a year, the ordinary high-school course would furnish sixteen such units in four years. The Carnegie Foundation, making allowance for certain possibilities, considers fourteen such units a fair measure of preparatory work, and fixes that number as the standard entrance requirement for any college which desires recognition. This standard demands not only four years of high-school training following upon good preliminary work in the grammar school, but involves a fair distribution of the time among different subjects. Some of the letters published in this report make it evident that this is a standard at present somewhat beyond the reach of many southern colleges in view of the undeveloped condition of secondary education. But the following extract from the president of a Kentucky university proves the wisdom of the trustees in setting up a standard which is really satisfactory:—"There is a positive advantage in a standard which will make it necessary for every college president and professor in the South to become an active missionary for public school development. . . . I know of no stimulus so powerful and effective as the maintenance of the standard for all alike by the Carnegie Foundation." Another president writes:—"We need your standard more than we need your recognition." It is evident, therefore, that one of the results of the working of this trust will be a great forward movement in secondary and university education in districts where until recently all higher education was in a very backward condition.

Another result of the conditions laid down by the Foundation in accordance with Mr. Carnegie's wishes will be the gradual liberation of many colleges from obsolete sectarian limitations. For not only is an educational standard required, but those institutions alone are recognised in which no denominational or sectarian test is applied in the choice of trustees, officers, or teachers, or in the admission of students. The trustees of an institution applying for recognition must further testify that "no distinctly denominational tenets or doctrines are taught to the students." Several of the institutions recently admitted to the accepted list have obtained release from conditions which constituted a sectarian barrier. Bowdoin College had to surrender to a theological seminary a sum of fully 10,000*l.*, which it had accepted as an endowment with denominational conditions. The Central University of Kentucky, with some difficulty, obtained freedom from sectarian patronage so as to qualify itself for acceptance by this foundation. Doubtless many other colleges will struggle to get rid of their bonds, in order to obtain a place on the coveted list.

Another desirable result at which the policy of the trustees aims is the raising of the standard of professional education in America. The "schools of law and of medicine had, up to recent years, no common standards and no relation to the general system of education." The tendency has been to make these schools of law and of medicine a department of the university. The desire of the trustees is to foster this tendency, and so aid in removing commercialism, raising standards, and giving unity to professional training. The public interest will thus be safeguarded by the provision of a regular supply of educated men thoroughly trained as physicians or lawyers. Low standards are dangerous to the nation and demoralising to the profession.

The report before us contains a hint that the trustees hope to promote in the colleges and universities increased security of position by obtaining freedom from political as well as sectarian restrictions.

It is not long since political and denominational influence was rampant in university matters. Even during the last year two State universities suffered severely through political interference with their organisation. If the Carnegie Foundation can help to bring about a complete divorce of educational administration from politics it will have added a bright jewel to its crown.

According to the third report there are now sixty-two institutions which satisfy the requirements of the foundation, and are recognised as accepted institutions. To their professors the benefits of the foundation are extended through the institutions themselves. That is, if the professor has reached the age agreed upon, or has been in the teaching profession for a certain period of years, he will receive his retiring allowance as soon as his institution applies for it. The trustees have given special consideration to the professors whose active salary is low. They have adopted a scale under which such a teacher is granted a much higher percentage of his salary than is granted to one receiving a high salary. Any person sixty-five years of age, who has been a professor for at least fifteen years, shall receive a retiring allowance on the following scales:—

A. *Salary not more than* 1200 *dollars*.—An allowance of 1000 dollars, or not more than 90 per cent. of his salary.

B. *Salary above* 1200 *dollars*.—An allowance of 1000 dollars, increased by 50 dollars for each 100 dollars of salary above 1200 dollars.

No retiring allowance shall exceed 4000 dollars. This is 1000 dollars more than the limit originally fixed.

In these sixty-two accepted institutions there are already in force 116 retiring allowances, the average amount of which is 1600 dollars per annum.

The trustees have also from the beginning granted retiring allowances to certain professors not on the "accepted list." These grants have in all cases been made on the ground of distinguished and unusual service. When applications from individual professors are received each case is minutely considered by the trustees and judged upon its own merits. At present sixty-six such retiring allowances are in force, the average amount of which is fully 1400 dollars.

The foundation has also incorporated in its rules a recommendation of the executive committee that a pension be granted to the widow of a professor in an accepted institution who has been for ten years married to the professor. This widow's pension is to be one-half of what the husband would have been entitled to receive.

According to the report, pensions are at present granted to nine widows of professors in accepted institutions, and to six widows of professors not in accepted institutions. The average allowance in the former case is 963 dollars, in the latter case 680 dollars.

The trustees are to be congratulated on the wisdom and firmness of their administration of the foundation, and on the influence which they have already exercised upon the progress of higher education. The full effect of that influence is just beginning to be foreshadowed.

JOHN EDGAR.

GERMANY AND THE PATENTS AND DESIGNS ACT, 1907.

WE have received a report to the Secretary of the Department of Agriculture and Technical Instruction for Ireland on a visit to Germany made by a deputation in connection with the operations of the Patents and Designs Act, 1907. Section 27 of the Act provides that any person may apply to the Comptroller for the revocation of a patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom, and also provides that unless the patentee proves that the patented article or process is manufactured or carried on to an adequate extent within the United Kingdom, or gives satisfactory reasons why this is not the case, the Comptroller may revoke the patent either forthwith or after a reasonable interval.

The wording of this section clearly suggests that a patentee who manufactures an article or carries on a process exclusively or mainly abroad runs a grave risk of having his patent revoked under the sanctioned procedure, and considerable alarm has been manifested by foreign patentees in consequence. They have hoped against hope that the section does not mean what it says, or at least that it will be interpreted to mean something quite different, and now that it is being borne in upon them that the section will be construed to mean exactly what it says, they are making very sincere attempts, in some cases, to comply with the plain requirements of the section.

One way of complying with the requirements and of thus avoiding the risk of revocation is obviously to work the patent in the United Kingdom, and there have been many inquiries from foreign patentees as to the feasibility of taking this course. There have been, on the other hand, numerous attempts to bring to the notice of such foreign patentees the advantages of particular places in the United Kingdom for the establishment of industries, and the chief object of this visit to Germany was to interest foreign manufacturers who might be affected by the Act in the opportunities for industrial enterprise now being offered in Ireland. When it is remembered that in the year 1906 more than 6000 patents were granted to foreigners, it is clear that the object of the visit might easily have been defeated by attempting too much, and, in order that this might not occur, the members of the deputation wisely decided to devote their energies particularly to industries specially suitable for introduction into Ireland. In seeking for such industries, they were of opinion that it was undesirable to concern themselves with industries already established in Ireland and capable of further development from within, and they were finally led to limit the object of the visit to an attempt to convince the directors of certain chemical industries, such as those concerned with the manufacture of anilin dyes, and certain electrical industries, that the conditions which exist in Ireland are specially suited to the requirements of these industries.

Most of the important centres of these industries in Germany were visited, and the report contains an account of the wonderful development which Germany has made in these industries during the last quarter of a century. Of their visit to Berlin they state that

We seized the opportunity of visiting the largest of the electrical firms—the Allgemeine Electricitäts Gesellschaft (known familiarly and shortly as the A.E.G.), which last year celebrated the twenty-fifth anniversary of its inauguration. The development of this company has been phenomenal. Founded in 1883, with a capital of 250,000*l*., it has to-day a capital of 5,000,000*l*.—including debentures and reserves, 9,200,000*l*. From the manufacture of dynamos, motors, and lamps it developed and erected in 1885 an Electric Power Station in Berlin, which developed into the Berlin Electrical Works, where they manufacture a great variety of electrical plant, and, keeping pace with every new discovery, are now manufacturing the metal-filament lamps which threaten to displace the carbon-filament lamps. Since 1885 it has erected power stations in nearly 700 German and foreign towns. It then took up electric traction, and has constructed a large number of electric railways. It has a vast number of agencies in Germany and other countries.

At Ludwigshafen,

We were fortunate in being able to see a portion, at least, of the well-known works of the Badische Anilin- und Soda-Fabrik at Ludwigshafen. By the kindness of the head of their Patents Department, Dr. Ehrhardt, and Dr. Lloyd, his assistant (both from Birmingham), we were shown through part of the huge works, to see the whole of which several days would be required. These works were founded in 1865 for the manufacture of colouring matters and other derivatives extracted from coal tar. In that year there were only thirty workpeople. In 1870 there were 835; in 1885, 2377; in 1895, 4450. Now there are 8000. They employ, moreover, some 200 trained chemists, 100 engineers, and more than 700 mercantile clerks. The area of the site of the factory is about that of the City of London. On one side of it is the Rhine, so that there is easy transport for the coal (they use 1000 tons a day) to drive their 370 steam engines, and for the pyrites (of which they use 100,000 tons a year), and other raw materials required.

This is not the place for a full account of the progress of discovery in this branch of chemistry, but each discovery in turn has been utilised and turned into gold. Their staff of trained chemists are continually adding to their store of knowledge, and are provided with well-equipped laboratories. To the benches are distributed hot and cold water, compressed air, vacuum and electrical power. The commercial value of their discoveries is safeguarded by a patent department having some seventeen assistants. They hold more than 1200 patents, and take out on an average about two a week.

The Badische Anilin- und Soda-Fabrik has already decided on a site at Birkenhead, but as it is only one out of a dozen German chemical companies which have during the past five years paid dividends of from 10 per cent. to 35 per cent. per annum, there appears to be good reason for bringing to the notice of the directors of these companies places in the United Kingdom which are specially suited to these industries.

There can be no doubt that before the directors of successful foreign companies attempt to establish industries in the United Kingdom, they will make exhaustive investigations as to the general industrial conditions in this country and as to the special considerations relating to their particular industries. The deputation discusses at some length the industrial conditions in Germany, and, in order to compare the industrial conditions there and here, reference is made to the recently published Board of Trade report (Cd. 4032, 1908) on the condition of the working classes in Germany. This question is so directly before the public to-day that there is no necessity to discuss the matter here, but it is of interest to know that Dr. Walther Rathenau, one of the leading industrial authorities in Germany, in his "Reflexionem," remarks that, speaking of the chemical industry,

the reason the Germans have so far surpassed us is because English science is not strong enough to direct the numerous ramifications of the source of the "black art" into the technical stream, and because English industry has not the army of trained workers which is annually recruited from the German high schools. The same difficulties, he remarks, are encountered by the electrical industries in England.

The other conditions which are considered of importance in deciding the question of the establishment of a chemical industry are stated to be:—

(1) The cost of motive power.
(2) The price of coal, alkali, and acids.
(3) The availability of salt or brine.
(4) The price of land and the amount of taxes.
(5) The supply of water and provision for discharge of effluent.

The deputation appears to have considered fairly fully the various conditions necessary to the successful establishment in Ireland of industries such as the electrical and chemical industries, and it is of opinion that there is no reason why such industries should not be profitably carried out there.

When the deputation made its report, the Comptroller's first decision under Section 27 (in the case of an application for the revocation of Hatschek's patents No. 6455 of 1900 and No. 22,139 of 1900) was under appeal, and it was doubtful what interpretation of the section would finally prevail. Since then, however, Mr. Justice Parker has delivered judgment in the appeal, and there can be no further doubt that a patentee who manufactures exclusively or mainly abroad runs a very grave risk of having his patent revoked. Patentees will therefore be more inclined than they have been to manufacture here, and in order to direct those who may benefit by this inclination, we give the general conclusions arrived at by the deputation, viz.:—

(1) The first is that, if reasonable facilities are offered, there is a strong probability that manufacturers in certain industries will find it to their interests to set up branches of their works within the United Kingdom.

(2) In the next place, in order to attract such manufacturers to any particular part of the United Kingdom, it will be necessary for those interested in the industrial development of any given city or locality to themselves make special and persistent attempts to bring before particular firms the facilities and advantages which the localities in question have to offer. In other words, it will not be enough to send circulars—even those translated into good German—to our Consular representatives abroad. We saw a large pile of these from various municipalities on the table of one of the large Consulates "in case of inquiry." There had been no inquiries. It needs to be recognised that the matter is one into which the keenest competition enters, and in regard to which only persistent efforts on the part of the competing localities themselves will produce results.

(3) There is a third general conclusion which we believe to be of considerable importance. It seems clear that the effects of the working of the Patents and Designs Act will not be immediate, but gradual and continuous. It is already evident that a number of foreign manufacturers will establish branches of their business in the United Kingdom, and will so maintain their patent rights. But many manufacturers will doubtless prefer to sacrifice their patents rather than take this course. The inventions contained in patents which will be revoked as a consequence become public property, and may be utilised by any enterprising person. Given the necessary enterprise, it will be possible to build up new industries, whilst existing industries may derive benefit from the freedom to utilise inventions in cases where the covering patents are not being worked to such an extent in the United Kingdom as to comply with the Act.

DR. VON NEUMAYER, For.Mem.R.S.

THE news of the death, on May 24, at Neustadt, in the Bavarian Palatinate, of Excellency Georg Balthasar von Neumayer was received with genuine regret by a world-wide circle of scientific men, to a very large number of whom he was personally known for his sterling qualities, the warmth of his friendship, his genial urbanity, and his kindly disposition, more especially towards young men entering upon a scientific career. To these he was the fatherly counsellor who gave them every encouragement to prosecute their studies in the broadest possible manner, for he had long ago realised that science had entered upon a new era of marvellous progress. The foreign visitor to German scientific gatherings has always been struck by the universal reverence for the name of Neumayer, for there have been very few of the savants of the fatherland during the past half-century who have not been influenced, more or less, by the great personality who is now no more.

Dr. von Neumayer was born at Kirchheimbolanden, in the Palatinate, on June 21, 1826, so that at the time of his death he was within a few weeks of completing his eighty-third year. From his early youth he developed a decided predilection for scientific investigation, and during his career at the Munich University he became intensely interested in the Polar expeditions which were being conducted by Sir James Ross and Sir John Franklin. The German navy and the German overseas trade are subjects which are widely discussed to-day, but few recognise that the vast changes which have taken place originated in the brain of the youthful Neumayer. At a time when divided Germany had neither navy nor mercantile marine worthy of mention, Neumayer was the first to entertain the idea as to the direction in which a united Germany should advance, which was long afterwards crystallised by the present Emperor, when he declared that "Unsere Zukunft liegt auf dem Wasser." So early as 1849 the university student had visions on the subject, and in 1850 we find him departing from Munich to take a subordinate post before the mast on a sailing ship bound for South American ports. This afforded him the opportunity for studying the theory as well as the practice of navigation and nautical astronomy.

On returning from the southern seas in the following year Neumayer went for a time to Trieste as a teacher of navigation, proceeding thence to Hamburg, where in after life he was destined to become a distinguished citizen. But he could not rest long ashore, the sea had its attractions for him, and in 1852 he again took ship for the southern oceans, where he spent a couple of years. In 1856 he went out to Tasmania, and there devoted his time to magnetic work at the observatory which Sir John Ross started at Hobart Town. The following year found him at Melbourne, and here, with the assistance of Maximilian, King of Bavaria, and Alexander von Humboldt, he founded the Flagstaff Magnetical and Meteorological Observatory, which was subsequently taken over by the Victorian Government authorities. A great deal of his time in Victoria was given to a magnetic survey of the country, which was carried on right up to the foot of Mount Kosciusko, in New South Wales. Having accumulated a mass of magnetical and meteorological information, he left Melbourne in 1864 by the then celebrated clipper ship *Sovereign of the Seas*, and returned to Europe. His reception in London on this occasion made a lasting impression upon him, and to the end he never failed to acknowledge the encouragement which he obtained from prominent members of the Royal Society—Sir Roger Murchison, Sir Edward Sabine, and many others, with whom a life-long friendship was entered upon. Settling down quietly in his native land, the Palatinate, he devoted about six years to the careful discussion of the voluminous records which he had gathered in Australia.

Placing a high appreciation on the value of the work thus far done by Neumayer, the recently formed Imperial Government of Germany in 1872 offered him the appointment of hydrographer to the Imperial Navy, a post which he occupied until 1876, when he was promoted to the directorship of the Deutsche Seewarte, at Hamburg, an institution the establishment of which in 1868, under Wilhelm von Freeden, as the Norddeutsche Seewarte, he had strenuously advocated. In his new post Neumayer was retained as adviser to the Admiralty at Berlin. The efficiency of the German navy of to-day is largely due to his unbounded admiration for the methods of the English navy. Whether in matters of discipline, surveying, magnetic observations, or any other subject, his aim was to train his countrymen to attain at least the English standard of excellence. During his directorship of the Seewarte he was indefatigable in his exertions to introduce the best scientific methods into all work performed in the German naval and mercantile services, and to-day, thanks to his guidance, both may be said to be second to none in the correctness and trustworthiness of their contributions to scientific progress.

While Neumayer was recognised as an authority on meteorological problems, the subject which he made specially his own was magnetism, and to this field of research he devoted the greater part of his life, down to within the past few months. With the object of furthering our knowledge of this subject he exercised his influence in promoting investigations in all parts of the world—in the international circumpolar expeditions of 1882–3; in the fitting out of the German Antarctic expedition on the *Gauss*; and in many other ways. Recognising the great international importance of the question, he, in February, 1898, made a special visit to London to join in the appeal which was then being made by the Royal Society for the equipment of an English scientific expedition into the Antarctic Ocean. The special points which he advocated on that occasion were gravity and magnetism. "A gravity survey," he said, "is, in connection with a thorough geographical survey of the Antarctic, one of the most urgent requirements of the science of our earth. There are no measurements of the gravity constant within the Antarctic region; indeed, they are very scarce in the southern hemisphere south of the thirtieth parallel, and they are so closely connected with the theory of the figure of our earth that it is hardly possible to arrive at any conclusive results in this all-important matter without observations within the Antarctic region."

Magnetic investigations always entered into his advocacy of Arctic and Antarctic expeditions in addressing meetings of the German Association, the Geographentag, and other scientific bodies. In Germany the rules regulating the retirement of public servants into private life are not so rigidly enforced as they are in England, and this was particularly noticeable in the case of Dr. Neumayer. With advancing years, and when he felt entitled to withdraw from the service, he several times sought permission to give up active work as director of the Seewarte, but such were the high opinions of him entertained by the ruling authorities at Berlin, as well as by his fellow-countrymen generally, that deaf ears were turned to his appeals. It was not until 1903, when he was approaching the close of his seventy-seventh year, that the Emperor paid a personal visit to the Seewarte, and at last the aged director was permitted to retire into private life with a pension and the honour of the ennobling title "von."

During the last six years Neumayer resided at Neustadt, a short distance from his birthplace, his rooms decorated with numerous mementos of his long career in both hemispheres, and to the last maintaining his interest in his favourite subject. He was a Privy Councillor of the Empire, and both at home and abroad he was awarded many distinctions. When the German Meteorological Society was founded at Hamburg, in November, 1883, he was unanimously chosen as its first president; in 1899 he was president of the German Association; while his services to the great port of Hamburg were recognised in many ways, the city perpetuating his memory by naming one of the new streets near the Seewarte and the Bismarck monument after him. In London he was elected an honorary member of the Royal Meteorological Society so long ago as 1874, and he became a Foreign Member of the Royal Society in 1899. "The world is certainly the poorer for his loss" is the expression of one of his English admirers. He was the author of numerous books and scientific papers, some in English, the results of the Victorian investigations being published in two English volumes. His papers and addresses are to be found in the publications of many scientific societies, and he was also the author of various magnetic and other charts and atlases.

Hy. Harries.

T. MELLARD READE.

BY the death of Mr. Thomas Mellard Reade, F.G.S., geological science has lost an amiable, painstaking, and enthusiastic geological worker. Educated as a civil engineer, he was at one time chief draughtsman in the civil engineering department (northern division) of the London and North-Western Railway. Later on he became engaged in independent engineering and architectural work, and was elected an Associate Member of the Institution of Civil Engineers and a Fellow of the Royal Institute of British Architects. In the course of his professional work, the strata exposed in foundations and trenches aroused his interest, and, recognising the practical advantages of a knowledge of geology, he began, when about thirty-five years of age, to pursue the study with great earnestness. The list of his scientific papers and works, numbering about 200, commenced in 1870 and continued until the present year. Residing in the neighbourhood of Liverpool, his attention was in earlier years given especially to the Glacial and post-Glacial deposits of Lancashire and Cheshire, and he was ever an advocate of the glacio-marine origin of much of the Boulder-drift.

Mr. Reade became a Fellow of the Geological Society of London in 1872, and was also an active member of the Liverpool Geological Society, of which he was three times president. His more important papers were communicated to these societies, and to the *Geological* and *Philosophical Magazines*, while many short contributions (dating from 1870) were published in NATURE. He extended his researches on Glacial geology into North Wales, Norfolk, Scotland, and Ireland. Tidal action as a geological cause, chemical denudation in relation to geological time, and the physiography of the Trias are among the subjects with which he dealt. In 1886 he published his great work on "The Origin of Mountain Ranges considered Experimentally, Structurally, Dynamically, and in Relation to their Geological History." The results of much original and experimental research were given in this volume, and the existence of a level-of-no-strain in a cooling solid globe was for the first time pointed out. It was recognised that his experiments on the rates of expansion of different kinds of rock were of great interest and value, although they did not explain some of the more complicated phenomena of mountain structure. In recognition of this work and other researches, the Geological Society in 1896 awarded him the Murchison medal.

Pursuing the subject of dynamic geology, and making further experimental investigations, he published in 1903 a volume entitled "The Evolution of Earth Structure, with a Theory of Geomorphic Changes." In this work he embodied much material which he had previously published, including researches on slaty cleavage, carried out in conjunction with Mr. Philip Holland, as well as essays on denudation and on the permanence of oceans and continents; and the volume may be said to summarise his main contributions to geological science. He expressed his conclusion that while the relative proportions of land and water have been fairly constant throughout the ages, regional changes of level are due to alterations in the bulk of certain portions of the lithosphere caused by expansion and contraction, without other movements in mass. Among his later investigations, those on "Sands and Sediments," in which he had the cooperation of Mr. P. Holland, are of great interest and importance, especially in connection with the micro-sediments, such as quartz-dust, and fine particles of carbonate of lime of detrital origin. In the latter case the suggestion is made that some deep sea-limestones may be due in part to mechanical causes.

Mr. Reade died on May 27, aged seventy-seven, at his residence, Park Corner, Blundellsands, Liverpool.

H. B. W.

NOTES.

THE Croonian lecture of the Royal Society will be delivered on Thursday, June 10, by Prof. E. A. Schäfer, F.R.S., on "The Functions of the Pituitary Body."

THE statue of Lamarck, erected by international subscription, is to be unveiled in the Jardin des Plantes, Paris, on Sunday, June 13, at 3 p.m. M. Fallières will preside at the meeting.

THE death is announced of M. Eugène Grenet, well known as an electrical engineer and the inventor of the potassium bichromate cell.

PROF. IRA REMSEN, president of the Johns Hopkins University, Baltimore, U.S.A., has been elected president of the Society of Chemical Industry for the ensuing year. The next annual meeting of the society will be held in Glasgow.

IT is announced that the principal trustees of the British Museum have appointed Mr. Lazarus Fletcher, F.R.S., keeper of the department of mineralogy, to the post of director of the natural history departments of the British Museum.

THE New York correspondent of the *Times* announces that the American delegates to the Darwin centenary celebration at Cambridge will bring with them a bronze bust of the great naturalist, 40 inches in height, which they will present to Christ's College.

IT is announced in *Science* that the American Academy of Arts and Sciences has awarded the Rumford premium to Prof. R. W. Wood, of the Johns Hopkins University, for his discoveries in light, and particularly for his researches on the optical properties of sodium and other metallic vapours.

MR. HORACE DARWIN, F.R.S., has been elected a corresponding member of the Vienna Academy of Sciences.

THE annual meeting of the Cape Chemical Society was held on April 30, when the following officers for 1909 were elected:—*president*, Dr. R. Marloth; *vice-president*, Dr. C. F. Juritz; *hon. secretary and treasurer*, Mr. St. Clair O. Sinclair; *additional members of council*, Mr. G. N. Blackshaw and Prof. P. D. Hahn. Dr. R. Marloth delivered his presidential address, on "The Chemistry of some Vegetable Products of South Africa."

AT the last meeting of the International Physiological Congress, which was held at Heidelberg in 1907, it was decided to hold the next congress at Vienna in 1910, at Whitsuntide. It has been found, however, that at this time of year it would be impossible for a large number of physiologists to attend the congress, and the local committee of the congress at Vienna has therefore, after consulting the local secretaries in the various countries, determined to change the date. In accordance with the general wish, the congress will now be held on September 26–30, 1910.

ON July 1 the price of the *Astrophysical Journal* is to be increased. In a letter upon this change, Prof. E. B. Frost, the managing editor, points out that a periodical of a strictly scientific character like the *Astrophysical Journal*, even though conducted without expense for contributions or for editorial or clerical assistance, cannot be self-supporting. The annual deficit of the journal has been met by a subsidy from the University of Chicago, which in the last two years has been 400*l*., but no increase in this subsidy can be expected. With the advance in subscription price it is expected that the size of the journal and the number of illustrations will be maintained as during recent years.

The fifth congress of the International Association for Testing Materials is to be held, under the patronage of King Frederick VIIIth of Denmark, on September 7–11 in Copenhagen. After the ceremonial opening of the congress on September 7, in the presence of the King of Denmark, and an address by the Prime Minister, Mr. Paul Larsen will read a paper on the development of the cement industry in Denmark. The three following days will be devoted to meetings of the sections, and on September 11 a paper will be read by Mr. J. E. Stead, of Middlesbrough, on the practical use of the microscope in testing metals and alloys. The latest date at which applications to take part in the congress can be received is June 15, and application should be made to the secretary of the Iron and Steel Institute at 28 Victoria Street, London, S.W.

We regret to see the announcement of the sudden death of Dr. J. D. E. Schmeltz, director of the Royal Ethnographical Museum at Leyden, at seventy years of age. From the *Times* we learn that Dr. Schmeltz was a native of Hamburg, where he made the acquaintance of a wealthy merchant, Herr Godeffroy, an enthusiast in geographical and ethnological studies. Godeffroy founded an ethnographical museum in 1863, and made Schmeltz director. When in 1882 the Godeffroy Museum was sold, Schmeltz had a name sufficient to secure immediate nomination as conservator of the Leyden Museum of Ethnography, of which establishment he was appointed director in 1897.

Disturbances, said by daily papers to be due to earthquakes, were reported from Tiverton and the surrounding district on May 25. They began at 12.54 p.m., and continued for twenty minutes, causing windows to rattle and houses to shake. They were preceded by a noise like thunder. The long interval throughout which the shocks were noticed, the apparent transmission of the waves through the air, and the fact that some observers remarked on the likeness between the disturbances and those caused by distant gun-firing, pointed to this as their cause. Inquiries have now shown that the supposed earthquakes were of artificial origin. They were caused by the firing of heavy guns in the Channel off Weymouth, about fifty miles from Tiverton. The disturbances at places nearer the centre, such as Dorchester and Yeovil, were, of course, assigned at once to their true cause.

In connection with the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease, Mr. Burns, the President of the Local Government Board, has authorised the following special researches:—(1) a continuation of the investigation into protracted and recurrent infection in enteric fever, by Dr. T. Thomson, in conjunction with Dr. Hedingham; (2) a continuation of the investigation into protracted and recurrent infection in diphtheria, by Dr. T. Thomson and Dr. C. J. Thomas; (3) a continuation of the investigation into flies as carriers of infection, by Dr. Monckton Copeman and Prof. Nuttall; (4) a continuation of Dr. Andrewes's investigation on the presence of sewage bacteria in sewer air, with the view of ascertaining their number and the distance they can be carried by air currents; also a continuation of Dr. Andrewes's investigation into the part played by changes in bone marrow in the defensive mechanism of the body against infection; (5) a continuation of Dr. Savage's investigations on the bacterial measurement of milk pollution, and on the presence of the Gaertner group of bacilli in prepared meats and allied foods; (6) an investigation into the chemical and physical changes undergone by milk as the result of infection by bacteria, and into the relation of the pancreas to epidemic diarrhœa, by Dr. Schölberg and Mr. Wallis; (7) an investigation of the records of charitable lying-in hospitals as to the nutrition of the mother and other factors influencing the vitality of infants and their progress in the first fourteen days of life, by Dr. Darwall Smith; (8) an investigation into the occurrence and importance, in relation to treatment, of mixed infections in pulmonary tuberculosis, by Dr. Inman; (9) an investigation on the relative importance of certain types of body-cells in defence against the tubercle bacillus, and the effect of tuberculin and other remedial agents on their activities, by Dr. J. Miller.

Count Zeppelin is reported to have beaten every existing record in the navigation of steerable balloons. On the evening of May 29, at 9.45, the ascent of the airship *Zeppelin II.* took place from Friedrichshafen, and the descent at Göppingen was made, in order to obtain a fresh supply of petrol, during the afternoon of May 31, when the cruise had lasted 37h. 40m. The *Times* of June 2 gives the following bee-line analysis of the voyage:—

Outward Journey (against wind).

	Distance	Time	Average Speed. Miles per hour
	Miles	Hours	
Friedrichshafen to Ulm ...	60	5	12
Ulm to Nuremberg ...	86	6	14
Nuremberg to Plauen ...	85	5	17
Plauen to Leipzig ...	60	$3\frac{1}{2}$	17
Leipzig to Bitterfeld ...	20	$2\frac{1}{2}$	...
Return Journey.			
Bitterfeld to Halle ...	18	$\frac{1}{2}$	36
Halle to Weimar ...	45	$1\frac{1}{2}$	30
Weimar to Würzburg ...	105	$7\frac{3}{4}$	13
Würzburg to Stuttgart ...	80	5	16
Stuttgart to Göppingen ...	25	1	25

The bee-line distance for the whole journey is 584 miles, and the total distance travelled was probably nearly 900 miles. Taking the running time as thirty-eight hours, and the distance 870 miles, the average speed works out at 23 miles an hour.

The sixteenth International Medical Congress is to be held in Budapest from August 29 to September 4 next, under the patronage of the Emperor Francis Joseph, who will be represented by Prince Joseph. The formal opening will be held in the morning of Sunday, August 29. The business of the congress will consist largely of sectional meetings, the sections being as follows:—(1) anatomy and embryology; (2) physiology; (3) general and experimental pathology; (4) microbiology (bacteriology) and pathological anatomy; (5) therapeutics (pharmacology, physical therapeutics, and balneology); (6) internal medicine; (7) surgery; (8) obstetrics and gynæcology; (9) ophthalmology; (10) diseases of children; (11) diseases of the nervous system; (12) psychiatrics; (13) dermatology and venereal diseases; (14) diseases of the urinary tract; (15) rhinology and laryngology; (16) otology (this section forming also the eighth International Otological Congress); (17) stomatology; (18) hygiene and immunity; (19) juridical medicine; (20) military and naval sanitary services; and (21) maritime medicine and tropical diseases. There will be six general meetings of the congress, when the following subjects will be dealt with. Dr. G. Baccelli, of Rome, will discourse on heroic medicine; Dr. E. F. Bashford, of London, on cancer; Dr. M. Gruber, of Munich, on inheritance, selection, and hygiene; Dr. R. Kutner, of Berlin, on the post-graduate instruction of medical men, his address being given at the request of the central committee of Prussian post-graduate instruction; Dr. A. Laveran, of Paris, on tropical medicine; and Dr. J. Loeb, of Berkeley, on artificial parthenogenesis and its bearing upon the physiology and the pathology of the cell. The first issue of the Journal of the congress will give particulars as to the place, the day, and the time of each of these meetings. The executive committee of the congress has also arranged general meetings for the discussion of the reports and communications dealing with the subjects of appendicitis and immunity. It is interesting to note that 408 addresses and 781 communications, covering every branch of medical science, had been received at the time of the publication of the circular we have received from Budapest. The office of the congress is viii., Esterházy-utcza 7, Budapest, Hungary.

To Messrs. John Wheldon and Co., of Great Queen Street, we are indebted for a copy of a catalogue of works and papers on vertebrates, exclusive of birds, marine biology, &c., including selections from several libraries.

In the thirty-seventh annual report of the board of directors of the Zoological Society of Philadelphia reference is made to the good results which have attended the testing with tuberculin of each monkey received at the gardens before its entrance to the quarantine-room. There has been no death from tuberculosis among the monkeys exhibited since October, 1907, and the results of the experiment justify the belief that, apart from an occasional sporadic instance, the disease can be held in check, and the heavy mortality due to this cause finally stopped.

To the May number of the *Zoologist* Captain S. S. Flower contributes a list of the known zoological gardens of the world; the total number recorded is 154, of which, however, a few appear to have been closed, while information is required concerning a few others. Of existing establishments of this nature, the oldest appears to be the Imperial Menagerie at Schönbrunn, Vienna, which was founded in 1752, the next in point of seniority being the menagerie at Madrid, dating from 1774, and the third that of Paris, founded in 1793.

From the report of the director of the Field Museum of Natural History, Chicago, for 1908, we gather the great progress that has been made in that museum (in common with other institutions of a like nature in the United States) in the mounting of groups of animals for public exhibition. During the year groups of woodchucks (marmots), musk-rats, and six of fishes have been added to the exhibition series in the Field Museum. The larger fish-groups are set up in cases 6 feet long by 20 inches in height and width, the specimens being mounted to give the effect, so far as possible, of live fishes under natural conditions.

A revision of the mice of the American genus Peromyscus, by Mr. W. H. Osgood, forming No. 28 of the "North American Fauna," now in course of issue by the U.S. Biological Survey, affords an instructive example of the elaborate and detailed manner in which that survey is being carried out. In this respect it is safe to say that it has no rival in any part of the world. We have only to look at the coloured map serving as a frontispiece, and illustrating the distribution of the races of *Peromyscus maniculatus* and its relatives, to realise the detailed nature of the survey's operations, and the enormous amount of collecting and technical work involved. Whether the game is really worth the candle need not now be discussed, and we may be content with congratulating Mr. Osgood and his co-labourers on the manner in which they have carried out their task, which is even now declared to be not finally completed. The members of the genus Peromyscus, commonly known as vesper-mice and white-food mice, include a vast number of species ranging over almost the whole of North America, and wonderfully numerous in individuals, and the group is therefore specially fitted for the study of the numerous problems connected with distribution, variation, and the limitations and intergradations of species and races.

Two articles have lately appeared in the *Fortnightly Review* under the title of "Suggestions for a Physical Theory of Evolution." The arguments of the writer are vitiated throughout by his implied assumption that the importance of the environment in evolution lies in its supposed power of directly inducing variation. The selective function of surrounding circumstances is passed over, and no serious attempt is made to deal with the essential differences that exist between somatic modification and variation properly so-called. The author commits himself to a "photographic" theory of the phenomena of mimicry and protective resemblance, ignoring the formidable difficulties that stand in the way of such an explanation. His treatment of this subject does not argue an adequate knowledge of the facts which he is endeavouring to explain.

America is by no means behindhand in celebrating the centenary of Darwin's birth. The April issue of the *Popular Science Monthly* is entirely devoted to a series of articles and addresses inspired by this occasion. Dr. H. F. Osborn leads the way with an excellent and appreciative lecture on the life and works of Darwin, in which, however, he avows opinions as to "directed variation" which would not have been acceptable to the object of his eulogy. Estimates of the influence of Darwin's work in the fields of zoology, botany, and geology are contributed by Dr. H. C. Bumpus, Dr. N. L. Britton, and Prof. J. J. Stevenson. Prof. T. H. Morgan's essay, "For Darwin," bases Darwin's claim to the gratitude of posterity chiefly on his method of investigation. This is inadequate; Darwin's preeminence consists in the revolution he has been the means of effecting in every department of thought; his method alone would not have singled him out from other great men. The substitution of the dynamic for the static conception of nature, of which Darwinism is at once a cause and a symptom, is well brought out by Prof. W. M. Wheeler, while the strength and nobility of Darwin's character and the distinctive features of his career and its results find a fitting interpreter in Prof. R. M. Wenley. The intensely interesting addresses given by Dr. A. R. Wallace and Sir Joseph Hooker at the Linnean Society's celebration, held last July, are added; and the record is completed by the insertion of a facsimile reproduction of part of the original manuscript of the "Origin of Species," together with portraits of Darwin himself, of Lyell, Hooker, Wallace, and Malthus.

THE Egyptian Gazette of April 21 supplies a report of a lecture delivered at the annual meeting of the Cairo Scientific Society by Dr. Elliot Smith, on the origin of the people of Egypt. He explained that the theories of the earlier anthropologists have now been in a large measure superseded by recent investigations of prehistoric interments, which have now rendered it possible to arrange archaic burials in systematic order. The earliest inhabitants of Egypt with whom we are acquainted were a people slightly below the average height of mankind and of poor muscular development. While they conform to the south European and Arab type, they are more closely allied to the Berbers of the southern shores of the Mediterranean. No remains of any population of like age having been as yet discovered in any neighbouring country, it seems clear that their culture was evolved in the Nile Valley, which they must have occupied at a period long antecedent to the earliest remains so far discovered. With the rise of the first dynasty a definite change sets in, the head becoming broader and more filled out, the nose narrower, and the physique improved. Little is known of the origin of this new race, but it seems probable that the original purely Egyptian population of Lower Egypt was modified by the immigration of alien elements entering the delta from the islands or northern shores of the Mediterranean, or wandering along the southern shores of that sea from Libya on the west or from Palestine on the east. The original type was, however, only slightly modified during the Ancient Empire, and at all times large numbers of persons of the pre-dynastic type are found. The modification really set in with the rise of the New Empire. In Nubia the case was different. Here the original type survived in early dynastic times unaffected by the immigration which made its mark in Lower Egypt; but instead of this influence the race here became subject to another—that of the negro. The Nubian is thus the descendant of pre-dynastic Egyptians slightly mixed with the negro, while the Egyptian of the delta represents the same primitive stock somewhat modified by intermixture with some Mediterranean people.

THE most important paper in the current issue of the Journal of the Royal Anthropological Institute is that by the president, Prof. Ridgeway, on the origin of the Turkish crescent. So far from being an ancient Mohammedan symbol, it was not employed by the Arabs or by any of the original nations who embraced the faith of the Prophet, nor was it borne by the Saracens who fought in the Crusades. It was not identified with Islam until after the appearance of the Osmanli Turks, and there is ample evidence that in the time of the Crusades, and long before, the crescent and the star were a regular badge of Byzantium and of its emperors. Comparing the crescent with similar forms of ornament used by other races, Prof. Ridgeway comes to the conclusion that the Turks derived it from two sources, the old amulet made of one or two boars' tusks, and the crescent and star which they found everywhere in their new empire. Without denying that representations of the moon may have been made and venerated by the inhabitants of the Swiss lake-villages, and that, in some regions and in some periods, the crescent of boars' tusks was likened to the new moon, still, with the evidence of Spartan and Danubian metal imitations of boars'-tusk amulets before us, we may conclude with some safety that the use of crescents of boars' tusks and of imitations of these was far older in the regions ruled by the emperors of Byzantium than the badge of crescent moon or star. It may well be that the latter was adopted by the emperors of the East from the Star of Bethlehem. The Turks probably became acquainted with the boar, and used its tusks as an amulet after their settlement in Asia Minor. In their standard, consisting of the crescent and horse-tail, we may perhaps recognise only another form of the amulet of badger's hair and teeth of wild beasts used now in Italy to protect horses from the Evil Eye.

THE annual statement, in this case for two years, of the collated series of phenochrons, *i.e.* the earliest observed dates of opening flowers and other natural phenomena, compiled from data supplied by a large number of schools in Nova Scotia and Canada, is published as a report of the Botanical Club of Canada by Dr. A. H. Mackay. The report would be more generally useful if the observations were summarised and a general comparison made with the data of preceding years.

THE mode of formation of balls of weed made by the rolling action of water, both in lakes and in the sea, is discussed by Dr. A. H. Mackay in vol. xi., part iv., of the Proceedings and Transactions of the Nova Scotian Institute of Science. It is suggested that the deposition of a mass of molluscan or other eggs on a basis of seaweed might, by furnishing agglutinate matter, start the formation of such a weed-ball; but in other instances roots of algas serve as a nucleus, while in some cases the whole structure consists of the finer kinds of brown algas.

A CONTRIBUTION, by Dr. S. Yamanouchi, to the cytology of Fucus, dealing chiefly with the first and second nuclear divisions in the oogonium and with the antheridium of *Fucus vesiculosus*, appears in the *Botanical Gazette* (March). The details of the mitoses, with numerous excellent figures, are given, but a full discussion of the fertilisation process is reserved. Regarding the number of chromosomes, it is found that sixty-four chromosomes are present in the Fucus plant, and that the reduction to half that number occurs at the end of the first two nuclear divisions in the oogonium and antheridium initials. Each of the four nuclei then produced contains thirty-two univalent chromosomes, and this persists to the sperm and egg.

AN account of the vegetation in and around the Redrock Lake, Colorado, published in the University of Colorado Studies (vol. vi., No. 2) by Dr. F. Ramaley, is interesting since the lake is situated at an altitude of about 10,000 feet, and the growing period is limited to a few months. Four zones are demarcated; *Nymphaea polysepala* provides the most abundant aquatic type, while *Carex utriculata*, with other species of Carex and *Caltha leptosepala*, are conspicuous in the sedge zone. The willows and *Betula glandulosa* are dominant in the shrub zone, beyond which the forest area lies, where *Picea Engelmanni* forms almost pure stands in wetter localities and *Pinus flexilis*, with *Pinus murrayana*, dominate the drier situations; *Vaccinium oreophilum* is the most characteristic undershrub in the woods.

MAY usually has a large amount of bright sunshine, but this year it has beaten all previous records, not only for the corresponding month, but for any month since the sunshine records for London were started in 1880. The duration of bright sunshine was 297 hours at the reporting station of the Meteorological Office in Westminster, and the previous highest record for May is 237 hours, in 1906, whilst the previous highest record for any month in the year is 261 hours, in July, 1900. At Greenwich the duration of bright sunshine for May was 326 hours, which is 140 hours more than the average, and in April there was an excess of 103 hours, making a total excess of 243 hours for the two months. In May there were seven days with more than fourteen hours of bright sunshine, and there have only been two days without sunshine during the last two months. At some places in the south of England the sun was shining in May for 350 hours. The aggregate duration of sunshine since the commencement of the year is largely in excess of the average over the whole of England, the excess for the twenty-one weeks amounting to more than 200 hours in the south-east of England.

An important contribution to the study of the upper air, by Dr. W. Köppen, is published in *Aus dem Archiv der deutschen Seewarte*, vol. xxxi., part i., entitled "Three Years' Simultaneous Meteorological Kite Ascents near Hamburg, Berlin, and St. Petersburg." In order to throw light on the lateral extension of the warm and extremely dry strata met with in kite ascents, on the conditions of their occurrence and disappearance, and on their effect on weather changes, the author has collated, side by side, the results for each day during the period December, 1903, to November, 1906, on 108 diagrams, each containing ten days, and showing temperature, wind direction and velocity, and low conditions of humidity. The general discussion of this very useful synoptic material is left for future work; the author nevertheless directs attention to several interesting points. The inversions of temperature are specially noticeable, particularly those which occur suddenly, where the warm stratum borders almost immediately on the cold layer beneath; the temperature gradients in these remarkable inversions are often very large, and mostly occur in late autumn and in winter. The increase of wind velocity with height naturally differs with the direction and with season; all the curves show a rapid increase up to 500 metres, after which it becomes more gradual. The diagrams only include altitudes up to 4000 metres; between the ground and 3000 metres, at Hamburg, the general mean of the velocity (irrespective of direction) in metres per second is 16·7 in the summer half-year and 17 in the winter half-year, while at Berlin the velocities are 9·1 and 12·8 respectively. These special points are discussed by the author in considerable detail.

In a pamphlet of twenty-seven pages published by Gauthier-Villars, of Paris, M. Jacques Boyer has recently given an admirable sketch of the work done of late years, especially in France, in the artificial production of precious stones. With respect to the formation of true rubies, some of which are quite undistinguishable from the natural stones, new and interesting information is given concerning the work accomplished by the successors of Fremy—Feil, Verneuil, Diener Wyse, Maiche, Michaud, and Marc Paquier—with photographs of the actual apparatus employed in the latest manufactures. While the reproduction of the ruby, of perfectly natural colour, has been so successful, much greater difficulty has been experienced in trying to imitate the sapphire, the actual source of the colour in this gem being more doubtful. M. Boyer, however, claims that excellent results have now been obtained by M. Disclyn and M. Louis Paris. In the reproduction of the varieties of quartz used as gems, it is interesting to learn that the different tints of the amethyst have been produced by the action of radium on the uncoloured mineral; and with regard to the opal and emerald information is given, though no results of commercial value have as yet been obtained. The work concludes with an account of what has been effected in the way of producing the diamond by artificial means, photographs of Moissan's electric furnace and other apparatus being given. A bibliography at the end of the paper is useful, but the work, though it contains much valuable and interesting information—sometimes on points upon which there has been much concealment—cannot be regarded as in any sense exhaustive.

Prof. J. Traube, of Charlottenburg, has always been one of the most pronounced opponents of the dissociation theory of solution, and in the April number of *Ion* he shows how the idea of cohesion pressure, that is, the attraction exerted by the molecules of the dissolved substance on the molecules of the solvent, may be used to explain the properties of solutions, whether these are met with in physical, chemical, or physiological fields. Prof. Traube's paper should pave the way to a thorough discussion of the question of solutions. In the same number Dr. V. Kurbatov, of St. Petersburg, shows the inadequacy of the electronic theories of the conduction of electricity in metals, as stated in various forms by Profs. Drude, Lorentz, and Sir J. J. Thomson, to explain the facts observed. He gives an outline of his own theory which is based on the electronic constitution of matter, but he does not justify the assumptions on which he founds it. The translation of this paper is far from perfect.

Since flame spectra were first discovered two explanations have been offered as to their nature. According to one, they are the direct result of chemical reactions going on in the flame—the reduction of the metallic salt, in the opinion of Pringsheim—while the other regards them as the effect of the normal oscillations of the atoms at the high temperature of the flame. In the latter case the speeds of the atoms are distributed according to the law of Maxwell, in the former there will be regions of chemical action in which the speeds will be in excess of the normal. The experiments of Pringsheim, and more recently those of Fredenhagen, seem to support the chemical luminescence theory, while the work of M. E. Bauer, described in the April number of *Le Radium*, lends strong support to the pure temperature explanation. M. Bauer has measured the radiation and absorption of a large Mëker flame for sodium light and for the long rays produced by repeated reflections from fluorite ("reststrahlen"), and finds that Kirchhoff's law is followed, while the temperatures of the flame calculated from the two sets of observations agree very closely. The conclusion seems forced on us that temperature is the essential factor in the production of flame spectra, and if chemical action accounts for any of the radiation it does so only indirectly.

The new 300-ton universal testing machine recently installed by Messrs. W. and T. Avery, Ltd., in the civil engineering laboratory of the University of Birmingham is described and illustrated in the *Engineer* for May 21. The machine is of the horizontal type, and can take exceptionally long specimens—under tension to a maximum stretched length of 33 feet 6 inches, and under compression up to a maximum length of 30 feet. An hydraulic pressure of 1000 lb. per square inch is supplied from an accumulator charged by a motor-driven pump, and advantage is taken of the city main pressure of 85 lb. per square inch for returning the straining cylinder ram and for low load tests. The weighing arrangement consists of a bell-crank lever connected to a second lever which in turn is connected to the steelyard. There are no loose weights; seven poises travel on the steelyard, each representing, when in extreme position, a load of 100,000 lb. on the specimen. These poises are traversed by means of a screw, and can be instantly engaged or disengaged. The machine, in the capable hands of Prof. Dixon, should turn out some useful and interesting results on the strength of built-up structures, for which it seems to be well adapted.

Bulletin No. 362 of the United States Geological Survey, by Mr. J. S. Burrows, deals with the mine sampling and chemical analyses of coals tested at the United States Fuel-testing Plant in 1907. This is one of a series of papers dealing with work done at the fuel-testing station, work valuable to the coal owner, coal user, and to all interested in the scientific study of coal. The results of the examination of seventeen samples of Jamestown coals are given in this bulletin, including proximate and ultimate analyses and the experimentally determined calorific values. A list is given at the end of the previous survey publications on fuel testing.

Bulletin No. 365 issued by the United States Geological Survey contains an interesting account of the fractionation of crude petroleum by capillary diffusion, by Messrs. J. E. Gilpin and M. P. Cram. When oil is allowed to rise by capillary attraction in a tube packed with Fuller's earth, there is a decided fractionation of the oil, the fraction at the top of the tube being of lower specific gravity than that at the bottom. There is a tendency for the paraffin hydrocarbons under these conditions to collect in the lightest fractions at the top of the tube, and the unsaturated hydrocarbons at the bottom. If the oil is mixed with Fuller's earth and then displaced with water, about one-third of the oil remains in the earth.

Briquette-making formed the subject of a paper recently read before the South Wales Institute of Engineers by Prof. W. Galloway. Small coal cannot be burnt so economically in the furnaces of boilers in its original state as when in the form of briquettes, partly on account of so much of it falling through the fire-bars, and partly because the particles lie so closely together as to prevent the free access of the air required for combustion. Briquettes made exclusively with anthracite coal burn too slowly, and it is advisable to mix a certain proportion of bituminous coal to overcome this objection. Up to the present, no kind of agglomerating material other than pitch or resin, or a mixture of these, has given satisfactory results. Briquettes made with resin alone become soft and lose their shape in the fire; those having a mixture of 4 per cent. of pitch and 1½ per cent. of resin give better results. It is of interest to note that the total output in the United Kingdom in 1906 amounted to 1,513,220 tons, while Germany produced 14,500,851 tons of this fuel in the same year. The paper contains full descriptions and drawings of the mixing and drying machinery and presses required for briquette-making, together with estimates of labour required and costs. For example, at an English works making 102¼ tons of briquettes per day of ten hours, the total cost, including labour, materials, fuel and stores, interest and depreciation, works out to 9*s.* 7·45*d.* per ton.

A recent paper by G. Jaffé in the *Annalen der Physik*, on the electrical conductivity of pure hexane, will possess considerable interest to those who are concerned with the *rôle* of the solvent in electrolysis, as well as to those who are working on the electrical conductivity of gases. The impure material owes much of its conductivity to electrolytic impurities, but these can be removed by electrolysis and by repeated distillation, when samples are obtained with a very minute but practically constant conductivity, about twelve times greater than that of air under similar conditions. The pure hydrocarbon, indeed, shows almost all the electrical properties of a gas of high density. How widely its properties differ from those of purified water or other feeble electrolytes may be seen from the fact that two-thirds of the conductivity vanishes when the measuring vessel is sheathed with lead in such a way as to cut off external radiations, and that the remainder of the conductivity is greatly influenced by the nature of the containing vessel, aluminium giving exceptionally low values. Two other remarkable points of contrast are (1) the constancy of the current at different temperatures, and (2) the fact that an increase of potential from 200 to 2000 volts produces no increase in the current, which reaches a "saturation" value analogous to those of gases, although at a much lower voltage.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in June:—

June 3. 11h. 43m. to 15h. 14m. Eclipse of the Moon, visible at Greenwich.
9. 20h. Mars in conjunction with Moon (Mars 2° 33′ N.).
12. 18h. Saturn in conjunction with Moon (Saturn 2° 13′ N.).
17. 12h. Sun eclipsed, invisible at Greenwich.
21. 8h. 22m. Transit (ingress) of Jupiter's Satellite IV. (Callisto).
,, 11h. 41m. Minimum of Algol (β Persei).
,, 14h. Sun enters Cancer, summer begins.
22. 18h. Venus in conjunction with Neptune.
,, Saturn. Major axis outer ring = 39·78″, Minor axis = 8·85″.
23. 1h. Jupiter in conjunction with Moon (Jupiter 4° 21′ S.).
24. 9h. 15m. to 9h. 59m. Moon occults ν Virginis (4·2).

The Dispersion of Light in Interstellar Space.—In the *Revue générale des Sciences* (No. 8, p. 350), Dr. Ch. Nordmann reviews the work recently performed by MM. Tikhoff and Belopolsky and himself on the dispersion of light in interstellar space. The results obtained in the first experiments have been questioned by a number of astronomers, and, in re-stating the case clearly, Dr. Nordmann disposes of many of the objections.

As has already been recorded in these columns, Dr. Nordmann's method consists in observing the difference, in time, of the minima of variable stars when screens of different colours are employed, whilst in the Tikhoff-Belopolsky method the dispersion is shown by the various displacements of lines in the different parts of the spectra of spectroscopic binaries.

It has been suggested that the observed differences may be due to physical changes in the binary system itself, but Dr. Nordmann argues that if this were the case the displacement of the curves for different parts of the spectrum would vary at different parts of the orbit, whereas if the displacement is due to dispersion in space it would be the same in all parts of the orbit. At present he is content that a matter of so great an importance to astronomers and physicists is re-opened, and would attach no rigorous significance to the quantitative results so far obtained; qualitatively they are in the right direction, and are in accordance with the results of ordinary refractive media. Should the validity of these results be established their importance in any cosmological discussion can scarcely be overestimated; for example, the determination of the distances of binary systems would become greatly simplified.

A Remarkable Transit of Jupiter's Third Satellite.—No. 4324 of the *Astronomische Nachrichten* contains an account, by Mr. Innes, of a remarkable transit of Jupiter's third satellite observed at the Johannesburg Observatory on April 3.

Before and after the transit both the north polar cap and the dark marking along the north torrid zone of the satellite were noticed. When the satellite was about three-quarters of its journey across the planet a double dark spot was seen in its position, and re-focussing failed to alter the apparition. Approaching the limb of the planet the n.p. part of the double spot was replaced by a bright spot, smaller than the satellite, but s.p. the remaining grey mark. A few minutes before internal contact took place the dark grey spot disappeared, whilst the bright spot increased in size.

Immediately after last contact J III. was seen against the sky nearly round, but perhaps shaded off a little towards Jupiter, and with a small north polar bright spot with a darkish band below it. When the dark double spot was visible it looked like a close double star, dark instead of bright, having a separation of 0·9″ and an angle estimated at 300°.

THE SPECTRUM OF MAGNESIUM IN HYDROGEN.—The significance of the "magnesium hydride" bands in the spectrum of sun-spots lends great importance to any investigation of their nature, and a paper, by Mr. E. E. Brooks, which appears in the April number of the *Astrophysical Journal* (vol. xxix., No. 3, p. 177), is therefore of astronomical interest.

Experimenting at the Leicester Technical School with magnesium in hydrogen, Mr. Brooks employed a unidirectional, but pulsating, current, which is intermediate between arc and spark, and arrived at the following conclusions regarding its spectrum:—(1) The spectrum represents some transitional unstable state; (2) although hydrogen is essential, the production of the "hydride" spectrum appears to depend far more upon the nature of the discharge than upon the quantity of the gas present; (3) a trace of water vapour appears to be more effective than hydrogen, yet its presence cannot be regarded as essential; (4) if due to a hydride the substance is probably decomposed as fast as it is formed.

THE PERTURBATIONS OF BROOKS'S COMET (1889 V) BY JUPITER IN 1886.—From his investigations of the perturbations, and the resulting path, of Brooks's comet, Prof. Poor concluded that this object could not be identified with the lost comet of Lexell.

In this regard an interesting paper, by Herr G. Deutschland, appears in No. 4321 of the *Astronomische Nachrichten*, giving the results of a re-investigation of the planetary perturbations, taking into account the oblateness of Jupiter. These results exhibit variations from those previously obtained by Prof. Poor, especially in the time of the comet's nearest approach to the planet.

RECENT OBSERVATION OF DANIEL'S COMET, 1907 *d*.—Among the photographic observations recorded by Prof. Wolf in No. 4321 of the *Astronomische Nachrichten* is one of an object which is, possibly, Daniel's comet of 1907. Owing to the faintness of the object and the poor sky, the identification is not quite certain, although the image appears on two plates. The middle of the exposure was at 13h. 25·4m. (Königstuhl M.T.) on April 19, and the position of the object was $\alpha = 15h.\ 18{\cdot}7m.$, $\delta = -7^\circ\ 37'$; magnitude 16·5.

THE VARIABLE STAR 6.1909 URSÆ MAJORIS.—In a note appearing in No. 4324 of the *Astronomische Nachrichten*, Prof. Wolf announces that the variable star near the spiral nebula M101 had decreased in brightness more than half a magnitude by May 9.

POLAR MAGNETIC STORMS.[1]

THE last ten or twenty years have been marked by great activity in Arctic and Antarctic expeditions. The results obtained in the department of terrestrial magnetism form a great contribution to knowledge, and prove that continued effort in this direction will do much to remove the difficulties that enshroud the problem.

The present expedition was the development of preliminary expeditions carried out in the preceding six years by Dr. Birkeland, the object being the study of the connection between and origin of auroræ and magnetic storms. The funds were provided by the Norwegian Government, by learned societies in Norway, and by Dr. Birkeland himself.

The preliminary expeditions had indicated the frequent occurrence of magnetic storms having a probable origin vertically above the vicinity of the North Cape, and the plan of the 1902–3 expedition was to make simultaneous observations at four stations in that region. The four stations were on Iceland, Spitsbergen, Nuva Zembla, and in Finmark. Each of the stations was provided with a similar set of recording magnetographs of the pattern due to Eschenhagen. These are admirably suited for expeditions on account of their portability and simplicity of adjustment. They can be given a high sensibility, although some may doubt whether the high value used by Dr. Birkeland was altogether a blessing for the purpose of studying magnetic storms. It was, of course, a distinct advantage in studying the minute and extremely regular periodic movements that were frequently observed. In addition, each station was provided with auxiliary meteorological and electrical apparatus, and one of the stations had an instrument for recording earth currents.

The present volume begins with a description of the equipment and installation of the various stations, and those of us who live in temperate regions may well reflect on the advantage of making physical observations without having to interrupt work for the purpose of suppressing the scientific ardour of a polar bear.

In analysing the magnetic storms, Dr. Birkeland was able to obtain simultaneous records from twenty-three observatories in various parts of the world, in addition to those from the four special stations. Dr. Birkeland at the outset indicates that the results have been analysed and presented with the view of supporting the theory he holds, viz. that these storms are due to the incidence of (negatively) charged corpuscles projected from the sun. The desirability of such a method of procedure may be open to question, but we think that the author has gained immensely by so doing, and the results are put in such a form that their value is not in the least prejudiced by whether we accept his ultimate conclusions or not.

The method is in outline as follows. Any disturbance of the magnetic needle may be represented as the effect of a certain electric current. The course of a storm may thus, so far as the horizontal components are concerned, be represented by an arrow of certain length in a certain direction. For each particular storm discussed the records from the various observatories are shown in a plate reduced to a uniform time scale. In the text a general description of the storm is given, followed by charts showing with arrows the direction and magnitude of the assumed disturbing current at different stages and at different places. These are followed by a discussion as to the general character of the horizontal current required to produce the storm.

The current charts are remarkably simple, and give an extremely clear presentation of the results free from any theory. In this way the existence of certain well-defined types of storm is established.

The supposition that these arrows represent true electric currents of corpuscles is almost a natural consequence. Arguments are given to show that they cannot be earth currents, but that they are probably due to streams in the upper regions of the air, the general height being some 400 kilometres.

It is remarkable that the stream so frequently sets between the four stations, and thus confirmatory evidence is obtained from the different signs of the vertical-force variations on opposite sides of the stream.

It is found that the horizontal stream is not always sufficient to account for the facts, but that the horizontal portion must be regarded as a bend in a stream descending vertically, and then with greater or less rapidity returned into space.

Dr. Birkeland supports, and we think very ably, his arguments by reference to experiments on a highly magnetised sphere (a terrella) placed in the path of kathode

[1] The Norwegian Aurora Polaris Expedition, 1902–3. Vol. i., "On the Cause of Magnetic Storms and the Origin of Terrestrial Magnetism." By Kr. Birkeland. Pp. viii+315; 21 plates. (Christiania: H. Aschehoug and Co.; London: Longmans, Green and Co., n.d.) Price 22s. net.

rays, the arrangements being made to imitate the earth with the sun as kathode. The experiments, of which numerous photographs are given, are exceedingly beautiful, and present distinct analogies with the deductions from the magnetic storms. At the same time, the analogies are by no means conclusive, and may in some cases be very misleading.

The work of analysing each storm independently must have been tremendous, but the results amply justify the work.

It is impossible to enter into details in such a brief review, but we think no serious student of terrestrial magnetism will read this book without feeling that a very distinct step has been made towards the solution of the refractory problem of terrestrial magnetism.

G. W. W.

ROCK-ENGRAVINGS IN SOUTH AFRICA.

MR. L. PÉRINGUEY, in the eighteenth volume of the Transactions of the South African Philosophical Society, continues his report on rock-engravings of animals and the human figure. The examples now described are superior in finish and artistic merit to those hitherto known. We have no longer mere lines or outlines produced by rough pointing or punching; the technique is more elaborate, and the figures are drawn in relief. Thus, in the illustration (Fig. 1) of an elephant fleeing before a hunter armed with a bow and arrow, the lines in relief represent the skin corrugation; and the position of the ears, the hanging lower lip, the curves of the back and legs, are all strikingly artistic, and suggest keen observation on the part of the sculptor. Equally artistic is the representation of the buffalo (Fig. 2), the figure of which is fully hollowed out, the attitude of the animal and the twitching of its tail being full of life.

FIG. 1.—Rock-engraving of an elephant and hunter armed with bow and arrow. Size 60×39 cm.

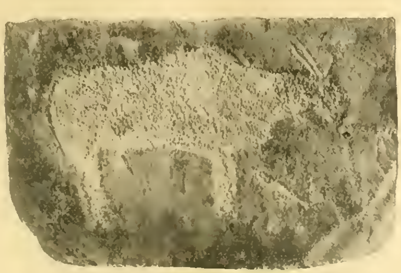


FIG. 2.—Rock-engraving of a buffalo. Size 60×40 cm.

The age of these sculptures is still uncertain. Mr. Péringuey, comparing them with similar rock-engravings in Algeria and the Sudan, and remarking the patination of the rock surfaces, the presence of Palæolithic implements in the neighbourhood, and the absence of scenes representing domesticated animals, believes them to be anterior to the Hottentot immigration. As in Mauretania, the most highly finished sculptures, as well as paintings, are the most ancient, and a decadence of artistic skill seems to have set in with the arrival of the newer immigrants. There is no evidence that these engravings were the work of the Bushmen, and it is equally difficult to attribute them to the Strand Looper Hottentots, whom Dr. Shrubsall has recently identified on the southern seaboard. On the whole, they suggest intercourse between North and South Africa, a view corroborated by the analogies between the engravings in Mauretania and those of South Africa, the identity of type in the stone implements in both these regions, and other considerations generally accepted by modern ethnologists.

CENTENARY OF THE PHYSICO-MEDICAL SOCIETY OF ERLANGEN.[1]

THE Physico-medical Society of Erlangen, founded by Joh. Christian Friedrich Harles in 1808, reached its one hundredth birthday on March 20, 1908, and celebrated the occasion on June 27 by an anniversary meeting and a dinner. The first of the two publications cited below contains (*a*) a history of the society, by Prof. M. Noelther, of the University of Erlangen, covering eighty-three pages, and illustrated by portraits of Harles, Henke, Leupoldt, Korn, Wagner, Canstatt, Gerlach, Gorup, Zenker, and Beetz; (*b*) an address, by J. Rosenthal, "Ueber die Beziehungen der Physik und Chemie zu den medizinischen Wissenschaften"; and (*c*) a report of the anniversary celebrations, by Oskar Schulz.

Honorary doctorships in medicine were conferred on Prof. Becquerel, Prof. Curtius, and Prof. Nernst; doctorships in philosophy were conferred on Sir Victor Horsley, Prof. von Leube, and Prof. von Kries. Honorary membership of the society was conferred, on general grounds, on Queen Margherita, Count Zeppelin, and Dr. Oskar von Miller; of the special sciences, chemistry was honoured by including in the list the names of Bechmann and Buchner; physics was represented by Blaserna, zoology by Dohrn, mineralogy by Zirkel, botany by de Vries, mathematics by Poincaré, geography by Günther, physiology by Pflüger, anatomy by Roux, and the medical sciences by Erb, Ehrlich, Kocher, and Kraepelin. Amongst the new corresponding members we notice the names of Prof. Rutherford, of Manchester, and Prof. Sherrington, of Liverpool.

The *Sitzungsberichte* for 1907, sent out with the report of the centenary, is a bulky volume containing seventeen scientific communications. Nearly half the volume is devoted to a memorial notice of Henri Moissan, written by Gutbier, and extending over 260 pages; a complete list of Moissan's papers is given, and his work on fluorine, boron, silicon, ammonium, calcium, diamond, the

[1] (1) Festschrift der Physikalisch-medizinischen Societät zu Erlangen, zur Feier ihres 100 jährigen Bestehens am 27 Juni, 1908. Pp. ix+124. (Erlangen: Kommissionsverlag von Max Mencke, 1908.)
(2) Sitzungsberichte der Physikalisch-medizinischen Societät in Erlangen. Redigiert von Oskar Schulz. 39 Band, 1907. Pp. xxiv+562. (Erlangen: Kommissionsverlag von Max Menche, 1908.)

metallic carbides and hydrides, and the electric furnace is fully described. Three *Beiträge zur Geschichte der Naturwissenschaften*, numbered xi., xii., and xiii., are contributed by Prof. Eilhard Wiedermann, and a paper on the emission-spectra of cadmium and zinc vapours jointly with A. Pospielow. Papers on the atomic weights of rhodium and of palladium are contributed by A. Hüttlinger and by P. Haas, and papers on electrolysis by Gutbier and by Herzog; papers dealing with medical subjects are contributed by de la Camp, by Grünbaum, and by Jamin, and a mathematical paper appears under the name of Noether.

At the end of 1907 the society included fifty-one ordinary, fifty-four honorary, and seventy-eight corresponding members; nine meetings had been held, and sixteen papers had been read and discussed. The "yield" of scientific work will bear comparison with that of many societies claiming a wider range of membership, but in view of the large variety of topics discussed and the small number of papers dealing with any one branch of science, it is at least doubtful whether the publicity attained can be sufficient to compensate for the heavy cost of setting up and printing; as a general rule, the disadvantages of local publication are so serious as to outweigh the advantages which arise from stimulating the local centres of research.

THE INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

THE seventh International Congress of Applied Chemistry was opened on Thursday, May 27, in the afternoon, at the Royal Albert Hall by the Prince of Wales, who was accompanied by the Princess. A very large gathering was present, and the Prince, who spoke as vice-patron, the King being patron, offered in His Majesty's name a most hearty welcome, and expressed the King's pleasure that the foreign delegates would be able to visit Windsor Castle. It is only recently that the Prince, as president of the Board of Trade Committee to deal with exhibitions, directed attention to the importance of scientific progress, and at the opening of the congress he accentuated the value of scientific progress in words of such importance that we reproduce a portion of his speech verbatim.

"The main object which you all have in view is, I assume, to discuss in your numerous sections the many topics of interest and importance that are continually arising owing to the marvellous discoveries which the science of chemistry, both pure and applied, is making from day to day. Those interested in some special branch meet in the different sections their *confrères* from other lands to their mutual benefit. . . . These conferences, whether of a scientific or of a more intimate character, between men living in distant lands, all working for the same object, although under different conditions, cannot but be favourable to the progress of science and of the industries to which many of you have devoted your lives, as well as to the general peace of the world. I fully appreciate the important part which chemistry plays in almost every branch of our modern industry. We all recognise that without a scientific foundation no permanent superstructure can be raised. Does not experience warn us that the rule of thumb is dead, and that the rule of science has taken its place—that to-day we cannot be satisfied with the crude methods which were sufficient for our forefathers, and that those great industries which do not keep abreast of the advance of science must surely and rapidly decline? On behalf of the Princess of Wales and for myself, I offer our cordial greetings to the members of the congress, and I earnestly trust that great results may accrue from your deliberations. I now have much pleasure in declaring the seventh International Congress of Applied Chemistry open."

Sir William Ramsay, in the course of his opening address, said it is impossible to draw a hard-and-fast line between scientific and technical chemistry. Above all, chemistry is a practical science, although in recent years it has more and more tended to become a branch of applied mathematics. The chief difference between pure and applied science consists in a satisfactory answer to the question—all-important to the technical chemist—"Will it pay?" This, however, is irrelevant to the man of science. On the answer to this question the success of a process depends; but in its essence applied and industrial chemistry are one. This has hardly been realised in a practical way on this side of the Channel or even on the other side of the Atlantic. Our Continental friends have realised it and acted upon it under the conviction that the industrial prosperity of a nation can best be advanced by an alliance between the technical and practical workers, that is to say, between the university and the factory. Such congresses as the present can teach much, and if this lesson be learnt, then a valuable national asset will have been gained. It is often said that science knows no country, and the existence of this congress accentuates the proof of the saying. All the nations of the civilised world are represented, and have met together to discuss how best to develop the special branches of chemistry to which the members have devoted their lives.

Prof. Wiley, of America, said there is no more apt illustration of the utility of chemistry than to say that if its principles were unknown and unapplied, teeming millions of the globe would be at this moment unclad and unfed. Sanitation is a chemical problem; pure food, pure air, pure water, which ensure activity of mind and body and cure disease, are also problems for the chemist.

Prof. Armand Gautier, of France, said that in the development of industrial science England and France are not the only, but the great leading nations—never enemies, but always rivals.

Prof. O. N. Witt, replying for Germany, said the field of applied chemistry extends in two directions. It includes the analysis scientifically and the control of commercial raw products, and also of finished products. It further includes the advance of the chemical industries which are concerned with them. The congresses promote friendly feeling and noble rivalry, and as a consequence obtain the patronage of the rulers of nations.

Prof. Paternò, of Italy, said that naturally the members responded with enthusiasm to an invitation from the country which was the birthplace of Boyle, Black, Cavendish, Priestley, Dalton, Davy, Faraday, Graham, and Woollaston. Even in the noisy rush and turmoil of London life scientific men know how to find the necessary tranquility to carry out their scientific investigations.

Prof. Arrhenius, in replying for other delegates of foreign lands, spoke of England as the classical world of applied chemistry. In this country, particularly in London, successful efforts have been made to improve hygiene by the employment of chemical methods, with the result that among the large cities of the world London has the lowest death-rate.

Later in the afternoon sectional meetings were held to arrange the work for the succeeding days of the congress. The organisation of the sectional work was a matter of considerable difficulty owing to the large number of papers sent in. This was notably the case in the sections for organic chemistry, analytical chemistry, and electrochemistry, in each case the number considerably exceeding one hundred, while the actual time available for work only amounted to 18½ hours.

In several cases, where the subject was of interest to more than one section, joint meetings were held. A special case of this was a joint meeting of five sections to discuss the fixation of atmospheric nitrogen, when Hofrath Prof. Bernthsen, Prof. Birkeland, and Dr. N. Caro presented the subject from different points of view. This particular discussion attracted great attention, not only because of its enormous importance, but also because Prof. Bernthsen's address was experimentally illustrated.

The process of Birkeland and Eyde, in which the arc is drawn out into a thin disc by the means of powerful magnets, is well known, but that of the Badische Anilin- und Soda-Fabrik had not been previously described in this country. An iron tube contains an insulated electrode at one end and itself acts as second electrode. At its formation the arc springs from the insulated electrode to an adjacent part of the iron tube which is only a few millimetres away. Air is, however, blown tangentially or with a rotary motion through the tube. This carries the end of the arc along the wall of the tube, so that it ends at a considerable distance from the electrode or on a special electrode placed at the further end for this purpose. Commercially, arcs nearly eight yards long have been produced. The air passing up the tube through the arc thus becomes oxidised. Prof. Bernthsen showed such an arc about three-quarters of a metre long. It was struck in a glass tube which had a copper spiral running up its entire internal length, this being shown in a darkened room. The sight of Prof. Armstrong's lecture theatre at the Central Technical College crowded to suffocation was very striking. After the arc had been burning for about one minute, two large glass globes connected with the arc tube became filled with brown fumes of oxides of nitrogen.

Prof. Birkeland followed, and accentuated some points in connection with the Birkeland-Eyde process. Then Dr. N. Caro described the cyanamide process, and claimed that it was the cheapest method for the fixation of atmospheric nitrogen. It was easy to obtain ammonia directly from cyanamide, and, furthermore, a host of chemical products could be made by using cyanamide as a starting product.

Mr. E. R. Taylor read a paper of great interest upon national and international conservation of water-power, a subject which is attracting considerable attention in America. It will also be remembered that at the annual meeting of the British Science Guild Sir William Ramsay also brought this matter forward, and a committee was appointed by the Guild to consider the matter.

The pollution of sea-water was discussed in the hygiene section by Prof. Kenwood and Mr. F. N. Kay-Menzies. Edible sea shell-fish reared or deposited in the neighbourhood of our shores are often exposed to dangerously contaminated sea-water; it is also questionable whether bathing in such water is not dangerous. The bacteria of typhoid can survive for several days in sea-water, and coastal tides and eddies are capable of carrying sewage contamination several miles in the course of twenty-four hours.

Dr. M. Frenkel described a method for rendering motor-car escape gas odourless. The car is fitted with a special box containing platinised asbestos or platinised porous porcelain. The exhaust gases are made to pass through this box, and the contact of the air and malodorous gas with the catalytic platinum causes complete oxidation, and thus deodorisation.

On Friday afternoon, May 28, Prof. Halle, of France, and Prof. Paternò, of Italy, gave addresses to the whole congress. On Monday, May 31, Prof. O. N. Witt, of Germany, and on Tuesday, June 1, Sir Boverton Redwood also gave addresses to the combined sections of the congress.

The congress was attended by more than 4000 members, and the number of papers presented was very large. The attendance at the sectional meetings was quite extraordinary, many members attending their particular section from 10 in the morning to 1.30, and then from 4 to 6 in the evening, and listening to the reading of twenty or thirty papers ranging over the whole scope of the subject. In one section there were at 6 p.m. more than 100 members alert and eager for more.

The hospitality has always been a feature of these congresses, and the countries in which the congresses have been held have vied with each other in the entertainment of their guests. In this respect also the congress in London was not behindhand. The members were entertained by the Lord Mayor and Sheriffs at the Guildhall on Wednesday, May 26, and on May 27 a reception was held at the Foreign Office by Mr. Lewis Harcourt, M.P., on behalf of the Government. About two thousand invitations were sent out; and the company bidden to meet the delegates included the French, Russian, Austro-Hungarian, Spanish, American, and Japanese Ambassadors; the Portuguese, Netherlands, Belgian, Brazilian, Swedish, Chinese, Greek, Norwegian, and Danish Ministers; leading members of the Government and the Opposition; and others of social and political distinction. Though most of the foreign members of the congress were present, apparently no effort was made to bring together British men of science of distinguished eminence in all departments of scientific activity to meet them. The visitors must have been disappointed to find that the chief people present at the reception, other than actual members of the congress, were renowned for their political and diplomatic connections rather than by their position in the scientific world.

There was a great banquet at the Crystal Palace on May 28, which was held in the central transept, and to which nearly 2000 ladies and gentlemen sat down. The dinner was followed by speeches, which some heard, and then by a special display of fireworks, which all saw. On Saturday, May 29, the King received a deputation from the congress, who were accompanied by Sir Henry Roscoe (hon. president), Sir William Ramsay (acting president), and Mr. W. Macnab (hon. general secretary). The following delegates had the honour of being presented to the King by Sir Henry Roscoe:—Dr. W. H. Nichols (America), K.K. Regierungsrat F. Strohmer (Austria), Dr. François Sachs (Belgium), Mr. O. Kouanze (China), Prof. Léon Lindet (France), Prof. Otto N. Witt (Germany), Prof. E. Paternò (Italy), Prof. Kohara (Japan), Dr. S. Hoogewerff (Netherlands), N. Tavildaroff (Russia), Prof. Pinerùa y Alvarez (Spain), Prof. Arrhenius (Sweden), and M. F. Reverdin (Switzerland). On Saturday there was also a great garden-party at the Botanic Gardens, given by the ladies' committee, and in the evening a reception by the president of the Society of Chemical Industry. On Sunday and Monday there was a host of private parties, which absorbed nearly three thousand of the guests. Finally, on Tuesday, June 1, a reception was given at the Natural History Museum.

Such congresses cannot but help international goodwill and stimulate friendship between the nations. No jarring word was heard; delegates from all the civilised world fraternised, and each taught the other something of the work which is being done in their own country; friendly rivalry has been stimulated, and by means of the social functions they have learnt to know each other as friends. It is often said that international sport is a bond of friendship between the nations, but it often leaves heartburnings. The meeting of a congress such as this leaves behind no unpleasant feeling, but stirs enthusiasm and admiration for the work which our rivals are carrying out, and cements the nations in a manner which no number of Dreadnoughts can accomplish.

EDUCATION AND RESEARCH IN APPLIED CHEMISTRY.[1]

THE question of the training of industrial chemists, after having been dormant for some years, has again been raised, and it has now taken the more definite form of whether our universities should develop schools of applied chemistry. Let us look at the example of the engineering industries. There has been more coherence and solidarity and more personal interest on the part of the leaders of the engineering profession with regard to technical education than has been shown by chemical manufacturers. The practical effect is that the term "technical education" in Great Britain has become almost synonymous with training in engineering, and on the governing bodies of the newer institutions the engineering influence is predominant. The lack of active interest in the educational side of applied chemistry on the part of the manufacturers has acted detrimentally to their own cause. The teachers, if left alone by the manufacturers, are apt to become too purely bookish, and the manufacturers, if they cut themselves adrift from the academic side of chemistry, are likely to become too narrowly practical. The recent discussions upon the desirability of the better training of industrial chemists have centred round the universities, and the technical schools and technical colleges have been passed over.

Definition of Terms.

In many cases where the education of the technical or industrial chemist has been under discussion, the manufacturers on the one hand, and the teachers on the other, have had in view totally different kinds of people. When the training of an industrial chemist is under discussion, do we mean his preparatory general scientific education, or that *plus* something more? If the latter, what is that "something more", to be? The manufacturers who ex-

1 From the presidential address delivered before the Society of Chemical Industry on May 26, by Prof. Raphael Meldola, F.R.S.

pected the new technical education movement to staff their works with expert technologists underestimated the complexity of their own industries. Those teachers, on the other hand, who are clamouring for the staffing of our factories by scientifically trained chemists, as distinguished from technologists, have damaged their case by leaving out of consideration the expert technologist altogether—the man whose knowledge of *technique* enables him to translate a discovery into pounds, shillings, and pence. The education of the "chemical technologist" is of the same importance for chemical industry as the education of the "pure" chemist. Highly competent scientific chemists are as inseparable from the "technologist" or the "chemical engineer" or the "practical manufacturer" as were the Siamese twins from one another. Severance is death to both; and the manufacturers cannot afford to leave out of account the scientific chemist any more than the teachers can afford to ignore the technologist. In these discussions on education the teachers have had in mind the research chemist and the manufacturers the chemical engineer. The research chemist ought to be producible from the universities and technical colleges. With respect to the chemical technologist, the question is whether he can be produced under any of our existing educational curricula, or whether the factory is the only proper training ground.

The Works Chemist.

So long as we know what kind of student we are talking about there need be no confusion. The research chemist is a man who has received the highest possible training as a scientific chemist, and whose resourcefulness has been developed by prolonged systematic research. It is immaterial whether he receives his training in a university or in an efficient technical college. When we come to the consideration of the chemical technologist there must be more discrimination between the different branches of chemical industry before the conflicting views of teachers and manufacturers can be brought into harmony. The requirements of a chemical factory may be thus classified:—

(1) Research for the discovery of new products, or of new processes for producing known substances, or for the improvement of processes already being carried on.

(2) Supervision of the factory operations with respect both to plant and products; the valuation of the raw materials and finished products; the testing of intermediate products.

(3) A knowledge of the markets with respect to the supply and cost of raw materials and the demand for the finished products.

The "works chemist," or technologist, must be qualified to come under category No. 2, with (possibly) an incursion into the domain of No. 1. By the "works chemist" (excluding the analyst, the mechanic, and the workman) I mean a chemist with more or less knowledge of the general principles of engineering as applied to chemical factory plant. He cannot be too much of a chemist, and the more he is of an engineer the more competent will he be to discharge his duties. Where is this combination of qualifications to be acquired? I consider the question first from the point of view of the technical college.

Theoretical and Practical Instruction.

We have to deal with the student who is entering the technical institution for a systematic three years' course with the view of his becoming a chemical technologist. We much prefer that the student should come to us with no previous school training in science, which is generally too shallow to be of use, and stiffens the mental attitude to the point of conceit, though there is no reason why school science should not be taught in such a way as to make it of preparatory value. In the technical college we have to begin from the beginning. The subjects which, in addition to chemistry, are indispensable for the future chemical technologist are mathematics, physics (including electricity), and mechanics (including drawing-room practice). It takes at least two years to lay an elementary foundation in these subjects; there is left but one year for advanced instruction. This course is not more than a preliminary training; it cannot pretend to add to the scientific training that "something more" which is necessary for the technologist. There is no time for specialisation, and there are few technical schools in this country (exclusive of universities) where specialisation is possible. Can the technical education given in technical colleges be developed into technological training? Can the teaching in technical schools be made to approach the diversified requirements of the different branches of chemical industry so as to make the preparation for technology more effective? I believe it can, if we are prepared to give the necessary time. If I were unable to justify this belief, these newer institutions could not claim to be discharging any function differing from those discharged by educational establishments of all ranks, in which chemistry is taught for purely academic purposes.

Specialisation should follow upon the general training; but it is this specialised training which the manufacturer has in mind when he speaks of "technical" education. The chemical teaching of technical schools can be given a bias in the specialised direction without detracting from its value as an educational discipline and without damage to its theoretical treatment. Chemical manufacture consists in converting certain raw materials into useful products, with maximum yield and minimum expenditure. The systematic treatment of elements and compounds, say in the second- and third-year courses, can be developed in much greater detail in cases where technical products are concerned. There is as much pure scientific doctrine to be deduced from the study of useful products as from the study of useless products. By giving a technical bias to the teaching it is not proposed that technical chemistry, in the sense of chemical technology, which is a specialised subject, should be made a part of that preliminary training which up to this stage I have alone had under consideration. Why should not the "preparations" in the laboratories of the technical schools be made quantitatively? It gives zest to the work if the student is supplied with a known weight of raw material and given to understand that the value of his results will be estimated by the yield and purity of his product. A series of "preparations" might be arranged in which, not only the weight of the raw materials and of the final product were taken into consideration, but also the quantities of the various reagents used, and from these data, making sufficient allowance for the usual—*not* the laboratory—"working expenses," the actual cost of the product ascertained. I advocate the introduction of the large-scale practical exercise into the advanced stage of the preparatory training. The first difficulty the college-trained student has to face in the factory is his want of familiarity with large-scale operations.

With advanced students in the technical colleges the preparation work should be increased in scale so as to introduce an element of training in chemical handicraft. I am not now advocating the introduction of working models of special plant used in particular industries. The plea is for the handling of apparatus illustrating such general operations as are carried on in all factories—heating and cooling, evaporating, distilling, mechanical mixing, grinding, solution, filtration, &c., on something more than the ordinary laboratory scale. This plea does not mean that the colleges should be expected to teach chemical technology in the strict sense—that is a distinct question; nor that *all* preparation work should be done on this increased scale.

Chemical Technology.

The stage of technical chemistry should lead to that of chemical technology. Manufacturers ought not to be satisfied with the youth who has spent his three years at a technical school. The chemical technologist is a chemist *plus* a great deal more. The factory is not the proper place for beginning the technological training. During the supplementary period following the preparatory training in the technical school there should be opportunity for research work. The supplementary advanced or technological training should do for industrial chemistry what the post-graduate training does for academic chemistry—it should enable us to sort out the different orders of faculty. A few students would be found capable of development as research chemists, a larger number as chemical technologists. The omission of research from our educational curricula means a loss to our industry of a class of chemical technologist of which we are in need—the man who has been trained in scientific habit of thought by the most effective of all known methods. In advocating the introduction of research into the advanced curriculum it must be most clearly understood that we are not contemplating the "research chemist" as defined in this address. He comes under another category. We are now considering only the higher education of the works chemist and the importance of research in relation to his advanced training. If it is admitted that some advanced training supplementary to the preparatory course is essential, and that science is to form part of that advanced training, the advanced laboratory work from the fourth year onwards could be made to include experimental investigation either in pure or applied chemistry.

The Sphere of the Chemical Technologist.

There appears to be a general opinion in favour of technological training. The proposals come chiefly from the university side, but that is immaterial. All attempts to move in this direction hitherto have been more or less paralysed by the teachers declaring for pure science and by the manufacturers proclaiming that it is impossible to teach chemical technology in the educational institutions. It is beginning to be perceived that when the technical education of the works chemist is under consideration it is really technological training that is meant. Chemical technology means generalised chemical engineering—a knowledge of the chemical, physical, and mechanical principles underlying the construction and working of the machinery and plant in general use in chemical industry. It is a composite subject, part of which is pure engineering, such as power production and distribution, and part of which is specialised engineering, such as the nature, source, and properties of the materials used in the construction of chemical plant.

There is practically no technical school in this country which provides a complete and coordinated course of training such as I have advocated. For the chemical industries, the technical education movement has been arrested just at that stage where the true technical training should begin. The technical institutions are not wholly, nor for the greater part, to blame; the manufacturers have not sufficiently encouraged them. The greater part of the chemical instruction in the technical institutions is carried on in evening classes. This kind of training is practically useless for industrial chemists. It would take the evening student nine years to complete the three years' preparatory course of the day student. At the same time, evening classes are of real value for men already engaged in the factory work—say foremen and managers who have had no training in scientific theory. After thirty years' technical education applied chemistry is lagging behind all other branches of technology.

The Universities as Schools of Applied Science.

While large numbers of institutions originally intended for instruction in applied science are carrying on purely scholastic courses, the universities, originally academic institutions, are now developing schools of applied science. Ought the universities to create departments of applied chemistry? If the ordinary graduate courses were not suitable for the chemical technologist they could be adapted without much difficulty. The university need only make provision for that kind of advanced work which I have advocated. It does not matter what kind of institution does the work so long as it is done efficiently; the need for it is great.

The Conclusion.

But if the higher work is to be taken over by the universities, the *raison d'être* of the technical school for chemical industry will become a thing of the past. It will be deplorable and wasteful if we find the university and the technical institution in the same town rivals instead of colleagues. The rational solution is that the technical institution should become a school of the university, as is the case at Manchester. Such a solution carries with it the implication that the technical institution will raise its technological teaching to the university standard. That is precisely what we want. In framing any educational policy of practical value for our subject the Society of Chemical Industry can play an important part. We are both imperial and international; we have the means of bringing together a body of expert knowledge and experience, both educational and technological, such as is possessed by no other organisation. An advisory or consultative education committee or board formed by our council from the ranks of our members, and comprising teachers and manufacturers, ought to be of such power that no departure in the technical training of chemists in any educational establishment, of whatever rank, could afford to neglect its counsels.

THE CAMPAIGN AGAINST MALARIA.[1]

MORE than nine years ago I had the privilege of addressing the Royal Institution (March 2, 1900) on the subject of my researches on the mode of infection in malarial fever, and I am now called upon to describe what has been done, or not done, in various countries to utilise for the alleviation of the disease the information then obtained.

The ancients appear to have recognised, not only the principal symptoms of malarial fever, but the fact that it is often connected with marshes; and more recently many authors ascribed this fact to the existence of poisonous vapours, which they supposed are given off by stagnant waters, or even by the soil. Still later, a series of pathological studies led to the discovery by Laveran in 1880 that the malady is produced by vast numbers of minute protozoal parasites of the red blood-corpuscles, and students of the subject now conjectured that these organisms originally inhabited the marshes, and infect man through air or drinking-water. My own studies, however, commenced eighteen years ago, and, confirmed and extended by many workers, showed that the parasites are carried from man to man by certain species of Culicidæ (gnats or mosquitoes), and that it is these carrying agents, and not the parasites themselves, which live in the marshes. Thus malarial fever was now proved to be merely a parasitic disease, the infection of which is carried from man to man by the agency of certain water-breeding insects.

As described in my previous lecture, the broad principles of this theorem were really fully established by the end of the year 1898. Although numerous minor details still required study—such as the precise species of mosquitoes which carry the infection in various countries, the exact habits of each species, and so on—yet I held that these questions could now be elucidated without difficulty in the ordinary course of work, and that we were already in a position to apply the discovery at once to the saving of human health and life. I propose, therefore, to take up the story again from this point.

First let me emphasise the great importance of this practical side of the subject. Malarial fever is spread over nearly the whole of the tropics, abounds in many temperate climates, and has been known to extend so far north as Sweden. In vast tracts of tropical Africa, Asia, America, and southern Europe almost every town and village is infested by it; millions of children suffer from it from birth to puberty; and native adults, though they tend to become partially immune, still remain subject to attacks of it. Although it is not often directly fatal, yet it is so extremely prevalent, so endemic in locality, so persistent in the individual, that the total bulk of misery caused by it is quite incalculable. More than this, its special predilection for the most fertile areas renders it economically a most disastrous enemy to mankind. Throughout tropical life it thwarts the traveller, the missionary, the planter, the soldier, and the administrator. From one-quarter to one-half the total admissions into military hospitals are returned as being due to it, and it is often the most formidable foe which military expeditions have to encounter. There are reasons for thinking that it indirectly increases the general death-rate of malarious countries by something like 50 per cent., and I venture to say that it has pro-

[1] Discourse delivered at the Royal Institution on Friday, May 7, by Prof. Ronald Ross, F.R.S.

foundly modified the history of mankind by doing more than anything else to hamper the work of civilisation in the tropics. Only those who have studied the disease from house to house, from village to village, can form any true notion of the total effect which it must produce throughout the world.

Next let us recall briefly the various methods which we possess for preventing and reducing the disease. The oldest of these—known to us since the time of the Romans—is *drainage of the soil*. The reason why it succeeds became quite obvious after 1898—because it tends to remove the terrestrial pools and marshes in which the Anophelines, that is, the family of mosquito which carry malaria, breed; but the new discoveries not only explained the old method, but also rendered it more simple, cheap, and yet precise, by showing us exactly what waters, namely, those in which the larvæ of the Anophelines actually occur, are to be drained away, or filled up, or otherwise treated. But science has given us other methods as well. Thus we have known for a long time that *quinine* is a preventive as well as a cure—that if, for example, a body of men are given quinine with regularity they will suffer less from fever in consequence. Still further, the old saying that the use of *mosquito-nets* at night will keep off malaria was now fully justified, not because the nets exclude any aerial poison, but simply because they exclude the infecting insects. This simple precaution can, moreover, be extended by protecting all the windows of a house by *wire-gauze*, as already frequently done in the southern States of America. *Punkas* and *electric fans* also serve to keep away the insects; and, lastly, *segregation* of Europeans from native quarters, as used so largely in India, will help to keep them from mosquitoes infected by native children (who suffer so frequently from the disease). It was thus apparent that if the inhabitants of malarious countries could be persuaded to protect themselves by mosquito nets or quinine, or if the Governments of such countries could be persuaded to undertake suitable drainage and other measures against mosquitoes, much improvement in the public health was likely to accrue.

But how precisely was such persuasion to be undertaken? Of course, I do not allude to utterly barbarous peoples, to areas far beyond the influence of civilisation, which are happily shrinking in magnitude every day. I allude to independent or dependent States professing themselves civilised, and to the numerous colonies of the great civilised nations. Here we already possess the requisite machinery. Such States or colonies are administered by governors and councils, and for the most part possess medical and sanitary departments controlled by well-paid officials, whose special duty it is to attend to such affairs. Many dependencies, moreover, such as some of these of Britain, are placed under the central Government of the nation concerned, and can be influenced by it. It might be supposed, then, that at the period referred to all such administrations would have gladly interested themselves in the prevention of a disease which produces so much mischief, and of which the cause had been so clearly elucidated; that they would at once have set about collecting preliminary information, and commencing at least some experimental trials. So far as I can see, there is no real reason why this was not done everywhere nearly ten years ago.

Unfortunately, though science may provide us with facts, humanity is slow to credit them, and still more slow to take advantage of them. History is full of examples of this. For instance, years elapsed before the discovery of Jenner was fully utilised—it is not fully utilised even yet. Another instance, closely connected with malaria, is that of filariasis, a parasitic disease of which elephantiasis is one manifestation. More than thirty years ago very good evidence was given to show that it is carried by mosquitoes, and, considering the horrible and widespread deformities which it produces, one would have thought that strong efforts would have quickly been made to control it by reducing the carrying agents. So far as I can ascertain, however, scarcely anything has yet been even attempted against it. No one has interested himself seriously in the matter, and consequently nothing has been done.

It was therefore early apparent to me that, though the machinery for extensive anti-malarial work existed in many countries, yet it would not easily be got to work unless someone could be found who would devote himself to the task—neither a pleasant nor a profitable one—of urging it forward, and I felt that the duty devolved on myself, in the absence of others, as regards British territory. Happily, Angelo Celli and Robert Koch occupied themselves similarly as regards Italy and Germany, and the creation of the Schools of Tropical Medicine in Liverpool and London in 1899 did much to popularise the recent discoveries. At my inaugural lecture the same year, at the former institution, I described my proposals for the prevention of malaria by mosquito reduction, and a few months later, accompanied by Dr. H. E. Annett and Mr. E. E. Austen, I left England for Sierra Leone in order to perfect the details.

Sierra Leone is a small British colony long notorious for its extreme unhealthiness. We determined rapidly the malaria-bearing species of Anophelines there, and their breeding places and habits, and drew up a series of proposals for their reduction. These have since become the basis of similar work elsewhere; but, simple as they were, we could not get the local authorities to understand them or act upon them. Two years later I again—twice—visited the colony, and, assisted by Dr. Logan Taylor and a sum of money presented to me for the purpose by a private gentleman, attempted to give an object-lesson on the subject. Though the result was successful at the time, we again failed in inducing the authorities to take up the work properly; and I can obtain no adequate information as to what has been done there during the last seven years, and may perhaps be excused for not wishing to inquire.

In the meantime, the Liverpool School of Tropical Medicine and the Royal Society had sent a series of expeditions to West Africa, which did much good work there. As a consequence, Sir William MacGregor, Governor of Lagos, and one of the most enlightened of British administrators, took up the task in that colony with great intelligence and energy, but, unfortunately, was shortly forced to leave by ill-health—a serious blow to anti-malarial work throughout the world. From that time, though much appears to have been done by energetic individuals in West Africa, and though, to judge from popular statements, public health has been decidedly improved there, yet the official reports and returns are too inadequate to enable us to form any trustworthy opinion of the results. The recent statements of Prof. Simpson on the subject are not encouraging; and to my mind, judging from many facts known to me, the sanitary administration of the West African colonies has been generally wanting in leadership and organisation, and the campaign against malaria has been constantly thwarted by administrative indifference and professional jealousy.

Turning elsewhere, I must now mention with great pleasure the early and successful campaign of Koch at Stephensort, in New Guinea. The method of Koch does not depend on mosquito reduction, but on the detection and treatment of cases of malaria by quinine, until they cease to spread the disease among their healthy neighbours. It is allied to the similar method used in other diseases, has been successfully followed in the German colonies and in Italy, and will always be a valuable weapon in the anti-malarial armoury. The great work of Celli and the Italian Anti-malaria Society, commenced early in 1899, has been based on the same, but also on a wider, principle of distribution of quinine, together with mechanical protection from mosquito bites. Working onward step by step against political and local indifference, they have gradually made, during the last ten years, a great reduction in the amount of the disease throughout Italy. An independent witness—Prof. Osler—has recently written as follows to the *Times*:—"In Prof. Celli's lecture-room hangs the mortality chart of Italy for the past twenty years. In 1887 malaria ranked with tuberculosis, pneumonia, and the intestinal disorders of children as one of the great infections, killing in that year 21,033 persons. The chart shows a gradual reduction in the death-rate, and in 1906 only 4871 persons died of the disease, and in 1907, 4160." I should be unable to hang a similar chart for British possessions in my lecture-room.

In 1900–1 a great discovery, closely connected with our subject, was made by the Americans in Havana—I mean the discovery that yellow fever, the scourge of tropical America, is also carried by mosquitoes of the kind called Stegomyia. With the Americans, however, there was no delay in turning this fact to practical account, and under General Wood and Colonel Gorgas they got rid of the disease from that large city in a few months. Since then Colonel Gorgas has been conducting the magnificent sanitary work of the Americans in the Panama Canal zone—work the success of which is too well known to require illustration by figures, but which has enabled the Americans to do what the French, before the date of these discoveries, failed in doing, namely, to continue the construction of the canal. It is not too much to say that the canal is being made with the microscope. Colonel Gorgas has repeatedly stated that the measure upon which he principally relies, against both yellow fever and malaria, is the general reduction of mosquitoes.

For three years my original proposals to remove malaria by this means had not been thoroughly and formally applied by any Government, but I have now to record the first classical successes obtained by it in Ismailia and in the Federated Malay States. The former is a town founded by Ferdinand de Lesseps on the Suez Canal. For many years it had suffered extremely from malaria, the cases amounting ultimately to about 2000 a year among a small population. In 1902 I was asked by Prince Auguste d'Arenberg to advise on the matter, and my advice was acted upon loyally and intelligently by his officers in the town. The result was that the cases fell to 214 next year and to ninety in 1904, and that since then there has been no endemic malaria in the town at all, while mosquitoes of all kinds have been practically banished from it. The work in the two small towns of Klang and Port Swettenham, in the Federated Malay States, was begun about the same time, chiefly by Dr. Malcolm Watson under the orders of the Government and of Dr. E. A. O. Travers, and has been equally successful. No one who has studied the facts published with regard to both these campaigns can for a moment deny the success obtained.

Since then excellent campaigns on similar lines have been conducted at Durban, Hong Kong, Khartoum, Candia, and St. Lucia. Most striking has been the anti-mosquito work conducted at Port Said under the orders of Sir Horace Pinching, recently head of the Egyptian Sanitary Service, by my brother, Mr. E. H. Ross. The town has been so completely cleared of mosquitoes that, as at Ismailia, the ladies no longer use mosquito nets for their children. I may add that I have just recently visited both localities, and was able to verify this statement by conversations with a number of people. Fuller accounts of some of these campaigns will be found in a paper by me published in the *Lancet* of September 28, 1907. Excellent and extensive work has been done for many years in Algeria by Drs. Edmond and Étienne Sergent (*Annales de l'Institut Pasteur*, 1909) by all methods, and by Drs. Savas and Kardamatis and the Greek Anti-malaria League (Annals of Tropical Medicine and Parasitology, Liverpool, June, 1908). The Italian work is published in the *Atti della Società per gli studi della Malaria*, and Dr. Laveran gives much information on the subject in his last book on malaria, "Du Paludisme," 1907.

Two years ago I was asked by the Government of Mauritius to advise regarding malaria in that ancient island colony. The War Office associated Major C. E. P. Fowler, R.A.M.C., with me, and after three months' studies, warmly assisted by the Governor, the officials, the planters, and everyone, we drew up our scheme for a general campaign against the disease. There is no doubt that this scheme will be followed when the present financial situation is rectified, but in the meantime I hope and trust that our reports, which were written with great care, and have been published by the Colonial Office and the War Office respectively, will prove of value in other parts of the tropics.

When I left India in 1899 I hoped that that great dependency of the British Crown, with its powerful Government and well-appointed medical and sanitary services, would lead the way against malaria, a disease which causes untold sickness, and possibly some millions of deaths, annually in the country; but though many local campaigns have been started by individual medical men, and though there has been a steady fall in the malaria rate of the army, I can find no evidence of a generalised effort against the disease. Less than three months ago I attended the Medical Congress at Bombay, largely for the purpose of inquiring into the reason for this, and concluded that though many capable officers, both of the Indian Medical Service and of the Royal Army Medical Corps, had done their best, yet the necessary leadership and organisation were wanting in India as in West Africa. An ill-judged and ill-conducted experiment at Mian Mir has done much to paralyse all efforts in this direction, and I gathered that anti-malarial campaigns were not popular among certain officials. Neither the Indian Government nor the medical services can be congratulated on the result.

Some years ago the Secretary of State for the Colonies issued a circular to the Governors of Crown Colonies asking for information as to what had been done in each against malaria and other mosquito-borne diseases, and statements on the matter from twenty-one colonies were published in the Report of the Advisory Committee of the Tropical Diseases Research Fund for 1907. I have criticised these statements in detail elsewhere. Only those furnished by seven colonies, namely, Southern Rhodesia, Papua, Mauritius, British Central Africa, Gambia, Ceylon, and Southern Nigeria, showed evidence of any real interest in the matter. Those from Bahamas, Barbadoes, Jamaica, and St. Kitts-Nevis showed, to my mind, nothing but neglect of public duty, while those from Northern Nigeria, St. Lucia, British Honduras, Grenada, Somaliland, Straits Settlements, and Sierra Leone gave no decisive evidence of the reverse.

For a number of years I have had very good opportunities of learning the truth as to what is really being done in many of these and other dependencies. It may generally be summed up in two words—very little. Festering pools which might have been cleared years ago for a few shillings or pounds are left in the heart of important towns to poison all around them; quinine prophylaxis is neglected, and house-screening forgotten. No efforts are made even to estimate the local distribution of the disease, much less to organise any serious efforts against it, although it may be causing, perhaps, half the sickness in the place.

Want of funds is always an excuse which is urged—and is always a false excuse. Much can be done at almost no expense; and the men who have actually carried out the work successfully in Panama, Ismailia, the Federated Malay States, and Italy have expressly declared the cheapness of it. Many a town could be kept clear of malaria for the amount, say, of the salary of a single European official. I estimate that a sixth of the medical and sanitary budget should generally suffice to reduce a disease which often causes half the sickness; but instead of doing really useful work which would benefit everyone, the authorities too often fritter away their funds on trifling schemes. I maintain that the health of the people has the first claim on the public purse.

Another excuse is that the possibility of preventing malaria has not been proved, but when one questions the sceptics one generally finds that they have not troubled to study the literature.

The fact is that the neglect of which I complain is due to quite other causes. I do not think that, as a rule, the blame is to be attached to the rank and file of the medical profession in the tropics. Men on the clinical side generally have enough to do with their hospitals and medical practice, while those on the sanitary side frequently complain that their recommendations are not seriously attended to. The immediate responsibility lies with the heads of the sanitary services of the colonies—men who are specially paid to organise such work. Now, though many capable individuals are to be found in such medical services, there is always a percentage of men, in them as in other services, who, to be frank, are not at all capable—men who from the date of receiving their medical qualifications take no further real interest in their work, read no literature, undergo no further courses of instruction, undertake no scientific researches, and make no additions to our knowledge either of medicine or of sanitation, and yet who manage to obtain the highest medical or sanitary appointments, either by seniority or by the well-known arts of self-service and wire-pulling. I am sorry to have to express such an opinion, but I think that this type of person is much too common in all branches of British administration. Worse heads of departments cannot be found. They scoff at the knowledge and efforts of others in order to cover their own ignorance and apathy. To them all new discoveries are frauds, and all new proposals are charlatanism. They repress every kind of honest endeavour among their juniors; they fill the best appointments with their own friends; and they truckle to their official superiors in the hope of obtaining further preferment. At last, decorated and pensioned, they leave the field to others of their own stamp—men without an idea or an ideal, except such as refer to their own advancement. These are the persons who are really responsible for the state of things which I have described.

As a rule, colonial Governments are far too careless in the selection of the men to whom they entrust the health of the public. It is openly said that they often choose either mediocrities or men who they know will be too subservient to them to assert the demands of sanitation—which is never a popular theme. At home, no one may be the medical officer of health, even of an English village, without possessing a proper diploma entitling him to practise as such; but it appears that anyone is good enough to be the chief sanitary officer of a whole country. The most amazing appointments are often made. Men of known and approved ability are passed over in favour of others who are supposed to possess special administrative qualifications, which frequently means nothing but a capacity for self-advancement, and both senior and junior sanitary officers complain that their representations regarding anti-malaria work often receive no intelligent attention either from the civil or the military authorities.

Root-and-branch reforms are required in all these respects. The failure of most of our tropical dependencies during ten long years to understand and act upon modern discoveries in connection with malaria, and, indeed, with other diseases, demonstrates that their sanitary services no longer fulfil the purpose for which they are paid and appointed. Reconstruction, similar to that which has revivified the Royal Army Medical Corps, is urgently demanded. It is not too much to ask that no man shall be appointed to an administrative post without previous examination as to his fitness—that no man shall be entrusted with the post of chief sanitary officer unless he can show evidence of having really worked at the subject, of having mastered scientific details, and of having obtained the qualifying diplomas of public health and tropical medicine. He should be placed on the Executive Council, which is now so frequently managed by the heads of less important departments. Proper arrangements should be made for expert inspection and supervision, and much more science, work, and discipline should be demanded, not only in the services, but in those who control them.

I have now outlined the general course of events. The immediate success which we had hoped for ten years ago has not been attained. The battle still rages along the whole line; but it is no longer a battle against malaria. Malaria we know, we understand fully, we can beat down when we please. The battle which we are now fighting is against human stupidity. Those of us who have taken part in it—not too numerous—know what it has been. We have written and lectured *ad nauseam*; we have interviewed ministers, members of Parliament, and governors; we have appealed to learned societies; we have sought the support of distinguished people; and we have received—sympathy. We have reasoned, and been ridiculed; we have given the most stringent experimental proofs, and been disbelieved; we have protested, and been called charlatans. I think that not one of those young men who have pioneered this important work in the field has ever received thanks for his labours. On the other hand, I know of several who have been actually punished for it. I know that all new movements have to face opposition of this kind; but surely the world is becoming too old for it. We talk much of science, and collect funds for research and teaching, and hold conferences and congresses, and blow trumpets over our doings; but when a useful discovery really is made, when the cause and methods of prevention of the most important of human diseases have been discovered, taught, and tried for ten years, this is the way we employ it for the good of humanity! Of what use is it to make discoveries if, when they are made, they are neglected? Remember that all this time, while we are questioning facts that are proved and methods that are established, hundreds of thousands, nay millions, of poor people are suffering from our dullness. I conclude with an appeal. The matter must be taken up in Parliament and in the Press as vigorously as possible. If some of the officials at fault could be persuaded to accept their pensions and decorations before the usual time, room might be made for more capable men. The few persons who have fought the fight and failed are scarcely able to continue it. If no stronger influences can be exerted, the future of malaria prevention in British dominions will certainly be as barren as the past has been.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed, in connection with the Darwin centenary, to confer the degree of Doctor of Science, *honoris causa*, upon the following:—Otto Bütschli, professor of zoology in the University of Heidelberg; Richard Hertwig, professor of zoology in the University of Munich; Hermann Graf zu Solms-Laubach, professor of botany in the University of Strassburg; F. Vejdovský, professor of zoology in the Bohemian University of Prague; and Max Verworn, professor of physiology in the University of Göttingen.

During the long vacation the science courses will include the following:—the curator of the herbarium, Mr. C. E. Moss, will give a series of demonstrations and lectures on systematic botany (flowering plants) in the botany school, beginning Tuesday, July 6. Weekly excursions will be arranged in connection with the lectures and demonstrations. Mr. K. J. J. Mackenzie will conduct classes on the University farm for a month, beginning on July 6. The classes are specially designed for students who have passed the natural sciences tripos, part i., and propose to take the diploma in agriculture. Dr. Fenton will give a course of fifteen lectures on the outlines of general chemistry on Tuesdays, Thursdays, and Saturdays. These lectures will begin on July 6.

THE directorship of the Harvard Botanical Garden, which recently became vacant through the resignation of Prof. Goodale, as reported in our issue of May 13, has been filled by the appointment of Mr. Oakes Ames, assistant professor of botany.

COMMEMORATION DAY was celebrated at Livingstone College, Leyton, on May 26. The college provides a medical training for missionaries, since the medical part of a missionary's work is now considered of prime importance. During the course of an address, Prof. Alexander Macalister said he had confidence in the course of training given at the college, and from his experience in Syria and China he believed it was essential that a missionary should be able to render simple medical aid to natives, and he hoped before long some such training would be regarded as an absolute necessity for every missionary. Dr. M. A. Stein, in the course of a short speech, referred to the valuable surgical aid he had received from an old student of Livingstone College during his explorations in Central Asia.

FROM July 6 to July 28 short courses of instruction for science teachers will be given at the Imperial College of Science and Technology, South Kensington, London, S.W., in chemistry, light, mechanics, plant physiology, and practical mathematics. Any teacher who wishes to attend one or other of the courses should apply at once for a form of application (Form 501 T) to the Secretary, Board of Education, Whitehall, S.W. The courses are limited to the teachers of classes in science, and in considering applications for admission the Board will have regard to (1) the character of the work done in the class or classes taught by the applicant and the probability of extension of this work; (2) the qualifications of the applicant as showing the extent to which his previous training will enable him to profit by the instruction given.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, May 12.—Prof. W. J. Sollas, F.R.S., president, and afterwards Dr. J. J. H. Teall, F.R.S., vice-president, in the chair.—The Hartfell-Valentian succession around Plynlimon and Pont Erwyd (North Cardiganshire): O. T. **Jones**. The stratigraphical succession and the geological structure of an area lying in the hilly district east of Aberystwyth are dealt with. The rocks within the district are divided into three stages, which are further subdivided into groups and zones. The Plynlimon stage is developed in the northern part of the district, the Pont Erwyd stage along the two valleys of the Rheidol and the Castell, while the Ystwyth stage is developed on the plateau-like tract extending from the Castell Valley to the Ystwyth Valley. The palæontological evidence is in entire accord with the stratigraphical evidence. Three types of structure are dealt with, (1) folding, (2) strike-faulting, and (3) normal faulting, but the first is predominant. Evidence is given for assigning to the "Aberystwyth Grits" of earlier observers a position much higher in the geological sequence than has hitherto been attributed to them. The paper concludes with a tabular list of fossils, correlation tables, and a description of two species of graptolites of zonal importance.—The geology of the neighbourhood of Seaford (Sussex): J. V. **Elsden**. This paper deals with a portion of the South Downs lying between Eastbourne and Newhaven. The inland outcrops of the uppermost zones of the Chalk are mapped. On the east of the Cuckmere River, the beds examined are found to be nearly horizontal. On the west side they are bent into a sharp uniclinal fold, striking east and west. Seaford Head represents a remnant of this fold. The low ground between Seaford and Chyngton occupies the trough of the fold. The complete disappearance of the fold on crossing the Cuckmere cannot be satisfactorily explained by the normal process of dying-out. It is suggested that a transverse fault may exist beneath the alluvium of that river. The fault, if it exists, seems to die away northwards, since no trace of it has been detected higher up the valley. The relation of the Seaford fold to the main flexures of the south coast is considered. Certain existing physiographical features are ascribed to the influence of this flexure, which facilitated the retention of the Eocene cover in the synclinal hollow thus formed. A brief comparison is made between the fossils of the inland exposures and those of the cliff-section, the most notable difference being the evidence in the former of a Conulus band at the top of the zone of *Micraster cor-anguinum*.

Physical Society, May 14.—Dr. C. Chree, F.R.S., president, in the chair.—A hifilar vibration galvanometer: W. **Duddell**. The paper describes a new type of vibration galvanometer and a series of tests made upon it. Vibration galvanometers may be divided into two types:—(1) those in which the moving part consists of a piece of iron or steel, and the current to be measured flows round fixed coils, as in the case of the Thomson galvanometer; (2) those in which the current to be measured flows round a moving coil placed in a fixed magnetic field, on the syphon recorder principle. The vibration galvanometers of Max Wien and Rubens belong to the first class, while Mr. Campbell's vibration galvanometer and the one described in the paper belong to the second. In the instrument described the mass of the moving parts is reduced to a minimum, the moving coil being reduced to the two wires forming its two sides, similar to a bifilar oscillograph, but with this difference: whereas the bifilar oscillograph is designed so as to make the damping aperiodic, the vibration galvanometer is designed so as to keep the damping as small as possible. A series of tests made upon the instrument showed that the total range of frequency was very large, namely, from about 90 ~ per second up to 1900 ~ per second. The damping is very small, so that the resonance is very sharp.—Effect of temperature on the hysteresis loss in iron in a rotating field: W. P. **Fuller** and H. **Grace**. The rotating field was produced by means of two phase currents. One phase was connected to a coil of long rectangular section and of sufficient length to produce a uniform field within a radius of 2 cm. from the centre. The second phase was connected to a similar coil enclosing this one, and causing a flux at right angles to it. The resultant field at the centre was uniformly rotating. The results of the experiment show that the effect of increasing the temperature of iron is to reduce the hysteresis loss at a given induction and to cause the maximum loss to occur at a lower value of the induction. In one specimen the maximum value of the loss at 220° C. was 12,300 ergs per cu. cm. per cycle at an induction of 16,000 C.G.S. units. At 580° C. the maximum loss was 2600 ergs at an induction of 10,700. The frequency of the experiments was 42 cycles per sec.—A method of testing photographic shutters: A. **Campbell** and T. **Smith**. The authors described a simple and rapid method of testing the speeds and efficiencies of photographic shutters, with a maximum error of 0·0001 second at the highest speeds. A vibrating beam of light falling through a narrow slit on to a moving plate serves to measure the time. This beam is obtained by reflecting the light of a Nernst lamp from the mirror (area 50 sq. mm.) of a vibration galvanometer actuated by a current of fixed frequency (say 100 or 500 ~ per sec.) obtained from a microphone hummer. The use of the vibration galvanometer, in which the amplitude is enormously increased by resonance, greatly facilitates the measurements. When the total duration of exposure only is required, the vibrating beam of light is passed through the shutter, tracing a sine curve on the moving plate. The duration of exposure is immediately found by counting the number of ripples recorded on the plate. Ten records of the various speeds of a shutter can be taken side by side on one 5×4 in. plate in one minute. When the efficiency in addition to the duration of exposure is required, the method adopted is essentially that of Sir Wm. Abney, but the time measurements are made with the vibrating beam of light instead of a screen.

Zoological Society, May 25.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—The anatomy of the olfactory organ of teleostean fishes: R. H. **Burne**. The chief structural variations were described in some fifty genera, mostly of common British species, the anatomical facts being illustrated by a series of coloured diagrams.—Description of a new species of the decapod crustacean genus Alpheus, Fabr., from the Bay of Batavia: Dr. J. G. **de Man**.

CAMBRIDGE.

Philosophical Society, May 3.—Mr. H. F. Newall in the chair.—A specimen of the cone *Calamostachys binneyana*, Carruthers: H. H. **Thomas**.—Note on two new leeches from Ceylon: W. A. **Harding**. The leeches described in this paper were collected in Ceylon by Miss Muriel Robertson. The material comprised examples of two species hitherto unrecorded, of which a brief description is given.—Note on an abnormal pair of appendages in Lithobius: L. **Doncaster**.—A property of summable functions: Dr. A. C. **Dixon**.

May 17.—Sir J. J. Thomson, vice-president, in the chair.—Phenomena of X-ray transmission: C. G. **Barkla**. By the use of homogeneous beams of X-rays the author investigated the variations in the relative ionisations in different gases due to changes in the penetrating power of the primary beams used. It was found that as the primary radiation passing through a gas was made more penetrating, within well-defined limits, the ionisation in that gas was approximately proportional to the ionisation produced by the same beam in air. When, however, the primary beam became just more penetrating than the secondary homogeneous radiation characteristic of one of the elements in the gas, the ionisation in that gas increased rapidly. The connection between ionisation in the gas, intensity of secondary radiation from the elements in the gas, and the absorption of the primary rays in those elements was exhibited. It was shown that the apparent irregularities recorded by many investigators in the various phenomena of X-ray transmission—absorption, secondary radiation, ionisation—may be explained in terms of a few simple laws.—Phenomena of the kathode discharge: J. A. **Orange**. The paper deals with the phenomena of the Crookes's dark space, kathode rays, and canal rays associated with double kathodes (as devised by Goldstein), and pairs of simple kathodes. The conclusions of Goldstein and Kunz with respect to the form of beams of canal rays are controverted. Remarkably well-defined beams of kathode rays were obtained with some arrangements. Schuster's relation between thickness of dark space and strength of current was confirmed. The records are photographic throughout.—Some fatigue effects of the kathode in a discharge tube: R. **Whiddington.** The kathode phenomena vary with time of running in such a way as to suggest that the emitted kathode rays become more homogeneous in velocity and more slowly moving. Restoration of the kathode cannot be effected by causing the absorption of hydrogen, oxygen, nitrogen, carbon dioxide, carbon monoxide, or helium, even at the temperature of liquid air. A transient recovery occurs on momentarily running the fatigued kathode as anode. Kathodes of carbon, platinum, and aluminium were tried. The kathode fall of potential shows a falling off with the time.—The influence of dilution on the colour and the absorption spectra of various permanganates: J. E. **Purvis.** Dilute solutions of the permanganates of barium, zinc, and potassium were compared in tubes of different lengths, and so that each tube contained the same amount of dissolved salt. The highly diluted solutions gradually changed from the well-known permanganate colour to reddish-brown and to yellow colours. At the same time several of the absorption bands became narrower, and others wider, until, when the colour had become quite yellow, the bands disappeared and only marked general absorption remained. These changes took place, not only when the solutions were subjected to the influence of light, but the phenomena were observed after the solutions had remained in the dark, although light appeared to accelerate the changes. The changes also occurred when the solutions were kept out of contact with the atmosphere and light. The explanation was that the MnO_4 ion broke down with the production of MnO_2 and O_2, and the MnO_2 was dissolved in the colloidal condition.—Note on the histology of the "giant" and ordinary forms of *Primula sinensis*: R. P. **Gregory.**

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part i. for 1909, contains the following memoirs communicated to the society:—

January 9.—The representation of unsaturated cyclic acids and carbohydrates with semi-cyclic connection: O. **Wallach.**

February 6.—*In memoriam* Hermann Minkowski. A proof that integers may be represented by a fixed number of *n*th powers (Waring's problem): David **Hilbert.**—Ordinary linear differential equations with singular regions and their particular functions: H. **Weyl.**—The concept of deformation-work in the theory of elastic solids: J. **Weingarten.**

February 20.—The uniformisation of algebraic curves by means of automorphous functions with imaginary substitution-groups: P. **Koebe.**

March 6.—The decomposition of matrices: J. **Wellstein.**

March 20.—Molecular free vibrations: E. **Madelung.**

DIARY OF SOCIETIES.

THURSDAY, June 3.

Royal Institution, at 3.—A Modern Railway Problem: Steam *v.* Electricity: Prof. W. E. Dalby.

Linnean Society, at 8.—On the Alcyonaria of the *Sealark* Expedition: Prof. J. A. Thomson.—On the Cephalochorda of the *Sealark* Expedition: H. A. S. Gibson.—Report on the Porifera collected by Mr. C. Crossland in the Red Sea: R. W. Harold Row.

Röntgen Society, at 8.15.—Annual General Meeting.

Institute of Actuaries, at 5.—Annual General Meeting.

FRIDAY, June 4.

Royal Institution, at 9.—Researches in Radiotelegraphy: Prof. J. A. Fleming, F.R.S.

Geologists' Association, at 8.—The Fossiliferous Lower Keuper Rocks of Worcestershire: L. J. Wills.

SATURDAY, June 5.

Royal Institution, at 3.—The Vitality of Seeds and Plants: (1) A Modification of the Vitality of Plants: Dr. F. F. Blackman, F.R.S.

TUESDAY, June 8.

Royal Institution, at 3.—Biological Chemistry: Dr. F. Gowland Hopkins, F.R.S.

Royal Anthropological Institute, at 8.15.—Prehistoric Human Remains from Various Parts of England: Dr. A. Keith.

WEDNESDAY, June 9.

Society of Public Analysts, at 8.—The Estimation of Iron by Permanganate in Presence of Hydrochloric Acid: G. C. Jones and John H. Jeffery.—On Jaffé's Colorimetric Method for the Estimation of Creatinine: A. C. Chapman.—The Estimation of the Alkalinity of Bleaching Powder Solutions: Dr. K. J. P. Orton and W. J. Jones.—(1) The Sabatier-Senderens Test for Distinguishing between Primary, Secondary and Tertiary Alcohols: (2) Note on a New Test for the Halogens: Dr. G. B. Neave.

THURSDAY, June 10.

Royal Society, at 4.30.—Croonian Lecture: The Functions of the Pituitary Body: Prof. E. A. Schäfer, F.R.S.

Royal Institution, at 3.—A Modern Railway Problem—Steam *v.* Electricity: Prof. W. E. Dalby.

Mathematical Society, at 5.30.—On the Behaviour at the Poles of a Series of Legendre's Functions representing a Function with Infinite Discontinuities: F. J. W. Whipple.—An Analogue of Pascal's Theorem in Three Dimensions: W. H. Salmon.

FRIDAY, June 11.

Royal Institution, at 9.—Problems of Helium and Radium: Sir James Dewar, F.R.S.

Physical Society, at 8.—The Arthur Wright Electrical Device for evaluating Formulæ and solving Equations: Dr. A. Russell and Arthur Wright.—The Echelon Spectroscope, its Secondary Action and the Structure of the Green Hg line: H. Stansfield.—The Proposed International Unit of Candle Power: C. C. Paterson.—Inductance and Resistance in Telephone and other Circuits: Dr. J. W. Nicholson.—Note on Terrestrial Magnetism: G. W. Walker.—On the Form of the Pulses constituting White Light: A. Eagle.

Royal Astronomical Society, at 5.

Malacological Society, at 8.—Diagnoses of new Trochoid Shells from North Queensland: H. B. Preston.—Notes on some of the Ampullariidæ in the Paris and Geneva Museums: G. B. Sowerby.—On the Radulæ of British Helicidæ: Rev. E. W. W. Bowell.

SATURDAY, June 12.

Royal Institution, at 3.—The Vitality of Seeds and Plants: (2) The Life and Death of Seeds: Dr. F. F. Blackman, F.R.S.

CONTENTS.

THURSDAY, JUNE 10, 1909.

TIDAL FRICTION.

Scientific Papers. By Sir George Howard Darwin, K.C.B., F.R.S. Vol. ii., Tidal Friction and Cosmogony. Pp. xvi+516. (Cambridge: University Press, 1908.) Price 15*s.* net.

THE papers in this volume form a collection which is especially interesting for several reasons. They are in effect parts of a single investigation, they were all written within a period of about three years (1879–82), and they form the foundation for more than one of the views in regard to cosmogony which are now widely accepted among scientific men. The following papers are included in the volume:—(1) On the bodily tides of viscous and semi-elastic spheroids, and on the ocean tides upon a yielding nucleus, (2) Note on Thomson's theory of the tides of an elastic sphere, (3) On the precession of a viscous spheroid, and on the remote history of the earth, (4) Problems connected with the tides of a viscous spheroid, (5) The determination of the secular effects of tidal friction by a graphical method, (6) On the secular changes in the elements of the orbit of a satellite revolving about a tidally distorted planet, (7) On the analytical expressions which give the history of a fluid planet of small viscosity, attended by a single satellite, (8) On the tidal friction of a planet attended by several satellites, and on the evolution of the solar system, (9) On the stresses caused in the interior of the earth by the weight of continents and mountains. These researches may be described as classical. In the reprint the papers have for the most part been left very much in the form in which they were published originally. It would have been possible, as the author points out, to re-write them as a compact treatise. On account of their great importance as original sources of information, and as pioneering work in a subject that is at once extremely fascinating and beset by unusual difficulties, it is likely that this carefully edited reprint will be more valuable than such a treatise.

The underlying thesis which pervades the volume is that, whatever the actual constitution of the earth may be, it must be more or less plastic. Although it may behave as a solid, and even as a very rigid solid, in regard to many types of forces, yet it must yield to great and long-continued stress almost as if it were fluid. For example, the figure it assumes in consequence of the diurnal rotation must be very nearly a possible figure of equilibrium of a rotating mass of gravitating fluid. In most of the problems discussed in the book the substance of the earth is treated as homogeneous and incompressible, and as resisting external forces in the same way as a viscous fluid. It is pointed out that a degree of viscosity which would be very large in comparison with that of ordinary fluids, as they are known to us, would produce hardly any effect in a body of the size of the earth, and that a substance of such viscosity as is necessary to produce any marked effect on the tides would behave in regard to periodic forces almost like a very rigid solid. Just as in many related questions, so here also, the enormous pressure exerted in the central parts of the earth by the weight of the superincumbent material becomes, as it were, a natural standard of stress. If the tangential stresses within the earth are everywhere small in comparison with this pressure the viscosity must be considered to be small, even though it may be greater than any that we know by experiment. In several places in these papers approximate results are obtained by treating the viscosity as a small quantity in this sense.

An alternative hypothesis to that of pure viscosity is the hypothesis of "elastico-viscosity," which includes pure elasticity and pure viscosity as extreme limits. The results of this hypothesis, so far as they are worked out, are qualitatively so similar to those of the hypothesis of pure viscosity that it was not thought necessary to develop them in full detail. The errors due to the hypothesis of homogeneity are discussed in Paper 2 It was there shown, by the aid of a simplifying assumption, that the effect of heterogeneity would be to diminish the ratio of the disturbance of ocean level to the displacement of the surface beneath the ocean, and an estimate of the reduction was obtained. Later investigations have shown that the reduction of this ratio on account of heterogeneity is really greater than it was estimated to be, but this paper contains the first attempt to determine the change that is produced in the earth's potential by tide-generating forces.[1] The general result that the errors due to the hypothesis of homogeneity do not seriously vitiate the qualitative results of the theory, though they may affect the numerical details, is probably true also of the errors due to the hypothesis of absolute incompressibility.

The main contribution of these papers to cosmogony is in regard to the efficacy of tidal friction as a cause of change in the configuration of the system of earth and moon. The chief cumulative effect produced by the lagging of the tides is a transformation of the angular momentum of the earth's rotation into angular momentum of the relative orbital motion of the earth and the moon. It is shown to be possible to trace back the configuration of the system from its present specification to one in which the moon was very near to the earth, the day and the month were nearly equal in length, and much shorter than the day is now, while the inclination of the lunar orbit to the equator and the obliquity of the ecliptic were very much less than they are now. It is concluded that probably the moon was once part of the earth, and that it broke away in consequence of some kind of instability, in regard to which various possibilities are indicated. It is concluded further that probably the changes in the configuration of the earth-moon system are mainly due to tidal friction, but that this cause of change has been much less efficient in the case of other planets and their satellites, and in the case of the solar system as a whole, although traces of the effects which it is competent to produce are discernible almost everywhere. Another important conclusion is

1 Reference to this paper was omitted by an oversight in the article "The Yielding of the Earth to Disturbing Forces" in NATURE, April 29.

that the slackening of the speed of the earth's rotation, due to tidal friction, more than counterbalances the quickening due to contraction of the earth as a cooling body. On the other hand, it is shown that the heat that has been generated in the earth by tidal friction, although very great in absolute amount, hardly affects at all the temperature gradient near the surface. All these conclusions are nearly independent of the special hypotheses adopted in order to render the mathematical problem definite and comparatively tractable, and this independence is brought out in a highly instructive graphic method of discussing the problem by the aid of the general principles of energy and momentum, a method which was developed by the author after discussing the theory with Lord Kelvin.

A subsidiary effect of the viscosity of the earth's substance is found in a tendency for any elevation on the surface to be displaced gradually westwards by an amount which is greatest at the Equator. This result suggests that equatorial lands may tend to be displaced westwards relatively to polar lands, and it is therefore a step towards a solution of the dynamical problem of the distribution of land and water. The existence of the continental elevations and oceanic depressions shows conclusively that the earth behaves in some respects as a solid body of considerable rigidity. The last paper in the volume is a discussion of the strength and solidity which the materials of the earth must possess in order that such continents as actually exist may be supported without interior compensation. This paper is the only one which has been much altered from its original form, and in this instance it is the mathematical theory that has been re-written, the general argument being but slightly affected. The author would seem, from a passage in his preface, to have come to hold the view that the continents are not actually supported in the manner assumed in the paper as a basis of discussion, but his investigation remains the most important contribution that has ever been made to the problem.

Workers in mathematical physics will be grateful to the author for his careful revision, and to the Syndics of the Cambridge University Press for their public spirit in re-printing and re-publishing the papers. The author's custom of summarising his methods and results in language comparatively free from technicalities should render his general arguments and main conclusions accessible to all persons interested in speculative astronomy. A. E. H. L.

PAPER-MAKING.

The Manufacture of Paper. By R. W. Sindall. Pp. x+275. (London: A. Constable and Co., 1908.) Price 6s. net.

THE author is well known as a specialist and a worker in this branch of technology, and, of course, in a treatise of nearly 300 pages, could not fail to deal, in an interesting way, with some critical problems of the industry. But this contribution to the subject, which is of deep, wide, and varied interest, hardly commends itself as a spontaneous effort in relation to its literature. From our brief but "brotherly" examination of its contents we are led to surmise that it owes its origin to mixed motives, such as would operate in the case of a publisher's "specification" adopted by the author, not as a call or inspiration illuminating as well as defining his task, but rather as a condition of a contract to be fulfilled. This somewhat artificial basis is already indicated in the pointless preface, in which the author first records some very obvious convictions, as to the complementary relations of engineer and chemist in this industry. But these are not applied as material to any purpose or plan of the present work, which is otherwise introduced in a paragraph of faint praise as follows:—

"In the present elementary text-book it is only proposed to give an outline of the various stages of manufacture and to indicate some of the improvements made during recent years."

The result is, as regards *matter,* a series of sectional chapters dealing with aspects of the industry and its processes, with no continuity or cohesion of plan; and as regards *form* there is not merely an absence of style, but a disregard of accuracy of definition and precision of statement which, in an elementary text-book, as it claims to be, is a usual feature of distinction as of moral influence on the mind of the student reader. It is a depressing task for a reviewer thus to record a depreciative estimate of a work which of course represents merit, as well as effort, on the part of the author, and it is equally thankless to have to justify such conclusions in detail. We can only lighten the task by shortening it.

The absence of plan is seen in the treatment of fundamental processes and effects, such as bleaching, beating, and sizing; matters of such general import are introduced in successive chapters dealing with different classes of papers without expository preparation. "Electrolytic bleaching" is treated in a detailed *exposé* of cost of production of the hypochlorite analysed into its factors. This, on the other hand, presumes a basis of critical knowledge on the part of the reader out of all perspective. The paper machine is introduced by way of photo-illustrations and a paragraph or two of descriptive matter; the reader is then rushed to the laboratory to test papers for the presence of mechanical wood-pulp; he is then rushed back to the machine for the task of calculating its output (pp. 119–25). The structural features of paper-making fibres are introduced at various points in the text by way of photomicrographs and descriptive remarks; but if the author were asked as to the educational effect intended, we think he would reply by stating that that is "a question of which he would require notice."

As regards form and the defects of the text in point of style and accuracy, examples might be taken from almost every page. Note the opening sentence:—"The art of paper making is undoubtedly one of the most important industries of the present day." Of course, we know what the author *means*, and in English composition this is the popular touchstone of language. A more typical example is the following (p. 40):—

"*Carriage and Freight Charges.* It is not too much to say that the whole success of the exploitation of new paper-making fibre hangs entirely upon this item, the majority of many fibres which have been brought to the notice of the trade being suitable, but impracticable solely on account of these and similar commercial considerations."

For looseness of technical exposition note the following (p. 150):—

"The main difficulty experienced is the liability of paper to stretch when damped, and various methods are devised to obviate this, either by employing paper which stretches very little when damp, or by making the paper partially waterproof before use."

We also observe such expressions as "the value of a *vegetable* plant for paper making" (p. 23), which is repeated on p. 26 in the following:—"The percentage of cellulose in the *vegetable plants*, employed more or less in the manufacture of paper." On p. 25 we also note, "The alternative treatment with bromine and ammonia," whereas what is intended is the *alternate* treatment.

More serious are the author's frequent errors in statement of matters of fact; thus hydration is confused with hydrolysis (p. 27)—"Cellulose is only oxidised by acid and alkali if treated under severe conditions"; again, "Cellulose benzoate is obtained when alkali cellulose is heated with benzoyl chloride and excess of caustic soda" (p. 31). The description of "artificial silk" is generally inaccurate, with an unfortunate misprint of "five" for "fine."

It must not be thought that we are hypercritical in citing these examples, and it is only fair to students and the reading public thus to direct attention to defects which are general. It is pleasant, on the other hand, to commend the author for his extremely interesting, original observations, such as the investigation of the process of beating (pp. 179–85), and also his chapter on the dyeing and colouring of paper pulp. In conclusion, such a work can be commended to a certain class of readers, notably those representing the stationers or consumers, and also those who require general information without regard to close accuracy. There is certainly room for a work of this character, and with a rigorous revision the volume might be made a useful addition to the literature of paper making.

HINTS FOR MINERAL COLLECTORS.

Mineralien-Sammlungen. Ein Hand- und Hilfsbuch für Anlage und Instandhaltung mineralogischer Sammlungen. By Dr. Wolfgang Brendler. I. Teil. Pp. viii+220. (Leipzig: Wilhelm Engelmann, 1908.) Price 7 marks.

MOST of us have in our youth been impelled to form a collection of objects, such as stamps or butterflies, which come within the purview of every-day life, but few have essayed minerals, partly because, except to those actually dwelling in a mining district, crystallised minerals in the natural state are almost unknown, and partly because it is on first acquaintance perplexing to understand how minerals may be determined. A brief experience soon shows that colour, the most obvious physical character, is no trustworthy guide. It is, indeed, impossible, without some knowledge of the physical and chemical characters of minerals, even to arrange a collection, much less derive any pleasure or satisfaction from it. Dr. Brendler has endeavoured to smooth the path of the collector by providing in this slender volume all the information necessary for the determination of the ordinary characters of minerals. If we judged by the slight interest taken in this country in mineralogical science, we should have anticipated that the demand for such a book would have been too small to justify its publication, but it appears from Dr. Brendler's preface that in Germany a more encouraging state of things prevails.

Rather more than two-thirds of the volume is occupied with the morphology of crystals and the different types of crystalline symmetry. The usual treatment of the subject is followed, and little comment is called for. As is customary in most German text-books, prominence is, unfortunately, given to Naumann's symbolical method of denoting the forms, although Miller's simple notation is also mentioned. We notice that it is styled the "Grassmann-Miller" notation, a conjunction which might suggest that Miller introduced some modification or adaptation of a method originated by Grassmann. It is true that the latter made use of the same notation in a publication issued in 1829; nevertheless, it was solely due to the revelation of the simplicity of this notation produced by the publication in 1863 of Miller's masterly tract that it came into universal use among active workers in crystallography, and it is probable that Miller arrived at the notation quite independently. Dr. Brendler is, perhaps, unaware that Whewell described the same notation in a paper read before the Royal Society on November 25, 1824 (Phil. Trans., 1825, p. 90). We have dwelt upon the point at some length because this is, we believe, the first time that Miller's claims have been apparently disparaged.

Some thirty pages are devoted to a brief discussion of the ordinary physical characters—cleavage, hardness, specific gravity, pleochroism, double refraction, and so on—and a few pages deal with the usual blowpipe reactions.

The concluding chapter, entitled "Die Mineraliensammlung," forms the most original, and, indeed, the most interesting, part of the volume. Here the author gives many invaluable hints, which are familiar to curators and are perhaps trifling in themselves, but for want of which considerable difficulties may arise as a collection grows. He describes a convenient type of case for housing and exhibiting the specimens, shows how the damage that might arise from the effects of light, damp, or dirt can be obviated or minimised, and suggests suitable mounts for the specimens exhibited in the tops of the cases and suitable trays for those placed in the drawers underneath. His advice that all specimens be numbered chronologically as they are incorporated seems sufficiently obvious, but collectors have sometimes numbered each species separately, a system which is possibly open to slight objection so long as the collection is small and composed of well-defined specimens, but which entails endless confusion as the collection increases in size; for instance, if a specimen, as often is the case, displays several species, it may not be easily traced in the register, and, again, if the species has been wrongly determined, a fresh number must be assigned to it. Dr. Brendler rightly lays stress on the importance of supplementing the general register by a card-catalogue in which the species are grouped separately, each card to contain the whole of the available information relating to the corresponding specimen.

The author has greatly increased the value of the book to the amateur collector by inserting lists of firms supplying mineral specimens or materials and apparatus required in the testing, housing or labelling of specimens and quoting, where possible, the prices. An error on p. 7 calls for correction; the branch in Paris of the Foote Mineral Co. (of Philadelphia) has been closed for some years.

G. F. H. S.

THE PLANT KINGDOM.

Das Pflanzenreich. Vols. xxviii. to xxxvii. Scrophulariaceæ-Calceolarieæ. By Fr. Kränzlin. Pp. 128. Price 6.40 marks. Erythroxylaceæ. By O. E. Schulz. Pp. 166. Price 8.80 marks. Styracaceæ. By J. Perkins. Pp. 111. Price 5.60 marks. Potamogetonaceæ. By P. Ascherson and P. Graebner. Pp. 184. Price 9.20 marks. Orchidaceæ-Cœlogyninæ. By E. Pfitzer and Fr. Kränzlin. Pp. 169. Price 8.40 marks. Liliaceæ-Aloïneæ. By A. Berger. Pp. 347. Price 17.60 marks. Sarraceniaceæ. By J. M. Macfarlane. Pp. 89. Price 2.40 marks. Stylidiaceæ. By J. Mildbraed. Pp. 98. Price 5 marks. Nepenthaceæ. By J. M. Macfarlane. Pp. 92. Price 4.60 marks. Araceæ-Monsteroideæ and Calloideæ. By A. Engler and K. Krause. Pp. 160. Price 8.40 marks. (Leipzig: Wilhelm Engelmann.)

THE ten volumes forming the subject of the present notice have appeared at intervals during the last two years. Six volumes deal with entire families, while four are confined to tribes. The tribe of the Calceolarieæ, represented by two small genera and Calceolaria, is collated by Dr. Franz Kränzlin. Fifty years ago these South American plants were in great request, but interest in collection and cultivation has waned until recently the collections of Dr. Weberbauer in Peru have furnished a number of new species. Basing his opinion on the well-known tendency of Calceolaria to hybridise, the author favours the view that natural hybrids occur, and appends a list of possible hybrids.

The volume on the Erythroxylaceæ is practically a monograph of the genus Erythroxylon. Systematic alterations are introduced by Miss J. Perkins in the family Styracaceæ; the genera Lissocarpa and Diclidanthera are excluded, Foveolaria is reduced to Styrax, and Pterostyrax is restored to generic rank. The distribution and a high proportion of endemic species are outstanding features of the principal genus Styrax. Dr. Graebner has undertaken the difficult task of classifying the Potamogetonaceæ, with the help of Dr. Ascherson for the marine genera. The chief difficulty lies in the interpretation of the numerous critical species of Potamogeton, which also hybridise readily; lists of hybrids and fossil species are given.

The monograph treating the tribe Cœlogyninæ is of considerable importance because the talented author, Dr. Pfitzer, who died before the manuscript was quite complete, had adopted a definite opinion with regard to splitting the large orchidaceous genera of which Cœlogyne furnishes a good example. Besides restoring some old genera, five new ones were formed, and are left by Dr. Kränzlin on Pfitzer's authority. The Aloïneæ fills a thick volume, as the genera Kniphofia and Haworthia each provides more than sixty species, and the species of Aloe number 168. The tribe, almost entirely African, supplies a number of the succulent plants cultivated in green-houses in northern climates or acclimatised on the Mediterranean littoral. Hybridisation is prevalent, and is even intergeneric, as crosses have been effected between species of Gasteria, on the one hand, and Aloe, Haworthia, and Apicræa on the other.

The two families Sarraceniaceæ and Nepenthaceæ have been monographed by Prof. J. M. Macfarlane, who presents his general descriptions in English. Naturally, a full account is provided of the lures for insects and the question of insect digestion. Sarracenia furnishes a number of artificial hybrids, and some natural hybrids have also been discovered. The name of Stylidiaceæ displaces the Candolleaceæ of the "Pflanzenfamilien," and Candollea gives way to Stylidium. Dr. J. Mildbraed also restores Forstera and Oreostylidium to generic rank. Finally, Drs. Engler and K. Krause have worked out two tribes of the Araceæ. Raphidophora, Monstera, and Spathiphyllum are the more important genera, all belonging to the tribe Monsteroideæ.

THE COMPARATIVE PHYSIOLOGY OF MAN.

The Human Species, considered from the Standpoints of Comparative Anatomy, Physiology, Pathology, and Bacteriology. By Ludwig Hopf. Authorised English translation. Pp. xx+457. (London: Longmans, Green and Co., 1909.) Price 10s. 6d. net.

THE literature of evolution is exceedingly extensive and varied, but there are not many books which, in a small compass, place before the general reader a simple account of man's structure, nature, and zoological relationships extending over the whole field of anthropology. This task has been attempted with considerable success in the present volume. Commencing with a review of the speculations of primitive man as to his own origin, the author passes on to a classification of mankind and his ancestral and recent history as revealed by fossil and other remains, from the Tertiary period to the present day. Subsequent chapters deal with comparative anatomy and physiology, psychology and sociology, while the last quarter of the book is devoted to the less studied, or perhaps less popular, topic of comparative pathology and therapeutics. To compress so vast a subject within the limits of a small volume has led to all descriptions being of the briefest. None the less, the book will appeal to those who desire to acquire a superficial knowledge of the main features of human evolution, while the sections will serve as starting-points for further study to those more deeply interested, and be of considerable assistance to popular lecturers, who will find therein a dense array of facts.

The introduction comprises a summary of the surmises made in the past as to the origin of man, and leads up to the study of evolution. The history of the systematic classification of mankind into races unexpectedly ends with Huxley and Max Müller, more recent authors being omitted. The section on comparative anatomy is full and freely illustrated, but is marred, at any rate for the general reader, by a tendency to give the names of the parts referred to in Latin in the text, and in the illustrations to label them sometimes in English, at others in Latin, while in some cases abbreviations only are made use of. This is the more to be regretted as the names employed are not always those found in English text-books of anatomy. Space being valuable, it may be wondered why long tables of chemical compositions, such as that of the brain, which occupies a whole page, were included. It seems at times as if the author was uncertain whether he was writing for the student or the general public. The sections on early man are too short for the former in comparison with the rest, while the number of unexplained technical terms must prove a stumbling-block to the latter. Indeed, in many respects the volume suggests a very full and illustrated syllabus of a course of lectures rather than a text-book or a popular description.

Regarded in this light, the book would be a useful aid to students of human or comparative anatomy and physiology. Perhaps the most interesting, because most unusual, chapter in a work of this kind is that dealing with pathology, which contains much that would otherwise have to be garnered with considerable labour, since the data are scattered through a multitude of technical journals. The author shows that in general the phenomena of disease in man, whether due to animal or vegetable parasites or to disorders of metabolism, are similar to those presented by the higher animals, the differences being largely explicable by such features as the assumption of the erect attitude, the habits of feeding, and more particularly by the aggregation into large communities, the often unhygienic methods of clothing, and the abandonment of free physical exercise which has characterised the recent history of man.

PRACTICAL PHYSICS.

(1) *Practical Physics*. By L. M. Jones. Pp. viii+330. (London: Longmans, Green and Co., 1909.) Price 3*s*.

(2) *Handbuch für physikalische Schülerübungen*. By Prof. Hermann Hahn. Pp. xv+506. (Berlin: Julius Springer, 1909.) Price 20 marks.

(1) OPINIONS will always vary as to the precise means to be adopted to achieve any definite end, and this is notably the case in the teaching of practical physics, as is shown by the many text-books on the subject. It is the more to be remarked that most teachers will readily subscribe to the thesis which Mr. Jones lays down, perhaps a little combatively, in the preface to his book, as to the fundamental idea of practical courses of physics. All students will agree that practice must illustrate and substantiate theory in a connected, logical manner, so that a "course" may review the fundamental conceptions of the subject, and, in so doing, train the reasoning power. Several text-books, however, might be conceived as conforming to this canon.

But Mr. Jones has that best of qualifications—of having actually used his course for several years, and proved it by success. The title of the book is slightly misleading, as the book only treats of heat, light, and electricity. Within these limits we have little but praise for it. The explanations of theory are lucid, and give an orderly, interesting, and withal simple conspectus of fundamental conceptions founded upon an extremely complete series of nearly 200 experiments. The illustrations are attractive and not too complex, and the instructions as clear as could be desired. Practical exercises at the end of chapters give scope for that element of initiative which is necessary to approximate students' work to the conditions of research, and the general revision papers at the end of the book afford a useful method of eliciting the physical conceptions learned.

The list of experiments covers such subjects as vapour pressure, dispersion, and electrolysis, which are not commonly included in "intermediate" courses, while simple methods of electrification, the electroscope, and electrophorus are omitted which are usually included. In spite of this, and a relegation of instruction as to probable errors to notes which might have been better treated in an introduction, the book is always stimulating, suggestive, and clear.

(2) The "Handbuch" of Prof. Hermann Hahn is a book of a totally different character. It offers a clear, eminently logical, and complete course of practical physics, with all that the term usually signifies, to teachers. It is a book which one can freely praise and blame with difficulty. Commencing with conceptions of space and mass, it covers very completely general properties of matter. Indeed, nearly half the book is devoted to this part of the subject, but we can hardly regret it. Incidentally, we find the student is to be introduced, at the outset, to his apparatus of calculation—an excellent idea. The slide rule comes on p. 5, and a student is early to be taught habits

of accuracy and means of attaining them with sufficient rapidity to keep them in their place of subserviency to the theory of the experiments. Another excellent point is the treatment of vibration and waves in general.

Prof. Hahn has a firm and broad grip of what has been accomplished on his own subject, not only by his fellow-countrymen, but by students of other nations. A bibliography at the head of each section contains almost all the well-known names among English, French, and American physicists. On p. 3, at the head of Section 2, we find Prof. Perry's excellent book on "Practical Mathematics" noted, and this fact is a significant specimen of the method in which the subject has been approached. A full bibliography at the end of the book contains even such references as the Board of Education syllabuses.

H. C. O'N.

OUR BOOK SHELF.

School Algebra. By W. E. Paterson. Part i., pp. 328+xxxix. Part ii., pp. 333–604+xli–lxxvii. (Oxford: Clarendon Press, 1909.) Price 3*s.* each with answers; 2*s.* 6*d.* each without.

PART I. is, except as regards one or two things, sufficient for students who are not going to specialise in mathematics, and part ii. contains the higher portions which are usually read by scholarship pupils. The author has, however, reserved the ordinary methods of finding the H.C.F. of two expressions and of extracting square roots until part ii., whereas in many cases these methods are taught in preparatory schools. In part i. he has shown the student how to obtain square roots by means of indeterminate coefficients, so that the postponement of the formal method is not a very serious drawback; moreover, the teacher can introduce it if he likes without difficulty, as boys readily learn it. But with regard to H.C.F. the case is different. If the author had, in part i., shown pupils that the H.C.F. is contained in the sum or difference of any multiples of the two given expressions, he would have put a powerful weapon into their hands, quite sufficient for all ordinary cases; but practically all he says is that both expressions must be factorised, the remainder theorem being used for cubic and higher expressions. Graphs are well treated, except that in the diagrams the author omits the minus signs on the negative side of the axes. There are a great many misprints and other inaccuracies, chiefly in part i., some of which are serious; for example, the rule given in Art. 80 (p. 113) is quite wrong as it stands, and even if corrected would be difficult to understand, and would be, moreover, of only partial application.

On the other hand, some of the hints are excellent, as, for example, that it is no use to try to factorise ax^2+bx+c by inspection if b^2-4ac is not a square number (p. 212), a good foreshadowing of the value of theory.

Part ii. is well done, though in some instances explanations are too condensed; the distinction between permutations and combinations, for instance, is not well explained. But, as a rule, proofs are clear as well as concise, and many important examples are worked out in a very instructive manner.

There is a good index to each part, and a large number of examination papers, including questions in French and German. In the hands of a good teacher the book would be an excellent concise introduction to all the parts of algebra required for scholarship work; but it would have to be supplemented in places, and it is most desirable that a careful table of errata should be provided as early as possible.

Eliza Brightwen: the Life and Thoughts of a Naturalist. Edited by W. H. Chesson, with introduction and epilogue by E. Gosse. Pp. xxxii+215; plates. (London: T. Fisher Unwin, 1909.) Price 5*s.* net.

ALTHOUGH in no sense a scientific naturalist—and, indeed, to a great extent ignoring the work of others—Mrs. Brightwen did good service in publishing first-hand accounts of the habits of animals—both in captivity and in the wild state—and thus helping to stay the flood of rubbishy works, compiled by those who had no real knowledge of their subject, which were only too common some twenty years ago. Perhaps the most remarkable feature in her career is the fact that her first, and apparently most successful, work, "Wild Nature Won by Kindness," was not presented to the public until its author had attained her sixtieth year. Throughout her life she had, however, devoted all her spare time to learning all that was possible about every kind of animal that came in her way, whether home or foreign, and this volume was, therefore, the result of long and close observation, and this, too, in a thorough and exhaustive manner. When it is added that this, as well as the five other volumes bearing her name, was written in a bright and attractive manner, it is little wonder that it leapt at once into popularity, and also obtained the honour of being translated into Swedish.

Mrs. Brightwen, who was a daughter of Mr. George Elder, a brother of one of the founders of the firm of Smith, Elder and Co., was born at Banff in 1830, and in the early 'seventies her husband purchased The Grove at Stanmore, where she was soon after left a widow. It was here that all her published works were written, and also much of the MS. of the volume now before us, mainly in the form of a diary, although the earlier portion dates from so far back as 1855. At her death the MS. was left to Mr. Edmund Gosse, with a free hand as to its ultimate disposal.

That he did well in deciding on its publication, under the careful editorship of Mr. Chesson, will, we venture to think, be the verdict of all those who read this charming volume, which, in addition to numberless observations on natural history, gives an instructive insight into the inner life of a striking personality.

R. L.

The Grammar of Life. By G. T. Wrench. Pp. xii+237. (London: William Heinemann, 1908.) Price 6*s.* net.

PHILOSOPHY is to some a liberation from the positive and dogmatic habit of mind, to others a new field for its exercise. As the title of his book indicates, Mr. Wrench belongs to the latter class. He does, indeed, profess at the beginning a philosophical phenomenalism: "We know only our own perceptions. Consciousness itself depends on previous perceptions; for without memorised perceptions with which to compare our present perceptions, consciousness would not exist." From this quotation it is evident that the infinite series, that nightmare of so many philosophies, has no terrors for Mr. Wrench. But, though without apparent misgiving on this head, he is only verbally constant to his sceptical presupposition. His "relativity" gives us such cardinal propositions as these: "Man has no ultimate purpose"; "life is a special form of matter in motion"; "the universe is an eternal series of cycles." It is legitimate for a philosopher to deny that we can penetrate the veil of appearance; but for such a one, the words "universe," "eternal," "ultimate," are unmeaning, or at best indicative of problems, not words to be lightly used in positive propositions. Mr. Wrench's phenomenalism is, in short, a very thinly-disguised materialism.

As philosophy, then, the book has no great merit. Nor can it be said greatly to extend or clarify our psychological knowledge. Mr. Wrench's fundamental classification—that of the instincts as self-preservative, reproductive, gregarious—is familiar, but it should not be accepted as final without strict examination. His notion of "sub-instinct," a specific form of one of the main instincts, as, *e.g.*, patriotism is a specific gregariousness, is not without value, but it is scarcely conducive to clearness to apply this same term to the objective social custom which results from the interaction and mutual modification of the "forms the instincts take in the thought of the individual." Mr. Wrench's main practical inference from his analysis of human nature is that our present system of education should be inverted, and science given the predominant place, for, he says, "the process of abstraction is essentially gregarious." The intellectualistic fallacy in educational theory has been so often exposed that it is unnecessary to do more than notice this remarkable version of it.

In statement Mr. Wrench is clear and concise, and such purely scientific exposition as he gives in the course of his work is admirable.

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 intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Need of a Great Reference Library of Natural Science in London.

Anyone desiring to see the new books in various branches of science who has had the use of the great libraries in Oxford or in Cambridge, and finds himself transferred to London as his habitation, must be astonished, as I have been, to find that there is no great scientific library in London, and that access to all the incomplete libraries of the various scientific societies does not enable him, even when he takes the large amount of trouble necessary to inquire at all of them, to see the important and necessary new books in various branches of work.

The deficiency is in regard to new "books" rather than in regard to periodicals. It must be noted that of late years, not only scientific periodicals, but large and costly separate scientific books or special memoirs, often expensively illustrated, have appeared, and are appearing, in increasing number. I could name several books in prehistoric archæology, in comparative anatomy, and other subjects, which I have been unable to find in London within six months or a year of their publication, and others which are not likely to be purchased by any of our societies. The smaller societies devoted to special subjects have neither money nor house-room for a first-rate library. The larger societies neglect special subjects, on the theory that they are provided for by the special societies. The Royal Society has by no means such a library as might be expected in view of its age and dignity. It has insufficient funds and space, and, whilst aiming at completeness in periodicals and the publications of scientific societies, is a "broken reed" for one who leans on it as a help in the matter of books. It is true that the Linnean, the Zoological, the Geological, and the Chemical Societies, and the Society of Antiquaries have in their libraries many splendid books, and annually purchase a limited number of new books; but if their libraries are taken all together, in conjunction with that of the Royal Society, the Royal Medical Society, and the London Library, they do not constitute that thing which is so necessary to the mature student of modern science, namely, a complete, or nearly complete, library of scientific publications, where the newest books may be seen and consulted as soon as published.

We are so behindhand in this matter that it is not possible in London even to see a new book from France or Germany with a view to its purchase. We ought to have in London a professedly *complete* library of modern scientific publications accessible to all mature students (whether on payment of subscription or otherwise), provided with a big reading-room where all the newest books can be seen and read. Such a library should not lend its books, but have them always ready for consultation. It should have a staff of really competent librarians able to help the reader to find what he wants, and it should be open until ten or eleven o'clock in the evening, and as late on Saturdays and all public holidays as on other days, for it is precisely at those hours when libraries are universally shut that a great number of eager students would find their only chance of using them.

It has been often suggested that such a library as I desire might be formed by the union and cooperation for this purpose of our various scientific societies, and I believe that might be so if a practical scheme were formulated. It would not be necessary for every society to give up its existing library, but it would be necessary for each society to contribute largely in money and books in order to constitute and maintain the new combined or central "consulting" library. Probably if the Government could be persuaded to give for this purpose the buildings formerly assigned to the University of London, and now occupied by the various examining bodies connected with the Civil Service and the Army, the National Scientific Reference Library could be at once constituted. In view of the urgent public necessity for such a library, the Government might be expected to provide a subsidy of two or three thousand pounds a year, and the scientific societies might contribute so much a head for their members and place their existing libraries at the service of the new institution without giving up their special rights to borrow certain books.

In order to move any further in the matter, it is clearly necessary to form, in the first place, an estimate of the minimum size of such a library and its reading-room, and of the annual expenditure, necessary for the purchase of books, as well as for librarians, attendants, heating, and lighting.

I should be glad to receive any suggestions from those who feel the need of such a library. It seems to me that the essential points to be aimed at are:—(1) completeness, so that any and every book of scientific quality shall be on the table as soon as published; (2) accessibility of the library to readers until a late hour of the evening and on holidays and half-holidays, as well as on ordinary days.

The value of such a library to every kind of worker in science would be immense. It should be open to everyone on payment of a moderate annual subscription. It may be objected to any new library (such as I propose) that the library and reading-room of the British Museum supply the want. They do not, since books are not obtained there without delay. Many foreign books are not obtained there at all.

E. Ray Lankester.

Vapour-density and Smell.

In a letter to Nature of May 13 I made a statement to which Dr. Perman very naturally takes exception (May 27, p. 369). He cites ammonia, hydrocyanic acid, and hydrofluoric acid as instances of volatile bodies lighter than air, yet odorous. In considering the physiology of olfaction, however, certain conditions which might lead to misconception must be ruled out. In the first place, a very minute addition of impurity suffices to give odour to an otherwise odourless substance. Formalin was the substance of which I was writing. My judgment, based on sensory experience, absolutely declines to accept the somewhat fatty scent which I recognise with my nose close to a dish of formalin as a property of the vapour which irritates my conjunctiva when far beyond the range of smell. The chief drawback to the ordinary commercial method of preparing formaldehyde is, I am told, the impossibility of preventing polymerisation. In the same way, as Dr. Perman himself points out, hydrofluoric acid at ordinary temperatures "consists mostly of molecules H_2F_2." Hydrocyanic acid, again, shows a great tendency to polymerisation and to decomposition in the presence of water. The possibility of ionisation in the presence of the film of moisture on the surface of the olfactory membrane and of the moist air in the nasal chambers must also be taken into account. It is also possible that certain gases produce an olfactive effect after the incorporation of water in their molecules.

In the second place, a distinction must be drawn between indirect olfaction due to chemical action and olfaction which can be accounted for only as the result of the vibration of olfactory hairs. I, personally, should hesitate to describe the effect upon my nervous system, through my olfactory membrane, of pure ammonia, as a sensation of smell. It seems to stand in an entirely different category from the smelling of musk. To make such a distinction recalls to mind the fact that olfaction is the successor of chemical stimulation, chemiotaxis. The sense of smell may be based upon the older and coarser mode of action of olfactive bodies as well as upon the more modern and refined.

Either of the three substances which Dr. Perman has cited as odorous is capable of producing a change in the constitution of protoplasm such as cannot, we suppose, be produced by the minimal amount of human effluvium which enables a dog to track his master, or even by the minimal quantity of drifting particles which are capable of appealing to a man's far less sensitive nose. It can be demonstrated experimentally that one part of mercaptan in 50,000,000,000 of air gives a recognisable odour to the mixture. Chemical action in such a case seems to be out of the question.

Although we cannot conceive the way in which so minute a quantity of matter plays upon the instrument which originates nerve-impulses, we picture the olfactory hairs as answering to some change in the vibrations of the molecules of air, or of the atoms within their molecules, due to the influence of the olfactive particles. Such evidence as is at present available, if we make allowance for the sources of error to which I have alluded, points to the conclusion that to produce this molecular or intramolecular change the added gas must be heavier than air. That olfactivity is not proportional to density is sufficiently evidenced by the aggressive scent of sulphuretted hydrogen and of many other substances which are comparatively light. In my letter of May 13 I suggested that the inability of flies to distinguish between pure water and water containing formaldehyde seems to point to the same conclusion.

Alex Hill.

The Germ-layer Theory.

The most important criticism in the review on May 13 of "The Origin of Vertebrates," by Dr. W. H. Gaskell, is based on a dogmatic view as to the fundamental distinctness of the germ layers and their predetermination for the formation of certain organs. It is evident that your reviewer regards this as a settled fact. It is therefore only fair to point out that this is by no means the opinion of all morphologists. Indeed, Morgan, Hertwig, Braem, Driesch, Conklin, Jenkinson, and many others grant little phylogenetic value to the germinal layers.

The germ-layer theory requires the supposition that there is a prelocalisation in the egg of the various substances necessary for the formation of the different organs, and that these substances in its segmentation pass into definite segments which form the germ layers. Now this supposition is directly contradicted—or at least made exceedingly improbable—by the results of the experimental separation of the first two, four, eight, or sixteen cells formed in the development of many animals. Further, some of the facts of regeneration and budding show that the ectoderm is on occasion quite capable of forming endoderm and mesoderm. The anomalies also which exist in the formation of the layers in vertebrates are patent to every student, while research on cell-lineages in the invertebrates has shown most diverse histories. So far as an independent observer can judge, the trend of modern research is to show that embryology gives no sure evidence of the homology of the germ layers.

J. Stanley Gardiner.

Cambridge, May 22.

Perhaps the reviewer should have made it plainer that the difficulty he stated at the top of p. 303 is not admitted by those morphologists who have ceased to believe that the germ layers afford any criterion of homology. He simply expressed his conviction, which he shares with many, that it does count for something which layer a structure develops from. He said that he was not prepared to follow Dr. Gaskell in throwing the germ-layer theory overboard, and that this made criticism difficult, a discussion of the author's dismissal of the theory being impossible in an article which appreciation of the book discussed had already expanded far beyond the limits prescribed.

The Reviewer.

Gaskell's "Origin of Vertebrates."

In the review of my book on the "Origin of Vertebrates," which appeared in Nature of May 13, the reviewer, discussing my theory that the vertebrate central nervous system represents the conjoint central nervous system and alimentary canal of an arthropod, says "this view lands us in difficulties which seem to us as insuperable as those of the reversal hypothesis seem to the author." He then proceeds to say, "we want to know, for instance, where the arthropod's mesenteron has gone?" This is the "only one of the most obvious difficulties" of which he makes mention. I wish he had mentioned more, as I am most anxious to have all the difficulties of my theory pointed out and fully discussed.

He will find in my paper in the *Quarterly Journal of Microscopical Science*, vol. xxxi., that I look upon the peculiar tissue which fills up the space between the brain and the cranial wall in Ammocœtes as the remains of the corresponding tissue which surrounds the brain of such animals as Limulus; in other words, this tissue represents the mass of generative glands and so-called liver-tissues in these animals. This so-called liver, together with its duct or ducts leading into the gut, constitutes the mesenteron, and the most distinct remnant of such mesenteron in Ammocœtes is the tube, called by me the old liver-tube, which leads from the fourth ventricle to terminate on the surface of the brain at the conus post-commissuralis, as is shown in a series of sections reproduced in that paper. In my book I have discussed this vestige of the arthropod's mesenteron on pp. 209, 210, 211, chapter v., but have not re-published the series of sections given in my former paper. In the *summary* of chapter v. I have not mentioned this question of the vestiges of the arthropod's liver, as it was not especially concerned with the subject-matter of chapter v.; possibly that is the reason why it has failed to attract the notice of the reviewer.

The reviewer says that "the tubular appearance of the vertebrate central nervous system appears to some an unimportant architectural consequence of the mode of development from a medullary groove," and also in reply to my argument "that the extraordinary resemblance between the structure and arrangement of the central nervous systems of vertebrates and arthropods is against the view of their phyletic distinctness," he asserts that, "given segmentation in two distinct types, we naturally expect similarity in the general plan of innervation." But the whole point is that the tube is not a simple tube such as would be formed by the coming together of medullary folds, but one, which invariably possesses a ventral diverticulum, the tube of the infundibulum, situated in exactly the position of the arthropod œsophagus, on the view of the phyletic relationship between the central nervous systems of the arthropod and the vertebrate.

The reviewer seems to think that I lay too much stress on Ammocœtes and ignore Amphioxus and the tunicates, and also that I am inclined to flit a little from type to type, making use of arachnids, Peripatus, and annelids when the Palæostraca are insufficient. I thought I had made it clear in my book that my object was to find out, so far as possible, the nature of the earliest fishes which appeared in Silurian times, and compare them with the type of arthropod which had been evolved up to that time. Ammocœtes was chosen rather than Amphioxus because it resembles the extinct Cephalaspids more closely than does any other living fish, while, on the other hand, Limulus is the only living example of the great arthropod group which dominated those Silurian seas, a group which gave origin to both arachnids and crustaceans, and was, of necessity, nearer to the ancestral annelid type than most of the arthropods of the present day. In the attempt, then, to generalise the characteristics of such a group, it naturally follows that account should be taken of the structure of annelids and of such a low type of arthropod as Peripatus.

In remarking upon my statement that, judging from Limulus, the *cartilaginous* skeleton of the arthropod race, which was dominant when vertebrates first appeared, had arrived both in structure and position exactly at the stage at which the vertebrate *cartilaginous* skeleton starts, the reviewer states:—"This almost sounds like proving too much, yet it does not account for the vertebrate's dorsal axis." I fail entirely to understand the purport of this remark; there is no *cartilaginous* dorsal axis in Ammocœtes; he cannot, surely, be thinking of the notochord, which cannot possibly be classed among cartilaginous skeletal tissues. W. H. GASKELL.

"Blowing" Wells.

IN NATURE of May 20 Mr. Sydney H. Long describes some "blowing" wells near to Norwich, and intimates that he had not heard of such before. Actually, such wells are not uncommon, and in a recently published memoir of the Geological Survey, on "The Water Supply of Bedfordshire and Northamptonshire from Underground Sources," some are described (*cf.* Duston, Long Buckby, Northampton).

A consideration of the varied phenomena presented by "blowing" wells seems to necessitate belief in three possible causes:—wind, variations in atmospheric pressure, and fluctuations in water-level.

Wind can only be effective in very special and obvious circumstances, and so a gusty "blowing" well is a comparatively rare phenomenon.

Most water-bearing beds are fed by the slow percolation of water downwards through porous material, and when such a bed is filling up there must of necessity be a displacement of air under a pressure greater than the then atmospheric pressure; indeed, the rate of percolation of water through moderately fine material, such as sand, deep down in the ground, must be materially retarded by the increasing air pressure. Supposing, however, that a well exists in such a formation, and that the rock is exposed, then fluctuations in atmospheric pressure will be immediately effective in the well, but only after a considerable period acting through the water-feeding area, hence every such well will in a sense "blow" when the atmospheric pressure falls. Quite recently I have been interested in a new well being made to the Lower Greensand; here, at a depth of about 100 feet, when the barometer dropped to 29·3 inches candles were extinguished, and, of course, the men could not work, although at a higher atmospheric pressure no inconvenience was experienced. Naturally, at first, the air squeezed out of a deep-seated porous bed is likely to be highly charged with carbonic acid gas, as this was. An old, deep, disused, and covered well a mile or more away from the one just referred to, that had a pipe fixed in the cover, is said by the people living near to give a "trumpeting sound during stormy weather."

In the case of rocks yielding water abundantly only from fissures, in-draught and out-draught of air from these fissures, in a well, is essentially a question of a falling or rising water-level. When the water-level in such a rock is sinking over a large area, slight though it may be as measured in depth, it draws in, mostly through the fissures, an amount of air equivalent in volume to the water being lost by running springs or by pumping elsewhere. A rising water-level, which may only be obvious in the well long after the rainfall causing it, will, of course, convert such a well into a "blowing" well, with or without a hissing sound depending upon the size of the fissures and the rapidity of rise in the water-level.

The Drumming Well at Oundle, in Northamptonshire, which was rather noted some 200 years back, no doubt owed its peculiar characteristics to air being forced through a water-lock in the crevices whence the water itself came, with a rising and possibly also a falling water-level. It was sometimes silent for years, and then broke out again, which naturally precludes variations in atmospheric pressure as a cause.

Northampton. BEEBY THOMPSON.

Dew-Ponds.

THE article in NATURE of April 22 emphasises the fact that the interesting problem of the dew-pond still awaits a definite solution. That these ponds are mostly fed by mist, and not dew, can hardly be doubted by anyone who has visited them at night, situated as they are on the topmost ridges of the Downs. In the driest summer the prevailing south-west wind, as it comes up from the sea, forms on these heights after dark thick clouds of mist, which soak everything that comes in contact with them, and keep green the short grass characteristic of the Downs.

The source of the water in these ponds, therefore, seems evident, but the mechanism by which the mist is precipitated into the ponds is not so apparent. The question also arises, Why is it essential that the pond be built on the very summit of the ridge of the Downs? Why is it, also, that a few weather-beaten bushes and trees often grow along the ridge of the otherwise bare hills? It appears to me that the only possible explanation is that the particles of mist must bear charges of electricity differing in potential from that of the earth. The charge on the earth would, of course, be most dense at the summits of the hills. Hence the tendency for the mist to deposit on the top of the ridge.

About ten years ago I made a rough and somewhat crude experiment to test this theory. The result, which was published in NATURE, September 20, 1900 (vol. lxii., p. 495), was satisfactory so far as it went. Unfortunately, I have never been able to repeat the experiment with better appliances. I feel confident, however, that it is by the investigation of the electrical phenomena of mists that the problem of the dew-pond will be solved.

ARTHUR MARSHALL.

Naini Tal, India, May 12.

The Colours of Leaves.

THE notice of Prof. Stahl's book under the heading of "Why Leaves are Green" in NATURE of June 3 (p. 393) leads me to direct attention to the effect of protection when applied to our copper beech trees. For the last two years I have, in the spring, partially covered with sacking about half of a small tree (less than 6 feet high), leaving one side open so that there should be some access of light. The aim was to protect a few branches from the effects of frost. This year the cover was put on the part which last year was left uncovered, and about the middle of April, before any leaves had appeared. The cover was removed on May 22 in the presence of several members of the Geologists' Association; the whole of the sheltered leaves were seen to be quite green, and a remarkable contrast to the others. In two days, however—protection being abandoned—the green leaves commenced to resume their usual spring coloration, and now are, with a few exceptions (as where one leaf may have been shielded by another), of the same tint as the other leaves, and probably no one would suspect they had ever been green.

The experiment, I suppose, shows the effect of our cold nights in April and May, which damaged, producing slight chemical change, but did not actually kill, the foliage. In a few months' time all the "copper" colour will have disappeared (? been absorbed), and the tree be as green as our common English beech. GEORGE ABBOTT.

4 Rusthall Park, Tunbridge Wells, June 7.

A GREAT NATURALIST.[1]

Philibert Commerson was one of our greatest naturalists, and we cordially welcome the first life to be published in English. Until twenty-one years of age he struggled with the law, in 1848 turning to medicine, which he studied at Montpellier. In those days the whole of biology was a relatively small study, and Commerson began to be distinguished in every line in his own small university sphere. However, the influence of Linnæus turned him towards botany, the chief research in which was at that time the discovery and description of new species. He worked in the botanic gardens at Montpellier, but a jealous professor intervened, and, on the excuse that he had purloined a fruit from the gardens for his herbarium, interdicted him from entering them. He became a scientific outcast, a circumstance we cannot deplore, since it made him a wanderer, the first scientific visitor to many lands. At first, as was the way in those days, he started to form a garden, where all the species of plants of the temperate regions should be grown. He travelled widely in western Europe, and arranged exchanges of seeds and fruits with every garden of note, he himself being the proud possessor of many new plants which he had discovered. One list of his shows the trees and shrubs of south-east France, arranged in environments, almost as Schimper might have done them.

In 1767 Commerson embarked in the *Etoile*, the consort of the *Boudeuse*, de Bougainville's ship, in her famous voyage round the world. His letters on Rio de Janeiro and Buenos Ayres show considerable penetration in affairs. He collected assiduously, and near Rio obtained the Bougainvillea. In addition to botany he made many curious observations on fish, which he generally dissected. Thus, the shark is always in a state of fearful hunger owing to the large numbers of tape and other worms in its intestines. The brown coloration of the Remora on both its upper and lower surfaces is referred to its habits. His observations were practical also, those on whales leading to the subsequent establishment of the prosperous Saint Malo industry.

After the usual difficulty in passing the Straits, Bougainville's expedition sailed across the Pacific in about latitude 27° S., passing through the Paumotua Archipelago to Tahiti. From here, after a search for Terra Australis, they coasted through the Solomon Islands to the Moluccas and Batavia, where they refitted, Commerson securing numerous new fish and plants as well as the first leaf-insect. He left his companions at Mauritius with his already immense collections, remaining with Poivre, who was at that time the civil governor. He was indefatigable in collecting, his work on the Mauritius plants being the foundation of Mauritius botany. At the same time he was urging a scheme for an academy in the island which should take general cognisance of all tropical, economic, and other products. Of peculiar interest now is Commerson's suggestion to introduce frogs to clear the stagnant waters of gnat larvæ. Then followed visits to Madagascar, the collections from which fortunately found their way into Lamarck's capable hands, and to Réunion, where the then active volcanoes were examined. The remainder of the tale is a piteous account of jealousy at home acting to prevent Commerson's return to Europe. His constitution was already enfeebled by five years of hard and exposed work in the tropics, and he died in Mauritius in 1773. His journals, of the quality of which we can judge from his letters, freely quoted in the book before us, were never published as such, though they form a large part of Lacépède's "Histoire Naturelle," and were freely used by Cuvier, and probably Buffon.

Had Commerson lived, he would have left a name second only to that of Linnæus among eighteenth-century naturalists, for besides his vast knowledge

Louis Antoine de Bougainville. From "The Life of Philibert Commerson."

he had a rare insight into the interrelations of animals and plants in nature, and their dependence on, and adaptation to, local geological and physical conditions. He was too clearly an evolutionist, and with his vast knowledge and extraordinary personality might well have changed the history of biology by causing the acceptance of that idea even in the eighteenth century. He himself knew 25,000 plants, and supposed the world must contain 125,000—it actually is now known to have rather more than 200,000—thus being more than 110,000 nearer the number than any of his contemporaries, even the great Linnæus thinking he had completed his arch with less than 10,000.

Commerson was indeed a great man, and his life is ably and attractively pieced together by the late Capt. Oliver from evidently very fragmentary mate-

[1] "The Life of Philibert Commerson, D.M., Naturalist du Roi: an Old-World Story of French Travel and Science in the Days of Linnæus." By the late Captain S. Pasfield Oliver, and edited by G. F. Scott Elliott. Pp. xvii+242. (London: John Murray, 1909.) Price 10s. 6d. net.

rial. We think perhaps he might have omitted many notes on the species of plants and fish, and have brought out more clearly Commerson's views on more general subjects. Indeed, undue stress is laid throughout on Commerson's qualities as a collector as compared with his qualities as a great thinker. The style and printing of the book are excellent, and the illustrations are all that could be desired. The index is very defective. J. S. G.

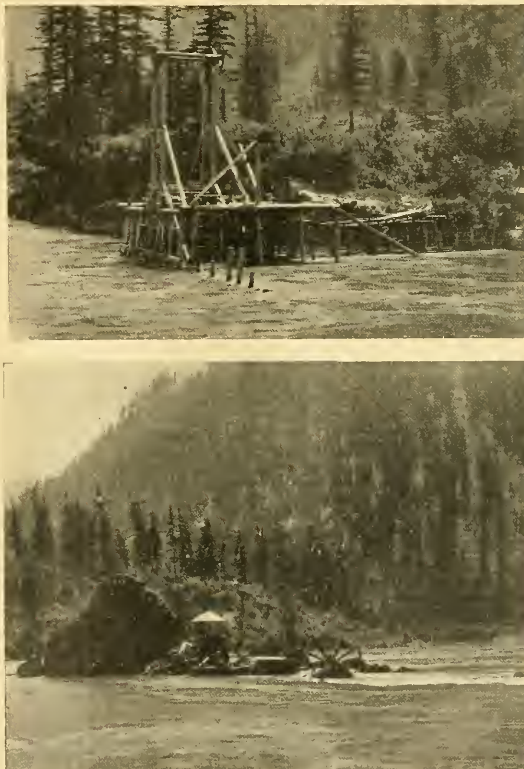
AN ANGLER IN NORTH AMERICA.[1]

THE name of the author is a sufficient indication that this is essentially a book for the angler, and can be trusted to contain an interesting and unexaggerated record of the results attained by a master of the craft who has gained much experience in strange and distant waters. Not many anglers can afford to pursue their sport so far afloat, but most can find some touch of altruistic pleasure in the story of another's triumphs, particularly if in waters that can never come under their own rods. Mr. Aflalo, too, is always careful to describe the local conditions and cost of his operations, so that his book has not only its intrinsic interest, but will serve as a practical guide to any fisherman fortunate enough to follow him.

It was with the ambition, though hardly with the hope, of catching the enormous tuna that the author undertook the long journey to Catalina Island, off the coast of California. It is the sea-angler's Elysium, where there are glass-bottomed boats through which to view the lively sea-gardens of the placid ocean; motor-launches to take the fisherman swiftly to the choicest spots; guides who are full of humour as well as of experience; and every comfort on shore—for those who can pay. In the event, as told in chapter iii. (in which lies the central interest of the book), the tuna did not materialise, but Mr. Aflalo found consolation and daring exercise for rod and line in huge sea-bass (*Cynoscion nobilis*), yellow-tail (*Seriola dorsalis*), and albacore (*Germo alalunga*).

Not only did he thus sample "the finest sea-fishing in the world," but he had also a short experience of "the most wonderful lake-fishing on earth," on his way home by the Canadian Pacific route, in a water near Kamloops, British Columbia, where rainbow trout that "jump like tarpon" and "fight like demons" are so plentiful that the happy angler may hook "a fish of some size at every cast." Previously, the author had tried his skill on Lake Tahoe, in California, and subsequently on Lake Minnewanka, near Banff, in the latter case apparently without noteworthy result, as there is a certain vagueness here in his narrative. Finally, on reaching eastern Canada he fished Lake Broom, some eighty miles from Montreal, and had sport with black bass and pickerel.

Reminiscences of fishing, however, barely suffice to make up one-third of the book. The remainder is filled with the author's descriptions and impressions of many old familiar places, such as Barbados, Trinidad, Cartagena, Colon and the Isthmus, New Orleans, the Pacific coast towns of the States and British Columbia, the Yosemite Valley and the big trees of Mariposa, the Columbia River, Puget Sound, the Canadian Rockies, the prairies, Niagara, and the St. Lawrence. His outlook on this panorama is that of the usual "intelligent traveller," and has little of novelty, save the touch of individuality that one may catch in every well-expressed personal narrative. He is frank in his disapproval of certain American traits that grate on most visitors brought up under different conventions. But the people of the Republic, with their still prevalent idiosyncrasy of seeking the opinion of travellers, must have become accustomed to such criticisms. Perhaps, indeed, like most young folk, they would rather endure some little disparagement than pass unnoticed.



Salmon Wheels, Columbia River. From "Sunset Playgrounds," by F. G. Aflalo. By permission of Messrs. Witherby and Co.

The book is illustrated with numerous reproductions from photographs of the usual scenic type and of Catalina Island fish.

Is the head-line on p. 229 a feeble joke or a printer's absurd blunder? It reads, "The Side-show Girl," while the only feminine noun in the underset growl at the surroundings of Niagara Falls is *The Maid of the Mist*, and this is no girl, but the well-known old pleasure steamer. G. W. L.

[1] "Sunset Playgrounds: Fishing Days and others in California and Canada." By F. G. Aflalo. Pp. xii+251. (London: Witherby and Co., 1909.) Price 7s. 6d. net.

THE WATER SUPPLY OF KENT.[1]

THE question of water supply, a matter of such vital importance to corporate life, has been studied from the practical and theoretical standpoint by numerous authorities, but no hard-and-fast rules can be laid down, owing to the fact that general principles are subservient to local conditions. This is, perhaps, the reason why the leading authorities are so often contradictory.

Owing, partly, to the large area of its outcrop and subterranean extension beneath the Tertiary beds of the northern part of the county, partly to its great thickness, and partly to its unlimited capacity for water storage, the Chalk is the most important member of the Cretaceous series which is so finely developed in Kent, and yet it is rare to find two authorities agreeing on any point with regard to the behaviour of water in Chalk, while all speak from many years of experience.

The reason is that the question is far more complex than appears at first sight; as Whitaker points out, the absorbent capacity is modified by the extent of exposure, which is not always made clear by geological maps. The surface may be bare, in which case the absorptive power is very high, in some cases, where the Chalk is open and fissured, large volumes of water being swallowed up with extraordinary rapidity; in others, where the soil is unusually thick or clayey, the absorption may be hindered; the case is modified by a covering of permeable beds such as Drift gravels and sand, and, again, where the Chalk is covered by beds of varying character, and, finally, where the Chalk is covered by beds of an impermeable character. Such an area as the latter is, of course, to be definitely excluded in calculating the absorptive area of the Chalk. In Kent this tract is confined to those districts where the London Clay covers the Chalk.

Again, the storing and transmitting capacity of the Chalk depends upon the physical nature of the different beds, and as in Kent the Chalk attains in many places a thickness of nearly 800 feet, it is obviously natural to find the different zones differing in character to a considerable extent; and yet engineering geologists have persistently ignored the value of a knowledge of the palæontological zones of the Chalk, of which eight are represented in Kent. There is no excuse for this apathy, since the work of Dr. Rowe has placed the geology of the Chalk upon a scientific footing. It is a striking fact that in all the literature quoted in the extensive bibliography, the author has only been able to find a single work dealing with the zones of Chalk from the point of view of the engineer.

In this memoir, one of the most useful that the Geological Survey has published, Mr. Whitaker discusses briefly the geological formations of Kent, and the nature and causes of the different kinds of springs occurring in the different beds, while a special chapter is devoted to swallow-holes and nailbournes, phenomena essentially characteristic of a Chalk area. A valuable chapter on the rainfall of Kent, illustrated by a map, is contributed by Dr. H. R. Mill.

The amount of water taken from springs in Kent is very small; there are only two large supplies, those for Maidstone and Folkestone, and neither of these is dependent upon the springs.

The Chalk area of Kent is pierced by very numerous wells for private or restricted use, but they are being rapidly superseded by the institution of larger corporate water works, which are only wells on a large scale. The quantity of water taken from surface deposits, as at Tunbridge Wells, from the Eocene beds, Lower Greensands, and sandy members of the Hastings beds, is insignificant compared with the amount provided by the Chalk, which supplies all the larger towns, as Ashford, Tonbridge, Dover, and the Kentish part of London.

Not the least interesting part of the book is the 147 pages occupied by sections of wells, and details of a large number of borings are also included.

Prominence is given to sections of some of the shafts and borings put down with the view of proving and working coal; these pages summarise our knowledge of the subterranean geology of Kent as it stood two years ago, but the impetus recently given by the new exploring companies since the discovery of the splendid coal-seams at the borings of Waldershare and Fredville has doubled the information available, though it has not yet all been made public. It is unfortunate that the author contented himself with the meagre sections of these two famous boreholes given by Boyd Dawkins in his evidence before the Royal Commission on Coal Supplies; if he had applied direct to the companies, the information would surely have been willingly given.

The work is completed by a large number of analyses of both well and spring waters, and a number of notes on various subjects, some of considerable interest, such as the effect of heavy pumping, infiltration of salt water, and the deep borings at Cliffe and Frindsbury, but the vital question of pollution might have received more attention.

As a striking instance of the value of well-managed public water companies over purely local sources we may quote the following remarks from the report of an analysis of a sample of water from Delf stream, which gave drinking water to Sandwich until recently:—

"Colour objectionable, a dirty pale yellow; microscopic examination eminently unsatisfactory. The residue . . . . was full of animal matter; . . . it would be much more appropriate to call the liquid from this pump sewage rather than water . . . . however valuable this fluid might be as a liquid manure, and it would be impossible to deny that it has a certain value in this respect, it should not be used as water." M. B.

[1] "The Water Supply of Kent; with Records of Sinkings and Borings." By William Whitaker, F.R.S. With Contributions by Dr. H. Franklin Parsons, Dr. H. R. Mill, and Dr. J. C. Thresh. (Memoirs of the Geological Survey of England and Wales, 1908.) Pp. v+399. (London: Published for H.M. Stationery Office by Wyman and Sons, Ltd., 1908.) Price 8s. 6d.

THE WINNIPEG MEETING OF THE BRITISH ASSOCIATION.

THE British Association will hold its annual meeting in Winnipeg from August 25 to September 1, under the presidency of Sir J. J. Thomson, F.R.S.

Regular attendants at meetings of the Association have become accustomed to reminiscences of previous meetings in the same city. Thus, when the association meets in Great Britain, the expression "When we met here twenty-five years ago," or "At our meeting fifty years ago," has become a stereotyped part of the presidential addresses. A meeting of the association in Winnipeg thirty years, or even twenty-five years, ago would have been almost an impossibility. At that period Winnipeg was little more than a Hudson's Bay Company's trading post—Upper Fort Garry—the population of the scattered settlement numbering only some 2000 people, mostly farmers. Winnipeg could not have been reached by the Canadian Pacific main line until some six years later; passengers arrived by stern-wheel steamers of the Mississippi type from Moorhead, Minnesota, *viâ* the Red River; or came by irregular trains over the Great Northern Railway from St. Paul to St. Boniface across the river. A daily paper, the *Manitoba Free Press*, had, however, been in existence for about five years. The Great West was unpopulated; and local troubles with the natives were concurrent with Cetewayo's disturbances in Zululand.

After the meeting in Montreal in 1884—twenty-five years ago—several members of the association went out West and caught a glimpse of Winnipeg; some of these have described their impressions of the Winnipeg of that date. The chief of these seem to be the wide Main Street, in the centre of it the rails of the one-horse tramcars, with a lateral ocean of black mud, in which it was no uncommon sight to see derelict vehicles of every description. Quite different will be the experience of the visitors next August. The width of Main Street, Portage Avenue, and Broadway will present itself as the most striking feature, with their fine asphalt roadways and granolithic "side-walks." The buildings will be found of the most modern type, and many may lay claim to considerable architectural excellence. The Bank buildings, railway termini, and Government offices will be especially noticeable in this respect. There is no need, however, in this place to enter into details about the city, as these will be fully dealt with in the handbook supplied to visitors on arrival.

The rate of progress in Winnipeg is too well known to need emphasis. The writer has noticed wonderful changes within even the past five years. The railway stations, principal hotel, largest business blocks, and the new theatre have all sprung up within this period. The following illustrates the attitude of mind of the enthusiastic "Winnipegger." A conversation was overheard on a train going east; a typical Winnipegger asked a returning tourist the inevitable question, "What do you think of our city?" "Not much of a place; saw it all in ten minutes!" "When did you see it?" "Two weeks ago." "Ah! but you should see it now!"

The invitation to meet at Winnipeg originated with the Royal Society of Canada, which considered that as previous meetings of the association had been successfully held in Montreal and Toronto, the third meeting in Canada might appropriately be held in the Prairie City. A committee of the Royal Society of Canada was appointed to approach the council of the City of Winnipeg, and to urge upon it the advisability of issuing an invitation to the British Association. The city, acting upon this suggestion, forwarded an invitation to the association at its meeting in South Africa, that it should meet in Winnipeg in 1907. This invitation was supported by the faculty of science of the University of Manitoba and by the Manitoba Historical Society. The council of the association, realising the difficulty of meeting overseas so soon after the South African meeting, felt bound to refuse the invitation for the year 1907, but intimated that if the offer were renewed for a subsequent year it would be favourably considered. The City of Winnipeg accordingly issued a renewed invitation to meet there in 1909, and a deputation consisting of the Rev. Dr. Bryce, Prof. M. A. Parker, and Prof. Swale Vincent interviewed the officers of the association, and, in addition, Profs. Parker and Vincent attended the York meeting and supported the invitation. At that meeting the offer was definitely accepted. Previously, the Dominion Government had promised generous financial support, and the fund now at the disposal of the executive committee at Winnipeg amounts to about 10,000*l.* In addition to the Dominion Government grant of 5000*l.*, the Province of Manitoba has appropriated 2000*l.*, the City of Winnipeg 1000*l.*, and the western provinces and cities have undertaken to bear the expense of the western excursion of office bearers and distinguished guests.

At a public meeting held in March, 1907, a large and representative local general committee was appointed, and the executive committee and the usual subcommittees were elected. The local arrangements are now well in hand. The four local secretaries are Mr. C. N. Bell, Mr. W. Sanford Evans (Mayor), Prof. M. A. Parker, and Prof. Swale Vincent, the local treasurer being Mr. John Aird, manager of the Bank of Commerce. The office of the local secretaries has been installed in the University of Manitoba.

Arrangements have been made with the Canadian railways by which members of the association can obtain return tickets to Winnipeg from the port of landing at single fares, and the same terms are also available for extended trips; some concessions have also been obtained from the steamship companies.

Much interest in the meeting has already been manifested in Canada and the United States, as well as in Great Britain, and it may reasonably be expected that a large number of men of science from both sides of the Atlantic will take advantage of the meeting—not only because of their interest in science, but in order to obtain a glimpse of the great Canadian West, and to meet its people.

Invitations to attend the meeting are being sent to the leading men of science on the continents of Europe and America. The attendance of a large number of men of science from the United States, and of distinguished foreigners, will go far to impart an international character to the gathering, and will give a special value and interest to many of the discussions.

The last week of August is perhaps the most favourable time at which to make a visit to Winnipeg and the Canadian West. The climate at this season is delightful—warm days and cool nights. In the city everything is looking at its best, and in the country the harvesting operations are in full progress.

By the kindness of the Provincial Government, the Department of Militia and Defence, and various boards, permission has been granted for the use of the following buildings, which will be used as meeting places:—the Legislative Chamber in the Parliament Buildings, the Drill Hall, the University of Manitoba, Manitoba and Wesley Colleges, the Alexandra, Carlton, and Isbister Schools.

One of the finest playhouses on the continent of America, the Walker Theatre, has been engaged for five evenings for the president's address, the evening discourses, and the popular lectures. Sir J. J. Thomson will give his address there on Wednesday, August 25. On August 26, Dr. A. E. H. Tutton, F.R.S., will discourse on "The Seven Styles of Crystal Architecture"; on August 31, Prof. W. A. Herdman, F.R.S., will lecture on "Our Food from the Waters"; Prof. Harold B. Dixon, F.R.S., will deal with "The Chemistry of Flame" on August 30; and Prof. J. H. Poynting, F.R.S., with "The Pressure of Light," on September 1.

Winnipeg is noted throughout the Dominion for its hospitality; the work of the hospitality committee is in full swing, and visitors may be assured of a hearty welcome.

THE DARWIN CENTENARY CELEBRATION.

CHARLES ROBERT DARWIN was born on February 12, 1809, the same day that Abraham Lincoln first saw the light. The anniversary of this day was celebrated by many gatherings and "recitations" in North America, and it is a marked sign of the times that these celebrations were in most cases held in the churches and chapels of the numerous denominations which flourish in the United States. But February in England is an awkward month to gather together from all over the world a large assemblage of distinguished men of science, and Cambridge decided to celebrate the centenary of her great biologist in what we hope may prove the more genial month of June.

The question of date was from the first a matter of some difficulty; it was, so far as possible, desirable to select such a time as would enable professors and others who are tied by university duties to be present, so it could not be fixed before the end of June. On the other hand, owing to the fact that the various courses of university lectures, which at Cambridge yearly become more numerous during the long vacation, begin this summer on July 6, the colleges will have their rooms for the most part fully occupied by July 5.

There was thus little margin for choice, and Tuesday, June 22, the day of the second general admission to degrees, was settled for the first day of the celebration. This will formally begin at 8.30 p.m., when there will be a reception of delegates and other invited guests in the Fitzwilliam Museum by the Chancellor of the University, Lord Rayleigh, O.M., F.R.S., Sc.D. The Chancellor will receive guests at the head of the staircase, and to him all delegates and guests who are not resident members of the Senate will be formally presented by the Registrary. On Wednesday, June 23, at 10.30 a.m., presentations of addresses by delegates of universities, colleges, academies, and learned societies will take place in the Senate House. This ceremony will begin with a short address by the Chancellor, followed by the presentation of delegates and of addresses. A short speech will be delivered by one representative of each of the chief countries represented.

During the earlier half of the afternoon visits to colleges will be paid, and from 4 to 6 p.m. a garden party will be given by the master and fellows of Christ's College in the college grounds. The rooms occupied by Charles Darwin when an undergraduate of Christ's College will be open to visitors during the afternoon of Wednesday, June 23, and during the morning and afternoon of Thursday, June 24. The bronze bust by Mr. Couper, of New York, which the American delegates are presenting to Christ's College will be on view.

At 7 p.m. there will be a banquet in the new examination hall, behind the museums.

After the banquet the master and fellows of Pembroke College will give an "At Home" in the college hall and gardens.

On Thursday, June 24, at 11 a.m., honorary degrees will be conferred in the Senate House on some eighteen distinguished men who have followed in the footsteps of Darwin; amongst these our only fellow-countryman is Mr. Francis Darwin, his father's distinguished biographer. At 12 noon the Rede lecture will be delivered by Sir Archibald Geikie, K.C.B., President of the Royal Society. His subject will be "Darwin as Geologist."

During the afternoon a garden party will be given by Mr. William Erasmus Darwin, Sir George and Lady Darwin, Mr. Francis Darwin and Miss Frances Darwin, Major and Mrs. Leonard Darwin, Mr. and Mrs. Horace Darwin, Mrs. Litchfield, and Miss Darwin, in the Fellows' Garden, or, if wet, in the hall and cloisters of Trinity College, which have been kindly lent by the master and fellows.

During the celebration, and for some days before, there will be an exhibition of portraits, books, and other objects of interest in connection with Darwin, in the Old Library of Christ's College (entrance from the First Court). The exhibition will be open from 10 a.m. to 1 p.m., and from 2 p.m. to 5 p.m.

Amongst the more interesting exhibits are the oil painting by Collier, lent by the Linnean Society; one by Richmond, lent by the University; and one by Ouless, lent by Mr. William Darwin. There are also numerous oil paintings of Erasmus Darwin, Robert W. Darwin, and other members of the family; several water-colours of Down and of Charles Darwin's birthplace are also shown. A very large number of sketches and photographs are also exhibited, many MS. note-books and letters, and numerous copies of the first editions of Darwin's books containing his own notes. There is also a collection of instruments used on board the *Beagle*, and medals, orders, and diplomas presented to Charles Darwin.

Charles Darwin's library, which Mr. Francis Darwin has generously transferred to the Botany School, Downing Street, may be seen on application at the Botany School at any time between 10 a.m. and 1 p.m., or between 2.30 p.m. and 5.30 p.m., during the celebration. A few of the most interesting volumes will be displayed in the Botanical Museum. Further, the Librarian, Mr. F. J. H. Jenkinson, has arranged in the University Library an exhibition of MSS. and books illustrating the progress of biological study during the last fifty years.

In connection with the celebration, numerous publications are appearing at Cambridge. At the instigation of the Philosophical Society the University Press has issued a volume of important essays, edited by Prof. Seward, in which some of the leading biologists of the world pass in review the results achieved by Darwin's own work, and others concern themselves with the progress of science on lines which are the direct outcome of his work. The University Press is also publishing reprints of the first sketch of "The Origin of Species." A copy of this will be presented to each of the delegates. Later it will be re-printed, together with Darwin's second sketch of his "species-theory," in a single volume, and be on sale. The executive committee is, further, preparing a quarto volume entitled "The Order of the Proceedings at the Darwin Centenary." This will have numerous illustrations, and will contain a sketch of Charles Darwin's life, together with a programme of the celebration.

Finally, Christ's College is publishing an exhaustive catalogue of the Darwin Exhibition, and a special Darwin number of the college magazine, on the lines of the very successful Milton number of last year. This will contain an account of the life of Darwin at Shrewsbury; at his two universities (Edinburgh and Cambridge); a sketch of Christ's College about the time Darwin was in residence, by the Master of the College; Darwin and the Linnean Society, by Dr. Daydon Jackson, the general secretary of the society; and some letters which Mr. A. R. Wallace has kindly placed at the disposal of the magazine committee, some of which have not been published before. There will also be short articles on present-day Darwinism, and on his Plants and Animals under domestication.

NOTES.

THE closing meeting of the seventh International Congress of Applied Chemistry was held on June 2, when Mr. Whitelaw Reid, the American Ambassador, read a letter from the Secretary of State of the United States intimating that the President had approved a joint resolution of the Senate and the House of Representatives authorising the President to invite the International Congress of Applied Chemistry to hold its eighth meeting in the United States of America in 1912. The invitation was supported by Dr. Wiley, of the U.S. Department of Agriculture, and Prof. R. Meldola, F.R.S., representing the Society of Chemical Industry, and was accepted with acclamation. Prof. E. W. Morley was elected the honorary president of the eighth congress, and Dr. W. H. Nichols the acting president. The official American delegates to the seventh congress were constituted the organising committee of the eighth congress, with power to add to their number.

At a meeting of subscribers to the statue of Lord Kelvin for Belfast, held on June 2, it was resolved unanimously that the statue be erected in the grounds of the City Hall instead of in the grounds of the new Queen's University as recommended by the executive committee.

Prof. A. Laurence Rotch, director of Blue Hill Meteorological Observatory, U.S.A., has been elected an honorary member of the Austrian Meteorological Society.

Prof. T. A. Jaggar, of the Massachusetts Institute of Technology, has completed his geophysical investigations in Japan. He will spend the summer in observing volcanic phenomena in Hawaii, with special reference to the reported activity of Kilauea.

The U.S. Navy Department is about to construct, in Rock Creek Park, Washington, a concrete tower, 600 feet high, for the purposes of wireless telegraphy. This will be higher than the Washington Monument. Indeed, no other American building will have a greater height, with the exception of two high structures in New York. The plant that will be installed is to send messages to a distance of 3000 miles.

A note in a recent issue of *Science* says that it has been estimated that the amount of wood annually consumed in the United States at the present time is twenty-three billion cubic feet, while the growth of the forest is only seven billion feet. In other words, Americans all over the country are using more than three times as much wood as the forests are producing. The figures are based upon a large number of State and local reports collected by the Government and upon actual measurements.

The American Geographical Society has accepted Mrs. Collis P. Huntington's gift of a 50,000*l.* site for a new building in New York City, overlooking the Hudson River. We also learn from *Science* that Mr. A. M. Huntington, the president of the society, has given 10,000*l.* toward the building fund, which will be increased by further subscriptions and the proceeds of the sale of the old building, which should be about 50,000*l.*

A new society—the Illuminating Engineering Society—has been formed to make the subject of illumination as a whole its special province, to collect together the scattered data bearing on the subject, and to provide a platform for the impartial discussion of all methods of lighting. Anyone interested in the subject of illumination and the aims of the society may become a member, and may be of either sex and any nationality. The first session will commence in November next. All particulars may be obtained from the hon. secretary, Mr. L. Gaster, editor of the *Illuminating Engineer*, 32 Victoria Street, London, S.W.

According to the report for 1908, the Horniman Museum at Forest Hill continues to make rapid and marked progress as a public educator, the Saturday afternoon lectures being so well attended that a large number of persons have to be refused admission. As the average number of disappointed individuals at each lecture is stated to be about fifty, the urgent need of a lecture-hall is self-apparent. At present the lectures are delivered in the insect-room, much to the disadvantage of its proper function. The natural-history collections are in course of re-arrangement, and it is intended to illustrate the adaptation of different groups of vertebrates to various kinds of progression and work, such as swimming, flying, and burrowing, by specially arranged series.

Vol. xix. of the *Journal of Comparative Neurology and Psychology* opens with an article by Mr. J. B. Watson on experiments in connection with colour-vision in monkeys. After reviewing the work of Kinnaman on the same subject, the author arrives at the conclusion that tests by means of coloured papers are practically valueless, and considers that trustworthy results can be attained only by the aid of a continuous spectrum. Next follows the description of the apparatus employed in the experiments. The most surprising result was the failure of the three monkeys experimented upon to react to red; on the other hand, the blue-yellow discrimination arose more rapidly than the red-green, and in one case the habit of reacting to blue (which may prove to be a "preferred" colour) was formed with remarkable rapidity. The writer refrains, however, from drawing any definite conclusions, and winds up as follows:—"With such questions raised is it any wonder that we find it impossible to accept the uncritical results which have been obtained by the use of filters, coloured papers, &c., as evidence for the presence of colour vision in animals?"

The Anaspidacea have lately loomed large in zoological literature, and zoologists will welcome the valuable monograph on this group of primitive Crustacea which Mr. Geoffrey Smith contributes to the May number of the *Quarterly Journal of Microscopical Science*. Carcinologists are, unfortunately, rather apt, while dealing in great detail with the appendages of the Crustacea, to pay but little heed to internal anatomy. In this memoir, however, we are furnished with a full description of the anatomy of the remarkable Tasmanian mountain shrimp, both external and internal, for which zoologists will be duly grateful. As a result of his recent visit to Tasmania, Mr. Smith has been able to secure ample material, not only of *Anaspides tasmaniae*, first described by Thomson in 1893, but also of a new genus and species, *Paranaspides lacustris*, discovered by himself. He also discusses the only other known modern representative of the group, *Koonunga cursor*, recently discovered near Melbourne by Mr. Sayce, and the fossil species from the Carboniferous and Permian formations of various parts of the world. He concludes that the Anaspidacea are a very primitive group of Malacostraca, combining in themselves characters which, in the course of evolution of the more specialised groups, have become "segregated out." In other words, they are of a generalised type. The memoir illustrates in a striking manner the rapidity with which our knowledge of the Crustacea has grown during recent years, largely as the result of work carried out by local or visiting naturalists at the Antipodes.

The May number of the *Quarterly Journal of Microscopical Science* contains also an interesting paper, by Mr. C. Clifford Dobell, on spore-formation in the disporic bacteria. The author's researches tend to throw doubt on the occurrence of "sexuality" in the bacteria, for he sees in the sporulation of the disporic forms, not a degenerate sexual process, but merely an abortive cell-division. Mr. W. Nicoll contributes a long memoir on the structure and classification of the digenetic Trematoda, and two other papers, by Mr. F. H. Gravely on polychæt larvæ, and by Mr. C. H. Martin on Acinetaria, help to make up an unusually interesting number.

IN the *Annals of Tropical Medicine and Parasitology* for May (vol. ii., No. 5), Dr. Breinl discusses the combined atoxyl-mercury treatment of monkeys infected with *Trypanosoma gambiense*, the parasite of sleeping sickness. In five out of six cases this form of treatment resulted in a complete cure.

Two articles by Messrs. Musgrave and Clegg and Miss Polk in the December, 1908, number of the *Philippine Journal of Science* (iii., No. 6) survey, respectively, streptothricosis (diseases due to Streptothrix organisms) and trichocephaliasis (whip-worm infections). These will be very useful on account of the attached bibliographies, which are very complete.

EXPERIMENTAL lead poisoning is the subject of a paper by Mr. K. Goadby in the *Journal of Hygiene* (vol. ix., No. 1, April). The results indicate that poisoning by lead may take place by absorption by the lungs through inhalation of air laden with lead dust, as well as by absorption by the alimentary tract. The journal contains several important papers.

DR. RICKETTS gives some interesting details of experiments on the transmission of "spotted fever," a disease resembling typhus fever occurring in limited tracts of country in the Rocky Mountains (Johns Hopkins Hospital Bulletin, May, vol. xx., No. 218, p. 151). The parasite, formerly supposed to be a piroplasma, is not known, but infection appears to be conveyed by a tick, and can be transmitted to guinea-pigs.

MR. K. SAITO, in a comprehensive article, discusses the occurrence of micro-organisms in the air (Journal of the College of Science, Tokio, vol. xxiii., 1907–8, art. 15). No fewer than fifty-five species of bacilli and seventeen species of cocci were isolated, of which eighteen are described as new species.

THE Bulletin of the Sleeping Sickness Bureau (No. 6) contains a note on the confirmation of Kleine's work that tsetse-flies (*G. palpalis*) fed on animals infected with *Trypanosoma brucei* fail to infect fresh animals during the following fourteen, or possibly twenty, days, but after that interval again become infective up to at least the forty-seventh day. Colonel Sir David Bruce has repeated Kleine's work with *G. palpalis* and the trypanosome of sleeping sickness of man, *T. gambiense*, and finds that the same latency in infectivity of the flies exists. This is a very important discovery, and it will be necessary to determine how long the flies may retain their power of infecting.

A VERY complete set of figures, prepared by Dr. E. J. Durand to illustrate the development of the sexual organs and sporogonium of *Marchantia polymorpha*, is published in the Bulletin of the Torrey Botanical Club (vol. xxxv.).

IN connection with the possible utilisation of rain or dew, Mr. S. Awano has investigated the power of plants to absorb moisture through the leaf surface. The question was studied from an ecological standpoint, and the results are tabulated, both individually and according to plant formations, in the Journal of the College of Science, Tokio University (vol. xxvii., art. 1). As would be expected, it was found that the upper surfaces of floating leaves, also the surfaces of leaves of strand plants absorb but slightly, if at all, while those of shade plants and ferns absorb fairly readily.

THE Government of India has published, as Forest Pamphlet No. 4, a note by Mr. D. N. Avasia on lac and lac cultivation with reference to conditions in the Central and United Provinces. The lac incrustation is mainly formed by the female insect after impregnation, and continues for a period of two and a half months, when the insect enters upon a period of rest; a month later the larvæ developing from the red liquid in the insect sac provide a new swarm, so that there are two broods in the year. It is stated that after swarming the lac is practically free from colouring matter, and therefore more valuable, since the lac dye, formerly the important substance, is now a useless impurity.

AN article on the gardens of Achnashie, Rosneath, by the Rev. D. Landsborough, will be found in the Transactions and Proceedings of the Botanical Society of Edinburgh (vol. xxiii., part iv.). Two silver firs, averaging 112 feet in height and with a girth of about 22 inches at breast height, are noted specimens. Such flowering shrubs as rhododendrons, kalmias, and fuchsias flourish, and bamboos are a special feature in the garden. Of the latter, the four species *Arundinaria nitida, Bambusa fastuosa, Phyllostachys Henonis*, and *Phyllostachys mitis* are mentioned as the most suitable and attractive; *Arundinaria Falconeri* was the first species planted in 1885. Two species flowered in 1904, and two others in 1906; seed that has germinated was obtained from *Arundinaria Simoni* and *Arundinaria Falconeri*.

THE report for 1907, by Mr. J. H. Maiden, on the botanic gardens and Government domains in Sydney, New South Wales, contains, as usual, notes on native plants brought into cultivation, as well as introductions from other countries. Reference is made to the asclepiad creeper *Tylophora grandiflora* that grows in the northern brushes of the colony, *Oncinocalyx Betchei* (Verbenaceæ), a scarce local evergreen shrub, and *Pherosphaera Fitzgeraldi*, a curious conifer from the Blue Mountains that thrives among the Todæas and filmy ferns, since its natural habitat is in spray-bedewed gorges. *Morrenia brachystephana*, an asclepiad from the Argentine, is recommended as a strong evergreen climber, and *Verbesina virginica*, a robust perennial composite from North America, for the shrubbery.

AN exceedingly interesting problem is presented by the production of a vegetative cross between two species of Solanum, the nightshade and the tomato, defined by the raiser, Prof. H. Winkler, as a graft-hybrid. The method of procedure consisted in grafting a scion of the nightshade on the cut apex of a tomato plant; when the graft had matured, a transverse cut was made across the apex at a point where tissue of both scion and stock was present, so that the buds arising from the callus formed at this position might partake of the characters of both species. In this way various adventitious shoots were obtained, which were separated and grown to form independent plants. One of these with distinct characters is the specimen described and named as *Solanum Tubingense* in the *Berichte der deutschen botanischen Gesellschaft* (vol. xxvia., part viii.). Subsequently four other hybrids were obtained, which are described in the *Zeitschrift für Botanik* (vol. i., part v.).

Mr. A. E. P. Weigall, chief inspector of antiquities in Upper Egypt, contributes to the *Century Magazine* for June a well-illustrated article giving an account of the recent discovery of the tomb of Horemheb, who started as a commander in the army of Amenhotep III., married the heiress to the throne to which he succeeded in B.C. 1350, and died in B.C. 1315, after a reign of thirty-five years. His tomb was constructed close to that of Amenhotep II. in the Valley of the Tombs of the Kings at Thebes. The tomb had already been rifled by ancient thieves, the great pink granite sarcophagus had been pillaged, and of the four skulls found it is now impossible to say which wore the crown of the Pharaoh, and this in spite of the fact that the sarcophagus bears figures of Isis and Nephthys, with their wings spread out, as though protecting the royal mummy.

In the May number of *Man* Mr. T. A. Joyce describes a collection of steatite figures, known as Nomori, from Sierra Leone, a class of objects to which attention was first directed by Prof. Rütimeyer, of Basel. These figures, represented in a sitting or standing posture, are of a grotesque character. Mr. Greensmith, who is well acquainted with them, calls them "farm-devils," by which he apparently means images of tutelary spirits intended to protect the crops. Associated with them is a class of curious metallic rings, and when thus found they are called Mahai-yafei, "king spirit or king devil," which Mr. Greensmith interprets to mean that "they are employed in the courts of the chiefs for the witnesses to be sworn upon." It is possible that the tatu marks found on some of these figures may throw some light on their age and suggest the people by whom they were made. In this region tribal society is so disorganised as a result of long periods of war and social disorganisation that local tradition is vague, and does little to suggest their origin; but there seems no reason to believe that they are of any considerable age, and in artistic style they are much inferior to the remarkable basalt sculptures discovered in southern Nigeria, with which they have nothing in common except the mystery which at present surrounds the origin of both.

The most important contribution to the fourth number of the first volume of Annals of Archæology and Anthropology, issued by the Liverpool Institute of Archæology under the editorship of Prof. Myres, is the report by Messrs. Wace, Droop, and Thomson on early civilisation in northern Greece. The excavation conducted by this party of a mound at Zerelia shows that the identification of the site with Itonos and the temple of Athene Itonia, patron goddess of Thessaly, can be no longer admitted; but the mound disclosed no fewer than eight successive layers of prehistoric deposits, the earliest of which cannot be dated later than 2500 B.C. The importance of this and the excavations conducted by Prof. Tsountas rests on the fact that it is in northern Greece and in the possible linking of it with the culture of the Balkans and of Central Europe that light may be expected on the ethnological problems of the Ægean. The mound-builders in northern Greece seem to have been in occupation of this region from 2500 B.C. to 2000–1800 B.C., when many of these structures were abandoned. About 1200–1100 B.C. Mycenæan influence reached the Gulf of Pegasæ, and thus for the first time the Neolithic folk of northern Greece came into contact with the bronze-users of the south. In the north, then, the Neolithic culture seems to have survived until late Mycenæan times. The relations of this culture, at least as regards pottery, with that of Servia, Thrace, Galicia, Bessarabia, and Central Europe are still obscure, and much further exploration is needed before this tangled archæological problem can be definitely settled. At present the choice lies between two alternatives. We may accept the views of Dr. Wosinsky, that the primitive culture of Central Europe is derived from the Ægean, or we may hold with Dr. Hubert Schmidt that early Greek civilisation came from Central Europe. Meanwhile, this band of explorers is again at work, and further details of their investigations will be awaited with much interest.

Mr. R. Langton Cole has sent us a prospectus of small artificial dew- and rain-ponds made by Messrs. F. C. Lowe and Son, Ltd., Sittingbourne, for coverts and other rearing places where a good supply of clean water is required without the necessity for frequent renewal. The troughs appear to consist essentially of one shallow metal tray inverted within another. It is claimed that, once having been filled with water, the troughs are always full, sufficient rain and dew being collected to keep up a constant supply in the driest of summers. Messrs. Lowe state that their troughs act by collecting whatever dew there is and retaining it by means of the cover; and an experiment made by Mr. Cole, extending over six weeks, indicates that moisture is condensed freely upon the under side of such a cover and prevented from evaporation. The collection and preservation of atmospheric moisture by these "Never-empty" troughs is of decided interest in connection with the study of dew-ponds.

The seventeenth annual report of the Sonnblick Society for 1908 includes results for several of the more important mountain stations. At the Sonnblick (3105 metres) the mean yearly temperature was 19·2° F., absolute maximum 44·1°, in May, minimum −19·5°, in January. Snow or rain fell on 220 days, and fog occurred on 245 days. April, 1908, was one of the coldest since the commencement of observations in 1887, being nearly 5° F. below the average. Edler v. Obermayer gives an interesting historical account of the several stations on the Obir, including the summit station (2143 metres), established in 1891, and named the Hannwarte in honour of Dr. J. Hann, the great advocate of mountain observatories. Dr. Hann contributes a summary of the meteorological results at the Hochobir station (2044 metres), with monthly and yearly results for each year, 1851–1908. The summer maxima reach 77° F., and the minima often fall below −13° during winter; the lowest was −17·1°, in January, 1907.

The administration report of the Prussian Meteorological Institute for the year 1908 shows that arrangements are being made for greater activity in all branches of the useful work carried on. With this view, the scientific staff, both at the central office in Berlin and at the Potsdam Observatory, has been re-organised; the form and contents of several of the regular publications have been modified, and efforts are being made to bring these up to date, so that more time may be available for fresh scientific investigations. Weekly meetings are held, both at Berlin and Potsdam, for the discussion of important recent publications, from which the junior staff and students naturally derive considerable benefit. Much time is devoted to constantly-increasing inquiries for weather information for scientific, industrial, and legal purposes; during the year in question, 475 such inquiries were received by letter, in addition to personal applications, and specimens of such letters and replies, which frequently necessitate reference to unpublished data, are printed in the report. In all these respects there is much analogy between the English and German organisations. For the first time an appendix has been added to the annual report, dealing with interesting scientific matters relating to weather conditions of the year and to special investigations. Among the latter is an article by Dr. Hellmann on the window exposure of thermometers, undertaken with the view of showing the small difference between the older observations and those made more recently with better exposure. The author points out that the window exposure is still the one most generally used in Europe, viz. in Scandinavia, Germany, Austria, Switzerland, and Italy, and to some extent also in Spain and Portugal. Illustrations are given of some of the window-screens now generally in use.

The results of meteorological and magnetical observations at Stonyhurst College Observatory for 1908 have been received. This observatory occupies an important position in Lancashire, and its observations go back for sixty-one years; it is one of the observatories adopted by the Meteorological Committee in 1867 for the supply of hourly observations, and although, for financial reasons, the subsidy originally allowed by the committee has had to be greatly reduced, it still supplies automatic records to the Meteorological Office. The year 1908 was, on the whole, mild and quiet, pressure, temperature, and rainfall being above the average; the wind velocity indicated a gale on four days only, the number of miles traversed during the year being the smallest on record. With regard to magnetic work, tabulations are supplied quarterly to the Netherlands Meteorological Institute for the International Committee on Terrestrial Magnetism, and considerable time has been devoted to an examination of the magnetograms of the last forty years in connection with solar influence. The work is not complete, but the preliminary results show many well-established recurrences of disturbances at 24-hour intervals, with a maximum of frequency between 9h. and 11h. p.m. (G.M.T.). The solar surface has been observed on all available days; on one day only the surface was found quite free from spots. The secondary maxima of the solar activity and magnetic disturbance, in 1907, is shown as follows:—

	1903	1904	1905	1906	1907	1908
Spot area...	1·9	2·5	6·8	4·8	5·8	4·6
Declination range ...	11·8	11·9	14·9	14·2	14·7	14·5

the unit of area being 1/5000 of the visible surface and that of declination being one minute of arc.

Dr. G. Agamennone contributes to the *Bolletino* of the Italian Seismological Society, vol. xiii., No. 2, an account of the seismological service which was established in Italy after the Riviera earthquake of February 23, 1887. There are now 678 observatories of the first, second, and third order distributed, so far as possible, at even distances of about 20 km. apart over the kingdom of Italy and in the islands belonging to it, which report regularly to the central office in Rome. This service, the special purpose of which is to obtain a record of every earthquake which takes place, enables the central office to form an estimate of the extent and importance of each shock, and to issue interrogatories to places not included in the network of observatories when such a course seems desirable. A special section of the daily weather report is devoted to a brief account of the reports of earthquakes, which are published more fully in the *Bolletino* of the Seismological Society. Besides this organisation for the study of local earthquakes, thirty-four observatories are equipped with one or more seismographs capable of registering distant earthquakes.

Mr. Ll. T. Jones, of Bingley Grammar School, has designed a simple apparatus which can be used by young students to measure the diffiusion of gases. It consists essentially of a U-tube with one long and one short arm. The short arm, into which gas can be passed by a side tube, is closed with a piece of clay pipe-stem sealed at the top. To perform an experiment the gas is first passed through drying tubes and thence into the short arm of the U-tube. The longer arm is then filled with mercury. The gas in the shorter tube meanwhile will have been forced through the porous pipe, so that the shorter arm will now be full of mercury. The rate of diffusion under different pressures can easily be estimated. The apparatus can be procured from Messrs. W. and J. George, Ltd., of Great Charles Street, Birmingham.

The Journal of the Röntgen Society for May contains a well-illustrated paper, by Mr. J. H. Gardiner, on the origin, history, and development of the Röntgen-ray tube. The council of the society has recently got together a collection of tubes showing the development of the modern apparatus from the original Crookes tube used by Röntgen in 1896, and has presented it to the authorities of the South Kensington Museum. Several of the improvements illustrated by the collection are discussed by Mr. Gardiner, but the most important step taken recently appears to be the substitution of tantalum for platinum in the anti-kathode by Messrs. Siemens. The higher melting point of tantalum makes it possible to employ currents of 30 milliamperes through the tube. With a well-focussed tube a current of this magnitude will melt the front surface of a tantalum anti-kathode 1 millimetre thick, and Mr. Gardiner advocates the use of a magnet to direct the kathode rays to a new portion of the surface.

We have received a copy of a communication made recently by Drs. Scheel and Heuse, of the Physikalisch-technische Reichsanstalt at Charlottenburg, to the *Zeitschrift fur Instrumentenkunde*, dealing with the relative efficiencies of many of the methods at present in use for the production of high vacua. In each case a 6-litre vessel of dry air was evacuated, in most cases from an initial pressure of about 10 millimetres of mercury obtained by a water or oil pump. A simple Toepler pump having a vessel of 850 c.c. capacity reduced the pressure to about 0·7 of its initial value in three strokes, and took five hours to reduce the pressure from 0·06 millimetre to 0·00002 millimetre. A Toepler pump as modified by Drs. von Reden and Rosenthal, requiring only 3·5 kilograms of mercury to work it, reduced the pressure from 15 millimetres to 0·00002 millimetre in a little more than two hours. A Gaede pump, starting from an initial pressure of 12 millimetres obtained by a Gaede oil pump, reduced the pressure to 0·00001 millimetre in an hour. The method which the authors find most convenient is first to reduce the pressure to about 0·01 millimetre by means of a Gaede pump, and to obtain further reduction by absorption of the remaining gases by cocoa-nut charcoal cooled in liquid air. By this means the pressure was reduced in less than two hours from 0·01 millimetre to 0·00001 millimetre of mercury.

Referring to the reproductions of South African rock-engravings in last week's Nature (p. 411), Mr. R. Lydekker writes to point out that the figure given as a buffalo is misnamed, the animal represented being an eland.

A new method of illumination for photographic work, particularly for enlarging and for projection purposes where great magnification is not required, has been brought under our notice. The apparatus is known as the "Petrolite" photographic lamp, and is sold by Mr. A. J. Garrad, of 317 High Holborn, W.C. The lamp consists essentially of an ordinary Welsbach incandescent gas-mantle, which is raised to a condition of incandescence by the use of petrol gas. The petrol is contained in a metal chamber, but is all taken up by a highly absorbent material; consequently, there is no loose petrol in the container. Once it is absorbed it does not escape, but is only given up again in the form of vapour as it is required at the burner. If from any cause the apparatus is overturned, the light goes out. The whole appliance will go inside an ordinary lantern body, and is obviously a good arrangement where either ordinary gas or any method of electrical illumination is unobtainable. The price is reasonable, and the cost of running is lower than that of any other similar method of incandescent gas lighting. The apparatus may be commended to those who require a source of light that must be independent of any extraneous supply of gas or electricity.

We have received from the Bausch and Lomb Optical Co., of 9 Thavies Inn, Holborn Circus, E.C., its latest catalogue of microscopes, apparatus for photomicrography, and various projection appliances. From it we gather that the Bausch and Lomb Co. is now acting in close cooperation with Messrs. Carl Zeiss, of Jena, and that many of its products are based on the investigations carried out by the latter firm. The apparatus for photomicrography appears to be now of a very complete order, and is in general design much the same as that made by Messrs. Zeiss, the camera and the portion of the apparatus supporting the microscope and optical accessories being regarded as two separate appliances. While this is what some regard as an objection, the whole apparatus not being fastened to one single solid base, yet, on the other hand, it ensures that any movement of either component is not communicated to the other part. The apparatus for the projection of both opaque and transparent objects is of new design, and appears to be built in a very substantial way, and is arranged to carry out work of almost any description in this direction As the Bausch and Lomb Co. is now fitting up new showrooms in London, where all these appliances may be seen under working conditions, a visit at the present time cannot fail to be of interest to those who contemplate purchasing such apparatus.

The Colorado School of Mines Quarterly for April is wholly devoted to a short monograph on tungsten, by H. R. Van Wagenen. The first part, which is more of local interest, gives an account of the Colorado mines and mill practice. The second part deals with the physical properties and uses of tungsten, its mineralogy, chemistry, and metallurgy. The preparation and properties of the tungsten alloys are also described, and at the conclusion of the paper there is a useful bibliography. The main applications of tungsten are found in the preparation of various tungsten steels and of metallic filaments for lamps, other uses being found for tungstates as a mordant in dyeing, in the preparation of non-inflammable fabrics, and as a pigment.

Attention has been directed more than once to the growth in size, year by year, of the "Statesman's Year-book," published by Messrs. Macmillan and Co., Ltd., and edited by Dr. J. Scott Keltie with Mr. I. P. A. Renwick's assistance. The 1909 issue, which is now available, represents a successful attempt to reduce the bulk, without affecting the usefulness, of this valuable statistical and historical annual. This satisfactory reduction by some 300 pages has been accomplished by the introduction of uniform type, the elimination of superfluities, economies of space, and various re-arrangements. The present issue has several new features; some deal with recent changes in the altered constitutional character of several countries, others with new census returns and various other matters of public interest, while a new section gives a brief statement with reference to the Hague Tribunal, with a list of members. The plates, which are all new, include a diagram exhibiting British and German naval expenditure on new construction during the last decade; and maps illustrating the Anglo-Siamese Treaty, 1909; the Anglo-Abyssinian Boundary, 1902 and 1907; the Anglo-German and German-French Kamerun Boundary, 1906 and 1908; the All Red Route; and the military divisions of India. The price of the year-book remains 10*s.* 6*d.* net.

Erratum.—Mr. Hy. Harries informs us that on p. 403 of Nature of June 3 the ship on which Dr. von Neumayer returned from Melbourne in 1864 was erroneously given by him as the *Sovereign of the Seas*; it should have been the *Garrawald*.

OUR ASTRONOMICAL COLUMN.

The Rings of Saturn.—Prof. Levi-Civito has written an interesting pamphlet on the mechanics of the ring of Saturn ("Sulla Forma dell' Anello di Saturno," Premiale Officine Grafiche Carlo Ferrari, Venezia). His conclusion is that under certain hypotheses the angular velocity of each ring exceeds that of a satellite at the same distance. He points out that the differential equations applicable to a flexible substance are applicable, even in spite of Clerk Maxwell's demonstration that the ring consists of discreet particles. He therefore reverses the procedure of Stazio in Dante:—

"Trattando l'ombre come cosa salda."

Changes in the Figure and Dimensions of the Sun.—In a mathematical paper appearing in No. 4, vol. xxix., of the *Astrophysical Journal* (p. 257, May), Prof. Moulton discusses the possibility of observing changes in the form and dimensions of the sun from the dynamical point of view.

After reviewing briefly the practical methods previously employed to detect any possible variation, he attacks the problem from various theoretical standpoints, with reasonable assumptions, and arrives at several interesting conclusions. First, he shows that the difference between the equatorial and polar diameters must be less than 0·07″ as seen from the earth, and is, therefore, beyond observation by any means yet employed. Then, considering possible oscillations, he demonstrates that, if they exist in the sun, their period cannot exceed a few hours, although different periods might combine to form "beats."

It seems possible, at first glance, that any possible shrinking might be demonstrated by the change in the rate of rotation before becoming directly measurable from the earth, but Prof. Moulton shows that this is unlikely. Variations of diameter would presumably produce corresponding variations of temperature, but it is surprising to find that a variation of the apparent diameter by 0·1″ should produce a change of 1400° C. in the temperature. Considering the effect of such dilatational oscillations on the power of radiation, it is shown that, were the diameter undergoing changes amounting to 0·1″, as seen from the earth, the rate of radiation at maximum would be 2·56 times that at minimum radius; in other words, the variation would be about one stellar magnitude. Langley and Abbot believed they had observational evidence of a 10 per cent. variation in the radiation, but this would correspond to a variation of only 0·01″ in the apparent diameter, an unmeasurable quantity.

CAMERA OBJECTIVES FOR SPECTROGRAPHS.—No. 4, vol. xxix., of the *Astrophysical Journal* contains an interesting practical paper, by Mr. Plaskett, of the Dominion Observatory, Ottawa, describing a large number of tests he has carried out whilst endeavouring to find the most universally useful form of objective for spectrographic work.

A number of tests were made by Hartmann's extra-focal image method adapted to spectrographic work, and the results are given in detail and illustrated by diagrams. For a dispersion of three prisms with a camera of fairly long focus, it was found that, of the objectives tested, the Zeiss "Chromat" and the Brashear Light Crown were the best. The former gives a flatter field and slightly better definition, but for the latter there is the advantage that the plate has to be inclined only 8° instead of 16°, and the absorption is less. For short-focus work the Zeiss Tessar and the Ross Special Homocentric gave good definition and flat fields.

THE ASTROGRAPHIC CONFERENCE AT PARIS.

THE permanent committee of the Astrographic Congress of 1887, as our readers are aware, recently held its fifth meeting at Paris. Invitations were by no means confined, however, to members of that committee, and they were largely accepted by other astronomers. The following were present, representing observatories cooperating in the work :—

Algiers: Gonnessiat; *Belgium:* Lecointe; *Bordeaux:* Picard and Kromm; *Cape of Good Hope:* Hough; *Catania:* Ricco; *Greenwich:* Cowell; *Helsingfors:* Donner; *Oxford:* Turner; *Paris:* Baillaud; *Perth (W. Australia):* Cooke; *Potsdam:* Scheiner; *Rome:* Lias; *San Fernando:* Azcarate; *Tacubaya:* Valle, Gallo; *Toulouse:* Cosserat, Montagerand; *Sydney* and *Cordoba* were not represented, owing to the recent deaths of their respective directors.

The following astronomers and others were also present :—

America: Hale, Leuschner, Perrine, Ritchey; *Austria:* Palisa; *Belgium:* Delvosal; *Denmark:* Strömgren; *France:* Andoyer, André, Angot, Bayet, Benoit, Prince Roland Bonaparte, Bouquet de la Grye, Bourget, de la Baume Pluvinel, Carpentier, Darboux, Deslandres, Fontana, Fournier, Gaillot, Gautier, P., Hanusse, Hatt, Lagarde, Lallemand, Lippmann, Lumière, Verschaffel; *Paris Observatory:* Baillaud, J., Bigourdan, Bouquet de la Grye, Hamy, Leveau, Puiseux, Renan; *Germany:* Hartwig, Kustner, Zurhellen; *Great Britain:* Dyson, Franklin-Adams, Sir David Gill, Hinks, Knobel, Major MacMahon; *Holland:* Bakhuyzen, Kapteyn; *Italy:* Boccardi; *Russia:* Backlund.

The conference assembled at the observatory at 10 a.m. on Monday, April 19. For nearly an hour the members were occupied in mutual greetings, introductions, and general conversation. The chair was then taken by M. Charles Bayet, Conseiller d'État, Directeur de l'Enseignement supérieure au Ministère de l'Instruction publique et des Beaux Arts, who delivered an address, bidding the members welcome in the most cordial terms, and expressing on the part of his Government and of the Republic their interest in and sympathy with the great work to promote which so many astronomers had now assembled from all parts of the world. M. Baillaud, director of the Paris Observatory, then delivered an admirable address. He thanked the assembly for the honour done him by electing him unanimously as their president so soon after his appointment as director of the Paris Observatory. He briefly traced the history of the undertaking known as the "Carte du Ciel," which had its origin in 1887. He referred in touching terms to Admiral Mouchez, to whom the "Carte du Ciel" owed in a great degree its successful origin; to Tisserand, whose classic labours so adorned the science that he loved; and to Lœwy, who had done so much, not only to develop the Paris Observatory, but to extend the scope and usefulness of the work of the "Carte du Ciel." He described the great share which Lœwy had taken in collecting, discussing, and printing the observations of Eros in 1900, which, in the hands of Mr. Hinks, had led to a very accurate determination of the solar parallax. He showed that by undertaking these observations, not only had thus a most important result been arrived at, but by the refined discussion of the observations of Eros some important systematic errors in photographic observation had been detected, and the sources of these errors found. We had, in fact, by this extension of our field of work, not only arrived at important new results, but greatly improved the results of our previous labours.

But much yet remained. We had now, for example, to study the problems of perfecting the systematic corrections applicable to the preliminary determinations of magnitude and position of all the catalogue stars, so that when the work of the different zones had been completed the final catalogue should present a harmonious whole. It was also necessary that we should make preparation for the regular observation of Eros in future, and begin to consider what should be done in order to take the fullest advantage of the extraordinarily favourable opposition of that planet in 1931. Everything that we did to improve the work of the catalogue would go towards perfecting the determination of the places of the comparison stars to be observed with Eros from now until 1931, and the necessary striving after systematic accuracy which must result from such researches must react in the way of improving the fundamenta of sidereal astronomy.

Such, at least, are the writer's recollections (without notes) of this admirable and inspiriting address, after the delivery of which M. Baillaud, in a few graceful words, proposed the election of Sir David Gill as "Président d'Honneur," a proposal which was carried by acclamation.

The bureau of the general assembly was then constituted as follows :—*vice-presidents*, Bakhuyzen, Backlund, Kapteyn; *secretaries*, Donner, Puiseux, Scheiner, Turner.

A suggested programme for the work of the meeting had been prepared by Sir David Gill, and was circulated by the president, M. Baillaud, in January last. This programme was accepted by the meeting, and, in accordance with it, the president formally presented two volumes, one marked A, containing advance proofs of the printed reports of the progress of the work of the chart and catalogue at the different cooperating observatories, and another, also in proof, marked B, containing papers and discussions of very great interest, such, for example, as Hinks's report on his great discussion of the Eros observations, Campbell's report on Perrine's discussion of the Eros observations made at the Lick Observatory, Hough's paper on a proposed method for the *raccordement* of astrographic plates, E. C. Pickering's report on a standard scale of photographic magnitudes, and other papers on kindred subjects by J. Baillaud, Pourteau, Cohn, and Millozevich.

Then, in accordance with the programme, the conference was divided into five commissions, viz. :—

(A) To report on the state of the work and the steps to be taken to perfect or accelerate the work.

(B) To report on the method to be adopted for the conversion of measured diameters of star-discs (or magnitudes, as estimated at the different observatories) into an exact and uniform system of magnitudes.

(C) To report on the existence and probable origin of systematic errors in the measured coordinates of star-discs on certain plates, on the best methods for avoiding such errors in the future, and of putting in evidence and eliminating their effects in the plates already measured.

(D) *The Catalogue Committee.*—To examine the origin of the star-positions employed in the preliminary reduction of the plates of each zone, to study the best means of coordinating the star-places of the different zones, and to determine the systematic corrections necessary to reduce the whole to a uniform and absolute system.

(E) *The Eros Committee.*—(1) To report on the steps to be taken for the preparation of a preliminary ephemeris of Eros at its opposition in 1931 of sufficient precision to permit the early selection of comparison stars. (2) To propose means for the regular observation of the planet from the present time onwards in order to perfect the ephemeris which will be finally employed for the definitive reduction of the observations in 1931, that is to say, for the direct determination of the solar parallax and mass of the moon, as also for the ultimate determination of the mass of the earth by means of the perturbations which it produces in the motion of Eros.

The *bureaux* of these committees were then constituted as follows:—

	A	B	C	D	E
President	Turner	Kapteyn	Bakhuyzen	Küstner	Backlund
Vice-Pres.	Donner	Puiseux	André	Hough	Dyson
Secretary	Andoyer	Bourget	Hamy	Luc. Picart	Lagarde
,,	—	Azcarte	Valle	Ricco	Hinks

A list was then submitted suggesting the names of members who should serve on the different committees, although any member of the conference was at liberty to attend and vote on any of the committees he pleased. As there was sufficient accommodation at the observatory a separate room was assigned to each committee. The conference then adjourned for the day, and many of the members attended the meeting of the Academy of Sciences at the Institute in the afternoon.

The committees sat from 10 to 12.30 in the morning, and from 3 to 5 in the afternoon, on Tuesday, Wednesday, and Thursday, April 20, 21, and 22, and by the latter date had completed their labours.

On Friday morning, April 23, the resolutions of the various commissions were successively submitted to the general conference, and, as a rule, were adopted without change. The resolutions as finally adopted are as follows:—

From Commission A.

The committee expresses the desirability that the measures of the catalogue plates made at Sydney and Melbourne should be published as soon as possible, and that a copy of this resolution be sent to the Governments concerned.

It is desirable that the zone (dec. $-17°$ to $23°$) not yet commenced should, for the catalogue, be divided between the observatory of Santiago, the new observatory of Hyderabad (Deccan), and, if necessary, the observatory of the University of La Plata. M. Baillaud is charged to arrange with the directors of these observatories for the partition of the work.

It is desirable that the Cordoba zone (dec. $-24°$ to $-30°$) should be divided for the catalogue between the observatories of Cordoba and the Cape of Good Hope. M. Baillaud will arrange with Mr. Perrine, the new director of the Cordoba Observatory, for this subdivision of the work.

The permanent committee directs attention to the interest which attaches to a repetition of the catalogue plates even after so short an interval as ten years. The high precision of the measures will already furnish indications of proper motion. It invites observatories, which are in a position to do so, to repeat the catalogue plates, taking care that the repeated plates be made at the same hour-angle and at the same season of the year as in the earlier series.

From Commission B.

The participating observatories are recommended to make direct photographic comparisons between the star-images of the polar area and twenty-four regions of the particular zone undertaken at each observatory.

In this comparison two exposures of each area shall be made, one of six minutes and one of twenty minutes, the two regions being taken at equal zenith-distance and in conditions as similar as possible.

Those observatories where the construction of the telescope mounting prevents access to the polar region may utilise the Pritchard-Kapteyn areas for the above-described comparison. For the plates in the neighbourhood of the pole it is recommended to select twenty-four areas, selected in the manner that appears most convenient to the astronomers engaged on the work.

It is to be understood that there is no objection to the making of the above-mentioned comparisons of different exposures on two different series of plates, nor to making additional series with different exposures.

The committee recommends a second series of twenty-four plates connecting in pairs the twenty-four type-regions of the same zone.[1] In this series there should also be two exposures, viz. of six minutes and twenty minutes respectively, for each of the two regions compared; but, as before, there is no objection to the making of the above-mentioned comparisons of different exposures on two different series of plates, nor to making additional series with different exposures.

The committee recommends that the astronomers whose zones include the declinations $\pm 0°$, $\pm 15°$, $\pm 30°$, $\pm 45°$, $\pm 60°$, and $\pm 75°$ should select Kapteyn's selected areas for their type-regions, or at least regions including these selected areas.

The committee is of opinion that several observatories should also undertake the photography of the Kapteyn-Pritchard areas, connecting each of them, on the same plate, with the pole, some with the North and others with the South Pole, and taking care to make both exposures under conditions (as to Z.D., &c.) as similar as possible.

The *raccordement* of the other regions of any zone with the corresponding type-regions of that zone may be made in a variety of ways. The committee thinks that the choice of the method of *raccordement* should be left to the participating observatories.

The committee, believing it to be premature to fix in an absolute manner the origin and interval of the scale of photographic magnitudes, entrusts the solution of the problem to a commission constituted as follows:—Backlund, B. Baillaud, Gill, G. Hale, Kapteyn, E. C. Pickering, Scheiner, Turner.

The members of this commission are recommended to select a photographic scale that is independent of the visual scale. Stars of the ninth magnitude of the visual scale should be taken as the point of departure for the photographic scale. Until the commission has completed its labours observers should continue to publish the magnitudes of stars on the same basis as that previously adopted by them, on the understanding that each participating observatory shall describe, with all desirable precision, the methods which have been adopted to determine the published magnitudes. In this way the corrections necessary to pass from the scales respectively adopted by the different observatories to the absolute scale which will result from the labours of the commission can be made with the minimum of uncertainty. At the present moment the scale most to be recommended is that which is defined by "the North Polar sequence of forty-seven stars" due to Prof. E. C. Pickering.

Observers may with advantage give to the three images of the same star on the chart plates such a linear interval that the three images of a star of the eleventh magnitude shall appear neatly separated.

Observers may diminish the duration of the exposure of each of the three images (on a chart plate)—from thirty to twenty minutes, for example—if it is recognised that the diminished exposure is sufficient to show the images of stars of the fourteenth magnitude on Argelander's scale, prolonged.

The attention of participating astronomers is directed to the advantages which might arise if the three exposures on the chart plates were made on different nights, with a moderate interval, of not more than several weeks in all. It appears preferable, indeed, to complete the plate-exposure on two nights only, with one exposure on the first night and the other two exposures on the second night. The advantages which would result from this plan of working would, on the one hand, be to facilitate the search for variable stars, and on the other the eventual discovery of a trans-Neptunian planet.

From Commission C.

At least twice a year the equatorial adjustment of the photographic telescopes should be tested.

Special attention must be given to the centring of the object-glass, and to the rendering of the surface of the

[1] It was understood that in this way the region of R.A. 0h. should be taken at 3h. hour angle W., and on the same plate the region of R.A. 6h. at 3h. hour angle E. (*i.e.* at approximately the same Z.D.), then R.A. 1h. on the same plate with R.A. 7h. and so on.

film normal to the axis of the object-glass. To examine the quality of the object-glass or its distortion Hartmann's perforated screen method is recommended, its efficacy having been already proved.

In order to determine the effects of optical distortion depending on the position-angle and distance, special plates of the Pleiades should be taken. These plates should also serve to show whether the formulæ and methods previously employed in the reduction are sufficiently accurate and complete. The committee is of opinion that the optical errors should be studied on the plates already measured by the methods referred to by Prof. Turner in Annex A (reports of the participating observatories).[1]

It is also desirable that observations should be made to determine the relative flexure of the photographic and visual telescopes.

From Commission D.

The permanent committee, convinced of the importance of the (meridian) determination of the positions of the *étoiles de repère* as contemporaneously as possible with the exposures of the plates, expresses its high satisfaction that these stars have been so observed, or are about to be observed in the near future.

With reference to these observations which have as yet to be made, the committee addresses its thanks to MM. Verschaffel, Backlund, Struve, and Boccardi, who have so kindly undertaken this outstanding work, and rests assured that these observations will be made by them with all desirable precision and promptitude.

The committee is of opinion that, in the future, meridian observations of faint stars, excepting for special researches, should be limited to the stars which have been selected as *étoiles de repère* for the catalogue plates. In this way the positions of the great majority of the stars (to the eleventh magnitude) can be determined with the greatest facility and precision.

Meridian observations may be divided into three classes, viz. fundamental stars; intermediate stars; *étoiles de repère.*

Fundamental Stars.—These should be so chosen that there shall be one star in each area of twenty-five square degrees, so that their distribution in the sky may be as uniform as possible. The observatories willing to unite in the formation of a new fundamental system should agree to select a common list of stars, and to observe all stars of that list which culminate at suitable altitudes above their respective horizons.

The observatories which at first sight appear to be available for this cooperation are:—in the northern hemisphere, Algiers, Greenwich, Leyden, Lick, Kiel, Paris, Pulkova, Odessa, Washington; in the southern hemisphere, Cape of Good Hope, Sydney. This resolution does not exclude the cooperation of other observatories for fundamental work, provided that they have time and instruments of the necessary type.

Intermediate Stars.—A second series, called intermediate stars, and preferably of the eighth to ninth magnitude, shall be established. These stars will be selected for the purpose of determining the positions of the *étoiles de repère* with respect to the fundamental stars with the least systematic error possible, with the view of the elimination of personal equation depending on magnitude both in right ascension and declination. The Bonn Catalogue of Stars for 1900, dec. 0° to 51°, offers an example of methods by which such a catalogue can be constructed. It is known that a similar catalogue is about to be made between dec. 51° and 90° at the Observatory of Kasan.

It is desirable that analogous observations should be made in the northern hemisphere, and, if it is possible, that two similar series or more should be made in the southern hemisphere. The stars which should be chosen for these additional series may be less numerous than those above indicated, but they ought to be taken exclusively from the adopted lists of *étoiles de repère*, and selected so that there shall be from four to six stars per hour in each zone of two degrees in breadth.

[1] The present writer thinks that a more complete system, viz. that described by Mr. S. S. Hough (Annex B), has been overlooked by the committee.

So far as the determination of the positions of the intermediate stars is concerned, the observatories which have good recent meridian observations of the *étoiles de repère* need not of necessity re-observe them. It will only be necessary to determine the mean corrections of the positions of the *étoiles de repère* of each plate by comparing the formerly adopted positions of these stars with the definitive positions of the intermediate stars; but for all meridian observations of the *étoiles de repère* made subsequent to the publication of the definitive positions of the intermediate stars it will be desirable to employ these positions as a basis for the reduction of the observations.

The commission charged with this work by the permanent committee will consist of the directors of the observatories engaged in cooperation, together with Messrs. Auwers, Gill, Kustner, and Newcomb.

The following supplementary resolution was added in general committee:—

The committee is of opinion that, in consideration of the small number of observatories fitted for fundamental work of high precision in the southern hemisphere, it is very desirable, in the interests of science, that a meridian instrument provided with all modern improvements should be installed in Australia. The establishment of a new observatory near Sydney offers a very fortunate opportunity for the fulfilment of this great astronomical desideratum. A copy of this resolution to be transmitted to the Government of New South Wales through the usual diplomatic channels.

From Commission E.

Mr. Strömgren is charged to compute:—(1) an approximate ephemeris of Eros for 1931; (2) precise ephemerides for the successive oppositions until 1931; (3) an ephemeris of high precision for 1931.

The committee expresses the desire that the ephemerides of Eros, relative to successive oppositions, be inserted in the chief official ephemerides—Nautical Almanac, Connaissance du Temps, &c.

The committee is of opinion that an international arrangement should be arrived at for the computation, as soon as possible, of the heliocentric positions of the chief perturbating planets—Venus, Earth, Mars, Jupiter, and Saturn—so that Mr. Strömgren may furnish in the course of a few years an ephemeris of Eros for 1931 which will be sufficiently accurate to permit the selection of the comparison stars.

The committee recommends the regular observation of the planet Eros from the present epoch onwards. These observations should be made, not only at opposition, but as long before and after each opposition as possible.

For the oppositions previous to 1931, observatories are requested to publish their results as early as possible. Especially in the case of photographic observations, the rectilinear coordinates of the planet and of the comparison stars should be given. So far as possible, these should refer to the *étoiles de repère* of the photographic catalogue for the region; the provisionally derived right ascension and declination of the planet should also be given.

As the *étoiles de repère* have already been selected for the whole sky, one can easily ascertain (for example, by correspondence) the stars to be measured with Eros.

From the Meeting of the General Committee.

The committee appoints a commission, viz. Messrs. Knobel, Lippmann, Perrine, and Turner, to examine the question of the production of star-images on a photographic plate both from the optical and photographic point of view, and to study the means of obtaining star-images more susceptible of exact measurement than those at present found on our existing plates.

This commission has power to add to its number.

The meeting concluded with a vote of thanks to M. Baillaud for the perfection of the arrangements made for the business of the meeting, for the ability and tact with which he had filled the post of president, and for the hospitality and kindness he had shown to all.

The following table, extracted from the printed reports, will enable the reader to judge of the state of the work generally :—

Observatory	Limits of declinations of centres of plates	Number of plates in zone	Catalogue Plates			Chart Plates	
			Taken	Measured	Reduced	Taken	Published
Greenwich	N. 90° to 65°	1149	1149	1149	1149	1149	1006
Rome	64 ,, 55	1040	720	—	—	103	30
Catania	54 ,, 47	1008	590	90	—	97	—
Helsingfors	46 ,, 40	1008	1008	679	435	843	—
Potsdam...	39 ,, 32	1232	1232	300	280	—	—
Oxford	32 ,, 25	1180	1180	1180	1180	—	—
Paris	24 ,, 18	1260	1260	540	540	373	373
Bordeaux	17 ,, 11	1260	958	819	493	127	127
Toulouse	16 ,, 5	1080	738	698	?	191	162
Algiers	N. 4 ,, S. 2	1260	—	517	425	335	335
San Fernando .	S. 3 ,, N. 9	1260	1260	1125	323	?	215
Tacubaya	10 ,, 16	1266	1260	1121	360	108	88
Cordoba...	[1] 24 ,, 31	1360	854	299	—	167	—
Perth	32 ,, 40	1376	1376	195	—	—	—
Cape of Good Hope	49 ,, 51	1512	1512	1402	803	1512	—
Sydney	52 ,, 64	1400	1400	705	—	—	—
Melbourne	65 ,, 90	1149	1149	1104	—	1129	—

There was throughout the meeting an earnestness of purpose of a very marked kind, a feeling that decisions having an important influence on the future of astronomy were being taken. Every resolution had been so fully discussed in one or other of the five commissions that in the end they were all adopted with unanimity, not only in the commissions, but at the general conference.

Perhaps the most important of these are the resolutions dealing with the methods to be adopted in connection with the organisation of a united series of meridian observations, and the establishment by international effort of a system of intermediate stars, as originally suggested by Sir David Gill in his presidential address to the British Association at Leicester. Hardly less important are the resolutions in regard to the adjustment of the scale of photographic magnitudes to an absolute and uniform system for the whole sky. Indeed, it is hardly possible to over-estimate the resulting importance of these resolutions to sidereal astronomy if due effect is given to these resolutions.

The plans for the observation of Eros show a still further extension of the work of the committee, for they carry us into another field of astronomy by providing the most refined determinations of the positions of that remarkable planet. If due effect is given to these resolutions, the gravitational astronomer will be provided with means of research on the masses of the moon and of the earth and other planets of a kind never before available. The meeting will also be memorable for the communication made to it by Mr. Hinks as to the result of his eight years of labour in deriving the solar parallax from the international observations of Eros.

Widely indeed has the permanent committee of the Astrographic Congress of 1887 extended the field of its labours, and with the best results.

Paris was, as usual, profuse in kindly hospitality. Prince Roland Bonaparte gave a reception to the members of the conference and their wives and families at his charming house in the Avenue d'Iéna. On the Thursday Baron Rothschild entertained some of the members to dinner, and on the same evening there was a delightful reception at the Paris Observatory, at which was given a little comedy by members of the Théâtre Français, and a little operetta by members of the Opéra Comique, the evening concluding with a *tour de valse*.

Many private entertainments to members were given at the hospitable homes of the Paris members of the conference, and the whole concluded with a banquet at the observatory on the Saturday evening, at which covers were laid for eighty-two guests.

[1] The zones −17° to −23° were originally allotted to La Plata, but as the work has not been done, they are assigned, if not entirely, at least in chief part, to Santiago and the new observatory of Hyderabad (Deccan).

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE general meeting of the American Philosophical Society was held on April 22, 23, and 24. The evening of Friday, April 23, was devoted to a Darwin celebration commemorative of the centenary of Charles Darwin's birth and of the fiftieth anniversary of the publication of the "Origin of Species," at which addresses were given by the Right Hon. James Bryce, the British Ambassador, on personal reminiscences of Darwin and of the reception of the "Origin of Species"; by Prof. G. L. Goodale, of Harvard University, on the influence of Darwin on natural science; and by Prof. G. S. Fullerton, of Columbia University, on the influence of Darwin on the mental and moral sciences.

On the afternoon of April 24 there was a symposium on earthquakes, at which papers were presented by Prof. E. O. Hovey, Prof. W. H. Hobbs, and Prof. H. F. Reid. In addition to the three papers presented at the Darwin celebration on April 23, forty-four papers were read at the morning and afternoon sessions. We have been favoured with a list of these papers and summaries of their contents, but limitations of space prevent us from giving more than an abridged statement of the proceedings. Abstracts of a few of the papers read are subjoined.

The brains of two white philosophers and of two obscure negroes, Prof. B. G. Wilder. The brains of Chauncey Wright and of James Edward Oliver were compared with the brains of two obscure negroes, one a mulatto, the other black, and a remarkable resemblance in the form of Wright's brain with that of the negro brains was pointed out, from which Prof. Wilder drew the inference that the negro is capable of as high development as the Caucasian. Some conditions modifying the interpretation of human brain-weight records, Dr. H. H. Donaldson. An account of the brain-weight records that have been collected at the Wistar Institute of Anatomy. After the fifteenth year, up to the fifty-fifth, the human brain loses slightly in weight, and then more rapidly after that period. This slight loss in weight between the fifteenth and fifty-fifth years is attributed to the influence of those diseases which ultimately end in death.

Some notes on the modifications of colour in plants, Prof. H. Kraemer. After reviewing the previous work on the control of colour in plants, and enumerating the factors which influence the colour in flowers, the author gave the results of his own experiments, which were begun in the autumn of 1904, and have been continued up to the present time. Various soils were experimented with, including an artificial soil, and sand to which a special nutrient was added. The chemicals used to modify the colour principles were supplied to the plants in the form of solutions of varying strength, or added to the soil in the solid form, solution gradually taking place. Probably the most striking result obtained by the use of chemicals was the production of a red colour in the petals of the white rose, Kaiserine. The red pigment occurred in the basal portion of the petals, and was produced in the flowers of plants which were supplied with potassium hydrate, potassium carbonate, calcium hydrate, and lead acetate. Blue flowers were produced by the red-flowering form Hydrangea (*H. Otaksa*), growing in both sand and garden soil, when supplied with potassium and aluminium sulphate, aluminium sulphate and calcium hydrate.

Recent work on the physics of the æther, P. R. Heyl. Considerable interest has been taken of late in the question as to whether the æther is or is not a dispersive medium with regard to light. The work of the author, published about a year and a half ago, leads to the conclusion that any dispersion in the æther must be less than 1 part in 250,000. Since that time others have arrived at the conclusion that there exists a dispersive effect of much smaller magnitude, about one part in a million. There seems to be no doubt of the correctness of their observations, but it is not clear that it is to be attributed to a real dispersive effect in the æther. It is more likely that it is due to tidal phenomena in the atmosphere of the variable stars used as sources of light in the experiments.

The detonation of gun-cotton, Prof. C. E. Munroe. In the use of gun-cotton in mines and torpedoes advantage is taken of the discovery of Mr. E. O. Brown that gun-cotton which is completely saturated with water may be detonated by the detonation of dry gun-cotton in direct contact with it used as a "priming charge," thus securing a large margin of safety for the naval vessels carrying the explosive. Wet gun-cotton containing as high as 35 per cent. of water has been shown to be a more efficient rupturing and shattering explosive than dry gun-cotton, but the question of how much water the discs of priming gun-cotton could contain to be efficient was the object of the research detailed in this paper. The primer was in all cases fired by the service detonator, containing 36 grains of mercuric fulminate. The results show that detonation of the entire charge was effected in every case in which the primer contained less than 12 per cent. of moisture, and occasionally was complete in cases where the moisture ran as high as 15 per cent., and therefore that such gun-cotton primers containing not more than 12 per cent. of moisture, fired by means of a detonator containing 35 grains of mercuric fulminate, may be relied upon to detonate wet gun-cotton with which they are in contact.

South American fossil Cetacea, Dr. F. W. True. Dr. True remarked that, in connection with a revision of the fossil whales and porpoises of the United States, he had had occasion to examine various specimens from Patagonia. Some of the Patagonian forms belong to families still represented in South America by living species. Others represent families no longer existing. The fossil fauna includes sperm whales, various forms allied to the Inia, others allied to Squalodon, and at least one species of whalebone whales, allied to the finbacks, but no ziphioid, or beaked, whales, nor any true dolphins, have been found.

On the remarkable changes in the tail of comet *c* 1908 (Morehouse), and on a theory to account for these changes, Prof. E. E. Barnard. The changes that occurred in the tail of this comet appear to indicate resistance to the passage of the body through space. In the discussion of the paper it was suggested that this resistance might arise from clouds of meteoric dust, too fine to be visibly appreciable, but still dense enough to offer a resistance that would account for the changes in the form of the tail of the comet.

On the ruling of diffraction gratings, Prof. A. A. Michelson. The paper gave a brief statement of the development of the grating. From the point of view of resolving power, the important fact is not so much the number of rulings per inch as the total number of rulings, and this greater number of rulings necessitates a correspondingly greater degree of regularity, an accumulated error of one ruling in the entire number being fatal. The ruling engine now set up in the Ryerson Laboratory gives this necessary increase in perfection of ruling, so that the spectra are almost free from ghosts, and those of the higher orders can be used. The resolving power is proportional to the product of the total number of rulings into the order. A photograph of a part of the mercury spectrum was shown, in which the distance between two of the lines was only 1/200 of the distance between the sodium (D) lines, and it was evident that lines separated by only half this distance would be distinctly resolved. This ruling engine is the result of seven years' work. The large 10-inch gratings are ruled on metal, to save the cutting edge of the diamond, and weigh about 30 lb. The greater part of this weight is supported by a float in mercury, only a small part pressing upon the ways. It is moved along the ways by a screw with a large head working by fine teeth in an automatically actuated worm. This screw was made as perfect as possible by long, careful grinding, and the remaining errors, which are of the order of the one-millionth part of an inch, are automatically compensated for by the slight tangential motion of the worm. This motion is a function of the position of the nut, determined empirically.

Solar activity and terrestrial magnetic disturbances, Dr. L. A. Bauer. This paper deals with the connections between the various manifestations of solar activity, *e.g.* sun-spots and the so-called magnetic storms which at times affect compass needles simultaneously all over the earth by several degrees, and even cause serious interruption in telegraph and cable lines, and are usually accompanied by fine auroral displays. One of the most important of the conclusions arrived at is that an increase in sun-spot activity is accompanied by a decrease in the earth's magnetisation, or that the magnetisation superposed on the earth's magnetic field during solar outbreaks is opposite to that of the earth's own field. It appears questionable whether the earth's magnetism ever settles down precisely to its former condition after the occurrence of a magnetic storm. The facts are not yet sufficient to draw a definite conclusion whether solar activity and magnetic storms stand to each other as cause and effect, or whether they are both effects of the same cause. The indications are that during a period of intense solar activity, in some as yet unknown manner, considerable fluctuations are caused to take place in the electric field that we know from various facts exists in the regions above us. These varying electric currents in turn affect the magnetic needles on the earth's surface.

On the Hevelian halo, Prof. C. S. Hastings. The paper reviewed the various kinds of halos that have been described and the explanations that have been offered in regard to their origin. It had been assumed by writers on the subject that the snow crystals, which are in the form of plates or prisms, would fall with the plate or prism presenting the least resistance to the air. Thus, according to this idea, the hexagonal plates would fall edge on and the prism end on. This was shown to be incorrect, and the contrary was the case; the plates and prisms could fall through the air with their longer dimensions horizontal. The plates would assume a horizontal position as well as the prisms. The halo was then caused by total internal reflection from the plates or prisms, and not by surface reflection. Assuming these general positions for the long or short prisms (or plates) and total internal reflection, the various types of halo that have been described could be explained, with the exception of the Hevelian halo. To explain this on the basis of total internal reflection, it was necessary to assume pyramidal planes in the crystal of such an angle as to produce the 90-degree halo of this rare type.

The effect of temperature on the absorption of certain solutions, Prof. H. C. Jones. Increase of temperature of the solution was found to alter the absorption spectra in the same way that they are changed by concentration of the solution.

Symposium on earthquakes, Prof. E. O. Hovey, Prof. W. H. Hobbs, and Prof. H. F. Reid. Prof. Hovey's paper served as an introduction to the subject. The ideas in regard to the cause of earthquakes were considered, especial attention being given to a discussion of volcanic earthquakes. Prof. Hobbs pointed out the fact that the seismic focus or centrum, as determined by the method of Mallet, was at best a line, and practically had no existence. He explained the production of earthquakes by the shifting of segments of the crust along already existing fissures, and insisted upon the tectonic origin of earthquakes. Prof. H. F. Reid considered three phases of the subject:—(*a*) conditions leading to tectonic earthquakes; (*b*) instruments used in the study of earthquakes; (*c*) suggestions for a national seismological bureau.

The burning bush and the origin of Judaism, Prof. P. Haupt. The burning bush was explained as the shrubbery on the heights of a volcano, lighted up at night by the glow of the incandescent lava. The story of the pillar of cloud by day and the pillar of fire by night was not that it hung over the Tabernacle, but over Mount Sinai. the cloud of steam from the active volcano was the "pillar of cloud by day and the pillar of fire by night." The destruction of Jericho and of Sodom and Gomorrah were attributed to earthquakes.

At the Darwin commemoration meeting, after the presentation of the three addresses, attention was directed to the fact that there are two members of the American Philosophical Society still living in England who were friends of Charles Darwin, Sir Joseph Dalton Hooker and Dr. Alfred Russel Wallace. It was unanimously resolved that the society should cable to them its greetings and congratulations on the general acceptance of the views in the elaboration and promulgation of which they had taken such an effective part.

The following resolutions were adopted in the course of the meeting:—(1) Whereas the United States in former years made many brilliant discoveries in the Antarctic, including the continent of Antarctica by Charles Wilkes, and whereas the United States have not taken any part in the recent scientific explorations of the South Polar region, therefore be it resolved that the American Philosophical Society requests the cooperation of the scientific and geographical societies of the United States, to urge on the navy of the United States and through the general Government, that it do make sufficient appropriations to fit a Government vessel thoroughly to explore and survey the coast of Wilkes Land and other parts of Antarctica.

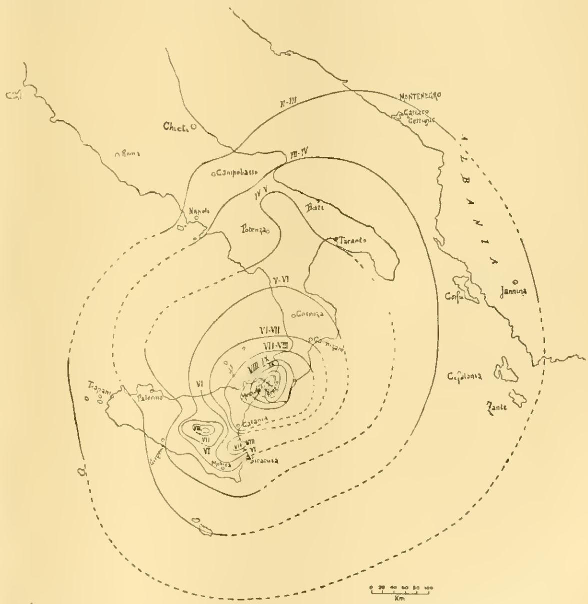
(2) Whereas earthquakes have been the cause of great loss of life and property within the territory of the United States and its possessions, as well as other countries, and whereas it is only through the scientific investigation of the phenomena that there is hope of discovering the laws which govern them, so as to predict their occurrences and to reduce the danger to life and property, and whereas such investigations can be successfully conducted only with the support of the general Government, be it therefore resolved that this society urges upon Congress the establishment of a national bureau of seismology, and suggests that this bureau be organised under the Smithsonian Institution with the active cooperation of the other scientific departments of the Government, and that this bureau be charged with the following duties:—(*a*) the collection of seismological data; (*b*) the establishment of observing stations; (*c*) the organisation of an expeditionary corps for the investigation of special earthquakes and volcanic eruptions in any part of the world; (*d*) the study and investigation of special earthquake regions within the national domain.

The annual election of members, held at the executive session on April 24, resulted in the election of the following candidates:—*Residents of the United States*: L. A. Bauer, M. T. Bogert, H. C. Bumpus, A. Carrel, E. B. Frost, R. A. Harper, W. H. Hobbs, A. V. W. Jackson, J. F. Lewis, A. L. Lowell, W. R. Newbold, C. B. Penrose, W. H. Taft, C. R. Van Hise, V. C. Vaughan. *Foreign residents*: Francis Darwin, H. Diels, E. Fischer, F. Kohlrausch, W. F. P. Ofeffer.

THE ITALIAN EARTHQUAKE OF DECEMBER 28, 1908.

A PRELIMINARY account, based on material collected for the official report, on the Calabrian earthquake of December 28, 1908, by Dr. G. Martinelli, is published in the last issue of the *Bolletino Bimensuale* of the Italian Meteorological Society. The earthquake was felt, not only over the whole of Sicily and of Italy south of Naples and Campobasso, but also in Montenegro, the coastal districts of Albania, and in the islands of Zante, Corfu, and Cephalonia. The greatest violence was experienced in the neighbourhood of the Straits of Messina, but there were also two independent centres in Sicily, one near Raddusa and the other near Augusta, in which the violence reached seven and eight degrees of the Mercalli scale respectively. The epoch of the shock was 5h. 20m. 23s., and its duration about 30s. to 40s.; outside the central area it attained 50s. at Capo d'Armi, Capo Spartivento, Palmi, &c., and as much as 60s. at Cataforio, but at greater distances the duration became less, being only 20s. to 25s. at Naples. The character of the shock is described as undulatory, perpendicular, and rotary or vorticose in the central district, but the vorticose movement was not noticed where the shock fell below the eighth degree of the Mercalli scale, or a destructive degree of violence.

The disturbance of the sea produced by the earthquake was greatest along the opposite coasts of Italy and Sicily, and much greater to the south than to the north of the Straits of Messina. It was noticed all along the northern coast of Sicily as far westwards as Termini, but on the Italian coast the only record is from Vibonati, where the sea is said to have been agitated for a short time, and it is expressly stated that no sea wave was noticed at Bagnara, Scilla, or anywhere north of Cannitello, which is situated at the entrance to the straits. The marine effects of the earthquake form the special subject of a note by Prof. G. Platania in the *Rivista Geografica Italiana* (vol. xv., 1909, p. 644), who gives some particulars not mentioned by Dr. Martinelli. The first effect everywhere was a retreat of the sea, and then the advance of a great wave, followed by two or three others of decreasing amplitude, except at Catania and Giampileri, where the second is said to have been greater than the first. The height of the wave, as shown by the marks left on buildings, was 2·70 m. at Messina, but considerably higher at other places, the greatest rise measured being 8·40 m. at Giardini and Ali, and 8·50 m.



at Briga Marina; at Catania the rise was 2·70 m., at Brucoli, just north of Augusta, 1·75 m., and at Pozallo, on the south coast, 1·60 m. North of the straits the amplitude of the wave was much less, being only 0·80 m. at Torre di Faro and 0·75 m. at Milazzo. The sea waves were recorded by tide gauges at Naples, Ischia and Civitavecchia, at Porto Corsini, near Ravenna, at Mazzara, in the west of Sicily, and at Malta; the amplitude was small, except at Malta, where the total height of the waves reached 0·91 m.

The cable between Gazzi and Gallico was broken at 3·3 km. from Gallico, and so deeply buried that part of it had to be abandoned, but the cable between Torre di Faro and Bagnara was uninjured, as were those connecting the Lipari Islands. The cable from Milazzo to Lipari was broken, and also, so it is said, that between Malta and Zante.

THE ROYAL OBSERVATORY, GREENWICH.

THE annual visitation by the Board of Visitors of the Royal Observatory, Greenwich, was held on Saturday last, June 5, when, in accordance with the usual custom, the Astronomer Royal presented his annual report showing the work performed during the twelve months ended May 10.

The transit and circle observations, 10,142 and 10,034 respectively, included the sun, moon, planets, and fundamental stars, and observations of stars brighter than magnitude 9·0 in the zone 24° to 32° N. for the Oxford astrographic work. From the observations made in 1907, the value of the co-latitude, using Pulkowa refractions, was found to be 38° 31′ 21·71″.

From the solar observations of 1907, the tabular value for the obliquity of the ecliptic requires a correction of −0·01″, whilst the discordance between summer solstice and winter solstice observations, +0·20″, indicates that the mean of the observed distances from the pole to the ecliptic is apparently too small by 0·10″. The 1908 values of the diurnal changes of level and nadir are sensibly smaller than the mean values for the period 1897–1905.

The mean error of the moon's tabular place, deduced from ninety-six observations made during 1907, is −0·387s. in R.A. and −0·37″ in N.P.D., while from 105 observations the mean error in R.A., for 1908, is −0·417s.

The Second Nine-year Catalogue (1900), completed in 1905, will shortly be ready for distribution.

The altazimuth was employed as in previous years, and a comparison of the results from the two instruments, altazimuth and transit circle, shows that the lunar observations agree very satisfactorily.

A ten-year catalogue of the stars observed with the altazimuth in the meridian, during the period 1899–1908, is to be prepared, and will contain about 1500 stars of the following classes:—(1) stars in Newcomb's Fundamental Catalogue; (2) stars used for the heliometer observations of the major planets at the Cape; (3) Eros reference stars, 1900–1; (4) moon culminators and other selected stars; the star-places will be reduced to the equinox of 1900·0.

With the reflex zenith tube 1040 double and seventeen single observations were obtained during the year, eighty-eight different stars being observed. An arrangement for controlling the field illumination of this instrument by tilting the annular reflector proved unsatisfactory, and the variation of brightness is now controlled by a rheostat.

With the 28-inch refractor, observations of double stars were made from a working catalogue including all known double stars showing relative motion, Hough stars not previously observed at Greenwich, and a number of pairs, having separations of less than 2″, selected from Hussey's and Aitken's catalogues; among the stars observed were κ Pegasi, δ Equulei, 70 Ophiuchi, and Procyon. Bifilar and double-image micrometer measures of the polar and equatorial diameters of Jupiter were also made with the 28-inch refractor, some measures being made by Mr. Bowyer, before sunset, to ascertain the effects of irradiation. The new dusky ring of Saturn, discovered at the Geneva Observatory, was examined on thirteen nights.

Nearly 300 photographs were taken with the 30-inch reflector, including 23 of Phœbe, 20, 8, and 15 of J VI., J VII., and J VIII. respectively, 32 of comet 1908c for position, and 139, on thirty-seven nights, for the study of the rapid changes in its tail and form. Twenty long exposures were made in the search for Halley's comet, but without success. Whilst comet 1908c was under observation it was found that the sensitiveness of the plates was lowered by the absorption of moisture during the exposures, and the difficulty was overcome by placing an electric heater, designed by Mr. Davidson, in the plate-holder behind the plate.

In astrographic work, the photographic division made about 12,000 prints, reproducing, on double scale, 202 plates. Only 125 plates now remain to be reproduced ere the Greenwich contribution of 1149 plates is complete, and it is hoped that the work will be completed this year.

A re-computation of the perturbations of Halley's comet, by Pontécoulant's method, gave April 13, instead of April 8, 1910, as the probable date of perihelion passage, whilst the method of mechanical quadratures gave April 16; the identifications of the comet have now been carried back to 240 B.C., beyond which date no satisfactory records exist.

The observed magnetic elements for 1908 were:—

Mean declination	15° 53·5′ W.
Mean horizontal force	4·0184 (in British units)
	1·8528 (in metric units)
Mean dip (with 3-in. needles) ...	66° 56′ 17″

and there were two days of great, and six of lesser, magnetic disturbance.

In the testing division both chronometers and chronometer watches showed an improvement in their performances over those of the previous year.

The time-signal report shows satisfactory performance, but the signals from January 1 to January 7 were to some extent erroneous, being affected by an uncertain error of the Greenwich clock.

In concluding his report, Sir William Christie outlines the growth of the observatory's work since 1836. For many years, it is stated, the work of the observatory has been seriously hampered by the inadequacy of the permanent staff.

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE third annual conference of the Association of Teachers in Technical Institutions, held at Liverpool during Whitsuntide, was highly successful. On the morning of Monday, May 31, after addresses of welcome from representatives of the Liverpool Education Committee, the president, Mr. J. Wilson, delivered the presidential address. In the course of the address he stated that one of the objects of the association was to further the progress of technical education by breaking down the barriers separating technical institution teachers from those engaged in primary, secondary, and university work.

After discussing certain matters of professional interest, such as the proposed minimum scale of salaries, the conditions of service of part-time teachers, superannuation of teachers, and the representation of technical institution teachers upon such bodies as local education committees, the consultative committee of the Board of Education, and the proposed Teachers' Registration Council, Mr. Wilson said members may congratulate themselves that, upon the whole, an increasing amount of attention is being directed to technical education. Employers are recognising its value more and more, and sociologists of all phases of political thought are increasingly insisting upon the vital importance of technical education to the community. The higher ranks in the commercial world recognise more clearly than their predecessors the necessity for technical education. The main obstacle lies in the opposition of the foremen, the Trades Unions, and the apathy of the workers themselves during the critical period from fourteen to twenty-one years of age.

The work done inside the technical institutions has been characterised of recent years by a steady improvement, both in quantity and quality. The calibre of the students is slowly rising, and systematic courses extending over a period of years are being taken by many students, instead of isolated subjects as in the past. The character of the staff, equipment, and courses of instruction (both day and evening) in some of the technical schools places them now on an equal educational level with many university colleges.

After discussing the educational reforms recommended in the Majority and Minority Reports of the Poor Law Commission, Mr. Wilson pointed out that, partly as a result of the Act of 1902, the country is now covered with a network of more or less efficient secondary schools, generally of one type, that is, the old-fashioned "grammar-school" type. We need two distinct groups of secondary schools, one preparing for the universities or the learned professions, and the other preparing the boys (and girls) for commerce, scientific and technical industries, trades and crafts, while continuing the general education of the pupils. Attention was directed to the necessity of developing day courses of instruction in technical schools or polytechnics, of which there should be one in each large town or centre of population. These day courses should be of a high standing, and should be restricted to students of at least sixteen years of age.

One possible reform of great urgency is the improvement in the organisation, curricula, and methods of the evening continuation school, which should link on with the evening technical school. At present, evening continuation schools, save in a few towns, are profoundly unsatisfactory. It was suggested that the time is now ripe for the appointment of a Royal (or Departmental) Commission to deal with the general question of the organisation and coordination of technical education and its relationship to primary and secondary education. With respect to the Imperial College of Technology, it was stated that if the desires of its founders and the needs of the country are to be satisfied, this institution should not undertake work of a diploma or degree standard, but it should restrict itself to post-graduate work, technical research, and such branches of higher technological teaching which are not provided for at present. A danger facing technical education at the present moment is the tendency in some quarters to close the higher classes in pure science in technical institutions, partly through motives of economy and partly through efforts towards an illusory coordination with university college work.

Mr. Wilson then discussed the "culture" value of technical education, maintaining that a broad scientific, technical, or artistic training affords a highly valuable mental discipline, and is truly educational in the strictest sense of the term. The technical schools of this country must be judged, not only by their purely economic results, but by their gradual leavening effect upon the mental inertia and intellectual sluggishness of the nation. Passing on to certain aspects of the work inside the institutions, doubts were expressed as to the value of the elaborate system of scientific and technical examinations now held by the Board of Education and the City and Guilds Institute. In concluding, Mr. Wilson dealt with the subject of "research" in technical institutions. At present the teaching staff of these institutions, although keenly anxious to engage in research, partly for its own sake and partly from motives of professional advancement, is generally unable, save in isolated cases, to do so. The stress of institution work, including, say, ten to fifteen lectures per week, with another ten to fifteen hours' laboratory work, to which is added departmental work, correction of notes and exercises, and preparation of lectures, is so great that "research" under the present conditions is generally impossible.

In the afternoon of May 31 a valuable paper was read by Mr. A. Galbraith (Glasgow and West of Scotland Technical College) detailing the successful efforts recently made in the Glasgow district to coordinate the work of thirty-seven local evening continuation schools with that of the Glasgow Technical College, resulting in approximately five hundred fully qualified evening students, who have successfully passed through a preliminary scientific two years' course in these schools, being annually passed on to the technical college. In the evening the annual dinner of the association was held, the chief guests being the Lord Mayor and the Lady Mayoress of Liverpool, and representatives of educational organisations and institutions, as the National Union of Teachers, the Liverpool University, and local education authorities.

The morning session of June 1, devoted to professional matters such as the salary scale, conditions of service of part-time teachers, superannuation scheme, and legal matters, was opened by the Lord Mayor of Liverpool (the Right Hon. H. Chalenor Dowdall), who in the afternoon gave a reception in the Town Hall to the delegates and members of the association. At night a public meeting was held, when addresses on various phases of technical education were delivered by Mr. Max Muspratt and other prominent local educationists.

The following resolutions on general educational matters were passed during the conference:—

(1) The preliminary training which students receive at present before entering technical institutions is not such as to fit them for benefiting by the instruction provided. To improve this, the following reforms are desirable:—

(*a*) No child should be allowed to leave school before the age of fifteen, and the half-time system should be abolished.

(*b*) In the education of children attending elementary schools special attention should be paid to the teaching of practical arithmetic, elementary science, and to manual training.

(2) *Resolutions concerning the present evening continuation schools*:—

(*a*) The evening continuation schools should be affiliated to the higher institutions in their respective districts.

(*b*) The curricula of the evening continuation schools should be arranged in conjunction with the authorities of the higher institutions, who should have the right of entry or inspection.

(3) Admission to technical schools should, in general, be conditional on the student having reached a standard of education to be subsequently fixed.

(4) (*a*) The work of the secondary schools should be divided into three branches, viz. (i.) technical-secondary schools (including trade schools); (ii.) commercial secondary; (iii.) classical-secondary.

(*b*) There should be a properly graded system of scholarships, with maintenance, available at these schools.

(5) This association heartily approves of the general principles embodied in the following recommendations of the Minority Report of the Poor Law Commissioners:—

It should be illegal to employ boys below the age of fifteen or any youth below eighteen for more than thirty hours per week, and boys should be compelled to attend some suitable public institute giving physical and technical training for not less than thirty hours per week at periods to suit the convenience of employers in different industries.

The main points emphasised during the discussions at the conference were the following:—

(1) The pressing need for coordination of technical education with primary and secondary education, especially the linking on of the technical school to the elementary school through the evening continuation school.

(2) The need for the provision of technical-secondary schools in which, while continuing the general education of the pupils in English, a modern language, and science, the curricula shall be such as to afford a suitable training for those who at the end of their secondary-school period will pass on direct to the day technical institution or enter upon industrial or commercial work.

(3) The necessity for the development of higher day technological training, coupled with a generous provision of scholarships with maintenance grants.

ECONOMIC ZOOLOGY.

THE black-currant mite (*Eriophyes ribis*) is a pest only too well known to fruit-growers at the present time, and also one which seems to be rapidly increasing and spreading. Anything that will check its ravages is therefore of great importance, and it is satisfactory to learn that two new parasites of this mite have been discovered and their life-histories described by Miss A. M. Taylor in the April issue of the *Journal of Economic Biology*. The first of these is a minute fungus of the genus Botrytis, near akin to the one which attacks silkworms. This fungus, which is deadly in its action on the mites, makes its appearance when the currant-buds begin to swell abnormally owing to the presence of the mites. Spores of the fungus become blown on such mites as are exposed by the bursting of the buds, and under suitable conditions rapidly develop on their new hosts. Neighbouring mites are speedily infected, and the disease spreads until the tiny parasite has worked completely through the bud, destroying not only the mites and their eggs, but the grub by which they are accompanied.

These grubs are the larvæ of a minute fly of the family Chalcididæ, and they, too, depend for their existence upon the mites, although the number they consume is comparatively insignificant in comparison with the swarms which exist in "big-bud." It is manifest, therefore, that the hope of parasitic infection proving efficacious in the case of the currant-mite must rest with the fungus.

The economic loss to the United States through disease-carrying insects forms the subject of Bulletin No. 78 of the Entomological Bureau of the U.S. Department of Agriculture. Dealing first with malaria, the author, Dr. L. O. Howard, points out how large is the number of persons incapacitated, for a time at least, from work by this fell disease, and how easily the plague may be stayed by the destruction of mosquitoes. As examples, are cited the work that has been so effectually done at Ismailia and also at Havana. Still more serious are the results of yellow-fever, which, in addition to the huge death-losses during epidemics, is responsible for checking the development of cities such as New Orleans, Memphis, Jacksonville, and Charleston. Their progress has been greatly impeded by this one cause, which has led to a general retardation in the industrial advance of the whole of the southern States. The house-fly, or "typhoid-fly" as Dr. Howard thinks it might well be re-christened, is in some degree an even worse enemy to human progress and development than the yellow-fever mosquito, and the urgent need of a war of extermination against both these pernicious insects is strongly emphasised. Although the influence of these enemies to progress has been ignored by historians, it has, nevertheless, been great in the past, and promises, unless checked, to be still greater in the future. "The world has entered the historical age when national greatness and national decay will be based on physical rather than moral considerations, and it is vitally incumbent upon nations to use every possible effort and every possible means to check physical deterioration."

The second annual report of the committee of the South African Central Locust Bureau, drawn up by Mr. C. Fuller, and recently issued by the Government printers at Cape Town, contains a full account of the means taken by the different local administrations for the destruction of locusts during the summer of 1907–8. It is somewhat unfortunate that the Central Bureau has no control over the action of these local bodies, so that its functions are in great measure limited to receiving and transmitting warnings of the approach of locust-swarms. It is, however, satisfactory to learn that German South-west Africa and Mozambique are cooperating with the British Government in the work of prevention. For years past, it is stated, the hope has been entertained by the farmers that the locusts would disappear for a time, as has been the case on previous occasions. Such a disappearance cannot be accelerated by the work of the Bureau, but when it does come, the information gained by the recent work of that body cannot fail to be of the highest value to the country in the future. The work of extermination in South Africa is rendered the more onerous on account of the presence in some parts of the country of two species of locust, one of which breeds much earlier than the other. Consequently, no sooner is one campaign completed than preparations have to be made for a second.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Prof. M. C. Potter, professor of botany at Durham University, has been approved by the general board of studies for the degree of Doctor in Science.

The chemical laboratory will be open for the use of students during the ensuing vacation from July 5 to August 21. Dr. Fenton will give a course of fifteen lectures on the outlines of general chemistry. Mr. J. E. Purvis will give a course of lectures and practical instruction in pharmaceutical chemistry.

Mr. F. G. Smart has offered to give to the University the sum of 600*l.* in order to found two prizes to be awarded in each year, one for botany and one for zoology. The council of the Senate recommends that Mr. Smart's offer be gratefully accepted.

Lord and Lady Stanley of Alderley have endowed the London School of Tropical Medicine with a capital sum producing a yearly income of 50*l.* in memory of their son, the Hon. T. J. Stanley, who died at Sokoto, in Northern Nigeria, on November 14, 1908.

Prof. Samuel Avery, who has been head of the department of chemistry in the University of Nebraska since 1905, has been elected president of that institution. He was born in 1865, and was educated at Doane College, the University of Nebraska, and the University of Heidelberg.

The University of Glasgow has conferred the honorary degree of LL.D. upon Mr. W. H. Maw, past-president of the Institution of Mechanical Engineers and of the Royal Astronomical Society, and Prof. C. S. Sherrington, F.R.S.

The Darien Press, Edinburgh, has published for the International Academic Committee of the Students' Representative Council of Edinburgh University "A Handbook on Foreign Study," which has been compiled and edited by Mr. H. J. Darnton-Fraser, convener of the committee. Copies of the handbook may be obtained, price sixpence net, from the offices of the Students' Representative Council. The object of the handbook is to popularise in British academic circles the idea of studying abroad, and to afford persons who desire to follow this course some general guidance as to the best place to go to with the maximum of pleasure and profit. The volume is provided with a short introduction by Mr. Haldane, in which he refers to the value of foreign study, and seven articles on study abroad in various subjects are included. Prof. A. S. Pringle-Pattison deals with philosophy, Prof. William Osler, F.R.S., with medicine, Dr. J. Howarth-Pringle with surgery, Mr. J. A. S. Watson with agriculture, and Dr. T. C. Thomson with science and engineering. Valuable information of the kind a student must have is given about the various universities of Europe, and useful general information concerning study in the various countries of Europe.

SOCIETIES AND ACADEMIES.

London.

Royal Microscopical Society, May 19.—Mr. F. J. Cheshire, vice-president, in the chair.—The Foraminifera of the shore-sands of Selsey Bill, Sussex, part ii.: E. **Heron-Allen** and A. **Earland**.—A new illuminator for the microscope: J. W. **Gordon**. The apparatus provides a simple and effective means by which the intensity of the light can be regulated without disturbing any focal or aperture adjustment.

Linnean Society, May 24.—Dr. D. H. Scott, F.R.S., president, in the chair.—Presidential address, adaptation in fossil plants: Dr. D. H. **Scott**.

Geological Society, May 26.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The cauldron subsidence of Glen Coe and the associated igneous phenomena: C. T. **Clough**, H. B. **Muff**, and E. B. **Bailey**. The succession of volcanic rocks in Glen Coe is mainly a series of lava-flows, of which there are three types, augite-andesite, hornblende-andesite, and rhyolite. Agglomerates, tuffs, and sediments form but a small portion of the sequence. The Lower Old Red Sandstone age of the rocks is proved by the occurrence of plant-remains in shales at the base. The sequence is divisible into groups, which are not, however, persistent over the whole area. Each group may contain different types of lava, which interdigitate one with the other. It is probable that the district was supplied from more than one centre, the foci being independent as regards type of material erupted, although their periods of activity overlapped. The volcanic pile with patches of conglomerate and breccia at the base rests upon an uneven floor, evidently a land-surface, of the Highland Schists, and, further, the eruptions appear to have been subaërial. The cauldron subsidence, which let down the volcanic rocks and the underlying schists some thousands of feet, affected an area roughly oval in shape and measuring eight miles by five.—The pitting of flint-surfaces: C. **Carus-Wilson**. Regular pittings of uniform size are occasionally seen on flints which have been exposed to the weather. It is believed that the pittings are due to mechanical action. Observations and experiments carried out by the author indicate that such markings cannot have been produced by blows, or by any process of desiccation, and that the freezing of the absorbed water seems to be the only satisfactory explanation to account for the various details of the phenomenon.

PARIS.

Academy of Sciences, May 24.—M. Bouchard in the chair.—A hypothesis relating to the nature of the internal pressure in fluids: E. H. **Amagat**.—The infinitely small deformation of ruled surfaces: J. **Haag**.—Mixed linear equations: G. **Bratu**.—The sum of the *n* first coefficients of a Taylor's series: Carl **Hansen**.—General representations of functions: L. **Desaint**.—Certain singularities of differential equations: Richard **Birkeland**.—Differential equations of the second order with fixed critical points: Jean **Chazy**.—The preliminary map of the Chari region (French Congo): G. **Bruel**.—A self-recording compass: M. **Heit**. An apparatus is described and illustrated capable of recording automatically the deviations of a marine compass, and hence the course of the ship. The instrument is capable of furnishing valuable evidence as to the responsibility in cases of collisions.—The theory of discontinuous discharges in Geissler tubes: H. A. **Perkins**. Regarding the tube as a condenser in circuit with a high resistance, a theory of the discharge through a Geissler tube is developed which is in accord with some hitherto unexplained experimental results.—Internal pressure in gases: A. **Leduc**. From Amagat's results, the internal pressure for any gas at constant temperature is inversely as the square of the specific volume. From a discussion of experiments made on gases at low pressures, 0·5 to 3 atmospheres, this law is confirmed, and the author regards this as furnishing a proof of the accuracy of his experimental work, especially that dealing with the coefficients of expansion.—The solubility of lead sulphate: J. **Schnal**. The solubility of lead sulphate appears to be the same at 20° C. and 100° C., 0·0824 gr. per 1000 c.c., and this figure is reduced by the addition of very small amounts of sulphuric acid. The experiments are in accord with the hypothesis that lead sulphate is insoluble as such, its apparent solubility being due to a slow interaction with water, lead hydroxide and sulphuric acid being formed.—Revision of the atomic weight of phosphorus: G. Ter **Gazarian**. The mean of six concordant experiments on the density of carefully purified hydrogen phosphide gave 1·5293 grams as the weight of a litre under normal temperature and pressure. This gives 30·906 as the atomic weight of phosphorus ($O=16$). It is worthy of note that this is exactly the figure calculated by Bernoulli, starting from certain hypotheses on the constitution of the elements.—Syntheses of some derivatives of racemic fenone: L. **Bouveault** and M. **Levallois**.—Ring formation of ketonic acids: E. E. **Blaise** and A. **Kœhler**.—The oxidation of the polyhydric alcohols by a peroxydasic system: E. **de Stœcklin** and E. **Vulquin**. The oxidising agent used is a saturated solution of quinhydrone containing a trace of a ferric salt, together with hydrogen peroxide. The application of the reagent to the oxidation of glycerol, glycol, mannitol, sorbitol, and dulcitol is described.—The phenomena of fertilisation in the Zygnema: P. A. **Dangeard**.—New observation on the moth of the olive (*Prays oleae*): Th. **Dumont**. This moth, in development, does not always have three complete generations; it may have two or three, according as the eggs are deposited on the leaves or fruit. If for any reason the flowers are lacking, only a single generation can be observed.—The action of the vibrations of the vowel siren on the ear in a pathological state: M. **Ranjard**.—The relation between sleep and the retention of interstitial water: M. **Devaux**.—The metamorphosis of the muscular system in the Muscidæ: Charles **Pérez**.—The existence of gemmiform conjugation in *Ephelota gemmipara*: B. **Collin**.—The function of external water in impregnation and first stages of development of *Rana fusca*: E. **Bataillon**.—The formation of the body by the union of two independent halves in Syllis: Aug. **Michel**.—Two different modes of regeneration in *Lineus ruber*: Mieczyslaw **Oxner**.—The phenomenon of intermittence of the *Gouffre de Poudak*: E. A. **Martel**. This basin is situated at a height of 540 metres, at Poudak (Hautes-Pyrénées), and has a depth varying from 3 to 14·5 metres. The water-level rises 4 metres in fifteen minutes, remains steady for three minutes, and descends to the original level in forty minutes, each complete pulsation thus taking fifty-eight minutes. A complete explanation is wanting for this curious phenomenon.—The roots of the higher strata of the western Alps: Émile **Haug**.—The extension of the chalk marl in the neighbourhood of Foucarmont (Seine-Inférieure): Paul **Lemoine**.

June 1.—M. Bouchard in the chair.—The relations between the permeability of soils and their aptitude for irrigation: A. **Müntz** and L. **Faure**. Alluvial deposits, contrary to the generally received idea, differ greatly in their permeability to water. Thus one of two supposed identical soils proved to be 600 times more permeable than the other, and the results of cultivation obtained were in close relation to the permeability. A method of measuring the permeability of a soil is described, and also a mode of establishing a scale by means of which different soils can be compared. Details of the results obtained with seventeen soils are given, showing permeabilities ranging from 0 to 141, and these figures are discussed from the point of view of the suitability of these soils for irrigation. The first results obtained by the commission for studying the water-power of the Alps and Pyrenees: Michel **Lévy**. The mean altitude of the greater part of the hydrographic basins of the French Alps has been calculated. The yields are considerably below the figures accepted before the survey.—The granite, gneiss, and porphyry of the island of Elba: Pierre **Termier**.—The perpetual secretary announced the death of T. W. Engelmann, correspondant of the academy for the section of medicine and surgery.—The theory of functions: Paul **Kœbe**.—The evolution of heat by radio-active bodies: William **Duane**. Two evacuated glass bulbs containing ether, and connected by a capillary, form a differential calorimeter of great sensitiveness, the whole being enclosed in a massive block of lead. Any heat evolved in one bulb results in an increase in the vapour pressure of the ether and the motion of an air bubble in the connecting capillary. This bubble is brought back to the original position by utilising the Peltier effect in an iron-nickel couple. The instrument has been applied to the measurement of the heat evolved from radio-thorium, 0·025 calories per hour, a quantity of the same order as that disengaged by radium.—The radium and uranium contained in radio-active minerals: Mlle. Ellen **Gleditsch**. A new method for determining the radium in radio-active minerals is described. The minerals examined were a French autunite, a Joachimsthal pitchblende, and a Ceylon thorianite; the ratio of radium to uranium was not found to be constant in these minerals.—The composition of atmospheric air: Georges **Claude**. A description of further results obtained by the fractional distillation of liquid air by the apparatus described in an earlier paper. The conclusion is drawn that 1,000,000 volumes of air contain 15 of neon, 5 of helium, and 1 of hydrogen.—The conditions of electric charge of particles in suspension in a gas: the charges of chemical fumes: MM. **de Broglie** and **Brizard**. The fumes were examined by the ultramicroscope in an electric field. Any fumes produced by chemical action without rise of temperature are not charged electrically, and this also holds for sulphur distilled in a current of nitrogen. Fumes produced in vigorous chemical reactions, with marked rise of temperature, are charged.—The physico-chemical study of some pharmaceutical incompatibles: E. **Caille**. Certain mixtures, such as salol and camphor, form eutectics fusible at ordinary temperatures. Curves are given for salol-camphor and resorcinol-camphor mixtures.—Observations on the oxides of uranium: Oechsner **de Coninck**.—A chromyl subchloride: P. **Pascal**. Chromyl chloride, CrO_2Cl_2, is reduced by nitric oxide, a chloride, $(CrO_2)_3Cl_4$, being formed. Details of the chemical properties of this substance are given.—A new medicinal bark from the Ivory Coast and its alkaloid: Ém. **Perrot**.—The catalase of the blood: C. **Gessard**. Hæmoglobin and fibrin, carefully freed from catalase, are without action on hydrogen peroxide solutions.—The determination of the temperature of Pasteurisation of milk with respect to its industrial applications. The influence of the heating on the conservation of the physiological properties of milk: P. **Mazé**, P. **Guérault**, and

M. **Dinoscu.**—The hypotensive and myotic action of normal human urine: J. E. **Abelous** and E. **Bardier.**—The metamorphosis of the muscular system in flies: Charles **Pérez.**—*Lathraea clandestina*, a parasite of the vine in Loire-Inférieure: M. **Col.**—The strata of the eastern Alps and their roots: Emile **Haug.**—The existence of a conglomerate and an Eocene discordance in Greece: Ph. **Négris.**—New observations on the strata of eastern Corsica: E. **Maury.**

DIARY OF SOCIETIES.

THURSDAY, June 10.

Royal Society, at 4.30.—Croonian Lecture: The Functions of the Pituitary Body: Prof. E. A. Schäfer, F.R.S.—(1) A Wave-length Comparator for Standards of Length; (2) The Use of Wave-length Rulings as defining Lines on Standards of Length: Dr. A. E. H. Tutton, F.R.S.

Royal Institution, at 3.—A Modern Railway Problem—Steam *v.* Electricity: Prof. W. E. Dalby.

Mathematical Society, at 5.30.—On the Behaviour at the Poles of a Series of Legendre's Functions representing a Function with Infinite Discontinuities: F. J. W. Whipple.—An Analogue of Pascal's Theorem in Three Dimensions: W. H. Salmon.—Some Symbolical Expressions for the Eliminant of Two Binary Quantics: A. L. Dixon.

FRIDAY, June 11.

Royal Institution, at 9.—Problems of Helium and Radium: Sir James Dewar, F.R.S.

Physical Society, at 8.—The Arthur Wright Electrical Device for evaluating Formulæ and solving Equations: Dr. A. Russell and Arthur Wright.—The Echelon Spectroscope, its Secondary Action and the Structure of the Green Hg line: H. Stansfield. The Proposed International Unit of Candle Power: C. C. Paterson.—Inductance and Resistance in Telephone and other Circuits: Dr. J. W. Nicholson.—Note on Terrestrial Magnetism: G. W. Walker.—On the Form of the Pulses constituting White Light: A. Eagle.

Royal Astronomical Society, at 5.—Observations of Helium D_3 Absorption in the Neighbourhood of Sun-spots in 1908: Capt. R. A. C. Daunt.—The Constants of the Moon's Physical Libration: F. J. M. Stratton.—On certain Coefficients in the Algebraical Development of the Perturbative Function: R. T. A. Innes.—Magnitude of η Argûs, 1909: R. T. A. Innes. Recent Observations of the Rings of Saturn, and their Bearing on some of the Phenomena of the Disappearance of the Rings in 1907: E. E. Barnard.—Ephemeris of Flora near the Time of Opposition in 1909: A. M. W. Downing.—Report on the Measurement of an Arc of Meridian in Uganda: Col. C. F. Close.—On the Erroneous Results of Stereoscopic Observations of a Comet: E. E. Barnard.—A Method of Double Star Measurement: J. B. Dale.—Note on an Electric Heater for use in a Plate Holder on Damp Nights: Astronomer Royal.—*Probable Paper:* Numerical Example of Mr. Innes's Method for the Development of the Perturbative Function: F. Robbins.

Malacological Society, at 8.—Diagnoses of new Trochoid Shells from North Queensland: H. B. Preston.—Notes on some of the Ampullariidæ in the Paris and Geneva Museums: G. B. Sowerby. On the Radulæ of British Helicidæ: Rev. E. W. W. Bowell.

SATURDAY, June 12.

Royal Institution, at 3.—The Vitality of Seeds and Plants: (2) The Life and Death of Seeds: Dr. F. F. Blackman, F.R.S.

MONDAY, June 14.

Royal Geographical Society, at 8.30.—Survey and Exploration in the Ruwenzori and Lake Region, Central Africa: Major R. G. T. Bright, C.M.G.

TUESDAY, June 15.

Zoological Society, at 8.30.—On some Points in the Structure of the Lesser Anteater (*Tamandua tetradactyla*), with a Note on the Cerebral Arteries of Myrmecophaga: F. E. Beddard, F.R.S. On Decapod Crustacea from Christmas Island, collected by Dr. C. W. Andrews, F.R.S.: Dr. W. T. Calman. Notes on a Young Specimen of the Walrus lately living in the Society's Gardens: Dr. P. Chalmers Mitchell, F.R.S.—Notes on the Viscera of a Walrus (*Trichechus rosmarus*): R. H. Burne.

Royal Statistical Society, at 5.—Annual General Meeting.

Faraday Society, at 8.—The National and International Conservation of Water for Power: E. R. Taylor. The Formation of Silicon Sulphide in the Desulphurisation of Iron: W. Fielding. A Contribution to the Study of Electric Furnaces as applied to the Manufacture of Iron and Steel: C. A. Keller.—Automatically Circulating Furnaces of the Gin Type for the Electrical Production of Steel: G. Gin.

Mineralogical Society, at 8.—On Carnotite and an Associated Mineral Complex from South Australia: T. Crook and G. S. Blake. On the Species Pilolite, and the Analysis of a Specimen from China: G. S. Whitby.—On Phenacite from Brazil: Dr. G. F. Herbert Smith. The Composition and Structure of a Meteoric Stone from the Dokáchi Shower (1903): H. L. Clarke and Prof. H. L. Bowman.

WEDNESDAY, June 16.

Geological Society, at 8. The Carboniferous Limestone of County Clare: J. A. Douglas. The Howgill Fells and their Topography: Dr. J. E. Marr, F.R.S., and G. W. Fearnsides. The Mandible of *Sthenurus* [illegible], sp.n.: L. Glauert. (1) On some Reptilian Remains from the [illegible] of Lossiemouth; (2) On some Reptilian Tracks from the [illegible]. (3) The Anatomy of *Lepidophloios laricinus*, Sternb.: D. M. S. Watson.

Royal Meteorological Society, at 4.30.—The Interdiurnal Variability of Temperature in Antarctic and Sub-Antarctic Regions: R. C. M[illegible].—Testing of Registering Balloon Apparatus at Low Temperatures: Dr. W. Schmidt and E. Gold.—A Plea for the Use of Freely-exposed Thermometers in Addition to Sheltered Ones: L. C. W. Bonacina.

Royal Microscopical Society, at 8.

THURSDAY, June 17.

Royal Society, at 4.30. *Probable Papers*: On the Origin of Certain Lines in the Spectrum of ϵ Orionis (Alnitam): Sir Norman Lockyer, K.C.B., F.R.S., F. E. Baxandall, and C. P. Butler.—On Electrostatic Induction through Solid Insulators: Prof. H. A. Wilson, F.R.S.—The Effect of Pressure on the Band Spectra of the Fluorides of the Metals of the Alkaline Earths: R. Rossi.—The Ionisation produced by an α Particle. Part I.: Dr. H. Geiger. On the Diffuse Reflection of the α Particle: Dr. H. Geiger and E. Marsden.—The Decay of Surface Waves produced by a Superposed Layer of Viscous Fluid: W. J. Harrison.—The Passage of Electricity through Gaseous Mixtures: E. M. Wellisch. A Study of the Use of Photographic Plates for the Recording of Position: C. E. K. Mees.—The Coefficients of Capacity and the Mutual Attractions or Repulsions of Two Electrified Spherical Conductors when close together. Dr. Alexander Russell.

Linnean Society, at 8.—On the Growth of a Species of Battarea: J. G. A. Tepper.—The Deposits in the Indian Ocean: Sir John Murray, K.C.B., F.R.S.—The *Sealark* Perseidea, Stenopidea, and Reptantia: L. A. Borradaile. The *Sealark* Polychæta. Part II.: F. A. Potts. The *Sealark* Lepidoptera: T. Bainbrigge Fletcher.—New Species of Malesian and Philippine Ferns: Dr. H. Christ. The African Species of Triumfetta, Linn: T. A. Sprague and J. Hutchinson.—The Acaulescent Species of Malvastrum: A. Gray and A. W. Hill.

FRIDAY, June 18.

Royal Institution, at 9.—A Recent Visit to the Panama Canal: A. H. Savage Landor.

CONTENTS.

THURSDAY, JUNE 17, 1909.

EXPERIMENTAL EMBRYOLOGY.

Experimental Embryology. By J. W. Jenkinson. Pp. viii+341. (Oxford: At the Clarendon Press, 1909.) Price 12s. 6d. net.

EMBRYOLOGY as a branch of science is usually taken as dating back to the publication, by Caspar Friedrich Wolff, of the "Theoria Generationis," in 1759. Experiment, as an aid to the study, is of more recent date, and may be considered as commencing with Prof. Wilhelm Roux in 1883, twenty-six years ago. The coming-into-being of any living thing is a cycle beginning at a certain point and ending at a similar one, the starting-point of a new round. Primarily the studies of the embryologist are concerned with the elucidation and explanation of the phenomena included within this. Wolff tried to demonstrate, in the instance of the chick, how from an apparently undifferentiated mass, what we should now term the cleavage-products of the egg, part was gradually added to part, much in the manner that any day one may witness the building of a house from a heap of materials. He thus founded what is known as the doctrine of *epigenesis*. As Dr. Jenkinson remarks, this theory was "tacitly accepted by all the great embryologists of the nineteenth century—Pander, von Baer, Reichert, Bischoff, Remak, von Kölliker, Kowalewsky, Haeckel," and "the epigenetic idea continued to control the progress of research."

As initiated by Prof. Roux, the experimental study of embryology is based on a modification of the doctrine of epigenesis, little or no consideration being paid to any rival theory of development. Following on the work and theories of Wilhelm His, Roux raised "what in His's hands had been merely a principle to the rank of a theory, the 'Mosaik-theorie,' or theory of self-differentiation," under which "every separately inheritable quality of the body has its own representative in the germ."

In this there has always been included implicitly the belief that it was the main, if not the sole, task of the fertilised egg to give rise to a new embryo. In this way the importance of "the embryo" in the embryological mind has been greatly exaggerated, and little or no weight has been laid upon other phenomena of the life-cycle prior to its appearance. As research so often has revealed in recent years, the cycle from egg to egg is possibly, even probably, nothing like so simple as the upholders of *epigenesis* in the nineteenth century and earlier believed and taught. It appears, therefore, of prime importance that, prior to operative interference with, say, the egg-cleavage of any particular form, a complete knowledge of the normal life-cycle be obtained. How necessary this is to the investigator is evident from the consideration that in many of the best investigated cases most of the cleavage-products are concerned, not in forming by *epigenesis* portions of an embryonic body, but in producing structures of an evanescent character, unrepresented in any way in the adult animal, or even in the embryo.

Then, as a perusal of the present ably-written book reveals, the experimental embryologist seldom has anything of the nature of an embryo before him. He may, and often does, speak of the Pluteus of a brittle-star, or the Bipinnaria of a starfish, indifferently as a larva or as an embryo. But there is no homology between the Pluteus and the brittle-star; neither as a whole nor as to its parts is the one converted or "metamorphosed" into the other, as mythologically Jupiter turned himself into a bull. In short, direct development is also assumed.

Modern forms of the doctrine of evolution or unfolding are usually supposed to be the "Mosaik-theorie" of Roux and the "Germplasm-theory" of Weismann. The former has much in common with epigenetic doctrine, and the latter, with the ids, determinants, &c., really only transfers the powers of the builder, epigenesis, to the cell-nucleus of the fertilised egg. There is a theory of development, not mentioned in the present book, and which had its most recent advocacy in the last presidential address to the British Association for the Advancement of Science. This is Ewald Hering's theory of (unconscious) memory of germ-cells (1876), which in recent years has been elaborated by Richard Semon (and by the writer). This theory of "Die Mneme," to use Semon's term, along with an actual continuity of germ-cells from generation to generation, would appear to be in better accord with the facts of animal development than that of *epigenesis*. Unlike the latter, it explains, for instance, how from a single egg two embryos (identical twins), or even as many as eleven (an armadillo, *Praopus hybridus*), may arise.

If in first principles investigation be based erroneously, as experimental embryology would appear to have been hitherto, it cannot be wondered that the results have been discordant, or that no really fundamental advances have been made. There is still another point to be emphasised, that is, how difficult, even impossible, it is in any experimental study of development to be sure what has actually been done in any operation. In a sense the results always border on pathology, although a recent writer, Prof. H. H. Wilder, has given good reasons for the opinion that, as a rule, monsters, as they occur in nature, cannot be produced experimentally, at all events by mechanical means. It is also a feature of practically all researches in experimental embryology that the organisms dealt with never revert to the normal, never resume or continue for any appreciable period the normal life-cycle.

The difficulties in the way of estimating the results, as well as of determining what has actually been done in the operations, throw light on other conclusions, such as Driesch's speculations on neo-vitalism, and on mechanical theories of the nature of life.

The investigations hitherto made in experimental embryology and their results, as given with an excellent critical discussion in this book by Dr. Jenkinson, remind one of "die Sieben Welträthsel" of Emil du Bois Reymond. No doubt the study is a fascinating one, for the unexpected is always happening in it, but it is questionable whether any investigations yet made in experimental embryology have furnished the solution of any important scientific problem. For more reasons than one it has appeared desirable to take into account in embryological teaching recent experimental researches, such as those described in this book, which, therefore, may be welcomed as of great value to the student and the teacher alike. It is well illustrated, clearly written, and the material is treated critically. Author and publishers may be congratulated upon the production of a work, which is everything that a text-book should be, though its price (12s. 6d. net) appears to be excessive. B.

ELEMENTARY BOTANY.

(1) *Plants and their Ways. An Introduction to the Study of Botany and Agricultural Science.* By E. Evans. Pp. viii + 171. (London: J. M. Dent and Co., 1908.) Price 1s. 4d.

(2) *Mikroskopischer und physiologischer Praktikum der Botanik für Lehrer.* By G. Müller. Zweiter Teil. Kryptogamen. Pp. xii + 165. (Leipzig and Berlin: B. G. Teubner, 1908.) Price 4 marks.

(3) *A First Book of Botany.* By Elizabeth Healey. Pp. viii + 142. (London: Macmillan and Co., Ltd., 1909.) Price 1s. 6d.

(4) *Familiar Swiss Flowers.* Figured and described by F. E. Hulme. First Series. Pp. 56; with 24 coloured plates. (London: Cassell & Co., Ltd., 1909.) Price 1s. net.

(1) IT has always been recognised that with the extension of natural-history teaching to schools under the designation of nature-study there was a danger lest the requirements of an exact science should not be maintained. The first of these books gives grounds for such apprehension, because, although it contains much good matter and observational study is made the keynote throughout, there is a lamentable amount of loose writing, some unsatisfactory deductions, several uncertain experiments, and a few mistakes. For instance, the definitions of bulb and epiphytes require emendation; in section 31 it is not shown *why* roots bend downwards; in section 34 there will certainly be an error in the amount of soil washed away; in section 105 flower buds are required, and in section 107 the word "nearly" vitiates the instructions. With regard to loose writing the following are a few selected quotations:—"When the pollen tube enters the ovule, the tip breaks off"; "pollen grains are cells to the botanist and each is a reproductive body"; "the reason why plants vary is not fully understood at present, but it may be largely due to *adaptation*, to *environment* or surroundings"; "the plants which come between the xerophytes and hygrophytes are known as mesophytes." Nevertheless, as the general scheme of the course is well conceived, it would seem worth while to correct the quoted and similar passages, to revise or replace unsatisfactory experiments, and amplify the information where it is often insufficient.

(2) The first part of Muller's "Praktikum" dealing with phanerogams followed conventional routine, but in the second part he has pursued a somewhat irregular course. The pteridophyta, *i.e.* lycopods and horsetails, as well as ferns, are confined to a dozen exercises; the thallus of Marchantia and the growing point of Metzgeria are the only features noted for liverworts, but several sections are devoted to mosses; further, in these groups the reproductive organs are entirely left out. Among the algæ, diatoms receive very ample consideration, although the red and brown seaweeds are almost entirely neglected. The fungi receive scant treatment, while a full quarter of the book is devoted to bacteria. Thus the book is exceedingly weak in taxonomy and is not of much value to the embryo teacher, although it contains a certain amount of information useful to the amateur botanist, especially if he is interested in mosses or diatoms; also there is that amount of information on bacteria which would enable him to grasp their general import, make a few personal experiments, and understand the general methods of culture. There is little fault to find with the actual information on individual points, as the author is exact and explicit. Excepting the experiments with bacteria, it may be inferred that the author bases his instructions on his own personal experience.

(3) The elementary book by Miss Healey provides a useful book for school teaching; it is well planned, is not overloaded with information, and is written in simple language. Each chapter contains a short lesson, and is followed by instructions for practical work in which due attention is paid to the necessity for careful observation and drawing. The course is arranged for morphology in the autumn, followed by physiology, and the chapters on classification would be reached in the spring. There are some doubtful points in the chapter on the root, notably the statement heading a paragraph that roots always grow downwards, but otherwise there are very few statements to which one can take exception.

(4) The volume on Swiss flowers forms part of the book published last year and already noticed in NATURE; it is now being published in five series. The illustrations are the chief feature, and, on account of the magnificent beauty of Alpine flowers, represent some of the most charming illustrations executed by the late Prof. Hulme. The absence of a systematic arrangement and the grouping of plants bearing no relationship to one another on the same plate are defects in an otherwise pleasing work.

AN ESSAY IN PALÆONTOLOGY.

The Transformations of the Animal World. By Charles Depéret. Pp. xvi + 360. (London: Kegan Paul and Co., Ltd., 1909.) Price 5s.

THIS book, well known in its French original, deals with the geological evolution of animals. It contains discussions on the phenomena of variation, extinction and migration, and is sufficiently modern to include a brief notice of the discoveries of early forms of elephants in the Fayum district.

The first part of the book, forming about one-third of the whole, consists of summaries of the chief work associated with names famous in geological and evolutionary literature. The geological work of Darwin himself is passed over with the remark, "the only fossil animals he had personally studied were the Cirripedes." The post-Darwinian writers alluded to are Gaudry, Neumayr, Cope, and Zittel. This section will be of considerable interest to those who are beginning palæontology.

The second part of the work deals with the nature of variation both in recent time and throughout the ages. The phenomena chosen are those exhibited by certain helices, and the discussion is inadequate to the extent and importance of the subject. The author subsequently passes on to another group of Mollusca, the ammonites, in order to discuss the relationship between species in successive formations. Throughout this section and the following one, dealing chiefly with the evolution of certain Ungulata, the author is at pains to discriminate between the laborious work of Neumayr in tracing out the branches of one phylum from the parent stem, and the more brilliant but (according to him) less permanent work of Gaudry in piecing together the fragmentary records of several phyla or orders into a continuous history.

The two following sections give a short summary of the factors that accompany extinction, and of the events that constitute migration. Under the first of these the questions of size and complexity, of appendicular growths, and of senility are illustrated by examples, but are, of course, not answered. We miss any reference to the suggestive work done by Beecher on old-age problems in palæontology.

Between the discussion on extinction and that on migrations the author has intercalated a couple of chapters on the very kernel of his subject, *i.e.* the relation between individual and racial development and the nature of that variation which provides material for the development of new species. The treatment of these topics will probably be considered as very inadequate to their importance. In regard to mutations (for which the author has the phrase "explosions"), an extremely brief reference only is given to de Vries and Nillson, and none whatever to Mendel or to recent discoveries in genetics.

The work concludes by suggesting that earliest forms of fossils will be found at the poles, where "the earliest sediments may have escaped metamorphism by reason of their rapid incorporation into continents and the absence of a heavy superposition of later deposits." Let us hope that Lieutenant Shackleton will confirm this supposition.

As the quotation suggests, this book suffers from inadequate translation. Not only is the rendering obscure, but the author's use of terms such as polyphyletic, mutations, &c., to say nothing of stratigraphical terminology, is not that accepted in this country. Undoubtedly a general work of this kind is a need of the times, but we fail to see that this volume is an adequate rendering of the factors that accompany evolution. The book suffers from entire lack of references and illustrations, and in its English dress it contains many serious mistakes, *e.g.*, "chiroptera like the squirrel" (pp. 315, 351); "narrow cuttings" (evidently intended for "thin sections," p. 329); "eaters" (p. 315) is possibly intended for "rodents." To those who are familiar with the fossils and the authors referred to in the text, the volume may be not unacceptable as an attempt to deal in a continuous narrative with many and complex problems; but for the larger public that is anxious to obtain the latest verdict of science on the mode of origin of that splendid diversity that has accompanied animal evolution, the author assumes, we fear, too much detailed knowledge both of zoology and of geology.

TWO BOOKS ON THEORETICAL CHEMISTRY.

(1) *Vorlesungen über chemische Atomistik.* By Dr. F. Willy Hinrichsen. Pp. viii+198. (Leipzig and Berlin: B. G. Teubner, 1908.) Price 7 marks.

(2) *First Principles of Chemical Theory.* By Dr. C. H. Mathewson. Pp. vii+123. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 4*s.* 6*d.* net.

(1) DR. HINRICHSEN explains that in composing these lectures he has expanded and completed two earlier works of his, (*a*) "Chemische Atomistik" (1906), and (*b*) "Über den gegenwärtigen Stand der Valenzlehre" (1902). The main topics are the usual ones of the atomic theory, the periodic system of the elements, valency, solution, and the relations between electricity and matter. Quite the best parts of the book are those dealing with the subject of valency, on which the author is an authority.

The lectures were delivered to audiences which did not consist entirely of chemists, and they begin and end with the relation between science and philosophy. In leading up to the atomic theory, the author makes a very suggestive quotation from Kant, of date 1786, to the effect that chemistry could not become a genuine science, and must remain a mere schedule of empirical knowledge, until the possibilities by number and measure of chemical action between different kinds of matter should be deduced from a theory. The author, instead of pointing out that Dalton did arrive at the law of multiple proportion by deduction from the atomic theory, adopts the erroneous view that the formation of the theory was a consequence of the discovery of the law.

J. B. Richter's work (1791–1802) is cited as a response—intentional or unintentional—to the stipulations of Kant. Actually Richter, with his hypothesis that the equivalent amounts of different acids fall into a geometric series, and of the different bases into an arithmetical, was much less fortunate than William Higgins, who explained the composition of different compounds of the same elements in terms of atoms. For instance, he supposed that sulphur dioxide consists of compound atoms, each made up of one atom of sulphur and one of oxygen, whilst the compound atom of the trioxide is made up of one of sulphur and two of oxygen. Higgins published his ideas in the year 1789.

The author states that he regards the historical development of chemistry as revealing the best order for studying and teaching the subject. Quite a number of chemists now profess this belief without realising that the use of the historical method presupposes that the teacher has a grasp of history. Ostwald's dictum—"a most remarkable and praiseworthy thing in scientific literature is that almost every word is written conscientiously" can hardly be applied to the usual treatment of the history of science. The historical conscience is somewhat blunt in the scientific man. In the present book, for instance, the statements are made that Lavoisier introduced the use of the balance into chemistry (p. 12), and that Dalton discovered the law of multiple proportion on consideration of marsh gas and olefiant gas, and then of carbon monoxide and dioxide, confirmed his discovery by the oxides of nitrogen, and then arrived at his atomic theory (p. 24). These statements are mere fiction.

In discussing solution, the author says nothing of the hydrate theory, and instead of pointing out that the theory of ions is extremely useful and extremely vulnerable, remarks that it can be regarded as one of the best-founded hypotheses of modern chemistry (p. 151). There is a curious statement on p. 40 to the effect that the practice of writing chemical formulæ, such as H_2SO_4, instead of H^2SO^4, is more common in Germany than elsewhere.

(2) This book is evidently the outcome of a keen interest in the teaching of chemistry. It is intended to be used by first-year students at a university, in connection with a course of lectures on chemical theory. There are chapters (in addition to what is to be expected on molecular and atomic weights, the periodic system, &c.) on the theory of electrolytic dissociation, the law of mass action, the phase rule, and thermochemistry.

Surely it is a mistake in policy to state Avogadro's hypothesis and to proceed without a moment's delay to apply the hypothesis to prove that the molecule of oxygen can be halved (pp. 11–12). Again, it would be much better to omit the proof on pp. 47–48—not a very clear one—that the "molecular weight of a gas is equal to twice its density compared to hydrogen." Once the student realises that under similar conditions the molecular weights of different gases occupy the same volume, it is obvious to him if it is only pointed out that he can find the density of a gas relative to hydrogen by dividing the molecular weight of the gas by 2 (the molecular weight of hydrogen).

A. N. M.

OUR BOOK SHELF.

Malleable Cast Iron. By S. Jones Parsons. Pp. xi+171. (London: A. Constable and Co., Ltd., 1909.) Price 8s. net.

THAT malleable cast iron has been given a work to itself is an index of its growing importance in the world of iron and steel. The methods of its manufacture are so closely allied to the other parts of foundry work that it is doubtful whether it is not better dealt with in a general work on the foundry, where its special features may be pointed out in a section devoted to this subject.

The present work deals with the whole of the foundry aspects of malleable cast iron, melting, moulding, annealing, cleaning and straightening, design, patterns, inspection and testing, supplementary processes such as galvanising, and applications. The practical part of the work seems well done and needs little comment, but it is very unfortunate for those who are endeavouring to promote the application of science in the foundry that the compositions given on p. 9, if such pigs could be procured, would yield disastrous results. This is particularly unfortunate as the number of what are called "practical men" seeking the assistance of science in the foundry is steadily increasing, and these men are very keen on the quest after they have proved its first benefit. Anything misleading which would give them a feeling of distrust should be avoided if possible.

The analyses on p. 9 show pig-irons with from 0·145 to 2·52 per cent. sulphur and 0·93 to 1·50 per cent. phosphorus as suitable for the manufacture of malleable cast iron, whereas good specimens of this material do not contain more than about 0·1 per cent. phosphorus.

The definition of shrinkage is not good, and the author fails to grasp the essential differences between the manufacture of Réaumur and Blackheart malleable iron. Many other points have been noted, such as "that theorists regard the pyrometer as indispensable, but in practice it is less trustworthy than the trained eye," &c. W. H. Hatfield, whom he praises, would tell the author that this statement is quite out of date. This work as a whole is untrustworthy so far as the science underlying the manufacture of malleable cast iron is concerned. A. McW.

A Manual of Infectious Diseases. By Dr. E. W. Goodall and Dr. J. W. Washbourn, C.M.G. Second edition, revised and enlarged by Dr. E. W. Goodall. Pp xii+426. (London: H. K. Lewis, 1908.) Price 14s. net.

THE second edition of this well-known book has been prepared by Dr. Goodall, who expresses the loss sustained by pathology and clinical medicine by the untimely death of Dr. Washbourn, which occurred since the first edition appeared.

Little but praise can be expressed for the work. The descriptions of the diseases dealt with, their symptomatology and treatment, are clearly and concisely stated, and the differential diagnoses are excellent. All recent work seems to be incorporated, and the pathology and bacteriology of the diseases are given so far as is known. Thus, under small-pox, we find descriptions of the *Cytoryctes variolae* of Guarnieri and of the intracellular bodies of Councilman, Calkins, and Tyzzer.

We think that in a few instances the arrangement of the subject-matter might with advantage have been altered, or at least cross-references inserted. For instance, dealing with the "dissemination" of enteric fever, the part played by "bacilli carriers" is just noted, this portion of the subject being elaborated later under "Protection and Duration of Infectivity." Similarly the presence of virulent diphtheria bacilli in "well" persons as a mode of spread of the disease might have been emphasised, and membranous rhinitis should have been more clearly referred to in the section on "nasal diphtheria." The reviser believes that an attack of enteric fever confers almost complete protection; in this he is at variance with other recognised authorities. "Slop" diet is advocated for enteric fever, rightly so, we think; but some mention ought to have been made of more generous dieting as advocated by some, particularly in prolonged cases.

The authors doubtless had to set some limitation on the number of diseases dealt with, but as chapters are devoted to relapsing and typhus fevers and plague, diseases rarely seen in this country nowadays, we think that brief accounts of Mediterranean fever and cholera might have been included with advantage.

The book is profusely illustrated, and some of the photographs, though only in black and white, give a remarkably good idea of the characters and distribution of rashes. R. T. H.

Beschrijving en Onderzoek van den gyroscopischen Horizon Fleuriais (Model Ponthus et Therrode). By L. Roosenburg. Pp. 94; 3 plates. (Utrecht: Kemink & Zoon, 1909.)

In this pamphlet the author describes some improvements introduced into the form of gyrostatic horizon proposed by Fleuriais. In the original construction, a top rotated in a chamber from which the air had been removed, and the whole could be fixed to a sextant in front of the horizon glass. Upon the top was placed a glass scale, with arrangements for reflecting the divisions of the scale into the sextant telescope in a direction parallel to the equator of the top. The angle subtended by the divisions of the scale was ten minutes, and the position of the object was estimated on this scale.

In the new form here described, a temporary vacuum only is made, and the chamber can be opened for the inspection of the parts, and renewal of the top point and the cup in which it rotates. The top is set in motion by an air-pump, which also creates the vacuum. Observations are possible for fifteen or twenty minutes. After the top has been rotating some six or seven minutes and the precessional effects rendered negligible, the sextant is clamped with the sun or star in the field of view, and a considerable number of readings taken of the position of the object on the scale. Lastly, the reading of the sextant is taken.

The author insists on the necessity of a large number of readings in order to get good results, apparently to eliminate the effect of irregular motion, which in unfavourable circumstances can amount to 13′ in three seconds. It is contended that though practice with the instrument is necessary, it is not difficult to use, is, in fact, easily mastered, and is equally available for stars as the sun. The results of more than 200 observations are given, and, with a few exceptions, the errors of altitude are always less than 3′. The author concludes that it is a trustworthy and very serviceable instrument for the determination of position at sea, preferable to other forms of the same class.

Revue de Géographie annuelle. Publiée sous la Direction de M. Ch. Vélain. Tome ii., Année 1908. Pp. 730. (Paris: Ch. Delagrave.) Price 15 francs.

This volume of the "Revue" ranges no less widely than the preceding one. As regional geography we find classified "Étude analytique du Relief de la Corse," by J. Deprat, and "Le Pérou," by C. Guibeaud. In the mathematical department G. Perrier deals with the figure of the earth and important geodetic operations, and A. Berget writes on "Les Méthodes et les Instruments du Géographe Voyageur." M. Zimmerman provides a review of half a century of European colonisation, and P. Girardin studies the subject of glaciation in the most recent geological epoch.

The first of these papers, that on Corsica, is an important contribution to the geography and geology of an island which has not been as closely studied as might be supposed from its accessibility. M. Perrier deals principally with the new measurement of the arc of the meridian of Quito which is in the hands of the Service géographique de l'Armée. It has been in progress for nearly ten years, of which the field work alone occupied five, and its results are far from complete as yet.

The article on Peru by M. Guibeaud is a general geographical study, most useful in its way. First it provides a short survey of the country according to natural regions, and then passes on to a consideration of its chief economic, ethnographical, and political aspects. This article is particularly well illustrated. M. Zimmerman's study of colonisation is a careful collection of facts and theories, with copious references to authorities, which should form an excellent foundation for the investigation of this subject of world-importance. The volume, judged on French standards, is particularly well printed and produced. It is heavy and bulks large, and not a few readers would no doubt like to be able to obtain one or other of its component articles separately.

Notes on Dynamics. By Sir G. Greenhill. Second Edition. Pp. 221. (London: His Majesty's Stationery Office, 1909.) Price 3*s*.

This cheap issue from His Majesty's Stationery Office of a second edition of Sir George Greenhill's notes, prepared for the advanced class of the Ordnance College, Woolwich, will, we hope, become known to teachers and students. The title is modest, the book has never been advertised, and few people are aware of its great value and originality. It contains many excellent numerical examples, rather different from those which teachers usually set in elementary dynamics classes, but the reader will be even more interested in letting the author carry him occasionally into problems which are quite outside any ordinary curriculum. When he deals with problems which are dealt with in the text-books, he takes a way of his own in each case, and gives us new ideas. The end sections dealing with the stability of rigid bodies moving in fluids are of great interest. J. P.

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 intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Temperature of the Upper Atmosphere.

Like Dr. Chree (Nature, June 3), I do not think the term "stratosphere" a suitable one, and isothermal layer is obviously open to criticism. We should all be indebted to Dr. Chree if he would suggest a better and more accurate term. Isothermal column appears to me sufficiently accurate to describe the phenomena over a single station, but cannot be applied to the whole upper part of the atmosphere. Some single word implying the absence of vertical circulation is required.

There is no reasonable doubt that the daily temperature variation becomes insignificant at a height of 1 km., and hence one is apt to infer that it is negligible at 10 km.; but the observations are not sufficiently well distributed, and in my opinion the effect of solar radiation on the balloon, if not on the instruments, is too uncertain for us to speak positively about a daily variation at such heights. The two years' observations in England have shown no annual temperature variation above 10 km., and I do not believe that there is any definite change from summer to winter. It is probable that the mean monthly temperatures at 10 km. do not differ greatly either with latitude or with the season, although all the observations yet available at 15 km. show lower temperatures over the tropics than over temperate latitudes at that greater height.

I am glad to see that Dr. Chree does not assert that errors of $\pm 10°$ F. are the usual thing. Probably few of those who use the instruments would assert that such an error might not occasionally occur. If the figures for

November 11, 1907, quoted by Dr. Chree, stood alone, one would readily accept his explanation, but since that date many similar differences, though not quite so large, have been recorded. In fact, the noticeable point about the so-called isothermal layer is the very large differences of temperature that are found at the same time over places a few hundred miles apart, and over the same place within a period of twenty-four hours. Because we cannot explain the phenomena, are we, therefore, to doubt their existence? It is perfectly natural to do so; the question is simply one of the credibility of the evidence.

The evidence is of various kinds. If one of the instruments used in England be completely immersed in a bath of liquid by an observer A, the temperature of the bath being, say, between $+30°$ C. and $-50°$ C., a second observer B having the record and the instrument can ascertain within $1°$ C., or at the most $2°$ C., the temperature of the bath used by A. Why, then, cannot B equally well ascertain the temperature of the air through which the balloon has carried the instrument? Secondly, these instruments are carried up by a balloon travelling through air that has been in contact with the balloon; the balloon in general bursts, and they fall, moving now at a much greater speed, since in England we use no parachute. Two traces are made, the one showing the temperature during the ascent, the other during the descent, but it is not often possible to say which is which. As a rule, the two traces are quite distinct; mostly, one indicates a temperature of from $1°$ C. to $3°$ C. below the other throughout, but sometimes the traces cross and re-cross each other. However, the point is that the two traces are practically identical; any peculiarity of gradient shown on the one is reproduced at the same height on the other. Now I think it lies with those who imply that our instrumental records are untrustworthy to explain this. If the temperatures shown by these two traces are not the approximate temperatures of the air, what are they? Systematic errors could not be the same in the different circumstances of the ascent and descent. It is inconceivable that casual errors could always so combine as to give errors of the same magnitude in pairs time after time. It is even less likely than that a man, drawing coloured balls from a bag, should draw the same colour in every two consecutive draws, for not only is the general trace reproduced, but every peculiarity in it is also reproduced.

Thirdly, the results obtained on the Continent and in America agree perfectly with those obtained with different instruments and a different system in England. This alone is not a good argument against the possibility of large casual errors, since casual errors are eliminated in the means, but the two sets of observations are as yet not very numerous—about 100 in England—and they show the same general relation between the temperature and height of the isothermal column and the height of the barometer at the surface.

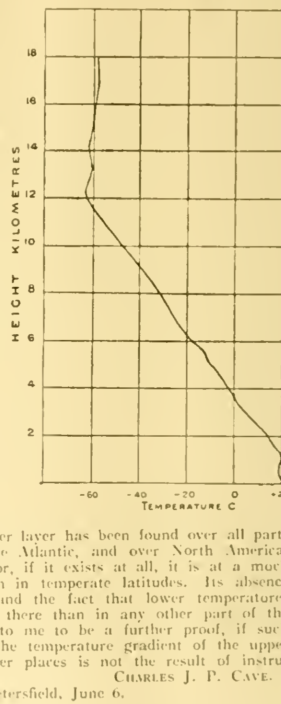
Dr. Chree, from the last paragraph of his letter, appears to think that the instrument makers supply the scale. This is not the case in England, and I do not think it is abroad. Almost every instrument sent up in England to the present time has been made here. The University of Manchester is responsible for the scales of those that it sends up, and I am responsible for the scales of the rest. These scales are verified before and after each ascent. The lag in our instruments is very small, since we depend on the expansion and contraction of a strip of very thin German silver, but I do not see that the lag affects the general question, since it will be largely eliminated if we take the mean of the ascent and descent.

W. H. DINES.

Pyrton Hill, Watlington.

As one who subscribed to the "Confession of Monaco," may I be allowed to say that no definitions of the names stratosphere and isothermal layer were supplied at the Conference as those present understood the terms? The meaning of a word has often divided the orthodox from the heterodox, and for the benefit of Dr. Chree, and also of "heretics in England," I will endeavour to make the matter clearer. Balloon ascents show that, apart from irregularities near the surface, the temperature of the air decreases with height fairly regularly up to a certain point; above this point the regular decrease ceases, and for still greater heights the temperature changes are very small; sometimes there is a small increase, sometimes a small decrease, and sometimes the temperature remains almost constant up to the greatest height reached by the balloon. At any one place and time it thus appears that the atmosphere is divided into two layers, which differ markedly from one another in their vertical temperature distributions.

A diagram from an actual ascent made here on October 1 of last year shows the two characteristic temperature gradients. To the upper layer the names isothermal layer and stratosphere have been given; the latter name is due to M. Teisserenc de Bort, who surmises that the lower layer, or troposphere, is the part of the atmosphere concerned in the vertical circulation associated with cyclones and anticyclones, while the stratosphere lies above such movements. The name isothermal layer is not a fortunate one; certainly none of the orthodox who were assembled at Monaco would maintain that the upper layer is isothermal either in time or in a horizontal direction. Some less misleading term might have increased the number of the "elect." Both terms, however, are now in general use, and give definite names to a definite thing, which, as Huxley said, is the object of nomenclature.



The characteristic temperature gradient of the upper layer has been found over all parts of Europe, over the Atlantic, and over North America, but near the equator, if it exists at all, it is at a much higher altitude than in temperate latitudes. Its absence over the equator, and the fact that lower temperatures have been recorded there than in any other part of the atmosphere, seems to me to be a further proof, if such were needed, that the temperature gradient of the upper air recorded in other places is not the result of instrumental error.

CHARLES J. P. CAVE.

Ditcham Park, Petersfield, June 6.

The Sense of Proximity.

IN NATURE for March 11 there is an interesting account by Dr. McKendrick of some investigations by Kunz, of Mulhausen, and Prof. Griesbach, on the senses of the blind. Among other points that he refers to and discusses is the question of the ability of the blind to avoid obstacles and find their way about. This calls to my mind some observations and experiments which I made upon myself some eleven years ago with reference to my ability to find my way about with my eyes shut or in the dark. These I had intended to extend and amplify, but up to the present these further experiments have been crowded out by press of other work.

Many people have the feeling that if, for instance, they are in a room in the dark, they have some perception of their relation to objects in the room, and particularly can appreciate when they are near one of the walls. I can remember having had this feeling for many years, but never had the opportunity of putting it to scientific test until the date I mention, when I was resident medical officer to a large London hospital.

Working as I was frequently until a late hour in the pathological laboratory, which opened off the entrance hall, I had, in order to reach my room, to cross the hall obliquely and enter the corridor by a wide door, some 6 feet wide, with folding glass doors, which were, as a rule, fastened back. The hall and corridor were unlighted. I usually walked well out into the hall from the door of the pathological laboratory, turned to the right when I thought I was opposite the door opening into the corridor, and then walked straight forward between the doors. I found, a good deal to my surprise, that though in the dark (even though I shut my eyes) I could judge as I walked through, very accurately, to which of the two doors I was nearest. I made a large number of observations, and the constant result was sufficient, I think, to preclude any idea of mere coincidence. I found I could even form a trustworthy estimate if I was only a few inches nearer one side than the other; and, further, if I gradually moved towards one or other side, when I got within a few inches of the door I "felt" that I was getting very close to it. The way in which I felt this is difficult to describe, but the sensation of "nearness" was situated in my face, on my forehead and cheeks, and seemed to be particularly keen on turning my cheek in the direction of the surface that I was approaching. The conclusion that I came to was that there were two different processes involved; in the first case (1) the nearness of a solid body was made evident by difference in the reflection and resonance of my footsteps as I walked, and in (2) the differences in the reflection of the heat of the face from a surface at varying distances were the cause of the sense of nearness or farness. It will be seen that I had arrived at almost precisely the explanation which Dr. McKendrick puts forward as the explanation of the power of the blind to recognise their relation to externals.

(1) To test my theory of sound reflection I tried the effect of walking in stockinged feet, and found that it sensibly diminished my power of recognising my position; this is, of course, quite analogous to the difficulty, which Dr. McKendrick describes, experienced by the blind when there is snow upon the ground. A still more conclusive test of the correctness of the theory would be to go through the same experiments with the ears effectively stopped.

Since I made these first observations I have noted many other occasions on which minute sound changes have given rise to a correct idea of relationship. Anyone may readily prove for himself in walking in the dark or with the eyes shut along a corridor with doors opening off it, some of which are open and others closed, how easy it is to recognise when one comes opposite one of the open doors, and a very little consideration will convince him that the explanation lies in the difference in resonance from the walls of the corridor and from the space into which the open door leads. Again, I have more than once noticed, when riding on top of a tram-car in the crowded city, that I have been "sensible" of another passenger sitting quietly down on the seat behind me, not through any sound that he has made, but by his cutting off from my ears a portion of the general roar of traffic. It is the finer sound indications of this type, to which we customarily pay little heed, since our eyes yield us more rapid and more complete information, that convey so much information to the blind, whose ears, if not more keen, are more intent, and the blind man's stick undoubtedly serves, not only to feel his way with, but by its tap to supply a source of sound the resonance of which may be noted. There is still much haziness, even among those who have to do with the management of the blind, as to their psychology, and one superintendent of a blind asylum with whom I am acquainted, indulging in that mysticism which at the present day is so fond of explaining phenomena, of which by experiment one may learn something, by theories of which we know nothing, would drag in that blessed word "telepathy" to explain the blind man's knowledge of surrounding objects.

(2) The second principle involved, viz. the reflection of the heat of the face from adjacent surfaces, is not so easily verifiable. I feel fairly confident, however, that accurate observations with a delicate surface thermometer would show that the cheek was receiving a certain amount of reflected heat as it was approached near to a solid object. That the skin of the cheek is peculiarly sensitive to the degree of temperature will be readily admitted by anyone who has seen a laundress testing the proper heat of her iron by holding it to her face. Further, the repetition of the experiment with the use of a mask, which would minimise the sensitiveness of the skin to changes of temperature, has struck me as likely to give conclusive results, and I am particularly interested to find this supposition supported by Dr. McKendrick's statement that the blind do not so readily avoid an obstacle if the face is covered. CHARLES H. MELLAND.

Manchester, May 29.

The Pollination of the Primrose.

IN NATURE of May 20 the reviewer, in the course of his appreciative and interesting notice of my book, "Life-histories of Familiar Plants," states:—"We notice that, without stating definitely what insect pollinates the primrose, the author refers to the bee or moth as doing it, in a misleading way. He would have been wiser to ask readers to notice what insect is really effective in the case of this plant. Neither honey-bees nor moths are known to be so." Regarding this point, on p. 78 I have written as follows:—"Now, watch the occasional bee that makes a visit to these two different types of flowers. Here is one alighting. With the sudden weight thus imposed upon it the flower sways," &c. This passage, of course, refers to a humble-bee, as the reference to "the sudden weight" clearly implies. It is true that I did not definitely state that it was a humble-bee, but, on the other hand, I have nowhere in the chapter referred to the honey-bee.

Probably the reviewer, and also readers of NATURE, will be interested in the two following notes from my diary for this year:—April 21: "Saw the first small white butterfly of the season, in garden, about 2 p.m. It was sipping nectar from a primrose flower." (Amongst the photographs illustrating the book referred to above it will be remembered that there is one showing a green-veined white butterfly feeding amongst primrose flowers.) May 3: "A species of large, black humble-bee in garden visiting only primroses and polyanthuses. Saw five of them within the space of two yards. One was a large female (the largest humble-bee that I have ever seen), and was apparently entirely black. In some of them, the pollen baskets stood out distinctly as yellow patches on their legs. One other specimen had an orange-coloured thorax." I could not at the time make a capture of one of the bees, and as cold weather followed, and the primroses had nearly done blooming, I did not see the bees again.

While possessing very little knowledge of the species of humble-bees, I am inclined to think that the species I saw was *Bombus harrisellus*, the large specimen being a queen, the one with the orange-coloured thorax a male, and the remainder neuters. Perhaps some of your readers can give some information regarding these bees, and may have observed them on primroses. So far as my observations went, the bees confined their attention exclusively to the primrose family. JOHN J. WARD.

Rusinurbe House, Somerset Road, Coventry, May 25.

REFERRING to a question raised in NATURE of May 20 (p. 345), the writer of the article "Recent Studies on Animal and Plant Life" may accept it as a fact that the primrose flowers are visited both by humble-bees and by moths, among which may be particularly named the humming-bird and bee hawk-moths. The flowers are also frequented by dipterous insects, a specimen of one of which is enclosed, by which, for the long-styled form at least, pollination may perhaps be sometimes effected.

W. E. HART.

Kilderry, Londonderry, Ireland, May 24.

THE determination of the insects that pollinate the primrose is an old problem, and my remarks in the review under consideration were made with the view of eliciting more observations on this point. The hawk-moths mentioned by one correspondent are scarcely sufficiently common to serve as the usual pollinating agencies, and the dipterous insect (apparently a Volucella) arrived in too fragmentary a condition for identification. The Bombi certainly visit these flowers, but the vague "bee" used in the book under review would certainly lead to confusion with the true honey-bee, which is not known to visit primulas. I may add that in the Manchester Museum there is a series of insects taken by Prof. Weiss on the primrose. No moths are included amongst them.

THE REVIEWER.

An Optical Phenomenon.

Is your correspondent "V. P." (NATURE, June 3, p. 398) perfectly sure that there is not in the glass pane in question one of those flattened oval air bubbles so common in window glass, which he may have overlooked? The phenomenon of the dark disc of shadow with the bright edge so exactly corresponds with the effect produced by these common flaws in glass that, in spite of his assurances, I cannot help suspecting that he may have misjudged the angle of incidence of the sun's rays. A window is before me as I write which presents identically the same phenomenon, and I was nearly being misled until, with a pencil point laid on the pane, I tracked the shadow to its source, which was much higher up on the window than I should have judged.

CHARLES E. BENHAM.

28 Wellesley Road, Colchester.

Dew-Ponds.

IN the recent correspondence on this subject several rival theories have been put forward to account for the supposed fact that certain ponds situated on the tops of hills have a plentiful supply of water. It seems to me that no satisfactory solution of the question can be expected until much more definite data are at hand.

What is wanted is a detailed, contoured survey of a typical "dew-pond" with its drainage area, and a year's observations of the height of water in it, an estimate of the number of cattle using it, rainfall and hygrometric observations in the neighbourhood, and a section showing the construction of the bed of the pond and adjoining slopes. If someone interested in the question and resident in the neighbourhood of one of these ponds would undertake the work, it would be of far more value than twice the labour spent in founding theories on insufficient data.

Wirksworth, June 12. L. GIBBS.

SPRUCE'S TRAVELS IN SOUTH AMERICA.[1]

DR. ALFRED RUSSEL WALLACE has rendered a great service to the scientific world, not only in having consented to rescue from oblivion the account of Spruce's remarkable travels, but also by the admirable way in which he has edited the manuscripts placed in his charge. Spruce's journal, which forms the substance of these volumes of about 1040 pages, has been carefully edited and considerably condensed. Passages of no particular interest have been omitted, and short summaries by the editor take their place. Several letters to Sir William Hooker, Mr. Bentham, and personal friends have been inserted which carry on the narrative and give a more life-like impression of Spruce himself.

These letters, which are keenly alive and full of human interest, form some of the most interesting portions of the book. Those to Mr. Bentham show the ardent botanist fired with enthusiasm for his work, whilst those to his friend Mr. Teesdale reflect the character of the man himself, and give a vivid picture of the every-day occurrences and of the perils which he experienced.

FIG. 1.—Cerro Duida (8000 feet), from the Cross near the Village of Esmeralda. Looking north. (R. Spruce, December, 1853.) From "Notes of a Botanist on the Amazon and Andes," vol. i.

At times the reader is inclined to complain of an occasional want of continuity and of abrupt changes of subject, but such blemishes are not common, and, owing to the necessity for condensation, could perhaps hardly have been avoided.

The first volume, covering the period from July, 1849, to January, 1855, deals with Spruce's travels on the Amazon and Rio Negro, including a journey along the Casiquiari and to the Orinoco cataracts.

The second volume opens with the account of the voyage from Manaos to Tarapoto, and continues his travels in the eastern Andes of Peru from that place, his excursions in Ecuador and in the Cinchona forests, and his last years on the western side of South America. There are also botanical and historical notes, which conclude with a highly exciting story of a hidden treasure of the Incas. The period spent in South America covered by this volume is from March, 1855, to April, 1864.

[1] "Notes of a Botanist on the Amazon and Andes." By Richard Spruce. Edited and condensed by Dr. Alfred Russel Wallace, O.M., F.R.S., with a Biographical Introduction, Portrait, 71 illustrations and 7 maps. 2 vols. Vol. i., pp. lii+518; vol. ii., pp. xii+542. With a Glossary of Native Names and Index. (London: Macmillan and Co., Ltd., 1908.) Price 21s. net.

The first volume has for frontispiece an excellent portrait of Spruce, and the biographical introduction by the editor which follows is of great interest. That a man so feeble in health as Spruce was in his earlier years could have endured the privations he experienced on the Amazon, or could have ever recovered from his illness at Maypures, or, again, could have carried on his work in the Cinchona forests with dogged determination when crippled with rheumatism, seems little short of marvellous; and yet his botanical work, which was of the highest order, was pursued with unflagging zeal, in spite of every difficulty either natural or physical.

The two volumes are full, both of well-ordered botanical information of great value, and contain also tales of peril and adventure of stirring interest. The voyage up the Rio Negro and the frequent passages of the rapids show how often Spruce was in imminent danger of his life. In the first volume one of the most interesting portions of the book is that dealing with the little-known region of the Casiquiari, the channel which unites the Rio Negro with the Orinoco. Here, in the country where Humboldt travelled, Spruce explored some rivers hitherto unmapped, and made extensive collections. He was much harassed by the mosquitoes, which, at the time of his visit, were making the region of Esmeraldas almost impossible for human habitation. The slopes of Duida and the Esmeraldas country are said to be magnificent, and Spruce's sketch, which is here reproduced, confirms his description. In addition to his sketches of the scenery, he gives some interesting drawings of the natives in this region, with good accounts of the different types of Indians with whom he met. After the excursion to the Duida mountains Spruce returned to the Rio Negro, and, going up stream, made the short portage of Pimichin, and then travelled down the Atabapo and Orinoco rivers as far as the falls of Maypures. Thence he retraced his steps a short distance; but fever was upon him, and so severe was the attack that for thirty-eight days he was unable to move.

On the return to Manaos from the Rio Negro, Spruce continued his journey up the Amazon to Tarapoto, where he spent a year and three-quarters making various difficult excursions. His letters at this period are full of graphic detail. While here he was able to effect a cure for a serious case of snake-bite, but had he failed his life would probably have been taken by the Indians.

Throughout his journeys on this side of the Andes, Spruce encountered exceptionally heavy rains, which severely hindered his botanical work, and rendered his voyage up the Amazon, particularly from Tarapoto to Canelos, very dangerous. He vividly describes the storm at Puca-yacu, where the river, normally only three feet deep and twenty-five yards wide, rose eighteen feet during the night, and they had to hold on to every creeper to prevent the canoes from being swept away, and were in constant danger of being dashed to pieces by the trees borne along by the surging waters. The journey from Canelos to Banos through the Montana, over a route which has hardly been traversed since, was attended with many perils, which were increased by the adverse weather conditions. Despite difficulties, however great, Spruce never ceased to add to his collections. Few people, we venture to think, would have dared to cross the foaming torrent of the Topo on improvised bridges of three bamboos, too slender to bear the weight of a man with his burden. The luggage and collections, therefore, had to be left, but, fortunately, they were recovered later.

FIG. 2.—Chimborazo, from the Paramo of Sanancajas. From "Notes of a Botanist on the Amazon and Andes," vol. ii.

On this journey Spruce describes how he walked through forests of giant Equisetums, 18 to 20 feet high, with stems as thick as one's wrist; to quote his own words, "a wood of young larches may give you an idea of its appearance. . . . I could almost fancy myself in some primeval forest of Calamites, and if some gigantic saurian had suddenly appeared . . . . my surprise could hardly have been increased."

After a stay of some length in the Ecuadorean Andes at Riobamba and Ambato, whence numerous excursions were made, Spruce then crossed to the western side of the Cordillera to explore the Cinchona forests, being commissioned to obtain seeds and young plants of Cinchona for India. It was fortunate that such a man as Spruce was on the spot to undertake the work. As his first visit to the forests of Alausi proved unproductive, he moved further north to the red-bark forests on the lower western slopes of Chimborazo, where the red-bark region extends from 2000 feet to 5000 feet above sea-level. Here he, with Mr. Cross, in the face of extraordinary difficulties, and in the midst of a revolution, collected seeds and raised plants of *Cinchona succirubra*. After a perilous voyage, they brought their cargo of Wardian cases safely to Guayaquil, whence they were shipped to India. The story of this enterprise is a remarkable narrative of energy and determination overcoming innumerable obstacles.

An interesting chapter in this second volume is occupied by Spruce's paper entitled "Ant agency in plant structure, or the modifications in the structure of plants which have been caused by ants, by the long continued agency of which they have become hereditary, and have acquired sufficient permanence to be employed as botanical characters." The paper was rejected by the Linnean Society in the form sent in in 1869, and was never printed, but it is worthy of careful perusal.

Other chapters deal with narcotics, the Amazons, and the interesting rock-pictures of the Amazon valley. The volume concludes with an account of the hidden treasure of the Incas, including a translation of one of the few existing copies of Valverde's guide to the Llanganati Mountains the locality of the treasure and the Royal warrant of the King of Spain discovered by Spruce after persistent search. It would spoil the exciting interest of the narrative to enter into particulars, but attention must be directed to the original and wonderfully exact map of the country, which is reproduced with the tracks of former treasure-seekers indicated. As Dr. Wallace offers an ingenious and apparently correct explanation of the reason why everyone has diverged from the right path at a certain point, there seems now to be every inducement for someone filled with the spirit of adventure to set out, chart in hand, on the five days' journey from Pillaro, and solve the question of the treasure of the Incas. A. W. H.

AN ANTARCTIC ALBUM.[1]

AMONG the most valuable assets of the National Antarctic Expedition were the artistic ability of Dr. E. A. Wilson and the photographic skill of Engineer-Lieut. Skelton; and a large selection from their sketches and photographs, supplemented by those taken by other members of the expedition, has now been issued in a sumptuous volume and portfolio containing 165 plates. The illustrations included in this collection have been selected and arranged by Dr. Wilson, and he has also written the introduction and the description of the plates; he gives full acknowledgment to Captain Scott and other of his colleagues for their help in this respect.

FIG. 1.—Mount Sabine. From a telephotograph by Lieut. R. W. Skelton; looking S. from Cape Adare to Mount Sabine, at the head of Robertson Bay, January 9, 1902. From "National Antarctic Expedition, 1901–4 Album of Photographs."

Sir Archibald Geikie contributes the preface, in which he states that the album has been printed by Messrs. Oliver and Boyd, of Edinburgh, and many of the photogravures are the work of the Swan Electric Engraving Company, by whom the pencil drawings were produced by a new process invented by Mr. Donald Cameron Swan. The sketches of the aurora and various meteorological effects are reproduced as

[1] "National Antarctic Expedition, 1901–4." Album of Photographs and Sketches; with a Portfolio of Panoramic Views. Pp. xvi + 303; 165 plates, 2 maps. (London: Royal Society, 1908.)

lithographs by Messrs. West, Newman and Co. The two key-maps were prepared by Dr. Wilson and Lieut. Skelton.

The illustrations deal with most branches of the work of the expedition, and they are naturally of most importance in connection with the topography, and Dr. Wilson's outline sketches are an invaluable supplement to the maps previously issued by the expedition, and his pictures of the aurora, clouds, and earth shadows represent features for which photography is useless. The characters of the scenery are especially well shown in the long panoramas by Lieut. Skelton, some of which are reproduced as folding plates three feet long. Some of the most interesting photographs were taken by Lieut. Skelton with a telephotographic lens, and he thus brings out the general outlines of Mount Sabine (Fig. 1) from a distance at which the ordinary photograph is comparatively useless. The album includes many zoological photographs illustrating the whales, seals, and especially those most attractive of photographic subjects, the penguins.

FIG. 2.—The Pressure Ridges at Cape Crozier. From a photograph taken by Lieut. R. W. Skelton, October 18, 1902; looking S.E. from the land-ice of the eastern extremity of Cape Crozier, Ross Island. From "National Antarctic Expedition, 1901-4. Album of Photographs."

The illustrations of the geological details are less numerous. Photographs of the glaciers are of especial value owing to the changes which take place in the distribution of the ice. There are many excellent illustrations of glacier tables, sastrugi, and icebergs; but the album would have been more useful had it contained more photographs showing the detailed intimate structure of the ice. There are several photographs of the Great Ice Barrier, but they add little to the evidence of that by Bernacchi, which was reproduced in the review in NATURE of Captain Scott's book. The photographs of the chasm between the Barrier and the land ice help to indicate the great difference between the rapidly moving barrier ice and the more stagnant ice along the shore.

The album is a more useful addition to the literature which has already appeared in connection with the expedition, and is to be regarded as a supplement to the works by Captain Scott and to the volumes of the scientific reports noticed already in NATURE, vol. lxxiii., 1905-6, pp. 297-300, two figures, and vol. lxxvii., April 16, 1908, pp. 561-2.

J. W. G.

AMERICAN AND CANADIAN WATERWAYS.

WHILE in this country the interest that at one time was evinced in the improvement of our canals, since the evidence that was brought before the Royal Commission, appears to have evaporated, in the United States and Canada this subject has come very much to the front. It is generally recognised that the question of transport by water is one of the most pressing needs of the country. During the last few years the home commerce has grown at such a rapid rate that the railways appear to be utterly unable to cope with it efficiently. During the past seven years, while trade has doubled in quantity, the railway facilities for transporting this have only increased one-fourth. It is generally acknowledged that it will be a wise policy on the part of the Government to spend as much money as will be available in improving the internal waterways and in constructing links with existing canals and rivers and the sea-ports, so as to render an efficient system of national transport.

During the last Presidential campaign, both political parties pledged themselves to make the transport by water a question of first prominence. Those engaged in mercantile traffic, and the large industrial companies are strongly in favour of an improvement in the waterways of the country as being beneficial to trade by the greater facilities of transport afforded, and in the reduction of freight charges. The railway companies are credited with offering no opposition to such an expenditure of the public funds, as they have already more traffic than they can cope with satisfactorily.

The project that is now occupying most attention is the linking up of the eastern and western sides of the country by a continuous circular waterway extending over 5000 miles, serving a district covering a million and a half square miles, or an area as great as that of this country and Europe, exclusive of Russia.

Taking New York as a centre, the proposal is to connect the waterways southward to Florida and the Gulf of Mexico, running nearly parallel with the Atlantic coast, and connecting up with the existing rivers and canals, thus providing an inland route for barges and small coasting vessels. By the Gulf of Mexico there would be communication at New Orleans with the Mississippi, and thence by the Illinois River along the Drainage Canal to Chicago and Lake Michigan. Along this part of the system dredging would be required in the upper part of the Mississippi and in the Illinois River, over a distance of 850 miles, so as to give 15 ft. depth at low water. By the Great Lakes communication already exists to Buffalo, along the Erie Canal to Albany, and thence by the River Hudson to New York. By Long Island Sound, in which some dredging would be required, Cape Cod and Boston could be reached. As collateral branches the Columbia River would be made passable for barges, and afford a way for transit to the Pacific for the States of Washington, Idaho, and Oregon.

The estimated cost of carrying out this scheme is 100,000,000 pounds.

New York at the present time is spending 20,000,000*l.* in widening and deepening the Erie Canal over a length of 445 miles, so as to enable vessels of 1000 tons to pass along it.

In the State of Illinois the Government has voted 4,000,000*l.* for deepening the Illinois River and connecting Lake Michigan by means of the Drainage Canal with the Mississippi, a distance of 100 miles.

The United States Government is also spending a large amount in improving and deepening the shoal places between the Great Lakes. At Sault St. Marie an additional chonnel has been cut, having a depth of 26 ft. of water. Below Detroit a curved channel has been replaced by a straight cut 13 miles long, having 20 ft. depth of water, which is to be increased to 26 ft. On the Ohio River, extending from Pittsburg to the Mississippi, a length of 1000 miles, for some time past works have been in course of construction for the improvement of the navigation, involving the making of fifty dams and locks at a cost of 12,000,000*l.* These locks have a length of 350 ft. by 45 ft. in width, with 17 ft. of water over the sills. A new and straighter channel, called the Ambrose Channel, has been dredged from the sea up to New York, giving a depth of 40 ft. at low water. This work has been in progress since 1901. For the over-sea shipping extensive works have also been carried out in the harbour, and a large pier constructed for ocean-going vessels. A canal has been made from the Hudson river, 2000 ft. long with 30 ft. depth of water, along which berths for vessels have been provided. At the city of Newark work has been commenced on a new port opening out of New York harbour; and a canal is being made 3 miles long by 700 ft. wide, in which berths for vessels are to be constructed, and a large area of marsh land reclaimed and adapted for storage purposes.

On the Delaware River and approach to Philadelphia a 30-ft. waterway has been dredged at a cost of 200,000*l.*; and a scheme is now under consideration for a further expenditure of 150,000*l.* by the city for the purchase of the river frontage and construction of wharves. Also, for the improvement of the navigation up to Baltimore, a 35-ft. channel is being dredged 25 miles long.

At the entrance to the Mississippi from the Gulf of Mexico, the jetties constructed by Captain Eade thirty years ago have been replaced and the channel deepened at a cost of 1,200,000*l.* A large sum is also being expended in improving the ports on the Great Lakes.

For the completion of the Panama Canal, which is now being carried out by the United States Government, 30,000,000*l.* has so far been appropriated by Congress.

In Canada the project of providing a cheap and convenient mode of transit for Canadian produce through Canadian territory to Canadian ports for shipment abroad, by connecting the Great Lakes with the St. Lawrence and so with the Atlantic by what is known as the Georgian Bay scheme, has now assumed a definite shape.

During the last few years a most extraordinary development of trade has taken place at the ports situated on the Great Lakes. The freight passing through the locks at Sault St. Marie rose from 13,000,000 tons in 1894 to 51,000,000 tons in 1906. The transit of wheat rose from 35,000,000 to 84,000,000 bushels; and of iron ore from 6,500,000 to 35,500,000 tons. In the meantime the capacity of the vessels trading on the lakes has increased to 10,000 tons. The greater part of this traffic, however, passes by American waterways to the sea coast, and only about 8 per cent. reaches the St. Lawrence. It is estimated that grain can be carried from Chicago to Montreal at two-thirds the cost of transit to New York, and Montreal is 300 miles nearer to Liverpool than New York.

The Canadian Government has been giving recently its serious attention to this matter, and it is generally admitted that the carrying out of this scheme is the next great work to be undertaken after the completion of the Transcontinental Railway.

This scheme was first mooted fifty years ago, and various routes for carrying the waterway have been proposed. A report has, however, been recently presented by the Public Works Department as the result of a survey made by its officers at a cost of 110,000*l.*, and a definite scheme settled. The route proposed is from Georgian Bay along the French river and Lake Nipissing into the Mattawa and Ottawa rivers, and so into the St. Lawrence, the distance between Montreal and Georgian Bay being 440 miles. The waterway where artificial works are required is to be sufficient to carry the largest vessels trading on the lakes, which require 20 ft. of water. The cost is estimated at 20,000,000*l.*, and the time for construction ten years. There will be required eighteen dams and twenty-seven locks, which are to be 650 ft. long. There will be 28 miles of canal excavation, and more than 400 miles of dredging in the lakes and rivers. It is also proposed as part of the scheme to use the water stored for generating electric power, and it is calculated that there will be sufficient supply and fall to develop 1,000,000 horse-power.

For improving the transit up the St. Lawrence to Montreal the Canadian Government is dredging the river over a length of 62 miles, so as to give a depth of 30 ft. at low water.

THE PROBLEM OF AN ULTRA-NEPTUNIAN PLANET.

IN this memoir[1] Prof. W. H. Pickering first gives a graphical method by which Neptune might have been discovered from the data used by Le Verrier and Adams. Having thus demonstrated the practical value of his method, he proceeds to apply it to a search for a planet beyond Neptune. He calls his hypothetical planet by the letter "O," obviously as the next letter of the alphabet to the initial of Neptune, and he finds, *inter alia*,

Mean distance	51·9
Period	373·5 years
Mass...	=twice that of the earth
R.A. in 1909·0	7h. 47m.

Now the problem presented by Uranus, Neptune, and "O" may be very readily reduced to the known problem, already fully worked out, of Mercury, Venus, and the earth, for it is easy to show that the theory of a pair of planets is the same if we retain the masses but alter the distances of both in the same proportion.

First of all, as, roughly speaking, we are only able to observe heliocentric longitudes of Uranus and Neptune, we must suppose that our fictitious observer, to whom the existence of the earth is unknown, is only able to observe heliocentric longitudes of Mercury and Venus. We may speak of him, therefore, as an observer in the sun.

Secondly, as the mass of "O" is twice that of the earth, we must credit the observer in the sun with instruments of twice the precision of those used by ourselves.

Lastly, we may divide all distances by 51, and all time intervals by 365. This latter factor enables us to substitute days for years.

We are, therefore, to suppose that an observer in the sun, with instruments of twice the accuracy of our own, has observed Mercury for four months and Venus for two months, and that in addition he has one or two stray observations of Mercury and Venus made before he recognised its planetary character.

Now let us turn to the tables of Mercury and Venus, and estimate for ourselves what chance such an observer has of demonstrating the existence of the earth.

Before doing this, however, we must pause for a moment in order to show that we may dismiss from notice all long-period terms. These terms play a very conspicuous part in planetary theory. Their existence depends upon the same principle as that of the swing, where a very small force applied at regular and suitable intervals will produce very large oscillations. Their existence necessitates the expansion of the disturbing function to ten or a hundred times the accuracy otherwise necessary, and the consequence is that from the computer's point of view the short-period terms are dismissed with scanty notice in the account that he gives of his work.

For example, in the heliocentric longitude of Venus there is a term

$$3'' \sin(13E - 8V)$$

with a period of 239 years. Our hypothetical observer, in the sun would have no chance of detecting such a term as this. If he detected in two months' observations any term at all it would be one of the following:—

$$5'' \sin(V - E)$$
$$11'' \sin 2(V - E)$$
$$7'' \sin 3(V - E)$$

the periods being 585, 292, and 195 days respectively.

[1] "Annals of the Astronomical Observatory of Harvard College." Vol. lxi., part ii. A Search for a Planet beyond Neptune. By W. H. Pickering. (Cambridge, Mass.: The Observatory, 1909.)

It may further be observed that it is the long-period terms which are largely affected by small changes in the elements of the disturbing planet; the short-period terms are not appreciably affected. During the hypothetical two months of observation the question is, "Where is the disturbing planet at that time?" not "Are the elements such as produce a long-period term?"

Further, it is not sufficient that a term of moderate amplitude and period should exist. In the hypothetical two months, only a very small portion of a complete period is observed, and the conditions must be such that the term is not mistaken for uniform motion or for a term periodic in the period of the planet under observation, for in either case the term could be represented by a change of the elliptic elements of the orbit.

At this point we wish to say that we do not think Prof. Pickering's case is a good one, and, having thus proclaimed ourselves adverse critics, we wish immediately to concede the following point. In our opinion the hypothetical observer could detect from two months' observations the term $7'' \sin 3(V - E)$ in the heliocentric longitude of Venus, and could distinguish it from a mere error of assumed elliptic elements, provided only the phase of the argument happened to be suitable during the period of observation. Reverting now to the actual case, the existence of planet "O" could be demonstrated from the observations of Neptune at the present date if the epoch of planet "O" were suitable. If the observations of Neptune show nothing, the hypothesis of the existence of "O" would not be negatived, but the hypothetical "O" would at least be confined to certain limits of longitude.

Prof. Pickering, however, has based his discovery of "O," not on Neptune, but on Uranus. In the hypothetical case we have to consider the perturbations of Mercury by the earth. In this case we have terms such as

$$0{\cdot}2'' \sin(M - E)$$
$$0{\cdot}3'' \sin 2(M - E),$$

which we believe to be quite incapable of detection from four months' observations, or at any rate of detection and distinction from elliptic terms. In saying this we do not forget that the terms must be doubled to take account of the double mass attributed to "O."

It will be seen that our criticisms are directed against Prof. Pickering's figures as we find them. We have argued against the extremely small mass assigned to the hypothetical planet, seeing that Prof. Pickering's data are the observations of Uranus. While constructing our argument we have, however, convinced ourselves that the time is ripe for a discussion of the observations of Neptune, for if the planet "O" exists, or any approximation to it, it should have produced, or at any rate should soon produce, a visible effect on Neptune.

NOTES.

MEETINGS of two special commissions appointed by the International Meteorological Committee at Paris in 1907 will be held in London during the week commencing Monday next, June 21. The appointment of the first commission arose out of a proposal made at Innsbruck by the Rev. Louis Froc, S.J., director of the Zi-ka-wei Observatory, for the general adoption of a code of maritime weather signals now in use in far eastern waters, and a further proposal made at Paris by Prof. Willis Moore, chief of the United States Weather Bureau, in favour of an international system of maritime weather signals. To this connexion the question of an understanding as to the projection and scale of charts for representing marine meteorological data was also referred. It is expected that M. Angot, director of the Bureau Central Météorologique at Paris; Father Froc, of Zi-ka-wei; Prof. Grossmann, representing Rear-Admiral Herz, director of the Deutsche Seewarte, who is prevented by illness from attending; Prof. Mohn, director of the Meteorological Institute, Christiania; and Prof. Willis Moore, will be present to take part in the meetings. The second commission is appointed to consider international questions concerning weather telegraphy, including wireless telegraphy from ships. The members to be present are Messrs. Angot, Grossmann, and Willis Moore. Both commissions are under the presidency of the director of the Meteorological Office, and the meetings will take place at the office. The commissions will report to the meeting of the International Meteorological Committee which is expected to be held in 1910. Some of the visitors will remain to take part in the meetings of the Solar Commission during the week beginning June 28.

THE annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on Wednesday, June 30.

THE death is announced, in his sixty-sixth year, of Prof. Carl N. J. Börgen, for thirty-four years director of the Imperial Observatory at Wilhelmshaven.

THE Prince of Wales will attend the meeting of the Royal Geographical Society at the Albert Hall on June 28 for the reception of Lieut. E. H. Shackleton, and will present to Lieut. Shackleton the special gold medal awarded to him by the society.

THE Pharmaceutical Society has awarded the Hanbury gold medal to Prof. W. O. A. Tschirch, professor of pharmacognosy and practical chemistry at Berne University. The medal is awarded biennially for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs.

WE have been favoured with a copy of the *Sydney Daily Telegraph* of April 20, containing an interesting account of the inaugural meeting of the Aërial League of Australia, at which Mr. L. Hargreave, the inventor of the box kite, presided. The objects of the league are, among others, to watch the latest achievements in aërial engineering; to secure the best recognition for Australian efforts in that direction; and to awaken public attention to the danger in allowing foreign nations to excel in aërial navigation.

THE Constantinople correspondent of the *Times* reports that a proposal, brought before the Chamber of Deputies on June 12, for the adoption of the system of time-reckoning used in Europe, instead of the Turkish system of reckoning time from the hour of sunset, was carried, in spite of the opposition of the *hodjas* and many Anatolian deputies, by a considerable majority, including the Arabs. But the clerical minority in the Chamber has made such an uproar that the motion has since been withdrawn.

THE council of the Royal Institute of Public Health has awarded the Harben gold medal for eminent services to the public health to Prof. E. von Behring, Marburg. Lieut.-Colonel W. B. Leishman, professor of pathology, Royal Army Medical College, has been appointed the Harben lecturer for the year 1910, and Prof. Angelo Celli, Rome, the Harben lecturer for the year 1911. The Harben lectures for 1909 will be delivered by Prof. R. Pfeiffer, Breslau, in the lecture-room of the institute on June 21, 23, and 25. The subjects of the lectures will be: the importance of bacteriolysins in immunity; endotoxins and anti-endotoxins; and the problem of virulence. The lectures will be given in English.

WE learn from *Science* that Mr. C. G. Abbot, director of the Smithsonian Astrophysical Observatory, has left Washington for Mount Wilson, California, to continue observations, in progress for a number of years, as to the intensity of the sun's rays and the effect of any variation in them upon the earth. There was recently erected on Mount Wilson a small permanent observatory especially designed for this purpose. Here Mr. Abbot, with the assistance of Dr. L. R. Ingersoll, of the University of Wisconsin, will study during the next few months. The expedition will also spend some time on the summit of Mount Whitney, 14,500 feet high, where the institution proposes to erect in July a shelter of stone and steel for the use of scientific investigators engaged in researches of any kind for which high altitudes, dry air, and clear skies are desirable.

THE famous Hope diamond was on view last week at Messrs. R. and S. Garrard's galleries, Haymarket, London, S.W. Its history has been romantic. It probably formed the larger half of the pear-shaped, Indian stone, which was stolen with the remainder of the French regalia at the time of the Revolution in 1792, and never recovered. In its present form it re-appeared in the collection of Henry Philip Hope, a wealthy banker. At his death it found its way to America, and last year, during the financial crisis, the owner disposed of it to M. Habib, a dealer, who was acting on behalf of the late Sultan of Turkey. Owing to the deposition of that monarch, the stone has come into the market once more. In the catalogue of the Hope collection it is described as of a sapphire-blue, but a slaty- or steely-blue would be more the correct description. It weighs $44\frac{1}{2}$ carats, and is by far the largest blue diamond known.

A SEVERE earthquake was experienced at many places in southern France at about 9.15 p.m. on June 11. From a full report by the Paris correspondent of the *Times* it appears that the shock was felt all along the French Mediterranean shores. On the coast it was most violent at Marseilles and Toulon. At Nice and at Cannes a shock was experienced, but it was not severe. More or less slight shocks were felt through the south-east of France from Montpellier to Grenoble and from Perpignan to Avignon. Telegrams from the Italian Riviera, on the one hand, and from Portugal, on the other, show that the shock was felt in regions so widely apart as these. The region most seriously affected by the earthquake is between Aix-en-Provence, a town about twenty miles north of Marseilles, and the River Durance, the northern boundary of the department. The line of greatest destruction seems to run in a north-westerly direction from Aix through the villages of Saint-Cannat, Lambese, and Rognes.

A SHORT account of the inauguration, on June 13, of the memorial to Lamarck, which has been erected in the Jardin des Plantes, is given by the Paris correspondent of the *Times* in the issue of June 14. The memorial was formally inaugurated in the presence of M. Fallières, and was committed to the charge of the French Government. It takes the form of a bronze figure of Lamarck seated in an attitude of meditation. Inscribed on the pedestal are the words, "To the founder of the doctrine of evolution." The *Times* says that in his speech M. Perrier traced the various stages of the development of Lamarck's theory, its relation to the studies of Buffon, Linnæus, and Cuvier, and its influence upon Darwin. The present year is at once the hundredth anniversary of the publication of Lamarck's "Philosophie Zoologique" and of Darwin's birth, and in a striking passage M. Perrier drew a parallel between the Darwinian theory and Lamarck's doctrine of methodical progress on a basis of rigorous determinism. The Minister of Public Instruction contributed to the proceedings a sketch of Lamarck's career, referring to Buffon's sympathy and friendship and to Cuvier's sceptical hostility. In the name of the French Government, M. Doumergue thanked all who had helped France to make this tardy reparation to the memory of her great son.

The launching of the magnetic survey yacht *Carnegie*, to the design and future work of which reference has been made more than once in these columns, took place on June 12 at the shipyard of the Tebo Yacht Basin Company, Brooklyn, N.Y. We have been favoured with an advance copy of an illustrated pamphlet dealing with the construction of the new boat, her object, and her work. The entire structure of the yacht is practically non-magnetic; with the exception of cast-iron pistons in the cylinders of the bronze internal-combustion engine, and the steel cams necessary for operating the valves, there are no magnetic materials in the vessel. It will be remembered that the function of the department of research in terrestrial magnetism of the Carnegie Institution of Washington is the accomplishment of a magnetic survey of the earth within a period of about fifteen years, and in connection with this scheme the magnetic survey of the oceans is assigned to the new yacht. This work will be done under the direction of Dr. L. A. Bauer, director of the department of terrestrial magnetism, and he will be represented on board the *Carnegie*, as chief of party, by Mr. W. J. Peters, who has great experience in such ocean surveying, gained when in command of the magnetic survey yacht *Galilee* from 1906–8. The *Galilee* has made a general magnetic survey of the Pacific Ocean, the total length of her cruises amounting to about 60,000 nautical miles. It is hoped that the *Carnegie* will effect a magnetic survey of the Atlantic Ocean and the Indian Ocean, and complete that of the Pacific.

We have received a copy of a paper by Drs. Raymond Pearl and F. M. Surface, reprinted from the first volume of *Zeitschrift für biologische Technik*, Strassburg, 1909, and entitled "Apparate und Methoden, die bei experimentellen Untersuchungen über Vererbung beim Geflügel gebraucht werden."

The Insectivora of the subfamily Gymnurinæ form the subject of a paper by Mr. M. W. Lyon, published as No. 1680 (vol. xxxvi., pp. 449–56) of the Proceedings of the U.S. National Museum. The author admits the distinction of the Bornean *Gymnura alba* from the typical *G. rafflesi* (or *G. gymnura*), and also describes a new and small race of the latter from Siam. The distinctive skull-characters of the allied genera Hylomys and Podogymnura, the latter at present known only by a single specimen from the Philippines, are likewise pointed out.

The May number of the *Museums Journal* contains an account, by Mr. R. T. Baker, the curator, of the Technological Museum at Sydney. The building, which was opened in 1893, contains considerably more than 150,000 specimens, and the establishment serves the purpose of a bureau of information in regard to the raw products and manufactures of New South Wales. When inquiries cannot be answered by the museum staff, visitors are referred to other sources of information.

In vol. xliv., No. 23, of the Proceedings of the American Academy of Arts and Sciences, Mr. S. Morgulis describes the capacity for regeneration possessed by one of the brittle-stars (*Ophiocoma pumila*), with special reference to the influence of the central nervous system. Although the author's experiments do not altogether support the theory that the rate of regeneration of a removed arm increases as the number of uninjured arms still remaining is diminished, it is, nevertheless, evident that there is some correlation between the degree of injury and the rate of regeneration, but this relation does not take the shape of the close parallelism suggested in the above-mentioned theory.

An account of the myxomycetes of Pictou County, Nova Scotia, by Mr. C. L. Moore, published in the Transactions of the Nova Scotia Institute of Science (vol. xii., part ii.), furnishes a noteworthy addition to the information on this little-studied group of fungi, as well as an interesting contribution to the flora of the country. In the latter respect, the diagnoses of the groups, genera and species will be found useful. One specimen, collected on *Tsuga canadensis*, is made the type of a new species, *Margarita pictoviana*. *Dictydium cancellatum* is stated to be the most general species, and others commonly found are *Fuligo ovata*, *Didymium melanospermum*, *Arcyria nutans*, *Arcyria incarnata*, and *Lycogala epidendrum*.

The Nyctaginaceæ provides an eminently fitting subject for the Contributions of the United States National Herbarium (vol. xii., part viii.), as the family is very largely American, and the group Mirabilieæ is essentially characteristic of Mexico and the adjacent southern States. This group is monographed by Mr. P. C. Standley, who adopts Allioniaceæ as the family name. The changes and additions submitted are very extensive. About twenty new species are proposed for the genus Abronia, from which the section Tripterocalyx is separated as a genus. Allionia, based on the species *Allionia violacea*, is converted into a large genus, partly by the inclusion of species of Oxybaphus and partly by additional new species. Mirabilis is reduced to four species, while Quamoclidion becomes a genus; similarly, Boerhaavia is split into four genera.

The beautiful autumnal tints characteristic of the foliage of certain trees and shrubs, so pronounced in temperate countries, are, of course, due to seasonal variations, the factors concerned being diminution of water, stronger insolation, and the advent of cold nights; also, the more marked the changes the more striking, as a rule, are the colour tones. In a short article in the Journal of the College of Science (vol. xxvii., art. 2), Tokio University, Dr. M. Miyoshi refers to a similar colour effect observed during the dry period in the leaves of the tropical tree *Terminalia catappa*. Here it is confined to the old leaves, while the younger leaves show their normal green colour, and is due to drying up of the leaves owing to the formation of an absciss layer. In both cases the colour is produced by the formation of anthocyanin.

Dr. Grasset publishes in the May number of *La Revue des Idées* an elaborate article entitled "La Physiopathologie clinique de l'Homme, Plan d'une Pathologie générale basée sur la Physiologie." The "circle of life" starts with general embryology and heredity, and passes on in succession to "fonctions de réception" (digestion and respiration); "fonctions de circulation de la matière" (blood and lymph); "fonctions de l'élaboration" (nutrition); "fonctions d'élimination de la matière" (external secretions); "fonctions de calorification" (production, transformation, and elimination of heat); "fonctions de réception, élaboration, et élimination de l'énergie"; "fonctions antixéniques" (protection of the organism against what is noxious in the environment); and, finally, "fonctions de reproduction." The scheme is certainly ingenious, and gives a good illustration of the methods of logical analysis for which science in many of its departments is so largely indebted to the savants of France.

In *Naturwissenschaftliche Wochenschrift* for May 23 Dr. Ludwig Reinhardt gives an illustrated account of a human skeleton discovered on April 10, 1908, in the well-known cavern of Le Moustier, in the Dordogne, in a stratum lying some 30 feet below the one worked years ago by Lartet and Christy. The latter stratum is assigned to the Neanderthal period, but the new "find," from the evidence of the associated implements, is identified with the earlier Acheuleën (St. Acheul) epoch. An age of some 400,000 years is assigned to the deposit in question, which belongs to the penultimate inter-Glacial epoch; the Le Moustier hunter, for whom the name *Homo mousteriensis hauseri* has been proposed by Prof. Klaatsch, representing the oldest human skeleton at present known. The skull was greatly damaged when discovered, but has been carefully pieced together, while the bones of the skeleton have been freed from matrix and placed in their proper positions. The remains indicate a young man of between sixteen and eighteen years of age. The limb-bones are relatively short and thick, the cranial portion of the skull is markedly receding, while the jaws are very protruding, after a fashion occasionally met with among modern Australians. Associated with the ape-like muzzle is an extremely powerful dentition, the individual teeth having much stouter roots and more enamel-folds than in any living race. Among other characters of the skull, it must suffice to mention the large size and wide separation of the orbits, and the broad and deeply sunk root of the nasals, the latter feature indicating a wide and flattened nose, with the nostrils directed mainly forwards. Whether the shape of the skull has been altered by the restoration has to be taken into consideration.

In the third Bulletin of the Archæological Survey of Nubia Dr. G. A. Reisner describes the excavations conducted up to the close of 1908, and Drs. G. Elliot Smith and Douglas E. Derry review the anatomical results. The excavations supply further evidence in support of the views advocated in the previous reports. In pre-dynastic times, and up to the third Egyptian dynasty, this part of Egypt and Nubia formed a territory occupied by a homogeneous race which was Egyptian, and not Nubian, in physical type and culture. This disposes of the theory that the archaic Egyptians contained a strong negro element. Since the rise of the third dynasty there has been a continuous intermixture of Egyptian and negro strains. Negroes seem to have moved north when the seat of Egyptian government was moved from Upper to Lower Egypt, and the hold of the Empire upon Nubia was probably relaxed. After that time both races were reinforced by fresh emigrants, but the fusion was gradual and continuous. In the time of the New Empire, doubtless owing to Hyksos domination, refugees flocked southwards and formed connections with Nubian women, individuals of both races of different sexes being found in the same grave. The question of the existence of tuberculosis in ancient times is again raised by Dr. Derry. The case reported in the first bulletin was discredited, but since then the body of a priest of Amen belonging to the twenty-first dynasty, found at Thebes, shows angular curvature of the spine and a psoas abscess, which are diagnosed as evidence of Pott's disease. If the disease prevailed at Thebes in the New Empire, it is not improbable that the Nubian cases of the Middle Empire may be of a similar character.

The *Bolletino della Società Sismologica*, vol. xiii., No. 4, contains an important paper, by Prof. Grablovitz, on the secondary oscillations recorded by the tide-gauge at Ischia. The period of these is found to have varied considerably during the last nineteen years, from a maximum of 14m. 10s. in 1892 to a minimum of 11m. 55s. in 1908; as a rule, the variation is slow, and the period remains constant for a considerable time, but at times it changes rapidly. During 1897, for instance, the period fell from 13m. 45s. to 12m. 34s., and in 1902 it dropped from 14·1m. on January 8 to 13·2m. on March 30, rose again to 14·1m. on April 26, fell to 13·0m. on May 14, and rose again to 14·3m. by May 27. Accepting the explanation that the period of these secondary undulations is the natural period of oscillation of the water, and is, consequently, a function of the dimensions of the basin, he shows that, as there has been no known alteration of the coast-line adequate to account for the observed variation in period, this explanation necessitates the assumption of variations in depth. Some facts are quoted which show that such changes may well have occurred, but it is also pointed out that the variations in period may be directly connected with the action of the exciting cause, and not entirely determined by resonance.

The report of the Southport Meteorological Observatory for the year 1908 has been received. This station occupies an important position in the Irish Sea, and is kept in great instrumental efficiency by the Corporation, the practice being to employ continuously two self-recording instruments for each of the principal elements. The observatory also maintains two subsidiary stations—Marshside, a mile to the N.N.E., for additional anemometrical observations, and an evaporation station at Barton Moss, about 5½ miles to the S.S.W. Regarded as a whole, the year was decidedly warm and the rainfall normal (32½ inches); there was a predominance of south-easterly winds quite unequalled in any other of the thirty-seven years over which the record extends. The report includes a useful comparison of sunshine and other climatological statistics at sixty-three health resorts and large towns, all of which have been checked by either the Meteorological Office or the Royal Meteorological Society.

The *Revue générale des Sciences* of May 15 contains an important article, by Prof. B. Brunhes, on "The Evolution of Barometric Depressions and M. Guilbert's Rules for Weather Prediction," illustrated by weather charts. The article is, in fact, the preface to a work which is about to be published by M. Guilbert entitled "New Method of Weather Forecasting." Eighteen years ago M. Guilbert, who is now secretary of the meteorological commission of the department of Calvados, communicated certain rules to the Meteorological Society of France; these have since been developed, and have attracted more general attention in consequence of his success at the international competition in weather forecasting in connection with the exhibition at Liége in 1905. The rules have since appeared in several meteorological periodicals, including the *U.S. Monthly*

Weather Review, and the method was referred to by Dr. Shaw at the British Association meeting of 1907, who explained that it "depends upon the comparison of the actual winds, as recorded on the map, with ideal or normal winds as computed from the distance apart of the consecutive isobars." Prof. Brunhes discusses at great length both the rules and the objections that have been raised against them. He thinks the principal questions now are:—(1) whether the method of forecasting, which in the hands of M. Guilbert gives such surprising results, can be formulated in a way which may obviate objections to his exposition; and (2) whether the principles can be so enunciated that other meteorologists may attain the same success. To the first question he gives a decided affirmative, but to the second the reply is more reserved; the publication of the work, which has been urged by M. Teisserenc de Bort and himself, is an effort to hasten the solution of these questions.

WE have received a new catalogue of physical and electrical instruments, balances, &c., from Messrs. W. G. Pye and Co., of Granta Works, Cambridge. We note that a considerable number of pieces of apparatus have been designed by Mr. G. F. C. Searle, F.R.S., of Cambridge. This kind of cooperation between the maker and user of scientific apparatus is much needed, and will, we believe, result in a great improvement in the utility and accuracy of the instruments made in this country.

THE question whether intermolecular radiation would account for any appreciable fraction of the heat transmitted through a metal owing to temperature differences existent in it has often been discussed. Several years ago Riecke showed that the part contributed by radiation must be excessively small. His calculations were, however, based on an equation given first by Sampson and afterwards by Schuster, which Königsberger showed was not accurate. In the *Physikalische Zeitschrift* for May 15 Dr. M. Reinganum takes up the question again, and, basing his investigation on the radiation work of Planck and on the law that the intensity of radiation in a medium of index of refraction n is n^2 times that in the ether in equilibrium with it, he arrives at the conclusion that in silver and in zinc radiation will not account for more than one-millionth part of the heat transmitted. In alloys it is still far below the order of magnitude of the conduction. In all electron theories of conduction it may therefore be entirely neglected.

EASEMENT curves form the subject of an interesting article, by Prof. R. H. Smith, in the *Engineer* for June 4. The term "easement" indicates a curve which can be turned without damaging collision, without the fury of whirlpool motion in fluids or of hard knocks between solid members. Within elastic limits, a heavy stress steadily maintained does no harm. The damaging intensity of a blow is proportional to the time rate at which the stress increases. When the stress is produced by curvature in the motion path, the author shows that the intensity of the radial shock is proportional to the product of the cube of the velocity and the rate of change of the curvature with respect to length measured along the path. In proportion as the cube of the velocity is high, the rate of change of curvature should be low. Hence the importance of examining different forms of easement curves in respect of this purely geometric characteristic. The author discusses mathematically curves shaped to the equation $y = Kx^m$, where m is any index. The time rate of increase of radial stress should be little or nothing at first, and should gradually increase up to the unavoidable amount. It starts with zero if m be anything greater than 3, but the most satisfactory result is not obtained with m less than 4. Of all this class of easement curves, the biquadratic parabola is the best.

IN several notices and reviews it has been pointed out that the experimental study of flow of air past resisting bodies not only was of importance in connection with aviation, but might also have valuable applications to the problem of dust formation in the wake of motor-cars. At that time it was not known to the writer of the notices that the matter was receiving attention. A paper by Mr. W. R. Cooper, read before the Royal Automobile Club on May 18, shows that automobilists have not been so behindhand in appreciating scientific methods as was supposed. Indeed, experiments involving photography of dust clouds were described in the Automobile Club Journal so far back as December, 1905, and an account of them appeared in NATURE. Mr. Cooper now describes a recording apparatus with which he has studied the direction of the stream lines in the neighbourhood of the car. It consists essentially of a small vane at the end of a bamboo rod, which can be moved about behind or in front of the car, the vane being connected by pulleys with a pointer inside the car. An apparatus for measuring air pressures is also described. Mr. Cooper is to be congratulated on the progress he has made, and though there are still many difficulties to be overcome, there is no doubt about the practical value of these researches.

AN American edition of Mr. R. C. Punnett's little book on Mendelism has been published by the Wilshire Book Co., of New York. The new edition is provided with a preface by Mr. Gaylord Wilshire, in which he deals with the sociological significance of the Mendelian theory.

MESSRS. MACMILLAN AND CO., LTD., now publish the well-known book by the late Prof. A. Milnes Marshall, F.R.S., on "The Frog." The volume, which, it will be remembered, is an introduction to anatomy, histology, and embryology, has been edited by Dr. F. W. Gamble, F.R.S., and has now reached its tenth edition.

A CATALOGUE of books on astronomy, mathematics, and physics, consisting mainly of important works purchased recently from several private libraries, has just been issued by Mr. Bernard Quaritch, 11 Grafton Street, New Bond Street. The price of the catalogue is one shilling.

DURING the seventh International Congress of Applied Chemistry, held recently in London, photographs of fourteen groups of the various sections were taken by the Dover Street Studios. Prints of these groups have been sent to us, and one of them, reproduced in a reduced form, accompanies the general article upon the scientific proceedings of the congress which appears elsewhere in this issue. We are informed that the photographs are to be published in complete album form at the price of four guineas, or they may be had separately.

A SECOND edition of "Sanitary Law and Practice: a Handbook for Students of Public Health and Others," by Drs. W. Robertson and Charles Porter, has been published by the Sanitary Publishing Co., Ltd. The original issue of the work was reviewed in NATURE of June 1, 1905 (vol. lxxii., p. 97), and it is sufficient to state here that much new matter has been added to the volume, and the former text completely revised and in many instances re-written. Among the new sections, those on school medical inspection and vital statistics may be mentioned. The size of the print has been reduced slightly, and the price remains at 10s. 6d. net.

OUR ASTRONOMICAL COLUMN.

The Ensuing Return of the Perseid Meteors.—The season especially favourable for the observation of meteors may be said to commence in July, and after the full moon of July 3 of the present year the sky will begin to exhibit a marked increase of meteoric activity. The Perseids, Aquarids, and many other showers give evidence of their presence at about the middle of July, and afford an abundance of material to the vigilant student until about the third week in August.

It is true that the great, annually visible stream of Perseids has been already fairly well watched, but it seems likely that we shall have to accumulate data for several future centuries before our knowledge of the system may be regarded as pretty complete and satisfactory. We do not know the period of revolution of the parent comet and of that particular region of the meteoric group where the particles are collected most abundantly, nor have we learnt the precise nature of the variations affecting the annual returns of the shower. The different conditions occurring every year in regard to the weather, moonlight, &c., render it extremely difficult to form correct conclusions as to the strength of the region encountered at successive returns.

During the forthcoming display it is to be hoped that observers will record the apparent paths of all the brighter meteors they may observe, for the computation of the real paths of these objects is very important.

The Solar Parallax, from Observations of Eros.—A preliminary account of the results obtained from the observation of Eros, at Mount Hamilton, for the determination of the solar parallax, is given by Prof. Perrine in No. 150 of the Lick Observatory Bulletins. The observations were made during the latter part of 1900, and the full discussion is reserved for publication by the Carnegie Institution of Washington.

The solutions of 126 equations, giving the correction to the assumed value of the parallax, 8·80″, are given, and the various methods of weighting the means discussed. Finally, the value 8·8067″ ±0·0025″ is adopted as the result.

Comparing the results of a long series of daily meridian observations with the ephemeris, an apparent periodicity of the residuals is exhibited, the double amplitude of the variation being 0·05s., and the period about nine days; this periodicity is not accounted for by the effect of any known bodies, but there appears to be some relation to the period of light variation of Eros during the opposition of 1900–1. For a further discussion it will be necessary to have brightness observations of Eros made at the same times as the position observations, but it is thought that, even should this periodic inequality be found to be real, the final value will be but little affected.

A Double-image Cœlostat for determining the Moon's Position.—In No. 2016 of Nature (June 18, 1908, vol. lxxviii., p. 152) Prof. Boys described an apparatus, designed by Mr. Wade, of the Egyptian Survey Department, for the field determination of longitude, the moon's position being known.

Mr. Wade has now adapted his apparatus so that it may be used for the inverse problem, viz. the determination of the moon's position when the longitude is known, and a lecture in which he described the modified instrument appears in No. 30, vol. iii., of the *Cairo Scientific Journal* (March, p. 64).

The two mirrors of the former instrument are combined in a cœlostat mirror, on which two distinct faces are figured, the one to reflect the moon's image, the other to reflect the images of the reference stars. The instrument having been adapted for photographic observations, the difficulties of the moon's relative brilliance and differential motion among the stars had to be obviated, and this has been done by the interposition of an especially designed prism before that half of the camera objective which forms the lunar image. This prism reduces the brightness of the image, and, when rotated by a handle at a uniform rate, corrects the moon's motion to stellar rate. Thus photographs are obtained showing a properly exposed lunar image among a number of star images, and it only remains to measure the positions of the moon's centre, or a well-marked crater, and the stars. A number of difficulties and devices are explained in Mr. Wade's paper, but cannot be given in a brief note.

The Determination of the Solar Constant.—In No. 4, vol. xxix., of the *Astrophysical Journal*, Messrs. Abbot and Fowle, jun., discuss a number of improvements and new results in solar-constant determinations.

Among other results is a new value for the effective solar temperature, which Mr. L. B. Aldrich computed from the previously published results, by Goldhammer's process, and found to be 6200° absolute. In the previous results, published by the Smithsonian observers, allowance was made for the extreme regions of the spectrum not observable by them, and recent research indicates that the corrections then applied were all too small. By employing a quartz prism and magnalium mirrors, it is hoped to settle this point definitely in future researches.

Another new point, arising from a comparison of the 1908 and 1906 results, is the suggestion that in 1908 the intensity of the ultra-violet rays in sunlight, as compared with that of the red rays, was less than in August, 1906; the proposed new outfit should enable the question of the reality of this apparent variation to be settled definitely. The "solar constants" for the two epochs indicate no such variation in the total emission.

Pyrheliometric experiments during 1908 gave a correction to the unit of energy previously employed which entails a lowering of the 1902–6 "solar constant" values by 7·6 per cent., whilst the correction for the unobserved infra-red and ultra-violet radiations would raise them about 10 per cent.

THE WELSH GORSEDD.

THE ritual of the present-day Welsh Gorsedd, while it attracts the curious crowd, arouses the indignation of many sober-minded nationalists, who deplore the tendency to "popery" so manifest in their fellows. But while these good people remain outside the mystic circle to rail and storm, every effort to persuade the bards to give up the Gorsedd and its ceremonies has been unavailing. The Gorsedd of the bards has grown year by year in its influence upon the life of the nation until it has become the centre of authority for holding the only truly national assembly of the Welsh people—the National Eisteddfod.

The bards, however, have done very little to satisfy the curious or to appease the indignant by a rational explanation of their doings, with the result that in certain quarters judgment has gone against them by default.

Perhaps the most serious effort to show them the evil of their ways was that of Prof. J. Morris Jones, of Bangor, during 1896. In a series of articles published in *Cymru* of that year he deplores the spirit of formalism that is on the increase in the "world and Church," and avows that it is "full time for the country to understand more plainly the true history of the Gorsedd" and the "fiction and deceit upon which its claims are based." The articles are five in number, and it must be admitted that they are a masterly contribution to the history of Gorseddic literature of modern times; since they appeared they have been considered as containing the last word on the antiquity of the Gorsedd, and as the author holds a position among the highest authorities on the poetry and language of Wales, it is in the nature of things that the results of his investigation of this subject should carry great weight. That this is actually so we will quote a paragraph from a very important book on Welsh history in general, "The Welsh People," by Sir John Rhys and D. Brynmor Jones. In chapter xii. of that book, dealing with the "language and literature" of Wales, an allusion is made to the Eisteddfod, and a quotation is given from the "Laws of Howel Dda" concerning the ceremony of chairing the bard. In a footnote relating to this quotation the following comment is made:—"We abstain from saying anything about the 'Gorsedd' as its antiquity is contested. See *Cymru* for 1896, where the reader will find several articles on the subject by Prof. J. Morris Jones, whom we have to thank for calling our attention to the passage concerning the Chair Contest" (third edition, 517). This statement is repeated in the fourth edition, 1906. This is the only reference to the Gorsedd in the whole of that work. To cause the learned authors of that book to become suddenly cautious on a matter of so great an interest to Welsh people as the Bardic Gorsedd, and that in the course of an allusion to the Eisteddfod, is a fine tribute to the authority of Prof. J. Morris Jones, but to "abstain from saying anything concerning the Gorsedd" throughout a book dealing with purely Welsh history and institutions, more than is contained in a footnote, is, it seems to us, to force deference to the critic almost to breaking point.

Our object is not to minimise the value of these articles; their value as a contribution to the history of post-Reformation MSS. no one can deny or destroy. Our desire is simply to direct attention to the fact that they deal with the Gorsedd history from the sixteenth century onwards, and that it is only in a qualified sense it can be said that they are an examination of the antiquity of the Gorsedd itself. They are being constantly referred to as contesting the antiquity of the Gorsedd; what they actually deal with is the modernity of the bards' connection with the Gorsedd. The antiquity of the Gorsedd itself they do not touch but in so far as they teach us to look beyond modern bardism for that antiquity.

The only reason why the Gorseddites have not given an effective answer to these articles hitherto is that they had no argument—they lacked an effective weapon. There are gaps in the history of the Gorsedd which the historian has failed to bridge. The astro-archæologist, however, has come to the rescue. An effective weapon has at last been forged, or, to change the metaphor, an antidote has been discovered to neutralise the baneful effect of the dose administered by Prof. J. Morris Jones to Gorsedd enthusiasts. The Gorsedd has been invested with new interest since Sir Norman Lockyer gave to the world the theory upon which ancient stone circles were constructed. It is only now, bearing that theory in mind, that the proper value can be assigned to these articles, and also to much other Welsh literature bearing upon the Gorsedd.

The object of these articles was to show that the Gorsedd of to-day was the creation of the bards of Glamorgan of the sixteenth century. In the first article the reader is asked to bear in mind the following statements. We give full quotations, because they indicate what the author has set out to prove; they also show that the author does not particularise between the terms "Gorsedd" and "*Gorsedd Beirdd Ynys Prydain*" (the Gorsedd of the bards of the Isle of Britain).

"(1) It was in Glamorganshire, *after* the middle of the sixteenth century, that every one of the manuscripts which mention the Gorsedd was written.

"(2) In all manuscripts written before that time throughout Wales, not a word is mentioned of such a thing as the Gorsedd of the bards of the Isle of Britain. Mr. Gwenogfryn Evans has examined hundreds of these older manuscripts, and has failed to observe so much as the name of the Gorsedd in one of them."

The author finds evidence in the Gorseddic literature of this period that the bards "poached" the laws of Howel Dda for rules and regulations to be applied to the institution they were setting up; and in his remarks on these laws we see again the want of distinction between "Gorsedd" and "Gorsedd of the Bards." He says:—"Not one of the three books of law, neither does one of the thirty-one editors, mention anything of the Gorsedd of the Bards. These books treat minutely of every aspect of Welsh life in those ages, from the ceremonies of the Princes' Courts to the marketable value of a wooden spade; they relate much of bards, of the office and place of every grade of bard and the gift that was due to him for his song; and of the different Gorsedds: Gorsedd of assembly (*dygynnull*); Lord's Gorsedd; Bishop's Gorsedd; Abbot's Gorsedd; but though mention is made of bards and of Gorsedds, Gorsedd of the Bards is not suggested."

When the writer says that no mention is made of "Gorsedd" in the whole range of Welsh literature, including the *Mabinogion* and the "Laws," we infer that he means to say that these ancient MSS. do not contain reference to "Gorsedd of the Bards" as such. Seeing that the word "Gorsedd" does occur in the *Mabinogion* and in the "Laws," we deplore the fact that the author does not give a philological analysis of the word and let us know what it meant before the bards appropriated it as a name for their stone circle. It is quite evident, even from the author's own words, that the modern bards did not coin the name, but borrowed the name and the idea from antiquity.

Space will not allow us to give an account of the author's examination of the Gorseddic literature from the fifteenth century onwards. It is not to our purpose, and in the main his judgment concerning the value of these MSS. will stand the test of time, and we accept them at his valuation. They "increased," we are told, as a result of a quarrel between bards at the Carmarthen Eisteddfod of 1451. The bards of Glamorgan from that year sought to set up an institution in opposition to the former assembly of the Welsh bards, and soon after began to call it a Gorsedd. The first document cited by the author containing reference to the new heresy is a collection of Triads by Rhisiart Iorwerth, who flourished *circa* 1510. Then is passed under review a series of MSS., beginning with the collection of Iolo Morganwg (who died in 1826) onward to the middle of the last century. Of the claims made by the bards to the antiquity of the traditions contained in these documents the author makes ridicule as a story worthy only of repetition to the "marines."

When we admit, without reserve as we do, that the author has in these articles given a masterly account of the connection of modern bards with the modern Gorsedd, we strike the sum total of the value of these articles as a contribution to the history of the Gorsedd. He has led us back to the beginning of the sixteenth century by documentary evidence, and if his statement of the bardic quarrel is correct, we arrive at the middle of the fifteenth; but he has done more. By playing the gamekeeper on the bards of the fifteenth and sixteenth centuries we must follow him to their "poaching" ground, and find that we have travelled backwards at least 600 years.

As we have to thank the bards of modern times for reviving and restoring the Gorsedd even when they appropriate it for their own use, we have also to thank Prof. J. Morris Jones for leading us to the source of their inspiration as to its rules and regulations. This source, or quarry, is the Laws of Howel Dda. The Gorsedd rules, the author tells us, were taken mostly from the sections of the Laws regulating the court of "landed property."

Most authorities agree that these Laws were compiled in the tenth century (E. Llwyd gives 940, Taylor 942, Wotton 943, Rhys and Jones 942–3). The authors of "The Welsh People" say of the authenticity of the copies we now possess:—"There is no reason for not carrying back the first setting down in writing of the Welsh customs to the time of Howel Dda. Nor is there any real doubt that these bodies of law consist of custumals which were once in actual operation" (third edition, 185).

The following quotations are taken from the "Venedotian Code," the oldest of the "Three Books of the Law" (from "Ancient Laws and Institutions of Wales," Commission Records, 1841, A. Owen).

"XI. Here begin the laws concerning landed property and the form of pleading in respect thereto.

"(1) Twice the law shall be open for landed property, and twice it shall be closed.

"(2) From the ninth of the calends of winter (Kalangayaf) it shall be open until the ninth day of February.

"(3) From the ninth day of February the law shall be closed until the ninth day of May.

"(4) From the ninth day of May the law shall be open until the ninth day of August.

"(5) From the ninth day of August the law shall be closed until the ninth day of the calends of winter.

"(6) The reason why the law shall be closed in autumn and spring is because the land is cultivated during these two periods: lest ploughing in the spring and reaping in autumn be impeded.

"(7) The cause why it is right for the law to be closed for nine days after the calends of winter, and nine days after the feast of St. Bridget to be open: is to avoid closing the law on one day: and the same manner, nine days after the calends of May to be closed, and nine days after August (footnote, the 'Calends of August') to be open: to avoid opening the law on one day likewise.

"(8) Whoever willeth to institute a suit for landed property let him do it when he will, from the ninth of the calends of winter forwards, or from the ninth of May, because those are the times the law is open for landed property."

Anyone conversant with the evidence given in Sir Norman Lockyer's "Stonehenge" as to the May-August-November-February arrangement of the year that once prevailed in this country, and the articles in NATURE by the Rev. John Griffith, of Llangynnwyd, showing that the Gorsedd of the Welsh bards is a May-November stone circle, will not fail to appreciate the confirmatory evidence contained in the above quotations from the Laws of the tenth century. It is conclusive proof, we take it, that the May-November year was the only division of time recognised for legal purposes at the time of Howel Dda. It must be remembered, also, that there is no evidence to show that these Laws were creations of the tenth century, but simply records of customs from time immemorial.

While the Venedotian Code of the Laws gives the May-November division complete, the Demetian and Gwentian Codes, which are of slightly later date, in one or two instances mention solstitial dates as the proper time to "plead." For instance, the Demetian Code has:—"There are two days, that is, the ninth of December and the ninth day of May, whereon it is right to commence proceedings as to the inheritance of land by kin," &c. The bardic literature of the sixteenth century onward, discussed by Prof. J. Morris Jones, mentions only the solstices and equinoxes as the proper times to hold Gorsedd meetings.

Did the bards have access only to the later codes, and therefrom take their Gorseddic instructions? The Rev. John Griffith in NATURE, May 2, 1907, directed attention to the interesting fact that the plan of the May-November Welsh Gorsedd preserved by Iolo Morganwg was accompanied by instructions applicable only to a solstitial Gorsedd. The full history of this plan has not yet been found out, but we would suggest that the solstitial instructions became attached to the May-November plan by quarrying in the wrong sections of the Laws. The Venedotian Code contains the instructions proper for holding a May-November Gorsedd; they correspond with the stone-circle plan preserved by the bards, while the bards have failed to preserve a stone circle to correspond with the solstitial instructions.

Sir Norman Lockyer found evidence at Stonehenge that the solstitial replaced the earlier May-November cult, and in Welsh bardic traditions we have to this day evidence of this struggle. We have references to the solstitial and the May-November years. They seem to have got mixed up by the blunderings of the bards. The Gorsedd plan as preserved, and followed this week in London by the Welsh bards, and the corresponding enactments of Howel Dda's Laws, especially the Venedotian Code, represent the older arrangement, while the several references in the Welsh Triads to Stonehenge as one of the mighty deeds of the Cymry, the solstitial instructions about holding a Gorsedd, and the great desire of present-day leading Gorseddites to hold a meeting at Stonehenge, represent the newer arrangement that prevailed until the coming of the Julian year.

While we have no excuse to offer for the present-day ritual of the Gorsedd, we would plead for a re-consideration of the whole question in the light of recent discoveries. The Welsh bards have been "guilty" of saving an obsolete institution from oblivion. The control of bards was, perhaps, only one function belonging to the Gorsedd of ancient times. Long before the fifteenth century all its functions, except the control of the bards, had been taken over by the secular and ecclesiastical administrative courts of England and Wales. In the records of the tenth century there were at least four Gorsedds, suggestive of peculiar administrative power, and on the analogy of the development of institutions in every country it does not require a very great effort of the imagination to see that in the long ago in this country there was but one Gorsedd, from which emanated the directing influence of a whole people.

W. GRIFFITH.

SCIENTIFIC WORK OF THE INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

IN reviewing the general nature of the papers communicated to the seventh International Congress of Applied Chemistry it may be observed that the tendency has been to discuss matters relating to the general improvement in the various chemical industries during recent years rather than to contribute the results of original researches. By far the greatest number of original papers before the congress were read in the section for organic chemistry, but the official order of the sections is here maintained.

In the section for analytical chemistry much stress was laid by various speakers on the general classification of the purity of marketable chemical reagents. Thus Dr. J. T. Baker proposed that all chemicals should be sold with a label stating the percentage of impurity present. The term "chemically pure" was described as liable to lead to confusion, since absolute purity is in all cases impracticable. The General Chemical Company of New York communicated improved methods for the estimation of small amounts of arsenic existing as impurity in sulphur and sulphoric acid. Messrs. Gardner and Hodgson described a method for the rapid estimation of phenols, based upon the action of iodine upon this class of substances. Prof. Chesneau gave an account of his work on the estimation of phosphorus in iron and steel, which indicated that the phosphorus is completely precipitated as ammonium phosphomolybdate only under definite conditions of concentration of the reacting substances, and that this precipitate, which is not a chemical compound, but a definite mixture of ammonium phosphomolybdate and molybdate, should in all cases be washed only with pure water. Papers on the estimation of creatinine were communicated by Mr. F. C. Cook and by Mr. A. C. Chapman. The effect of the creatinine in alkaline solution is to cause reduction of the picric acid to picramic acid, and errors of analysis are liable to be produced by the excessive reduction of the picric acid to colourless tri-amido phenol. A new form of electrode for electrolytic determination of metals was advocated by Mr. J. W. Turrentine. This was composed of graphite which had been impregnated with paraffin wax, and gave results as accurate as those obtained by the use of platinum electrodes.

In the section for inorganic chemistry Dr. Forster Morley read a paper recommending authors to index all communications to scientific journals according to the system employed for the International Catalogue of Scientific Literature. This procedure would considerably lighten the labour of the regional bureaux. Papers on the decomposition of Portland cement by sea-water were read by Prof. Le Chatelier and by M. J. Bied. It was shown that the stability of cements towards sea-water is increased by the addition of puzzuolana. A review of the chemical nature of puzzuolana was contributed by M. R. Feret. Dr. George Harker gave an account of the methods of fire extinction in ships and enclosed spaces by means of flue-gas.

In the section for mining and metallurgy the greater portion of the communications dealt with purely technical points. Mr C. W. Bannister reviewed the processes for extraction of zinc from its ores, and discussed the losses of this metal during distillation, recommending the employment of carbonaceous filters to prevent the admission of oxygen and to prevent the condensation of lead vapour with the zinc. Prof. R. Schelle described the production of pure tellurium from its ores. The finely powdered ore was fused with soda and sulphur, with formation of the sodium sulphide compound of tellurium. On treatment of the aqueous solution of this compound with sodium sulphite, a grey precipitate of the pure metal was produced. M. C. F. Jarl gave an account of the quarrying of cryolite, which occurs in quantity only in south-west Greenland. After a rough hand-picking, the mineral is shipped to Copenhagen, where it is purified. It is at present employed as a constituent of a leadless glaze and for the electrolytic production of aluminium. Dr. C. H. Desch read a paper on eutectic alloys, and discussed the suggested method for predicting the position of the eutectic point. Flavitzky's rule was shown to rest upon an insufficient theoretical basis.

In the section for organic chemistry the great majority of the papers read were of importance in their technical bearing, but a certain number dealt with subjects of theoretical interest. On Friday, May 28, all the papers read related to hydrocarbons and their simple derivatives. Dr. M. Z. Jovitchitch communicated the results of his experiments on the action of the silent electric discharge on ethylene and acetylene. The remarkable statement was made that in all cases the analyses of the total resultant products showed a deficiency in carbon, always above 10 per cent. and often so great as 20 per cent. Moreover, when these products were allowed to stand in open vessels the carbon content was observed to rise, sometimes to the extent of 5 per cent. These substances were found to fog photographic plates through the dark-slide, and were therefore considered to be radio-active.

Dr. Gustav Koller gave an account of the chlorohydrocarbons produced by the action of chlorine on acetylene under the influence of ultra-violet light. The utility of these substances as non-inflammable and non-explosive solvents for fat extraction and other purposes was emphasised.

On Saturday, May 29, the communications in the section for organic chemistry dealt with the chemistry of naturally occurring hydrocarbons, such as the terpenes, with cellulose, and with the synthesis of alcohols. With regard to the chemistry of cellulose, Prof. Wichelhaus described the formation of pure phenol during the destructive distillation of cellulose, no other phenols being detected. In reference to the mercerisation of cotton, Dr. Vieweg dealt with the action of cuprammonium solutions on cotton cloth. The mercerising effect was found to decrease with rise of temperature. Dr. Hübner stated that caustic soda lye of specific gravity 45° Twaddell caused the maximum degree of mercerisation. Prof. Knecht gave an account of the action of certain dicarboxylic acids on cellulose. When cellulose is treated with oxalic acid, formyl cellulose is produced by loss of carbonic acid. Similarly, malonic acid and its derivatives yield acetyl cellulose and the corresponding acyl derivatives of cellulose. With succinic and glutaric acids this effect is not produced.

On Monday morning, May 31, the subjects under discussion in the section of organic chemistry were colloids, fatty acids, &c., paints and varnishes. Mr. H. R. Procter discussed the structure of organic jellies, advocating the view that jellies consist of a solid solution of the solvent in a network of colloid molecules. Doubt is cast upon the justice of a distinction between colloidal and "true" solutions, the difference depending merely upon the size of the molecules or molecular aggregates. Prof. Haller, of the Sorbonne, read a paper on the alcoholysis of certain esters. The esters, on being heated with a 1 per cent. solution of hydrochloric acid in methyl alcohol, were quantitatively converted into the corresponding methy esters. This method was found to be especially applicable to the case of fats, glycerine and the methyl ester of the fatty acid being produced. In another paper the same author gave an account of the action of ozone upon the methyl ester of ricinoleic acid. Results somewhat different from those obtained by Harries and Thieme were observed. M. Jean B. Senderens described a new method of pre-

Photo.] [*Dover Street Studios.*

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paring ethyl ether. The vapours of the alcohol were passed through a tube containing gently ignited precipitated alumina at a temperature not exceeding 200° C. Quantitative yields of ethyl ether in a high state of purity were obtained. Above 200° the ether itself was dehydrated, with formation of ethylene. In the case of methyl alcohol, methyl ether was formed even at higher temperatures.

On Monday afternoon a joint meeting of the section of organic chemistry with the section for colouring matters was held for the discussion of fluorescence and colour in relation to chemical constitution. Dr. Kauffmann advocated an extension of the "auxochrome" theory to account for fluorescence. Analogous terms, such as "fluorogen," "fluorophore," "luminophore," "luminogen," were suggested. Contributions to this theory were adduced by Dr. Ley. A theory of selective absorption as conditioned by conjugate linkage was advanced by Dr. Hewitt. This theory is founded on considerations of the atomic attractions produced by changes in dynamic conditions. With increase in the number of conjugated double linkages in a chain the oscillation frequency is diminished, although the atomic forces involved in the dynamic change are not increased in proportion to the number of double linkages. Other contributions to the theory of colour were introduced by Prof. Green, Dr. Morgan, and Dr. Mascarelli.

On Tuesday morning, June 1, papers on miscellaneous subjects were communicated to the section of organic chemistry. Dr. E. Biilmann stated that only two stereoisomers of cinnamic acid were known, namely, the ordinary variety and an iso-acid, which, however, is trimorphous. The ordinary variety was shown to be fumaroid, while the iso-acid was the maleinoid form. Description of the refractometric determination of the solubility of ethyl ether in water was given by Mr. Y. Osaka, and the existence of gaseous compounds of carbon and nitrogen other than cyanogen was discussed by M. A. P. Lidoff, who asserted the probability of the existence of a gas "oxan," CNO. In the afternoon of the same day the contributions dealt with compounds of therapeutic interest. Dr. Power gave a striking account of his exhaustive researches on the composition of jalap, and showed that the products obtained from jalap resin are all mixtures of indefinite constitution. M. A. Guyot described several new syntheses of vanillin, depending on the condensation of aromatic compounds with esters of ketonic acids, such as mesoxalic acid, with formation of the corresponding carbinols. The relations between physiological action and constitution of certain series of compounds were discussed by Dr. Jowett, who pointed out the uncertainty of predictions as to the effect on the human organism. M. F. Garelli gave an account of the production of soaps by the interaction of fats, sodium chloride, and ammonia, which, if practicable on a commercial scale, may prove to be of great industrial importance.

A large number of papers were contributed to the section for colouring matters, and many were discussed at length by the meetings. The dyeing effect of dyes in aqueous solution upon inorganic matters, such as sand, was described by Mr. Dreaper. It was shown that basic dyes were absorbed to a greater extent than acid dyes, while the addition of salt caused a considerable increase in the dyeing action. The decolorising action of various forms of charcoal was discussed by Prof. Knecht, who pointed out that the absorptive power depended entirely upon the amount of organic impurity present in the charcoal, and that the purer the sample the less absorbent action is observed. The same author, in a joint paper with Mr. Batey, adduced evidence, based upon conductivity and ebullioscopic determinations, to prove that certain dyestuffs do not behave as colloids in aqueous solution. M. L. Vignon gave an account of his experiments in relation to the theory of dyeing. The conclusions drawn were that the fabric behaves as a porous body endowed with chemical properties; that the ionised dyes are fixed in the fabric by chemical action; while the insoluble dyestuffs in water behave as colloids, and are fixed by molecular attraction. A description of the various and important uses of formaldehyde sodium bisulphite in the dyeing industry was furnished by MM. Baumann and Thesmar. M. T. Valette discussed the influence of the various bleaching and fat-removing agents upon the dyeing properties of wool, and stated that of all such agents lime gave the most satisfactory results, while chlorine gave good results, but weakened the fabric. An account of the chemistry of aniline black was given by Prof. Green, in which he described his process of oxidation of aniline by atmospheric oxygen by the catalytic influence of a paradiamine associated with a copper salt. An explanation of the formation of hydrocyanic acid during the oxidation of aromatic nitro-compounds by ammonium persulphate was communicated by MM. Seyewitz and Poizat. Dr. Cain described a method of acetylation of diamines of the benzidine type in cold alcoholic solution, by which monoacetyl derivatives could be prepared in good yield. The same author described new dyestuffs of the methylene-blue type derived from paranitrosomethylethylaniline. Mr. G. A. Prochazka stated that the recent legislation in the United States permitting the use of duty-free alcohol for the manufacture of coal-tar dyes has been rendered valueless owing to the unreasonable regulations of the Inland Revenue.

In the section for physiological chemistry the sectional meetings were held on Saturday, May 29, at University College, for the purpose of demonstrations. Two papers on colloids were included in this section, both of which were of considerable importance, namely, that of Dr. W. B. Hardy, who discussed the source of the electric charge on colloidal particles, and that of Dr. W. M. Bayliss, who dealt with the general properties of colloids as exhibited by certain dyestuffs. Dr. H. Bechold also considered the nature of colloids from a physiological point of view. The part played by adsorption in the mechanisms of the animal organism was described by Prof. H. Freundlich. Prof. Hans Meyer discussed the pharmacological action of the lipoids.

The use of a 15 per cent. to 25 per cent. solution of hydrofluoric acid at 100° C. was recommended by Dr. L. Hugounenq for the hydrolysis of proteins. Less oxidation and humic decomposition was observed in the employment of this reagent than in the hydrolysis by means of 25 per cent. sulphuric or hydrochloric acid. Moreover, by this method certain natural polypeptides of considerable importance were detected among the products of hydrolysis. A monograph on nucleic acid was contributed by Dr. H. Steudel.

In the section for agricultural chemistry the chief subject of discussion was the employment of artificial nitrogenous manures. A paper on the employment of cultures of leguminous bacteria was communicated by Dr. H. von Feilitzen, of the Swedish Society for the Cultivation of Peat Land. It was stated that cultures such as "nitragin" and "nitro-bacterine" produced absolutely no effect, and that the only certain method is inoculation with naturally favourable soils. M. M. A. Vivien showed that the loss of nitrogen from dung-hills is accelerated by the presence of inorganic substances such as sodium nitrate and calcium carbonate. The reactions of dicyandiamide were stated by Prof. Prianichnikow to indicate that it may be regarded as cyanoguanidine.

In the section for hygiene several papers upon the sterilisation of drinking-water were communicated. The majority of these dealt with the action of ozone, which appears to have a considerable germicidal action, and can be utilised at no great expense. Papers on the purification of sewage were contributed by Dr. W. E. Adeney, Mr. J. H. Johnston, and M. J. Begault. In reference to lead poisoning, a communication from Mr. K. Goadby and Dr. F. W. Goodbody proved that by far the greater portion of the lead present in the system of operatives suffering from lead poisoning enters by the lungs. The condition of the patient is considerably aggravated by the inclusion of alcohol in the diet. The experiments described in the paper were carried out on cats.

In the section for physical and electrochemistry the most striking event was a lecture and demonstration by Prof. Bernthsen on the oxidation of atmospheric nitrogen by the flaming electric arc, with formation of nitrogen peroxide, followed by an account of the process for the manufacture of calcium cyanamide by Prof. Caro. Since the formation of calcium cyanamide is an exothermic reaction, much less power is required than for the oxidation of nitrogen. From this substance ammonia can be produced, which can then be converted into nitric acid by Ostwald's electrolytic process. A *résumé* of the recent work on the electrometallurgy of iron and steel was given by Mr. F. A. Fitzgerald. Prof. Taussig read important papers on large electric furnaces, and on the electrolysis of sodium chloride, in which the recent developments in the Castner-Kellner process were reviewed. A recommendation for national and international conservation of water-power was introduced by Mr. E. R. Taylor, in which the author deprecated the failure to employ the waste power of rivers and streams. The combination of nitric oxide and oxygen was shown by Dr. M. Bodenstein to consist of a trimolecular reaction. M. A. Coppadoro described a process for the simultaneous production of hydrochloric and sulphuric acids, in which electrolytic chlorine was caused to interact with sulphurous acid. The question of the amount of chemical work produced by light was discussed by Dr. F. Weigert, who by examination of the photochemical change of anthracene into dianthracene concluded that nearly 5 per cent. of the total amount of absorbed light was converted into work. M. Malfitano, in a paper on the constitution of colloids, described the use of celluloid membranes, which permit the passage of electrolytes, but remain impermeable to colloids. The mechanism of the absorption of hydrogen by carbon at low temperatures was shown by Dr. J. W. McBain to depend entirely upon condensation of the hydrogen upon the surface of the carbon.

THE SUPPLY OF SECONDARY EDUCATION IN ENGLAND AND ELSEWHERE.

IN their report, published in 1895, the Secondary Education Commissioners, when discussing the amount of secondary education required for the whole country, stated :—

"After the most careful consideration we have been forced to the conclusion that the problem contains so many indeterminate elements that any attempt at a solution applicable to the whole country would necessarily be misleading."

The Schools Inquiry Commissioners of 1868, however, had no such hesitation, and light-heartedly estimated requirements at 16 per 1000 of the population for boys in towns, of whom one-half would be third-grade pupils.

Circumstances have changed since 1895. A new Education Act has been in operation for six years; a list of recognised schools has been prepared and issued; surveys of their districts have been instituted by many educational authorities. These facts give warrant for making an approximation to the result. Any such approximation must be subject to errors; in some cases it is well-nigh impossible to obtain information, and the difficulty of standardisation is ever present.

Presuming that the reader is acquainted with, and can make allowance for, disturbing influences, we will place before him material which will enable him to answer three questions, and will throw light incidentally on others. These three questions are :—

(1) How many of our population receive a secondary education?

(2) What proportion continue their education after the age of sixteen as all-day scholars?

(3) How do we compare in these respects with the foreigner?

The latest returns concerning higher elementary education in England give the number of pupils as :—

	Boys	Girls
Boys	8035	6178
Average attendance	94·3 per cent.	92·4 per cent.

These pupils correspond to Bürgerschüler, and represent those who, under more favourable conditions, would receive secondary education. In Germany the Bürgerschule exists in many places on sufferance; the local authority wishes to have the whole elementary education under its control, and maintains a Bürgerschule as a means of checking the establishment of private schools. In Great Britain we have encouraged the private school, and have thus only this small pittance of higher elementary pupils to put forward. We shall discover our missing Bürgerschüler later.

The number of pupil-teachers and pupils in classes preparing for pupil-teachership, or its equivalent, was given in 1906–7 as :—

	Boys	Girls
Preparatory classes	1,077	5,473
Pupil-teachers (*a*)	2,771	10,735
Pupil-teachers (*b*)	2,468	8,550
Total	5,239	19,285
Training college students ...	2,663	5,645

In this same year the secondary schools under the Board account for 62,712 boys and 50,877 girls, *i.e.* five boys to four girls nearly, classed as follows :—

	Boys	Girls
Preparatory classes ...	18,214	13.993
Age 12–13	12,521 (4,011)	10,505 (1,433)
Age 13–14	9,812 (3,179)	9,180 (1,445)
Age 14–15	5,248 (3,377)	6,673 (1,276)
Age 15–16	2,551 (1,806)	3,052 (637)
Over 16	1,993	2,683

where the numbers in brackets refer to those taking special courses.

If, for the moment, we class pupil-teachers as secondary scholars, these figures show that secondary education for a girl too frequently means preparation for the teaching profession. If we analyse our table we find that for every

100 boys	100 girls	age 12–13
there were		
78·5	89·0	age 13–14
52·2	66·6	age 14–15
26·3	30·9	age 15–16
12·0	22·5	over 16

who were taking an approved course. That is, only about one boy in four who begins a course of secondary education ever remains to finish it. Our national view of secondary education is that it is simply a veneer of respectability which has no bearing on the capacity of the individual or the future of the nation. This statement of the national conception of education is unjust to some local areas. Let us consider London, the State-aided schools of Scotland, and Wales. The corresponding figures read :—

	London		Scotland		Wales	
Age	Boys	Girls	Boys	Girls	Boys	Girls
12–13	100	100	100	100	100	100
13–14	123	125	149·6	148·5	71·5	77·3
14–15	114	117	184·3	186·7	47·9	54·6
15–16	69·5	75·6	163·4	174·2	29·2	26·1
16–17	35·2	45	106·6	135·4	14·7	13·6
17–18	16	26	48	90	—	—
18–19	6·4	7·5	17·7	46·8	—	—

After her sacrifices for education, no one will accuse Wales of indifference. Yet her standard is still far from satisfactory. London is showing that she appreciates the value of a course of secondary education. What about Scotland? Explain that the Scotch parent is satisfied with the primary school, and keeps his children there until thirteen or fourteen years of age, and you give deserved praise to the elementary school. Explain that the lower age of entrance to the Scotch universities induces a parent to give his son a full secondary education so that he may see, if he does not gather, the prizes that lie beyond, and you compliment the foresight of the nation. Allege that the Scot does not succeed in life and you will be laughed to scorn. Protest that his success is not due to superior insight or fertile imagination or sporting enterprise, and you only accentuate the value of steady, disciplined intelligence. The German has this virtue, and so has the Scot. If you wish to know where the Scot gained it, remember the traditions of the country and study closely the middle column.

The list of secondary schools recognised as efficient for 1907 (Cd. 4374) accounts for 132,849 children, classed thus :—

	Under 12	12 to 16	Over 16
Boys	16,084 ...	49,829 ...	5,478
Girls	12,724 ...	40,165 ...	8,669

The total number of pupil-teachers enrolled at these schools is 9809, and the total number of pupil-teachers noted as at secondary schools or pupil-teacher centres is 4745 boys and 15,803 girls.

Thus in 1907, 89,994 pupils out of 132,849 (67·74 per cent.)
in 1906, 76,728 pupils out of 115,594 (66·38 per cent.)
in 1905, 53,309 pupils out of 85,358 (62·45 per cent.)

were taking an approved course. The rise in numbers and percentages is satisfactory, as it indicates the approach of a time when the secondary school will have a complete secondary character, and, when this is attained, we shall have a rise in standard of performance.

If we compare the schools discussed in Prof. Sadler's county reports (of date 1904 and 1905) with the particulars given in the Blue-book for 1908 about these same schools, we find the following results:—

Boys	Under 12	Between 12 and 16	Over 16
Reports ...	... 997	... 4174	... 374
Blue-book	... 1127	... 4478	... 417
Increase ...	13 per cent.	... 7·3 per cent.	...11·5 per cent.
Girls			
Reports ...	... 608	... 2049	... 406
Blue-book	... 752	... 2494	... 521
Increase ...	8 per cent.	... 21·7 per cent.	...28·3 per cent.

Here again a welcome improvement is recorded, and the more welcome because it shows a large increase among girls. It is interesting to note that whilst we are debating what to do with children under five, the question is being debated in Germany whether school attendance might not be postponed until seven, because, among other things, the German mother has received such a good school training that she is able to give efficient elementary education in the home up to the age of seven.

Secondary schools for boys may be divided into four classes, according as they are, or are not, recognised by the Board of Education or represented at the Headmasters' Conference.

The classes are:—

(A) Recognised schools which are represented.
(B) Recognised schools which are not represented.
(C) Non-recognised schools which are represented.
(D) Non-recognised schools which are not represented.

The last two, which trouble the calculator, may be classed as "proud but probably efficient" and "mean and probably inefficient." With a satisfactory system of inspection, as is being evolved, these harsh epithets will come more and more to be deserved.

In class A, of the schools which take pupils between eight and nineteen there is one pupil under twelve for every four between twelve and sixteen and for every one over sixteen. This proportion is nearly exact, the error being slightly in favour of the oldest and against the youngest pupils.

To class C the "Schoolmasters' Yearbook" assigns 24,638 pupils, of whom 16,928 are at schools which take pupils under the age of twelve, and 7710 at schools which have no pupils under twelve. The larger number we will divide up in the ratio 1 : 4 : 1. The smaller we will divide on the supposition that there are two pupils under sixteen for every one over that age.

To calculate class D we will compare with the totals of classes A and B. Here Mr. Sadler's reports on Liverpool, Newcastle-on-Tyne, Exeter, Essex, Hampshire, and Derbyshire, a representative list, will give us a standard. This standard is:—

	Under 12	Between 12 and 16	Over 16
Classes A and B ...	100	... 100	... 100
Class D	336	... 52	... 41

We promised to show where the Bürgerschüler were. Here they are, in non-recognised schools, which are probably primary in character, and perhaps not efficient at that, yet aping the respectability of a secondary school.

Our total for boys is thus:—

	Under 12	Between 12 and 16	Over 16
Classes A and B ...	16,084	.. 49,829	.. 5,478
Class C_1	2,821	... 11,286	... 2,821
Class C_2	—	... 5,140	... 2,570
Class D	54,042	... 25,911	... 2,246
Pupil-teachers at schools	—	.. 60	.. 4,685
Total	72,947	... 92,226	... 17,800

Or, if we take the population of England as 32,000,000, there are in secondary schools

2·28 boys, per 1000 inhabitants, under 12
2·88 ,, ,, ,, ,, between 12 and 16
0·56 ,, ,, ,, ,, over 16.

And, it should be noted, 26 per cent. of those over sixteen are preparing for work as teachers in primary schools.

A similar calculation could be made for girls: but it would be much harder to work out. If the proportion of five boys to four girls be taken, an error will be made for older girls, as many girls remain at school from want of a fixed occupation, and in many cases the secondary school has still to perform for women the functions of a university.

If we take the number of boys in primary schools in England as 2,800,000, these figures give, for every 100 boys in primary schools, 6·53 in secondary schools, of whom 3·93 are more than twelve years of age.

Against this we may set the following:—

		Higher Grade	Age	Secondary	Age
Basel Town...	Boys ...	54·7	(10–14)	... 45·3	(10 18)
	Girls ...	57·4	(10–14)	... 28·2	(10–18)
Mannheim ...	Boys ...	20·5	(8 14)	... 24·2	(10 19)
	Girls ...	21·6	(8 14)	... 9·1	(10 19)
Zürich Canton	Boys ...	17·0	(12–15)	... 2·04 5·24	(12–15) (15 18)
	Girls ...	13·6	(12 15)	... 1·91	(15 18)
Boston, U.S.A.	Boys and Girls	19·43	(14 19)		
Württemberg	Boys	12·85	(8 14),	2·69	(14 18)

The figures for girls in Zürich apply only to pupils in public secondary schools. Whatever exceptionally favourable circumstances may be put forward in these cases, compulsory military service or social precedence, taken as a whole they show that England is far in arrear.

It is possible, though in some cases difficult, to construct a table giving the number of secondary pupils in various areas. If we take the figures for Prussia in the "Statesman's Year-book," 1908, we get, for boys and girls in public and private schools:—

8·28 pupils per 1000 inhabitants in secondary schools.
4·51 pupils per 1000 inhabitants in Mittelschulen.

The Mittelschulen may, for social distinction, rank as intermediate, but many of them would be recognised by us as secondary schools.

Other figures for recent years which may be quoted are, per 1000 inhabitants:—

	Boys	Girls	Boys and Girls
U.S.A.	—	... —	... 10·61
Boston, (14 19)	12·37	... 12·67	.. 25·04
Connecticut (13 19) ...	—	... —	... 12·67
Maine (13 19)	—	... —	. 18·94
Massachusetts (13 19) ...	—	... —	... 17·26
Germany—			
Cologne	8·7	... 4·7	... 13·4
Hamburg	11·4	.. 11·7	. 23·1
Mannheim (10 18)	14·56	... 5·52	... 20·08
Munich (10 15)	11·0	... 7·20	.. 20·45
Munich (16 18)	2·26		
Switzerland			
Confederation:			
Age 12 15 (Higher Grade)	7·31	... 6·01	13·32
Age 12 19 (Secondary)	—	... —	. 7·4
Basel Town:			
Age 10 14	8·71	... 8·01	16·72
Age 14 18	5·00	... 3·43	. 8·43

Zürich Canton :			
Age 12–15	11·61	9·63	21·24
Age 12–19	4·03	2·22	6·25

The foregoing statistics may be compared with those subjoined :—

Birkenhead	6·59	8·72	15·31
Derbyshire	3·53	1·54	5·07
Essex	6·11	5·76	11·87
Exeter	11·14	13·73	24·87
Hampshire	6·85	3·88	10·73
Huddersfield	3·99	3·46	7·45
Liverpool	4·14	3·70	7·84
Newcastle-on-Tyne	6·79	5·88	12·67
Shropshire	5·9	5·6	11·5

It will thus be seen that in education we are not yet up to a one-Power standard.

If, however, we take Edinburgh, where a representative committee has been studying the subject, we find from the committee's figures :—

	Under 12	Age 12 to 15	Over 15
Higher Grade	0·3	5·40	1·12
Secondary	6·36	6·28	3·84

being 6·82 per 1000 inhabitants for higher-grade schools and 16·48 for secondary schools. These figures are for boys and girls, and only three private schools are included.

England has no reason to despair. There is sufficient evidence to show that progress is being made. The West Riding County Council has the following record per 1000 inhabitants :—

	1903–4	1904–5	1905–6	1906–7	1907–8	1908–9
Boys	1·5	1·7	1·9	2·1	2·3	2·4
Girls	0·7	1·3	1·6	1·9	2·2	2·3
Total	2·2	3·0	3·5	4·0	4·5	4·7

where, again, the number of girls has greatly increased, a notable augury for the home of the future.

In the West Riding a large number of pupils go to schools in county boroughs; this may account for the slower increase in the figures for boys. If allowance be made for them and for other variations, the average becomes at least 6·2 per 1000, promising, but not yet sufficient.

Statistics relating to university education are liable to uncertainty, on account of the presence of the foreign or colonial student. Thus in Switzerland the chief problem of university education is to exclude the Russian undesirable without offending democratic sentiment. The foreigner who attends a German university does so from belief in its efficiency. At home let us assume that what we gain by the presence of the non-Britisher we lose by emigration to the Continent.

The "Statesman's Year-book" for 1908 gives the following figures for the United Kingdom in 1907 :—

Oxford and Cambridge	7205
Durham	926
London, including School of Economics	7141
University Colleges	3081
Birmingham, Leeds, Liverpool, Manchester, Sheffield	4685
Scotch Universities	7579
Wales	1301
Ireland	2066

a total of 33,984, or about 7·8 per 10,000 inhabitants.

In No. 591 of Diplomatic and Consular Reports, Dr. Rose gives the following figures per 10,000 males in Germany :—

1870	1873	1876	1881	1886	1889	1892	1897	1900
8·89	10·03	11·08	11·73	13·85	14·39	13·87	15·70	16·78

The returns for Switzerland give per 10,000 inhabitants :—

Summer Term 1906—
Natives 9·58 ... Foreigners 12·34 (Men 8·10, Women 4·24)
Winter Term 1906–7—
Natives 10·29 ... Foreigners 12·88 (Men 7·67, Women 5·21)

The figures for German universities given in "Minerva" for 1907 are classified for winter and summer sessions and for matriculated students and Zuhörer. Interpolating for omissions we get :—

	Matriculated students	Total attendance	Ratio
Winter	44,590	51,045	100 : 114·5
Summer	45,052	54,137	100 : 120·2

Or, on the standard of students per 10,000 inhabitants :—

Winter, 8·1 and 9·28. Summer, 8·2 and 9·84.

Further figures bearing on university statistics in Germany will be found on pp. 51 and 57 of No. 591 of Diplomatic and Consular Reports. Estimating for university education on the German basis, we should expect to find 44,370 students in Great Britain and Ireland. We have already enumerated 33,984 at degree-granting universities. The Board of Education accounts for 2,655 at "day technical institutions" in England. Let us add half that number for the rest of the United Kingdom, though 1029 of them are known to be under eighteen years of age. At agricultural and veterinary colleges we know there are 630 students. We thus get a total of 38,597, without any allowance for duplicates.

This is much better than we might expect. The newer universities in the north and the Midlands show the presence of large numbers of people who believe in education of a high standard. There is nothing to compare with the 16,000 or more students at German technical high schools, and little to record in commercial education of a high standard, London always excepted; but there is much promise for the future.

That we have plenty of people willing to be taught is shown by the official returns. Under the heading "Schools of Art" we find :—

	Men	Women
Day classes	1,474	7,631
Evening classes	15,887	11,938

Under "Day Technical Classes" there are 8538 students, and under "Other Classes for Further Instruction" 307,908 men and 207,989 women who qualified for grants, of whom 90,656 were under fifteen and 163,448 between fifteen and eighteen.

In dealing with numbers, the author has endeavoured to put a good complexion on the British position. He has touched but briefly on standards and curricula. He has not overstated the case for the foreigner. The result of all this labour is to leave the impression that the future is promising though the present is deficient. The existence of a crisis in education is being recognised. Local authorities are making schools efficient; parents are availing themselves of the opportunities so created; inspection is telling those most interested whether the work of a school is satisfactory or whether its reputation is only sustained by skilful advertisement. It would be well if the great public schools were to pocket their pride and accept recognition, for that would give a hall-mark of respectability which private schools could not ignore.

Amid all this promise there is much to deplore. The English parent does not whole-heartedly believe in secondary education. Of four boys entering a secondary school, only one completes the curriculum. If the parent can be got to see the value of trained thinking power and to resist the enticement of an immediate wage; if he can appreciate the self-discipline that a steady, self-contained course of education demands; if he will realise the remorselessness of research and ignore the sporting chance of a prize limerick; if he will value the moral forces which have moulded nations and despise the patriotism of the music-hall: then there is still hope for the nation. We can add one-eighth to the number of our university students without creating an academic proletariate. We can almost double the numbers of our secondary schools without being overstocked. We can open a technical university where now a technical institute exists. And if all this is done, we shall neither be financially ruined nor oppressively over-educated. Whilst much remains for the statesman to do, much also remains for the teacher. If parents will insist on knowing what careers are open for their children on leaving a secondary school, the narrow-mindedness of the teacher must give way. If the public will encourage attendance at continuation classes during the day, the employer will attach more value to the work of his employees, and the parent will take care that the primary school does not become a wilderness of book-learning.

The difficulties of making this comparison and the devices which have been employed will be apparent to everyone. Of the conclusions that can be drawn, one at least is incontestable: it is not yet possible to give a definite statistical statement because the materials do not exist. It seems bad economy to suggest further advances until the completion of a national stock-taking.

A. J. PRESSLAND.

THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES.

UNDER the presidency of Dr. D. H. Scott, F.R.S., the South-Eastern Union of Scientific Societies held an extremely successful congress at Winchester from Wednesday to Saturday of last week. As Sir Archibald Geikie in his presidential address to the congress at Hastings last year had dealt with the geological history of the Weald, Dr. Scott this year appropriately discoursed on the flora of the Wealden strata. This was a subject of peculiar interest to the Union, inasmuch as many of the most interesting fossil plants of Wealden age have been obtained within the sphere of its activity. The flora was of similar type to that which had prevailed from the beginning of the Mesozoic period, and in so far as seed-bearing plants are concerned consisted chiefly of conifers and cycads. It is believed that the angiosperms did not appear until later Cretaceous times, and their comparatively sudden rise was probably related to the contemporary development of insect life.

With a living specimen of *Cycas revoluta* in front of him, and aided by a fine series of lantern-slides, Dr. Scott described the structure of recent cycads and their relation to the fossil types. Before dealing with cycads, however, he referred to the fact that in the Secondary flora there were many plants more or less related to the Ginkgo, or maiden-hair tree, which at the present day survives as an isolated species, possibly wild on the mountains of western China. It was discovered by Japanese botanists that cycads and Ginkgo alone among living seed-plants were fertilised, like ferns, by motile cells, or spermatozoids. Misled by the resemblance of the leaves of the African cycad Stangeria to the fronds of a fern, the systematic position of Stangeria was at one time misunderstood. It is interesting to learn from Palæozoic botany that a real affinity exists between the cycads and the ferns.

During the Jurassic and Wealden stages of the earth's history cycadaceous plants were so abundant and varied that probably among vascular plants one in every three was a cycad, whereas at the present day the proportion scarcely reaches one in a thousand. Although cycads have now a very limited geographical distribution, they formerly spread over the whole world, and, as their relics testify, must have abounded in what is now the British area. Many of the Mesozoic cycads, notwithstanding the general resemblance of their leaves, differed essentially from the modern types, and where the reproductive organs have been preserved, as in specimens of Bennettites, the fossil fructification is found to be much more complicated than are the simple cones of the living cycads. In America, where abundant material has been discovered, Dr. Wieland, of Yale, has shown that the fructification of many cycad-like plants consisted of true bisexual flowers, comparable in general terms with those of such highly organised modern plants as the magnolias. Recent researches have, indeed, led to the conclusion that the origin of the angiosperms, which are to-day the dominant plants in the world, may perhaps be sought in those cycad-like plants that are so abundantly represented in the Wealden beds. If, as is probable, the flowers were brightly coloured, the fertilisation by insects may have begun among these cycads.

Not without some relation to the subject of the presidential address was a lecture by Mr. R. W. Hooley, of Southampton, on the Age of Reptiles in Hants and the Isle of Wight. The lecturer gave the results of much original investigation in the Wealden beds of the island, resulting in the discovery of many interesting remains. He held strongly to the view that the strata were of deltaic origin.

Another evening lecture was on the prehistoric memorials of Hampshire, by Mr. W. Dale, of Southampton. The lecturer, who is an active archæologist in the field, illustrated his discourse by some fine local antiquities in stone and bronze from his own collection, as well as by a large series of lantern-slides, including many original photographs.

Each morning during the congress two scientific papers were read; these related to botany, entomology, and geology, and most of them were appropriately of a local character. The afternoons were devoted to excursions, which were admirably organised by Mr. N. C. H. Nisbett; and in the evenings, before the lectures, there were receptions by the Mayor and by the headmaster of Winchester College. An excellent temporary museum was arranged at the Guildhall, under Mr. E. W. Swanton, of Sir Jonathan Hutchinson's Museum at Haslemere, the collections including a large series of interesting objects from the Hartley University College, Southampton. The success of the congress was largely due to the energy of the hon. local secretary, Mr. W. Norris, and the hon. general secretary, the Rev. R. Ashington Bullen.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. H. F. Newall, F.R.S., fellow of Trinity College, has been elected to the recently founded professorship of astrophysics. Mr. Newall was formerly assistant to the Cavendish professor of physics and demonstrator in experimental physics in the same laboratory, and now holds the position of assistant director of the observatory at Cambridge.

H. E. Durham, King's College, has been approved by the general board of studies for the degree of Doctor in Science.

The general board of studies has appointed Dr. Haddon as reader in ethnology, and Dr. Bromwich as university lecturer in mathematics.

The same board has re-appointed S. Ruhemann as university lecturer in organic chemistry; Dr. Sell and Dr. Fenton as university lecturers in chemistry; Dr. Duckworth as university lecturer in physical anthropology; H. Woods as university lecturer in palæozoology; A. Harker as university lecturer in petrology; and T. S. P. Strangeways as Huddersfield lecturer in special pathology. All these re-appointments are for five years, and date from October 1, 1909. They have also all been confirmed by the special boards connected with the subjects mentioned.

The Vice-Chancellor, Dr. Ridgeway, W. Durnford, C. E. Grant, A. Gray, P. Giles, L. Whibley, and S. C. Cockerell have been nominated a syndicate to consider the administration of the Museum of Classical Archæology, the relation between that museum and the Fitzwilliam Museum, and, in particular, the appointment, duties, and powers of the curator of the Museum of Classical Archæology; the syndicate is empowered to confer with such bodies and persons as it may think fit, and is to report to the Senate before the end of the Lent term, 1910.

It is proposed, the Chancellor, as president of the University Association, having given his approval, that a sum of 1000*l*. from the unassigned portion of the benefaction fund be appropriated towards the cost of the erection of the first block of the new museum of archæology and ethnology, and that the Vice-Chancellor be authorised to accept a tender for the erection of block i. of the new museum of archæology and ethnology provided that the tender does not exceed the sum of 11,000*l*., and that the sums subscribed or guaranteed amount to 12,500*l*. before any contract is signed.

Mr. Francis G. Smart, having made to the University an offer to give the sum of 900*l*. in order to found two prizes to be awarded in each year, one for botany and one for zoology, a Grace will be brought before the Senate to-day, June 17, recommending that Mr. Smart's offer be gratefully accepted.

The special board for divinity has nominated Dr. Humphry as assessor to the regius professor of physic for the ensuing year, and the special board for mathematics has nominated Sir Robert Ball as an elector to the Isaac Newton studentships until September 30, 1913.

The Cavendish professor of experimental physics announces that a course of demonstrations in practical physics will be given during the long vacation, beginning July 5.

The first three names in the Mathematical Tripos list, part i. (old regulations), are P. J. Daniell, Trinity; E. H. Neville, Trinity; and L. J. Mordell, St. John's.

DR. H. A. WILSON, F.R.S., professor of physics in King's College, London, has accepted the appointment of professor of physics in McGill University, Montreal.

THREE lectures on "Aëronautics" are being delivered at the East London College by Mr. A. P. Thurston. The first lecture, on Monday, June 14, was on flying machines (heavier-than-air type). The second, on Wednesday, June 23, will deal with balloons, airships, and kites, and the subject of the third, on Wednesday, June 30, will be the mechanical principles of flight. Applications for tickets of admission to the lectures should be sent to the registrar at the college.

THE Department of Agriculture and Technical Instruction for Ireland will in August next award not more than six industrial scholarships to persons engaged in industries, such as the woollen, linen, leather, and tanning industries. The object of these scholarships is to enable selected persons, who must already have been engaged in one of the higher branches of the industry, to take a full course of instruction in an institution providing special courses of an approved character with the view of training them for the management of such an industry. The scholarships will be tenable at some higher institution, to be approved by the Department, in which the industry, and the principles underlying it, are taught. They will be of the value of 80*l*. each, and may be renewed for a second or a third year at the discretion of the Department. Candidates must fill in and return, addressed to the secretary of the Department, not later than June 30, Form S. 192, copies of which may be had on application.

THE philanthropic aspects of the work of the administrators of the Children's Country Holidays Fund are appreciated and understood widely, but it is not generally known that, without some preliminary training, the ordinary town child is unable to benefit educationally from a short stay in the country. We are glad to learn, therefore, that a subcommittee, called the countryside committee, of the workers who organise the holidays was formed some time ago to develop means of interesting the children sent into the country in the natural wonders of countryside life. The subcommittee has arranged for the children, who will in August be sent by the fund into the country, a series of lantern lectures and nature talks about common animal and plant life, and also a succession of short rambles into metropolitan environs on Saturday afternoons to secure for them some preliminary practice in observation and general open-eyed intelligence. An appeal is made to competent men and women who love children to give, during the present month and the first weeks of July, nature talks to the children in the schools they attend, or to arrange for Saturday afternoon rambles in the immediate neighbourhood of London. Similar persons who live in the country and are willing to assist in making the fortnight's holiday a profitable time physically and mentally for the children are asked to communicate with the honorary secretary of the countryside committee, Mrs. Douglas Wilson, 17 Buckley Road, Brondesbury, London, N.W.

BEDFORD COLLEGE (University of London), the oldest university college for women, celebrates this year the sixtieth anniversary of its foundation. Since 1849, when it was first opened, its progress has been continuous, and the number of students entered this year exceeds three hundred. It is the only college exclusively for women which receives a Parliamentary grant. Recent developments in the work and the increase in numbers of students have caused serious pressure on the space available in the present buildings. In 1903 a building and endowment fund was started, which has received generous support; and the end of the lease of a Crown property in Regent's Park, known as South Villa, has been purchased, with a promise from the Crown for its renewal on a further lease of ninety-nine years. It is estimated that to erect on this site buildings well equipped for college purposes, including a library, laboratories, lecture-rooms, and a residence for students, will cost about 80,000*l*. The council of Bedford College, encouraged by the support it has already received (which includes a special bequest for a botanical laboratory), hopes that sufficient support may be forthcoming to enable it to obtain this sum, and to build a college in which the educational work so worthily begun may be carried on in worthy surroundings. In order to celebrate the sixtieth anniversary, and to make this desirable site known to their friends, the council and principal will hold a garden-party at South Villa on Tuesday, June 29, from 4 p.m. to 7 p.m., for which cards of invitation may be obtained from the secretary, Bedford College, York Place.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 10.—Sir Archibald Geikie, K.C.B., president, in the chair.—The functions of the pituitary body (Croonian lecture): Prof. E. A. **Schäfer**.—A wave-length comparator for standards of length: Dr. A. E. H. **Tutton**. Two and a half years ago the author was requested by the Standards Department of the Board of Trade to devise and superintend the construction of a new comparator, for comparing standards of length—the imperial standard yard, for instance, with official copies, and the latter with the copies constructed for local authorities—in terms of wave-lengths of light. The instrument now described is the result. Besides performing its functions as a wave-length comparator, and being the first instrument specifically constructed as such, it is also the most perfect instrument yet devised for measurement in wave-lengths in general. It is described to the Royal Society by permission of the President of the Board of Trade. The principle of the instrument is that of the author's interferometer, described to the society in 1898 in connection with an interference dilatometer, and again as improved in 1904 in connection with the author's elasmometer or interference elasticity apparatus. The interferometer, which is totally different from that of Michelson or that of Fabry and Perot, is adapted, as regards details, in a special manner for the specific object in view, but with the exception that a Hilger constant-deviation prism is employed instead of a train of two spectroscope prisms, its principle is preserved intact. The essential point of the instrument is that one of the two microscopes, employed to focus the two defining lines on a standard yard bar, actually carries just above the objective one of the two glass plates of the interference apparatus, which reflect the monochromatic light (hydrogen or cadmium red radiation) which is caused to interfere and produce rectilinear dark bands. When the microscope is moved the plate consequently moves with it, and the amount of movement is absolutely afforded by the movement of the interference bands, being equal to half the wave-length of the light employed for every band which passes the reference spot in the centre of the field of the interferometer telescope. So perfectly has this fine movement been achieved that the microscope and the bands can be caused to move simultaneously, by rotation of a large, fine-adjustment wheel, so steadily that each band can be made to pass the reference spot as slowly as one wishes, and be arrested instantly, without the slightest tremor, at any fraction of its width, so that the control of the bands and the counting is a perfectly simple matter. In order to compare two standard bars, it is only necessary (1) to place the bar of known length, supported on an elaborate mechanism for the adjustment of the bars, also novel, under the two microscopes, carried on massive yet delicately moving sliders on a 6-feet V-and-plane bed, so that the two defining lines are adjusted between the spider-lines of the micrometer eye-piece in each case; (2) to replace the standard by the copy to be tested, so that the defining line near one end is similarly adjusted under the corresponding microscope; then, if the other defining mark is not also automatically adjusted under the second microscope which carries the glass interference plate, as it should be if it is an exact copy, (3) to traverse that microscope until it is so adjusted, and (4) to observe and count the number of interference bands which move past the interference spot during the process. The difference between the bars is this number multiplied by the half-wave-length of the light in which the bands are produced. The paper also gives an account of the electrical and thermal arrangements, as well as of the foundation masonry of the new comparator room. The temperature of the whole room is controlled entirely electrically, being maintained constant at the official temperature, 62° F. The thermostatic arrangements are of an original character, and of two different independent types—a thermometric and a resistance type.—The use of wave-length rulings as defining lines on standards of length: Dr. A. E. H. **Tutton.** The delicacy of the method of measurement in wave-lengths described in the preceding communication calls for a corresponding refinement in the engraved lines which form the defining lines of the length of a standard yard or metre or other line-measure bar. The defining lines on the imperial standard yard are sharp-edged, but contain the equivalent of forty interference bands of red light in their thickness, and the Benoit defining lines of the platinum-iridium copy made in 1902 are not only very ragged-edged, but contain fifteen interference bands in their thickness. The author has been in communication with Mr. J. H. Grayson, of Melbourne, whose fine rulings have recently evoked such interest among microscopists, and after a long investigation has found that wonderfully satisfactory rulings on the scale of 40,000 to the inch can be made on polished speculum metal, covered with a thin cover-glass cemented only at the corners away from the rulings. Now the forty-thousandth of an inch is a single wave-length of red light (for $H\alpha = 1/38710$ inch and Cd red $= 1/39450$ inch), so that the interval between any adjacent pair of these lines is equivalent to only two interference bands. The thickness of each line, which is absolutely sharp-edged, is less than a single interference band. The author has therefore devised a defining mark in these rulings, which he terms a "Tutton location signal," to distinguish it from the "Benoit defining line." It consists of five such parallel lines spaced one forty-thousandth of an inch apart, with a pair of strong "finder" lines outside them and parallel to them, and another pair of similar finder lines perpendicularly transverse to them, to indicate a central part of the lines for use. The central line of the five fine Grayson rulings is *the* defining line. These location signals can also be ruled on platinum-iridium, and with less success on gold and invar; but the result on speculum metal is so very superior that a large number of location signals have been made on this metal by Mr. Grayson for the Standards Department. The paper indicates their possible mode of use, not only as the end-mark defining lines of standard bars, but for a new mode of determining, by a stepping-off process of repeated doublings, the total number of wave-lengths of red cadmium light contained in the British yard.

Linnean Society, June 3.—Dr. D. H. Scott, F.R.S., president, in the chair.—*Calamites (Calamitina) Schutzei*, Stur, and on the correspondence between the length of internodes and the position and function of the short internode in the genus Calamites and in the recent Equisetaceæ: A. R. **Horwood.** The author stated that a specimen of *Calamites Schutzei*, Stur, shortly to be figured, exhibits graphically the fistular character of the stem in Calamites, a specimen 3 feet long having been split into two portions longitudinally and so preserved. In the same specimen (from the Main Coal, Stanton-under-Bardon, Leics.) and in another from Brighouse, Yorks, provisionally referred to the species, the regularly uniform length and position of a short internode at the commencement of each period of uniformly longer internodes are specially marked. As a result of a study of this specimen and of a comparison made between it and specimens of the recent species of Equisetum, it is found that there is a strong resemblance between the two groups, Calamarieæ and Equisetaceæ, in the position of the short internode, and a marked similarity in the uniform rate of increase or decrease in the length of the internodes in both groups also, most apparent in Calamitina, but probably in a modified form in Eucalamites and Stylocalamites, and in subterranean stems of *S. Suckowii* there is a strict homology.—The Cephalochorda "amphioxides"—of the *Sealark* expedition: H. O. S. **Gibson.**—The Alcyonaria of the *Sealark* expedition: Prof. J. A. **Thomson.**

Mathematical Society, June 10.—Sir W. D. Niven, president, in the chair.—The behaviour at the poles of a series of Legendre's functions representing a function with infinite discontinuities: F. J. W. **Whipple.**—An analogue of Pascal's theorem in three dimensions: W. H. **Salmon.**—Some symbolical expressions for the eliminant of two binary quantics: A. L. **Dixon.**

EDINBURGH.

Royal Society, May 17.—Dr. John Horne, F.R.S., vice-president, in the chair.—A simple radioscope and a radiometer for showing and measuring radio-activity: Dr. J. **Aitken.** The instruments were a natural development of his own and C. T. R. Wilson's investigations on cloudy condensations. A U-tube about 2 cm. internal diameter was filled partly with air and partly with water. The open end of the tube was in connection with a rubber ball, by which pressure on the enclosed air could be increased and diminished at will. The rubber ball was compressed by a simple, suitable mechanism of hinged levers. When the pressure was suddenly diminished by relief of the ball after compression had been applied, fog cloud might be observed in the air space. After a few alternate compressions and reliefs of pressure the cloud ceased to form, the air being purified of natural nuclei. When, however, a radio-active body was brought near, the relief of pressure was accompanied by formation of cloud. Various forms of the radioscope were described. To convert the instrument into a radiometer, Dr. Aitken made use of his method of counting the drops as they fell on a surface ruled into small squares. The instrument was not capable of the same accuracy as Wilson's form of apparatus, but it was simple and easily worked, and could give results of quantitative value in comparing the radio-activity of different substances.—Mendelian action on differentiated sex: Dr. D. Berry **Hart.** After referring to the well-known facts that the male and female genital tracts contain, not only the potent elements proper to the sex, but also non-potent elements of the opposite sex, Dr. Hart proceeded to apply the principles of Mendelism, regarding the non-potent elements as recessive and the potent elements as dominant in Mendel's sense. If the genital tract contained dominant and recessive determinates, then, in Weismann's terminology, the zygote from which they arose contained dominant and recessive determinants, and this made it an impure determinant. To get such a heterozygote two varieties of gamete seemed to be necessary, viz. a non-sex and sex male gamete and a non-sex and sex female gamete. By the crossing of a sex male gamete and a non-sex female gamete, and of a sex female gamete and a non-sex male gamete, respectively, male and female zygotes were produced—variation zygotes. Evidence was given that the dominant and recessive genital determinants were not segregated in the gametes, but combined in the sex gamete. The origin of the gametes was discussed in relation to the Owen-Weismann law of the continuity of the germ-cells. Ovarian and testicular teratomata were regarded as derived from a non-sex gamete, which, owing to imperfect reduction from a primitive germ-cell, retained some power of zygotic development. The general view was that dominance and recession acted on differentiated sex, but that the dominant and recessive genital determinants were in the sex gamete, and were not segregated in the gametes as the theory of gametic segregation demands. The dominant and recessive elements are not segregated in the human race, but are segregated in the free-martin, and probably in bees. In the free-martin—a sterile bull usually with a potent twin—the potent bull has the dominant determinates as the result of the division of the zygote, while the free-martin has the recessive determinates.

DUBLIN.

Royal Dublin Society, May 25.—Prof. Sydney Young, F.R.S., in the chair.—Injurious insects and other animals observed in Ireland during the year 1908: Prof. G. H. **Carpenter**. Observations were given showing the uselessness of sprays recommended for destroying the eggs of the apple sucker (*Psylla mali*), the early stages of which are described and figured. The larva of the beetle *Dascillus cervinus*, which feeds on the roots of oats and cereals, is described, and some details of its external structure are given; in many respects it appears a remarkably primitive larval form. Attention was directed to the unusual abundance in Ireland during the autumn of 1908 of the laburnum moth (*Cemiostoma laburnella*).—The analysis of beeswax: Prof. Hugh **Ryan**. By a method in principle similar to, in detail different from, that of Hehner, the author determines the percentage of beeswax in mixtures of that substance with other waxes. The acid number of the wax is first found, sand is added, and the mixture is evaporated to dryness; the esters and hydrocarbons are then extracted with low-boiling petroleum-ether in a Soxhlet apparatus. From the percentage by weight of the free acids and the acidity of the wax, the percentage of cerotic acid can be calculated, and from the latter the amount of beeswax in the mixture. If Montana (Montan) wax and stearic acid be present, the method will yield incorrect results. In the latter case it will be necessary to find the percentage of hydrocarbons, and the mean molecular weight of the combined acids in the wax, before the true percentage of beeswax can be calculated. Analyses of waxes from Ireland, Chili, Sierra Leone, and Madagascar, and of an artificial wax composition containing, amongst other substances, Montana (Montan) wax, are given to illustrate the methods described.—Montanin and Montana (Montan) waxes: Prof. Hugh **Ryan** and T. **Dillon**. A sample of wax called Montana wax, identical with that known in Germany as Montan wax, examined by the authors, melted at 76° C., had an acid number 73·3, an ester number 0·6, and contained 47 per cent. of unsaponifiable matter. The iodine number of the wax was 16, and that of the unsaponifiable matter was 31·13. The saponifiable portion consisted of an acid (montanic) the molecular weight and analysis of which agreed with the formula $C_{28}H_{56}O_2$. Montanin wax is a white, hard, brittle wax of melting point 96° C., much higher than that of Montana wax, with specific gravity (15° C.) 0·980, acid number 56·9, ester number 1·0, and containing 34·8 per cent. of unsaponifiable matter. The acid liberated from the saponifiable matter proved to be montanic acid, and the unsaponifiable matter was identical in composition with that obtained from Montana wax. The great difference in the physical properties of the two waxes is due to the presence of 23·87 per cent. of sodium montanate in montanin wax, and the absence of the sodium salt from the Montana wax.

NEW SOUTH WALES.

Linnean Society, March 31.—Mr. C. Hedley, president, in the chair.—Notes on the geology of the Mount Flinders and Fassifern districts, Queensland: Dr. H. I. **Jensen**. Mount Flinders is a rugged peak attaining an altitude of 2240 feet, and situated about eleven or twelve miles S.S.E. of the town of Ipswich, Queensland. Surrounding the main peak there are a number of smaller cones and rugged rocks, most of which represent former parasitic vents or smaller foci of eruption which encircled the large volcano. It is noteworthy that the conical mountains are usually composed of breccia, with more or less of basic trachyte, dacite, and andesite, and, further, they are characterised by better soil (usually of a red or brown colour), and a thicker vegetation; patches of vine scrubs occur on them. The volcanic rocks of the Fassifern scrub are all post-Triassic, and probably post-Cretaceous. There seems to have been an old series of dolerites anterior to the trachytes, but the author has not satisfied himself on this point. The remaining links of the sequence are (1) trachyte, later (2) andesite, and still later (3) basalt. —Can opsonins be obtained directly from bacteria and yeasts? Dr. R. **Greig-Smith**. Since the inoculation of dead cultures of bacteria and the ingestion of yeast give rise to an increased production of opsonin in the blood, there is the possibility that this might be derived directly from the digestion of bacteria and yeast. Staphylococcus and yeast were attacked with pepsin and with pancreatic extract, but while anti-opsonin was clearly present, no evidence of the formation of opsonin could be obtained.—The coagulation of condensed milk: Dr. R. **Greig-Smith**. Condensed milk which became coagulated or "jellified" in the course of a few months was found to contain a micrococcus closely allied to *Staphylococcus albus*. Pure cultures of the micro-organism produced a coagulation in sterile condensed milk. The coagulation was hastened by the presence of traces of calcium carbonate, and the trouble appeared to have been aggravated by the small quantity of residual air in the tins.

PARIS.

Academy of Sciences, June 7.—M. Bouchard in the chair.—Presentation of the *Comptes rendus*, reports and communications of the first International Low Temperature Congress, Paris, October 5–12, 1909: M. **d'Arsonval**.—Presentation of a meridian catalogue of the Observatory of Bordeaux: B. **Baillaud**. The catalogue contains 6999 stars, the declinations of which are comprised between −15° and −20°.—Hertzian waves and Fredholm's equation: H. **Poincaré**.—Preparation of the three oxy- and the *p*-dimethylamido- and diethylamidobenzylidenecamphors and the *p*- and *m*-tolylidenecamphors: A. **Haller** and Ed. **Bauer**. A general method is given for the preparation of these substances by condensation of camphor with aldehydes in presence of sodium amide. The chemical and physical constants of several of these compounds are detailed, special attention being given to the influence of the introduction of various groups into the benzene ring upon the colour and optical properties.—Congruences the two focal surfaces of which are quadrics: C. **Guichard**. —The total eclipse of the moon of June 3, 1909, observed at Marseilles by MM. Borrelly and Coggia: H. **Bourget**. —Surfaces such that the geodesic lines of curvature are respectively functions of the principal corresponding curvatures: A. **Demoulin**.—A generalisation of the geometry of the cyclid: B. **Hostinsky**.—The altimetry of the Pelvous-Écrins *massif*: P. **Helbronner**. A preliminary paper giving the heights of thirty peaks. Comparison is made with data furnished by the *Carte de l'Etat-Major*, and the causes of the divergences discussed.—A physical representation of the θ-functions: H. **Larose**.—The standardisation of condensers: M. **Devaux-Charbonnel**. The results of the application of the tuning-fork method are described. The convenience and exactitude of this method (0·1 per cent.) is pointed out. The capacity of an air condenser was found to be constant and independent of the vibration frequency of the fork, but the capacity of a mica condenser was found to be slightly less with a higher frequency.—The absolute measurement of an electrical resistance in electrostatic units: M. **Hurmuzescu**. —Catalytic action produced by moisture: J. **Meynier**. Mixtures of dried nitric oxide and oxygen were treated with minute quantities of water vapour, freed from large ions by filtration through cotton wool. No proportionality could be traced between the velocity of the reaction and the amount of water vapour present.—Chemical reactions in gaseous mixtures submitted to very high pressures: E. **Briner** and A. **Wroczynski**. The gaseous mixture is liquefied by cold in a thick-walled tube, the latter sealed, and allowed to assume the ordinary temperature. Results are given for the mixtures (NO,HCl), (NO,SO_2), (HCl,SO_2), (NO,CH_3Cl), and (SO_2,O_2).—The hydrated combinations of thorium chloride with alkaline chlorides: Ed. **Chauvenet**.—Normal butine and some of its derivatives: Georges **Dupont**. The most satisfactory yields were obtained by starting from normal butyl alcohol; this was converted into butylene by the Senderens reaction, absorbed by bromine, and the resulting bromide heated with dry potash. The pure butine, $C_2H_5.C{\equiv}CH$, boils at 18·5° and melts at −130°. Numerous derivatives are described. —The synthesis of derivatives of racemic fenone: MM. **Bouveault** and **Levallois**.—The maltase from buckwheat: J. **Huerre.** This maltase acts between 3° C. and 70° C., the maximum effect being produced at 55° C. The activity is increased either by a partial neutralisation of the alkalinity or by the addition of amino-acids or acetamide.—Some Tertiary French basalts of the Alpine Vorland: Albert Michel **Lévy.**—The reddening of the branches of Salicornia: H. **Colin.** The accumulation in the plant cells of a considerable proportion of mineral compounds, such as sodium and magnesium chlorides, does not prevent the production of anthocyanine.—The influence of various nutritive media on the development of the embryos of *Pinus pinea*: J. **Lefèvre.** Sugar is the essential food of the embryo; small quantities of nitrogenous materials, such as peptones, are only accessory foods.—The phytogeographical subdivisions of the Kabylie of Djurdjura: G. **Lapie.**—Some observations relating to anaphylactic phenomena: P. **Delanoë.**—The effects of chocolate and coffee on uric acid and the purins: Pierre **Fauvel.** In a healthy man, on a vegetarian diet, chocolate and coffee increase the excretion of purins, diminish the excretion of uric acid, and prevent the precipitation of the latter, and this diminution of uric acid is not due to retention in the body.—The problem of kinematographic vision without vibrations: C. **de Proszynski.** The frequency of interposition of the shutter which cuts off the light during the motion of the film is increased from fourteen to fifty-six per second. In this way the painful vibratory sensation is completely suppressed.—The treatment of nœvus by electrolysis and radium combined: Fouveau **de Courmelles.** Positive electrolysis with multiple needles followed by the application of radium reduces the necessary time of treatment to three or four days.—The signification of the Rhabdospora, supposed parasitic Sporozoa in fishes: L. **Léger** and O. **Duboscq.** The conclusion is drawn that this is not a parasite, but a normal histological element in fishes, a glandular secretion cell, and hence that *Rhabdospora thelohani* should be deleted as a species.—The madrepores of the islands of San-Thomé and Prince (Gulf of Guinea): Ch. **Gravier.**—Contribution to the experimental analysis of the process of fecundation in the Amphibia: E. **Bataillon.**—The skeleton of the trunk and limbs of the fossil man of La Chapelle-aux-Saints: Marcellin **Boule.** The characters of the skeleton show that the fossil distinctly belongs to the human group. It presents, however, a mixture of characters; some correspond to those found in the lowest type of the existing races, others belong more to the anthropoid apes.—Earth induction currents in the Polar regions: Kr. **Birkeland.**—The compensation between the types of seasons in certain regions of the earth: H. Hildebrand **Hildebrandsson.**

DIARY OF SOCIETIES.

THURSDAY, JUNE 17.

ROYAL SOCIETY, at 4.30.—On the Origin of Certain Lines in the Spectrum of ε Orionis (Alnitam): Sir Norman Lockyer, K.C.B., F.R.S., F. E. Baxandall, and C. P. Butler.—On Electrostatic Induction through Solid Insulators: Prof. H. A. Wilson, F.R.S.—The Effect of Pressure on the Band Spectra of the Fluorides of the Metals of the Alkaline Earths: R. Rossi.—The Ionisation produced by an α Particle. Part I.: Dr. H. Geiger.—On the Diffuse Reflection of the α Particles: Dr. H. Geiger and E. Marsden.—The Decay of Surface Waves produced by a Superposed Layer of Viscous Fluid: W. J. Harrison.—The Passage of Electricity through Gaseous Mixtures: E. M. Wellisch.—A Study of the Use of Photographic Plates for the Recording of Position: Dr. C. E. K. Mees.—The Coefficients of Capacity and the Mutual Attractions or Repulsions of Two Electrified Spherical Conductors when close together: Dr Alexander Russell.—On the Effect of Previous Magnetic History on Magnetisation.—Prof. E. Wilson, G. F. O'Dell and H. W. K. Jennings.

LINNEAN SOCIETY, at 8.—On the Growth of a Species of Battarea: J. G. A. Tepper.—The Deposits in the Indian Ocean: Sir John Murray, K.C.B., F.R.S.—The *Sealark* Perseidea, Stenopidea, and Reptantia: L. A. Borradaile.—The *Sealark* Polychæta. Part II.: F. A. Potts.—The *Sealark* Lepidoptera: T. Bainbrigge Fletcher.—New Species of Malesian and Philippine Ferns: Dr. H. Christ.—The African Species of Triumfetta, Linn.: T. A. Sprague and J. Hutchinson.—The Acaulescent Species of Malvastrum: A. Gray and A. W. Hill.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Department. Annual Meeting.

FRIDAY, JUNE 18.

ROYAL INSTITUTION, at 9.—A Recent Visit to the Panama Canal: A. H. Savage Landor.

MONDAY, JUNE 21.

VICTORIA INSTITUTE, at 4.—Annual Meeting: Presidential Address by the Earl of Halsbury, F.R.S.

THURSDAY, JUNE 24.

ROYAL SOCIETY, at 4.30. (Meeting at the Royal Astronomical Society).—*Probable Papers*: The Possible Ancestors of the Horses living under Domestication. Part I., Introductory: Prof. J. C. Ewart, F.R.S.—The Electrical Reaction of Certain Bacteria, and an Application in the Detection of Tubercle Bacilli in Urine by Means of an Electric Current: Charles Russ.—(1) On Pressure Perpendicular to the Shear Planes in Finite Pure Shears; and on the Lengthening of Loaded Wires when Twisted; (2) The Wave Motion of a Revolving Shaft, and a Suggestion as to the Angular Momentum in a Beam of Circularly Polarised Light: Prof. J. H. Poynting, F.R.S.—Thermal Conductivity of Air and other Gases: George W. Todd.—The Effect of the Injection of Intra-cellular Constituents of Bacteria (Bacterial Endotoxins) on the Opsonising Action of the Serum of Healthy Rabbits: R. T. Hewlett.—On the Occurrence of Protandric Hermaphroditism in *Crepidula fornicata*: J. H. Orton.—The Alcoholic Ferment of Yeast-juice. Part IV., The Fermentation of Glucose, Mannose, and Fructose by Yeast-juice: Dr. A. Harden, F.R.S., and W. J. Young.—Studies of the Processes Operative in Solution. XI., The Displacement of Salts from Solution by Various Precipitants: Prof. H. E. Armstrong, F.R.S., and Dr. J. V. Eyre.—And other Papers.

FRIDAY, JUNE 25.

PHYSICAL SOCIETY, at 5.—A Transition Point in Zinc Amalgam: Prof. Carhart.—A Method of Producing an Intense Cadmium Spectrum, with a Proposal for the Use of Mercury and Cadmium as Standards in Refractometry: Dr. T. M. Lowry.—On the Measurement of Wave-length for High Frequency Electrical Oscillations: A. Campbell.—An Electro-magnetic Method of Studying the Theory of and Solving Algebraical Equations of any Degree: Dr. A. Russell and J. N. Alty.—The Sine Condition in Relation to the Coma of Optical Systems: S. D. Chalmers.—Exhibition of a new Fery Thermo-electric Calorimeter: C. V. Drysdale.—An Instrument for Measuring the Strength of an Intense Horizontal Magnetic Field: F. W. Jordan.—On a Method of Determining the Sensibility of a Balance: Prof. Poynting, F.R.S., and G. W. Todd.—The Balance as a Sensitive Barometer: G. W. Todd.

CONTENTS.

THURSDAY, JUNE 24, 1909.

EVOLUTION: OLD AND NEW.

Darwin and Modern Science. Essays in Commemoration of the Centenary of the Birth of Charles Darwin and of the Fiftieth Anniversary of the Publication of the "Origin of Species." Edited for the Cambridge Philosophical Society and the Syndics of the University Press by Prof. A. C. Seward, F.R.S. Pp. xvii+595. (Cambridge: University Press, 1909.) Price 18s. net.

IN bringing together the series of essays composing this volume, the Cambridge Philosophical Society, the syndics of the University Press, and the editor of the work, Prof. Seward, have rendered a public service for which all those who cultivate science in any of its numerous branches must be deeply grateful. It is an appropriate international memorial raised at a most opportune time in memory of the centenary of the birth of our greatest naturalist, and in celebration of the jubilee of the publication of that epoch-making book which made the principle of organic evolution a living reality in the strictest scientific sense. We have now been provided with a symposium of twenty-eight essays by English and foreign experts—every name being that of a recognised authority in that subject with which he deals. It is no exaggeration to speak of this work as monumental; it is a monument of greater durability than bronze or marble, because it stereotypes the collective thought of our age. For the future historian of science it must for all time serve as a land-mark indicating the present stage of development of scientific doctrine in every department of human thought where science holds sway, and where the great principle of evolution has, under Darwin's influence, served as a guide in the interpretation both of organic and inorganic nature.

It detracts in no way from the value of this volume that it is in the best sense "popular" as distinguished from technical. As stated in the preface, "Authors were asked to address themselves primarily to the educated layman rather than the expert." From this point of view some writers, as might have been expected, have succeeded better than others, although, on the whole, the result is highly satisfactory. The book should thus be particularly valuable to those workers in other departments of science or in other fields whose occupations have precluded their keeping pace with the rapid development in knowledge and mode of thought to which Darwin gave the impetus half a century ago. But it is difficult, if not impossible, to impose any restriction with respect to the class of reader to which these essays will appeal. The names of the authors whose services have been invoked will suffice to show that every branch of scientific culture has been influenced by the teaching of the man who in his modesty wrote of his own work shortly before his death:—

"With such moderate abilities as I possess, it is truly surprising that I should have influenced to a considerable extent the belief of scientific men on some important points."

Biology naturally predominates, and for zoology and botany the names of Weismann, de Vries, Francis Darwin, Strasburger, Bateson, Sedgwick, Klebs, Loeb, Poulton, and Goebel stand as sponsors for their respective subjects. Schwalbe treats of the descent of man, and Ernst Haeckel of Darwin as an anthropologist. Geographical distribution is handled by Thiselton-Dyer and Hans Gadow; geology by Judd, and palæontology by W. B. Scott, of Princeton, and D. H. Scott. Lloyd Morgan writes on the "Mental Factors of Evolution," Höffding on evolution in relation to modern philosophy, Bouglé on sociology, the Rev. P. N. Waggett and Jane Ellen Harrison on the religious influence of Darwin's work. Philology is treated by P. Giles and history by J. B. Bury. For the essays on the application of the principle of evolution to inorganic nature we are indebted to Sir George Darwin, who treats of double stars, and to W. C. D. Whetham, who gives an account of the evolution of matter according to the modern hypothesis of atomic "disintegration." The history of evolution is written by J. A. Thomson, who treats of Darwin's predecessors, and by J. G. Frazer, who gives an account of early theories of the origin of man. An introductory letter from Sir Joseph Hooker appropriately prefaces this splendid contribution to the modern literature of evolution.

A work of the order and magnitude herein indicated does not come within the purview of the ordinary reviewer of scientific treatises. There is ample scope for discussion, for the views of some of the writers are at variance with those of others respecting the cardinal doctrine of the "Origin of Species by Means of Natural Selection," to quote the exact title of that classical work which the present volume commemorates. The one bond which unites all the contributors is the principle of evolution and the indebtedness of science, philosophy, and history to the man who made the nations "think in terms of evolution." Perhaps the best praise that can be bestowed upon the historical collection of essays forming the subject of this notice is to compare it in its candour with the writings of the master himself, for, as has so frequently been pointed out, the best and the severest critic of the theory of natural selection was Charles Darwin. It is only in harmony with the scientific spirit of our great leader that we should find between the same covers, and written with the same object of paying homage to the far-reaching influence of that leader's work, the strictly "selectionist" contributions of authors such as Weismann and Poulton, and the later divergent views of the schools represented by de Vries and Bateson. We quite agree with the latter that the greatness of Darwin's work is "that it may be admired from more aspects than one" (Essay v., p. 85). Perhaps not the least important of these aspects is that we must credit the "Origin" with having been the first work which successfully rescued the species question from the domain of ancient mysticism and ecclesiasticism, and handed it over to the scientific world for treatment by those same methods of investigation which had long been recognised as the only legitimate weapons of attack in other departments of natural knowledge—a true scientific emancipation of the whole group of natural sciences to which we now attach the label biology.

But even if the claim to our admiration be not based upon his application of the principle of natural selection, it must never be forgotten that for Darwin the conviction of the reality of this principle was the motive power of his life-work. The history of the revolutionary little volume which convulsed the world of science and shocked the outer laity in 1859 shows that, as the result of his observations and reflections during and after the voyage of the *Beagle*, he had become convinced of the mutability of species. But the mechanism of the process by which species were produced in nature was suggested to him, as it was subsequently to his compeer, Alfred Russel Wallace, by the writings of Malthus. From the time of his perusal of that work "for amusement" in 1838, his views began to take definite form. This is an oft-told story and hardly requires recapitulation, but at this momentous period it may be pertinent to point out that without this light from Malthus there would have been no Darwin-Wallace theory of the origin of species unless the illustrious founders of that theory had independently discovered the Malthusian principle. Whether the recognition of natural selection as "the main but not the exclusive means of modification" ("Origin," sixth edition, p. 421) is Darwin's chief claim to our homage is, as appears from the present essays, a matter of individual opinion. But whatever view be held now with respect to the function of natural selection, it was the predominant factor from the first to the last edition of the "Origin." It is not going too far to say that all his later work was prompted by this theory, which was, and is, a theory of "adaptations," as shown by his adoption of Herbert Spencer's paraphrase "survival of the fittest" for "preservation of favoured races." Happily for us of the present generation, Darwin resolved at the outset of his work to refrain from polemical discussion. His champions were numerous, and, like Huxley, masters of that art, and to them he left it to give battle to his opponents. The nearest approach to controversy to be found in his writings is the well-known chapter (vii. of the sixth edition) in the "Origin" in which he discusses a number of "miscellaneous objections" which had been urged against his theory. A re-perusal of that chapter at the present time will serve to show that *utility*—the "adaptational" value of the characters of organisms—was still the basic idea underlying his replies to his critics.

A collection of essays such as those which make up the present volume would require, not a single reviewer, but a staff of reviewers to do justice to their contents. It would be impossible to give anything approaching an adequate account of the treatment of the various subjects by their respective authors within the limits of an ordinary press notice, even in the columns of a scientific journal. Some of the essays are quite easy to follow; others are necessarily more or less technical. In the way of absolute novelty there is not much to be found, nor, indeed, could novelty be expected from writers dealing with subjects which have in one form or another been before the scientific world for many years. The novelty is to be found rather in the way in which each contributor presents his case—in the consensus of homage paid to Darwin's influence in each particular field. If it is not invidious to make a selection, Judd's chapter on "Darwin and Geology" (xviii., p. 337) is the most fascinatingly interesting from the historical point of view. Weismann's, Poulton's, and D. H. Scott's contributions will be found delightful reading by those who (like the present writer) still believe that the Darwinian theory is a theory of adaptations. Poulton, by the way, gives us more novelty than any other writer by inserting some hitherto unpublished letters of Darwin, and by printing extracts from Burchell's note-books bearing on mimicry and protective resemblance. It is in no captious spirit that the essay of de Vries is referred to as lacking in lucidity; his statement of Darwin's position (p. 67) might have been made clearer, and the presentation of his own views whether they are accepted or not—scarcely does justice to their distinguished author. Haeckel's contribution still rings with the battle-cry of the victor over his defeated German anthropological opponents. Those who look to the work as an authoritative expression of evolutionary opinion must perforce be struck by the omission of certain names which we should have liked to see on the list of contributors. The names of Alfred Russel Wallace and Francis Galton are conspicuous by their absence. Biologists would no doubt have been glad also to read essays by Henry F. Osborn, of Columbia University, by Sir Ray Lankester, and by Karl Pearson. "Biometricians" are not represented. Presumably there are valid reasons for these omissions, but the loss is ours nevertheless. The hypercritical reader also may want to know what influence can have been exerted by Darwin's work upon the genesis of double stars (Sir George Darwin, Essay xxviii., p. 543), or upon the evolution of matter as expounded by Mr. Whetham (Essay xxix., p. 565). Speculations on the "transmutation" of matter are older than any theories of the transmutation of species. But both these subjects now fall as naturally into the general scheme of evolution as do any of the cosmical theories admitted by Herbert Spencer in the "First Principles," and are, therefore, quite appropriate in the present volume. The only regret that can be expressed is that more space has not been given to inorganic evolution. We should have profited much by a popular exposition both of Sir Norman Lockyer's views on stellar evolution and of Sir George Darwin's suggestive application of the principle of survival among elementary atoms in his address to the British Association in 1905.

Now, bearing in mind the *raison d'être* of the work under consideration, the "resting stage," to use a biological expression, in the history of Darwinism provided by this galaxy of expert opinion enables us to formulate certain very definite questions. What has the "educated layman" to believe now with respect to Darwin's cardinal doctrine after the lapse of half a century? Has the theory that species *originate* mainly but not exclusively by natural selection stood the test of time; has it been modified in any material particulars since Darwin's days, and, if so, in what direction and to what extent? Out of the conflicting views on this fundamental point it is safe to extract the general conclusion that for the great majority of living biologists natural selection is still a working power in organic evolution. Equally evident must it be to those who weigh the evidence brought together in these essays that the theory, as bequeathed to us by its illustrious founder, has, to borrow certain photographic terms, undergone in some directions intensification and in other directions reduction. By way of intensification we have the elimination of the effects of "use and disuse" and of "direct action" of the environment—the deletion by Weismann of all the Lamarckian factors. It is sufficiently notorious that Darwin attached a certain weight to these factors. When, in 1862, Hooker was inclined to throw over "direct effects of conditions," he wrote:—

"It is really curiously satisfactory to me to see so able a man as Bates (and yourself) believing more fully in natural selection than I think I even do myself" ("More Letters," vol. i., p. 199).

The same point is well brought out by Schwalbe in the present volume (p. 125), and by Haeckel (p. 141), although it may well be doubted whether Darwin was so much of a Lamarckian as Haeckel would make out. But in accepting the Lamarckian factors as subsidiary aids in the development of species, it must not be forgotten, as has so frequently been pointed out, that Darwin was only expressing the current belief of the time. The efficiency of these factors in producing individual modifications was an observed fact, but their inheritance was an assumption. The validity of this assumption was not challenged by Weismann until after Darwin's death, and the master, to our everlasting regret, never had an opportunity of weighing the evidence brought against these factors which he regarded as subsidiary. If it is permissible to speculate as to the probable effect of Weismann's contention upon Darwin's "immortal work" (Schwalbe, p. 125) and "epoch-making" volume (Haeckel, p. 143), it may, perhaps, be admitted that "the 'Origin' without 'use and disuse' would be a materially different book" (Bateson, p. 89). But in what way different? It may very well have transpired that the views of its great author would have become more rigidly "selectionist," as did those of Wallace after he had considered and admitted the cogency of the arguments against the Lamarckian tenets.

In view of the state of knowledge concerning heredity at the time of the publication of the "Origin," it may fairly be asked whether it is so absurdly unscientific, as many opponents of natural selection used to tell us, to extend the views of the founder of a great principle beyond the limits foreseen by their founder. The history of science furnishes numerous examples of such developments. We never heard it urged in scornful argument, for example, against the electro-magnetic theory of light that Clerk-Maxwell had made himself ridiculous by becoming more of an "undulationist" than Young and Fresnel. If, departing from Haeckel, who agrees with Herbert Spencer in rejecting Weismann's views (p. 140), we follow Francis Galton, Wallace, Poulton, Bateson (presumably, p. 89), and those who agree in believing that Lamarckism is discredited, we strike out a factor in species formation which "aided [natural selection] in an important manner" ("Origin," sixth edition, p. 421). The importance of natural selection *may*—it does not logically follow that it *must*—thereby be enhanced. It is perfectly scientific, and quite in harmony with the spirit of the great leader whose mind was ever open to fresh evidence, to believe that not only has natural selection stood the test of time, but that its author may have under-estimated rather than exaggerated its importance. This is the direction in which the theory has undergone intensification.

In the opposite direction and by way of reduction we have a number of opinions which practically amount to traversing Darwin's claim for natural selection as the "main" factor. Some attach less importance to it, some give it quite a subordinate *rôle* and a few almost appear to imply that it can be dispensed with altogether:—

"The discovery of de Vries that new species may arise by mutation and the wide if not universal applicability of Mendel's law to phenomena of heredity, as shown especially by Bateson and his pupils, must for the time being, if not permanently, serve as a basis for theories of evolution" (Loeb, p. 269).

Perhaps the author of the above passage will not admit that it bears this construction, but at any rate, as an example of the reducing action exerted by a certain class of modern workers, it seemed typical. Darwin thought that he had given a working theory which, if it did not completely solve, at least went a very long way towards solving the problem of the origin of species in nature. Bateson tells us (p. 99):—

"The time is not ripe for the discussion of the origin of species. With faith in evolution unshaken—if indeed the word faith can be used in application to that which is certain—we look on the manner and causation of adapted differentiation as still wholly mysterious."

The "educated layman"—if his sense of humour has not been educated out of him—may possibly want to know why, if the species question is to be thus thrown into the melting-pot, the Cambridge authorities thought it advisable to issue a volume to commemorate "the fiftieth anniversary of the publication of the 'Origin of Species.'" It is, of course, perfectly legitimate for any biologist who has considered the question to declare that he is dissatisfied with the evidence on which Darwin based his claim for the prepotency of natural selection—to bring in a verdict of "not proven." That is a matter of individual judgment on the evidence submitted. But in giving this verdict, it must be clearly recognised that he is taking a position diametrically opposed to that of the author of the book which is being commemorated. It may be said, and is virtually said by some of the contributors, that the claim to the commemoration of the "Origin" is not based upon the discovery of the principle of natural selection, but is due to the circumstance that that work brought conviction to naturalists as well as to the educated public of the truth of evolution as a principle. It unquestionably did so, but since the assertion has been made that without Lamarckism the "Origin" would have been a different work, it may be permissible to raise the question whether, without natural selection, the mere marshalling of the facts of evolution—even by the master mind of Darwin—would have done more towards establishing that principle than did the writings of the pre-Darwinian evolutionists or the powerful advocacy of Herbert Spencer before the publication of Darwin's work. At any rate, the discovery of natural selection was the cause of the publication of the "Origin," and the success of that book is attributable to the theory—the working mechanism of species formation which, rightly or wrongly, it proclaimed.

Not the least valuable feature of this volume of essays is that, by bringing together the views of the different and often antagonistic writers, it enables the ordinary reader to get a clear notion of the various lines of divergence from Darwin's original position. The representatives of the modern school of "genetics," for example, base their homage on the fact that he introduced scientific method into the study of variation and heredity:—

"Evolution is a process of variation and heredity. The older writers, though they had some vague idea that it must be so, did not study variation and heredity. Darwin did, and so begat not a theory, but a science" (Bateson, p. 88).

Perfectly true so far as it goes; but his study of variation and heredity was prompted from beginning to end by his desire to find out how the raw materials were supplied by nature for the action of natural selection (see the introduction to "Variation of Animals and Plants," *passim*). Also it is now a matter of history that Darwin's work in this very line of study did beget a theory—the "provisional hypothesis of Pangenesis," of which Strasburger says (p. 111):—

"We can however affirm that Charles Darwin's idea that invisible gemmules are the carriers of hereditary characters and that they multiply by division has been removed from the position of a provisional hypothesis to that of a well-founded theory. It is supported by histology, and the results of experimental work in heredity, which are now assuming extraordinary prominence, are in close agreement with it."

There can be no reasonable doubt in the minds of those who are familiar with Darwin's books that his study of variation and heredity centred round his main theory of natural selection, and the first question that the "educated layman" may well ask in this connection is, How far has our knowledge been extended since Darwin's time? It does not appear from the present body of evidence that we have got very much beyond Darwin with respect to the causes of variation in nature. Some ingenious hypotheses have been suggested, and varieties have been classified and put into named categories, but that is all. With respect to heredity it is generally conceded that *when certain varieties appear* the laws which determine their transmission are now, thanks to the experiments of Mendel and those who are continuing his work, being definitely established. This is undoubtedly a most important line of investigation, and evolutionists will anxiously await further developments. In the meantime, however, it would appear that at the halting period marked by this present volume, the experiments on cross-breeding have not yet contributed anything constructively to the main problem which Darwin set out to solve, since we have it on the authority of the leader in this class of work that "the time is not ripe for the discussion of the origin of species."

With respect to another divergence since Darwin's time, viz. the mutation theory of de Vries, readers must be referred to the author's own account (Essay iv., p. 66). Want of space forbids an analysis of this later departure in the way of "saltatory evolution," only it must be noted that this kind of variation was considered by Darwin over and over again, and always with the conclusion that it played no important part in the formation of species in nature. It will be noted also that de Vries still subordinates his "mutations" to the action of natural selection, and to this extent is a follower of Darwin. Although the bearing of this aspect of variation upon Darwin's theory has been discussed by many able writers, it may be useful at this period to direct attention to the fact that it is unhesitatingly rejected by Haeckel as giving no explanation of adaptations and as having "no causal value" (p. 141). Here is what Darwin wrote on this point in the last edition of the "Origin":—

"Mr. Mivart is further inclined to believe, and some naturalists agree with him, that new species manifest themselves 'with suddenness and by modifications appearing at once.' . . . This conclusion, which implies great breaks or discontinuity in the series, appears to me improbable in the highest degree" (p. 201).

"Although very many species have almost certainly been produced by steps not greater than those separating fine varieties; yet it may be maintained that some have been developed in a different and abrupt manner. Such an admission, however, ought not to be made without strong evidence being assigned" (p. 203).

Whether the evidence offered on behalf of this divergence from the "Origin" is sufficiently strong to warrant its adoption is still an open question (see Poulton's "Essays on Evolution," introduction, p. xiv). It is true that the author of modern "mutationism" is inclined to believe that Darwin recognised two kinds of variation, ordinary fluctuations and those which "happen to arise" ("Origin," sixth edition, p. 160), but those who have really mastered Darwin's meaning will agree with Prof. Seward's and Mr. Francis Darwin's contention (p. 71, footnote, of present work) that this interpretation of the passage in the "Origin" is incorrect. This, by the way, is the only "editorial" comment to be found in the volume under consideration.

Now, if we ask ourselves what has been the net result of the publication of the "Origin of Species" on the main question with which it deals, or, in other words, How stands the species question after passing the ordeal of half a century? the answer must be that the only theory of species formation which still holds the field is that theory of natural selection which suggested itself to Darwin after reading Malthus in 1838, and independently to Wallace in 1858. Before 1838 it may be said that Darwin was a convinced evolutionist; subsequently he became a selectionist. Whether the reader of the present collection of essays takes the view that time has acted as an intensifying or a reducing agent upon the validity of the fundamental doctrine enshrined in that work which is now being commemorated, it is perfectly clear that the historian who in the distant future—say at the next Darwin jubilee—consults the present book in order to ascertain what platform had been reached in the year 1909 cannot but arrive at the conclusion that at the time of the publication of this memorial volume no alternative theory of the origin of species had survived the test of scientific criticism. No more effective mechanism of organic evolution than that offered to us by Darwin fifty years ago has up to the present time been suggested. We may degrade natural selection from the position assigned to it by Darwin, or the still higher position assigned to it by Wallace and Weismann as the result of post-Darwinian discovery; we may attach quite a small value to it as a factor, or we may eliminate it altogether. If so, the other factors remain to be discovered, and we must declare that we are still without a theory of the origin of species. The effects, direct or indirect, of the publication of the "Origin" upon lines of thought and of work other than those centring round the main question of species are sufficiently well known; the present volume bears living testimony to their far-reaching importance.

There is one other aspect of Darwin's work which at this juncture it may be opportune to insist upon. There is much talk in our time about "scientific method, "scientific habit of thought," and so forth; and yet it seems that there is a tendency among our present workers to neglect the example set by the great master, whose memory will ever be upheld with undiminished reverence by those who had the privilege of knowing him personally. It is he who, above any scientific worker of his time, taught us the value of *cumulative evidence* in establishing a new theory. Of his own doctrine he wrote:—

"Now this hypothesis may be tested—and this seems to me the only fair and legitimate manner of considering the whole question—by trying whether it explains several large and independent classes of facts" ("Variation of Animals and Plants," first edition, 1868, p. 9).

Is that canon faithfully followed now? We fear not. With many workers, one or a few observations, or the taking of a few measurements, combined with the complete exclusion of "independent classes of facts," suffice to provide a new theory of the universe. The lesson conveyed by the revolution in scientific thought effected in a comparatively short period by one book is in danger of being overlooked by the present generation. R. MELDOLA.

PROF. FISCHER'S INVESTIGATIONS ON THE CARBOHYDRATES AND ON FERMENTS.

Untersuchungen über Kohlenhydrate und Fermente (1884–1908). By Emil Fischer. Pp. viii+912. (Berlin: Julius Springer, 1909.) Price 22 marks.

PROF. EMIL FISCHER continues to put all chemists under an obligation to him by the re-publication, in collected form, of the series of remarkable investigations by which he has made the present Berlin school of chemistry famous for all time. These contributions to chemical literature are absolutely unique; in extent, in character, in originality and completeness, they are unparalleled. Not even Liebig, in his most forceful and prolific period, showed himself more able as a leader, more fruitful in directive ability, or more inspiring as a central controlling figure, than the present head of the most celebrated chemical laboratory of the world. The volume before us follows in quick succession that on the amino-acids, polypeptides, and proteins (1899–1906), and that on the investigations in the purin group (1882–1906). Collectively, these works constitute a monument more enduring than brass, and mark an epoch in the development of the science.

In a sense, Emil Fischer is the Paracelsus of his period—not, we hasten to add, in his mental habitudes or in his methods of inculcating his doctrines, but as the exponent and representative of a new phase in the evolution of chemical thought. What Paracelsus and van Helmont were to iatro-chemistry, Pasteur and Fischer are to bio-chemistry. But the analogy is only partial, and, indeed, soon breaks down. The truculent, turbulent Schweizer added ideas to science, but no new facts; the bland and suave Berliner, distinguished in manner and courteous in bearing, has enriched his science with innumerable facts and illumined it with ideas as the logical outcome of the facts. Other times, other manners. Nothing is more reassuring than to compare the "Opera Paracelsi," as turned out by Operinus, with the "Opera Fischeri" as published by the house of Julius Springer. Four hundred years have certainly done something for human civilisation. We may at least lay that unction to our souls.

The main significance of Fischer's work is in its relation to physiology. That physiology and chemistry are intimately connected and mutually related goes without saying; the fact has been recognised from the earliest times—certainly from the period of Galen and Avicenna. But it is Fischer's great merit that, after a comparatively arid and sterile period in physiological chemistry, due largely to the circumstance that the time and energy of the leaders of organic chemistry were directed to the exploration of other regions, he should have turned the force of his genius to the elucidation of the constitution of those substances which are dependent upon, or obviously connected with, vital processes. The sugars and the starches were among the earliest known of so-called organic compounds. They have long been recognised as among the most characteristic products of the physiological activities of plants, and from time immemorial they have been regarded as among the most important alimentary substances used by man. The modes of their origin and transformation, first within the organism which produces them, and then within the organism which assimilates and consumes them, have been the subject of innumerable inquiries and of endless speculation. Comparatively simple in composition, their true nature and constitution long remained shrouded in apparently impenetrable mystery, and all the methods which chemists were in the habit of employing in the attempt to unravel the internal structure of bodies were in their case unavailing. This was no doubt due in large measure to their limited range of chemical activity, and the relatively small number of combinations and derivatives which could be obtained from them. Even when, by more or less drastic treatment, they were forced to yield other products, the few compounds so formed were products of small molecular weight and of simple constitution, evidently "degradation" products far removed in structure from the parent molecule, and incapable of affording any valid clues to its real nature.

In the work before us it will be seen how all this has been changed. Incidentally Prof. Fischer has gathered together all that has been accumulated respecting this large and important group, and, proceeding to attack in detail its individual members, he has succeeded, by a masterly series of researches extending over nearly a quarter of a century, in laying bare the internal structure of many of the more important constituents of the group and in exposing their genetic relations. The greater bulk of the volume consists of reprints of papers, contributed for the most part to the *Berichte* of the German Chemical Society either by Prof. Fischer, by him in collaboration with his pupils, or by certain of them alone working under his inspiration and direction. The memoirs on the sugars alone number ninety-three. In addition there are seven papers on the ferments. It is significant of Prof. Fischer's power and of the influence of the Berlin laboratory as an engine of research that a considerable number of his collaborators are English, Scotch, and American. This great wealth of experimental material admits, luckily, of very simple classification, viz. (1) as nitrogen-derivatives of the sugars; (2) the syntheses and configuration of the monosaccharides; (3) the disaccharides; and lastly (4) the glucosides. To the student and the investigator who may follow Prof. Fischer into the territory he has thus opened out, the compilation will be invaluable. He has provided us with a *vade-mecum* which will be indispensable to all who purpose to occupy themselves with what, as the direct result of his own assiduous cultivation, will long remain a fruitful field of inquiry.

Of more general interest, however, are the five introductory memoirs in which Prof. Fischer summarises the outcome of this prolonged experimental research. Two of them—"Syntheses in the Sugar-group"—have already been published as lectures delivered to the German Chemical Society and have appeared in the *Berichte*, and are everywhere regarded as among the classics of contemporary organic chemistry. The third paper has been put together for the purposes of this work. It deals with the material which has been accumulated since 1894, the year of the preceding lecture. The fourth and fifth papers are of special interest to the physiological chemist and medical man. The former is a reprint of a popular lecture given on the occasion of the celebration of the founding of the German Military Medical Academy (1894), and the latter is a contribution to the *Zeitschrift für physiologische Chemie* (1898), and is of particular importance as summarising the work then done on the action of enzymes, and more particularly the enzymes of yeast, upon the hydrolysis and fermentation of the polysaccharides.

The work before us is characteristic of much that we admire in Germany and of much that we deplore in our own country. With the possible exception of America, nowhere else in the world would such a monumental work have been possible. Prof. Emil Fischer, in the Prussian capital, worthily carries on the traditions founded by the Roses, by Mitscherlich, and by Hofmann, aided by all the material appliances which a wise liberality places at his disposal. Economically and financially Germany is even in a "tighter place" than we find ourselves to-day, but she is sufficiently wise to perceive that to starve her educational agencies and to cramp and hinder the development of her schools of research, and thereby interfere with the development of her material resources, is not a sane method of combating her difficulties. But every nation has a Government as good as it deserves. What is possible in Germany is possible only by the attitude of its people towards science and research, and what that attitude is is sufficiently indicated by the circumstance that a German publisher is willing to take the risk of issuing to the German public this memorable series of works, so strikingly characteristic of German capacity, energy, and thoroughness, and of which the volume under review forms a fitting crown and consummation. T.

THE "VALDIVIA" EXPEDITION.

Die Grundproben der "Deutschen Tiefsee-Expedition." By Sir John Murray and Prof. E. Philippi. Pp. 80–206; with 7 plates and 2 maps. (Jena: Gustav Fischer, 1908.)

THIS valuable monograph forms the fourth part of the tenth volume of the scientific results of the voyage of the German exploring ship *Valdivia* in the Atlantic and Indian Oceans, made during the years 1898–9. These admirable volumes are published under the editorship of Prof. Chun, the zoologist of Leipzig, who was leader of the expedition; and Prof. E. Philippi has secured the valuable cooperation of Sir John Murray, whose wide experience in researches of this class has proved of the greatest service. Prof. Philippi gratefully acknowledges the assistance he received at the *Challenger* office in Edinburgh from the members of the staff, as well as from Sir John Murray himself.

The route taken by the *Valdivia* was round the north of the British Islands, and thence southward, following, at some distance, the western coasts of Europe and Africa; from the Cape of Good Hope a course southward was taken, until a latitude of 64° was reached; from that point the line taken was by Kerguelen Island to Sumatra, and thence by Ceylon and the East African coast to the Suez Canal. This route was sufficiently different from that of the *Challenger* and other exploring expeditions to supply much new and important evidence, in the 217 soundings and dredgings, concerning the contours of the floors of the Atlantic and Indian Oceans, and the deposits that cover them.

The nature of the materials brought up at various points during the voyage is well illustrated by a series of fine plates, similar to those accompanying the *Challenger* volumes. The globigerina ooze from different latitudes in the two oceans is represented by four very beautiful figures; the pteropod, radiolarian, and diatomaceous oozes, with the glauconite and coprolitic muds, have eight excellent figures devoted to them. Interesting points of difference from the deposits figured in the *Challenger* volume may be noticed on a careful comparison, though the general features are the same.

Of greater interest, however, than the organic deposits are the components of these oozes which are of mineral origin. No trace was found of any particles to which an extra-terrestrial origin could be assigned, neither particles of nickel-iron nor chondritic fragments occurring. A discussion is given of the mode of transport of the mineral fragments—by ice, wind, volcanic eruptions, and currents—and of the alternation of these deposits as proved by the soundings. In addition to the accounts of the glauconite, phillipsite, palagonite, and manganese nodules, of which some interesting particulars are given, we have in this monograph much valuable information concerning materials occurring at the bottom of the deep oceans, previously very imperfectly described or not known at all.

Besides the nodules containing up to 36 per cent. of calcium phosphate from the Agulhas Bank, a blue coprolitic mud is described from near the mouth of the Congo, at a depth of 214 metres, which contain numerous small, oval, phosphatic masses, believed by Sir John Murray to be the excrement of echinoderms. Among the concretions from the Agulhas Bank were found nodules containing 33 per cent. of calcium carbonate, 28 of calcium phosphate, 14.6 of calcium sulphate, and 4.8 of magnesium carbonate, with some ferric oxide, alumina, and silica. These nodules were dredged at a depth of 155 metres.

Perhaps the most interesting and suggestive, certainly the most novel, portion of this memoir is that which deals with the exploration of the "Seine Bank," a portion of the sea-bottom lying north-east of Madeira, which rises with steep slopes from depths of more than 4000 metres to within 146 metres of the surface of the ocean. This bank was first discovered in 1882 and 1883 by the cable steamers *Seine* and *Dacia*.

The calcareous sand dredged from the bank in question, at a depth of 150 metres, was found to be made up of fragments of Bryozoa, corals, and hydroid polyps, and shells and pteropods and other mollusca, spines, and plates of echinoderms, various Foraminifera, spicules of alcyonarians and sponges with fragments of crustaceans and otolites of fish. The inorganic constituents consisted of fragments of pumice and felspar.

The chemical analysis of different samples of this calcareous sand by Herr Pillow, of Berlin, revealed the interesting fact that the material had undergone a greater or less amount of dolomitisation. The several analyses gave percentages of 11·11, 14·36, 17·28, and 18·17 of magnesium carbonate, with a small amount, in some cases, of calcium phosphate. The study of thin sections of the material, stained by Lemberg's solution, showed that the dolomitisation was most marked in the calcareous mud, in which the fragments of organisms were embedded, but had also commenced in the latter themselves. Sometimes as much as nine-tenths of the cementing matrix of the deposit was found to be converted into the characteristic rhombohedra of dolomite.

The similarity of these results with those obtained by the study of the materials sent home by the Funafuti expeditions is very striking. The proportion of magnesium carbonate in the Seine-Bank material does not greatly exceed what is found in many organic deposits in which a gradual leaching out of the calcium carbonate appears to have taken place. It is interesting to notice that the depth of the deposits of the "Seine Bank" is only about 500 feet, and at this depth the chemical changes in question may be assumed to have taken place. The conditions under which the dolomitisation of limestones is brought about are still very obscure, but the facts described in the present memoir, with those contributed by Högbom, Natterer, Nichols, and other observers, are valuable contributions towards the solution of the problem.

Another interesting discovery was made in the South Atlantic Ocean in soundings, where the globigerina ooze was found to graduate into the red clay at a depth of 5040 metres. In the mixture of clay and calcareous ooze there were found numbers of minute, clear yellow crystals, which were shown by Prof. Linck to be the fundamental rhombohedra of calcite without any trace of magnesium carbonate. We seem to have evidence here that, at depths at which solution of calcareous organisms is going on, the dissolved matter may, under certain conditions, be re-deposited as calcite.

The whole of the memoir before us, indeed, abounds with facts and suggestions that cannot fail to be of great service in the solution of the problem of the chemical operations going on at various depths in the ocean—a problem which as deeply interests the geologist as it does the geo-physicist. J. W. J.

THE GEOLOGICAL SOCIETY OF GLASGOW.

History of the Geological Society of Glasgow, 1858–1908, with Biographical Notices of Prominent Members. Edited by P. Macnair and F. Mort. Pp. v+303. (Glasgow: Published by the Society, 1908.) Price 6s. net.

THE city of Glasgow, situated in the midst of a busy coal- and iron-mining district, within easy reach of the Highlands, the Western Isles, and the Southern Uplands, all replete with fascinating and intricate geological problems, is exceedingly favourable ground for the development of an interest in geology, not only from a purely scientific, but also from a commercial standpoint. That such an interest was abundantly manifest in the earlier half of the last century is shown by records of numerous courses of lectures at the various public institutions, and by attempts to found a geological society both in 1840 and 1850. The latter venture lasted but a year, the earlier not so long.

The present society, with the history of which the handsome volume now under review is concerned, grew out of a "Young Men's Society" connected with Free St. Peter's Church. It was inaugurated on May 17, 1858, by eight young men, and by the end of its first summer and winter sessions had achieved a membership of ninety-eight. Since then the society has gone on and prospered. No provincial geological society can show a better record of work done or a more valuable series of Transactions than the Glasgow society. This is partly due to the exceptionally favourable surroundings, and partly to the fact that the society was able to secure contributions from men like Lord Kelvin, Sir Archibald Geikie, Prof. Lapworth, and others, some of which have become geological classics.

This jubilee commemoration volume begins with a brief account of the geology of the Clyde district. Then follows a notice of some of the earlier workers in the geology of this area, amongst whom may be mentioned the Rev David Ure, author of the "History of Rutherglen and East Kilbride" (1793), containing the first descriptions and plates of western Scottish fossils; and John Craig, theologian, poet and geologist.

Chapter ii. contains a very full and interesting account of the origin and early history of the society, reprinted from a paper by Mr. T. M. Barr in the Transactions, vol. vii. The ensuing chapters contain reviews of the fifty years' work of the society in various branches of geological inquiry. Physical and dynamical geology is dealt with by Prof. J. W. Gregory, who gives a convenient summary of Lord Kelvin's early papers. The chapter on stratigraphical geology has been contributed by Mr. P. Macnair, that on mineralogy and petrology by Mr. Jos. Sommerville, and that on glacial geology by Mr. John Smith. Special praise must be given to the chapter on palæontological geology by Mr. James Neilson. This is really a most valuable summary of western Scottish palæontology, especially of the Carboniferous rocks.

Later chapters are devoted to biographical notices of some of the society's more prominent members. There is here quite a galaxy of famous names, amongst which we note those of Lord Kelvin (president for twenty-one years), Sir A. Geikie, Prof. C. Lapworth, Dr. B. N. Peach, James Smith of Jordanhill, R. H. Traquair, and Thos. Davidson, all, with the exception of the last-named, past-presidents of the society.

The book is well got up and illustrated by a fine series of photographs of prominent members. The editing seems to have been excellently done, the only errors discoverable being the substitution of "stations" for "sections" in the quoted title of a paper on p. 104, and the unaccountable omission of the names of T. G. Bonney, H. Woodward, and J. J. H. Teall from the list of honorary members at the end of the volume. G. W. T.

OUR BOOK SHELF.

Unités Électriques. By Le Comte de Baillehache. Pp. x+202. (Paris: Dunod et Pinat, 1909.) Price 6 francs.

SOME time before the Cambridge school of physicists (which we have heard irreverently termed the "ion-catchers") had made even the man in the street more or less familiar with molecular dimensions, a celebrated mathematician had been making some calculations as to atomic quantities. He was much surprised at the results he obtained. On looking over his work he was unable to find any mistake, but, nevertheless, felt sure something was amiss. At last a humble physicist was able to point out to him that he had forgotten to multiply by "v," his result being, therefore, only some thirty thousand million times too small, which put things more or less right. In this case the enormity of the error made excited grave suspicion, but it is not easy to say how many times in ordinary practice grave errors may not have arisen, for example, in the magnetic testing of iron, from failure to remember that the C.G.S. unit of current is not an ampere.

Count Baillehache's book is a useful and up-to-date summary of practically all that is required to be known by the physicist, engineer and technologist about electrical units of all kinds, dealing with matters even as recent as the Congress of Electricians held in London during October last.

Though nominally confined to electric units, the book deals in a preliminary chapter with units in general, and commences with definitions and a clear account of the evolution of the various systems in use. A chapter on the metric system follows a fairly complete history of the work done in the establishment of the metre and the kilogram, and the determination of the volume of the kilogram of water.

The bulk of the book consists of a description of both the C.G.S. system and the various systems of practical electrical units and standards, the equations to their dimensions, their relations to one another, with a number of conveniently arranged tables.

Some account is also given of the legislation of the various countries on electrical matters, and of the labours of the various electrical congresses.

Full historical details of the evolution of the ohm, volt, &c., and the construction of the practical standards of the same, such as mercury-tube resistances, the various forms of Clark and Weston cells, &c., are also found.

The book appears to have been carefully compiled, and we have not detected any serious errors. We cordially recommend it to practical physicists and electricians. J. A. HARKER.

Traité de Mathématiques générales a l'usage des Chimistes, Physiciens, Ingénieurs, et des Elèves des Facultés des Science. By Prof. E. Fabry. Pp. x+440. (Paris: A. Hermann et Fils, 1909.) Price 9 francs.

IN 440 octavo pages of generously spaced printing, the author gives treatises on algebra, analytical geometry, the calculus, including differential equations, and even partial differential equations and mechanics. The book is very interesting, as it is intended for persons presumably not very mathematical, and there is hardly one page of it which can be understood by a person who has not already made a study of higher mathematics. Every now and again it seems to strike the author that he is philosophising over the head of his reader, and for a moment he drops low enough to be understood by a chemist who has given more than the usual time to mathematics, but it is only for a moment. Naturally, he does not mention dy/dx until he has quite finished his treatment of curves by analytical geometry, and the time of vibration of his simple pendulum is given as an infinite series. He does not show anywhere that he knows the problems to which the chemist, physicist, or engineer would apply his mathematics. He does not seem to know that there are mathematical principles underlying thermodynamics and the flow of heat and problems in electricity which he might have referred to. The harm done by such a presentation of the subject is incalculable; it gives a student the notion that he cannot possibly learn to use mathematics, whereas we know that almost any person can be taught to use the highest kind of mathematical weapon with confidence and security. J. P.

Probleme der Protistenkunde. I. Die Trypanosomen ihre Bedeutung für Zoologie, Medizin und Kolonialwirtschaft. By Prof. F. Döflein. Pp. 57. (Jena: Gustav Fischer, 1909.) Price 1·20 marks.

IN this monograph Prof. Döflein deals in a simple and non-technical manner with an important group of protozoan parasites, the trypanosomes, in particular those which cause important diseases of man and animals, such as sleeping sickness of man, and nagana, surra, and dourine of horses, &c., so that the medical man without special zoological knowledge can readily understand the subject.

The author considers that there is little or no evidence that these trypanosome parasites leave the body of the host in an encysted or sporulating form, which may then re-enter the body and cause infection. Infection generally occurs through the agency of an intermediate host, or, in the case of dourine, by direct contact. He regards the reputed encysted forms as probably the result of degenerative changes in the parasite. The observations of Schaudinn on the supposed transformation of certain intracellular parasites of birds into trypanosome forms are discussed, and considered to be probably erroneous. After discussing the possible evolution of these parasites, the author concludes with some remarks on the economic importance of the diseases they produce in the colonies. The book is very readable, and is well illustrated. R. T. H.

American Philosophy: the Early Schools. By Prof. I. W. Riley. Pp. x+595. (New York: Dodd, Mead and Co., 1907.)

THIS rather bulky volume is the first of a series intended to give an historical summary of the progress of philosophical thought in America. The European reader must have an unusually determined interest in the history of speculation if, from the purely philosophical point of view, he is willing to follow Prof. Riley in his studies of minor thinkers, whose names, except in a few cases, will probably be entirely unknown to him. Regarded from a wider point of view as a study of the earlier development of the "soul of a people" that has come to fill so important a place in the modern world, the book will be found both valuable and interesting.

Prof. Riley has taken advantage of his three years' tenure of the Johnston scholarship in Johns Hopkins University to acquire an exhaustive knowledge of his subject, and he presents the results of his inquiries lucidly and attractively. After a brief historical survey and a still shorter essay on the relations between American philosophy and American politics, he develops in five successive "books" the history of the several movements—philosophical or religious—to which the thinkers of his period are related.

Of these movements the only one with which the philosophical student will, as such, feel much concern is early American idealism, which is decorated by the names of Samuel Johnson (of Connecticut) and Jonathan Edwards. Both these writers have relations with Bishop Berkeley, "the only European philosopher of the first rank who visited the colonies." Students of Berkeley already know that Johnson was his avowed admirer and follower, but they will be glad of the much fuller light which Prof. Riley has thrown upon the dealings of the two philosophers with one another. In the case of that remarkable man, Jonathan Edwards, Prof. Riley makes it manifest that his idealism was an independent development from Locke—a development the main positions of which Edwards reached at some time between his thirteenth and his sixteenth years!

The scientific reader will be tempted to give special attention to the pages on Benjamin Franklin, who, as "a kind of Socrates in small clothes," played an interesting if not imposing part in American deism, and will be reminded painfully of the bitterness of English intolerance in the eighteenth century when he comes upon the name of Joseph Priestley among the apostles of American materialism.

The Photography of Coloured Objects. By Dr. C. E. Kenneth Mees. Pp. vi+69. (Croydon: Wratten and Wainwright, Ltd., 1909.) Price 1s. net.

DR. MEES being a partner in the well-known photographic firm of Wratten and Wainwright, and writing on a subject most intimately connected with the manufactures of the firm, naturally refers almost entirely to the plates and colour filters that he is most interested in, but the volume is in no sense, or in any part of it, a trade advertisement. The author explains in a clear and straightforward way the details of the subject, and the chapters on "portraiture," "landscape photography," and "the photography of coloured objects for reproduction" have been produced by the aid of several authorities who devote themselves to these branches of work.

Many will be surprised to see the great advantage in photographing polished mahogany attainable by the use of a panchromatic plate and a red screen, as compared with the result obtained by an ordinary plate. The latter emphasises the scratches and other surface imperfections and hardly shows the grain, while the panchromatic plate gives what is obviously the natural appearance of the wood. For the correct representation of ordinary coloured objects, the general advice is to use a panchromatic plate and a rather deep yellow screen. M. Callier, in a note that he contributes, points out the practical shortcoming of the ordinary orthochromatic plate (erythrosin type) in the photography of open meadows and pine-trees. The green of the pines falls just into the gap of deficient sensitiveness in the spectrum, while the green of the meadows corresponds to the maximum of green sensitiveness: hence there is obtained an exaggerated contrast which no ordinary yellow screen will correct.

The author deals also with the suppression of certain colours, as in the photography of stained documents, the increase and decrease of contrast in coloured objects, as in photomicrography, and with three-colour photography, that is, so far as plates and colour screens are concerned. Although the volume is small it deserves an index.

The Nautic-Astronomical and Universal Calculator. The Mechanical Solving of all Arithmetical Problems, Plane and Spherical Trigonometry, including Terrestrial and Astronomical Navigation. By R. Nelting. Pp. 67. (Hamburg: R. Nelting, 1909.) Price 4 marks.

In many numerical processes there has been too great a tendency on the part of computers to employ more decimal places than are necessary, and to use logarithms where more direct methods would be effective. The introduction of mechanical contrivances for the performance of arithmetical operations has brought the problem of a possibly greater simplification of calculation more to the front, with the result that some neglected resources have been made available. One outcome has been the improvement in accuracy and ingenuity in construction of sliding scales for obtaining an approximate solution of many simple problems. With increased usefulness, however, comes a tendency to increase the number of moving parts and to give greater variety to the system of dividing, but this more complicated mechanism often destroys the simplicity of construction which is one great merit in the sliding scale. Certainly, the invention described by Mr. Nelting does not err on the side of simplicity. The inventor claims for his calculator that it will give the logs. of numbers, with their squares and square roots; the values of trigonometrical functions of sine, tangent, cosecant and cotangent of angles, whether expressed in time or in arc; tables of reciprocals with their squares and square roots. In addition to many other combinations, the scales can be used for facilitating or completely solving problems required in nautical astronomy connected with altitude, longitude, and latitude, with an accuracy sufficient for the purposes of navigation. Unfortunately, we have not had an opportunity of studying the mechanism, and the rules that are given for its use are not easily followed when the necessary constructions cannot be made. Moreover, the description is obscure in many parts.

The Theory of Electric Cables and Networks. By Dr. Alexander Russell. Pp. x+269. (London: A. Constable and Co., Ltd., 1908.) Price 8s. net.

We opened this book expecting to find it filled with the solutions of rather unpractical problems, the solutions, however, being of considerable importance in higher mathematics. We find that it is a very practical treatise which will prove useful to the increasingly numerous class of electrical engineers who deal with distributing networks, their insulation and faults. The last two chapters, on electrical safety valves and lightning conductors, are particularly good. J. P.

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 intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

On the Relation of "Recoil" Phenomena to the Final Radio-active Product of Radium.

In the course of some experiments made by Miss Brooks (Nature, July 21, 1904, vol. lxx., p. 270) on the active deposits from radium, it was found that the active product, radium B, escaped in some manner from a body which had been rendered active in the presence of radium emanation, and was carried at low pressures to the walls of the containing vessel. In his interpretation of this result, Rutherford ("Radio-activity," p. 392) suggests the possibility of the phenomenon being due to a recoil effect rather than to a volatility possessed by the product radium B.

Radium A atoms, in breaking up, are known to emit α particles with a velocity of $1\cdot 7\times 10^9$ cm. per sec., and as the mass of the α particle is 4 (H=1) and that of the radium B atom approximately 200, it is clear from the explosive nature of the disintegration of the radium A atoms that the radium B atoms must be hurled away with a considerable velocity in directions opposite to those in which the α particles are projected.

Recent papers by Otto Hahn and Lise Meitner (*Verh. der deut. phys. Ges.*, xi., Jahr No. 3, and *Phys. Zeit.*, 10 Jahr, p. 81) and by Russ and Makower (Proc. Roy. Soc., No. 5, 553, p. 205, May 6) contain descriptions of experiments which confirm the truth of Rutherford's explanation, and also show that it is possible to isolate the radio-active products, radium A, B, and C, thorium D and actinium X and C, through the agency of this recoil action alone.

Other examples of this recoil phenomenon are also contained in the recent experiments of Debierne (*Le Radium*, April) and in those of Kennedy on the active deposit from actinium (*Physical Review*, May).

In considering these examples of the recoil effect, the question naturally arises of a possible connection between this phenomenon and the final transmutation product of radium. Radium G (polonium) is known to emit α rays, and when deposited on plates of copper, as Logeman and others have shown, to emit also a feeble δ radiation. From the illustrations which have been cited above it seems clear that here also the recoil phenomenon should manifest itself in the projecting from such radium G coated plates of atoms of the final radio-active product.

Evidence of such projection has recently been obtained in the physical laboratory at Toronto by Mr. V. E. Pound. In his experiments an insulated plate of copper, A, approximately 3 sq. cm. in area, which was coated with a deposit of radium G, was placed in a highly exhausted chamber facing a second insulated plate of copper, B. The plate B was joined to an electrometer, and the electrical charges which it acquired under various electric and magnetic fields were observed.

With moderate electric and magnetic fields results similar to those of Logeman, Ewers, Aschkinass, and others were obtained, and from the form of the charging curves which were obtained in such circumstances it was clear that at least three types of radiation were present and exerted an effect of greater or less degree on the charge acquired by the plate B, viz.: (1) the α rays emitted by plate A; (2) easily absorbed δ rays emitted by plate A; and (3) an easily absorbed secondary radiation emitted by plate B, consisting of negatively charged particles.

With higher magnetic fields, however, an entirely new phenomenon appeared. With such fields, especially when the plate A was charged to an increasingly high positive potential, it was found possible gradually to increase the positive charge acquired by the plate B. As such higher magnetic fields were sufficient to prevent the secondary radiation from leaving the plate B, and the high positive potentials were sufficient to retain the δ radiation on the plate A without affecting the α radiation, it seems evident that the rise in the positive charge acquired by the plate B was due to the existence of a radiation of negatively charged particles from the plate A which had hitherto escaped detection, but which in these experiments were deflected by the magnetic field. When the plate A was neutral or negatively charged, the application of the magnetic field failed to give any indication of the presence of this radiation, but with the application of a potential of 160 or 240 volts (positive) to the plate A it could be readily brought into evidence. It is of interest to see, therefore, that in this case a positive electric field united with a magnetic field was the means by which the radiation was isolated.

The experiments are being continued, and it is too early at present to write more definitely regarding the new radiation. It seems, however, highly probable that this radiation can be attributed to the "rest-atoms" of the active product radium G. The expulsion of an α particle would leave this rest-atom negatively charged. Such rest-atoms would leave the plate in all directions as a stream of negatively charged particles. They would be less penetrating than the α particles, and so would escape detection in absorption experiments in gases at ordinary pressures.

If this new radiation consists of the "rest-atom" of radium G, we have in the property that it is projected with high velocity and in that that it carries an electrical charge the means of ascertaining its mass. Such a knowledge would give very definite information regarding the constitution of the final radio-active product of radium, and would also, in addition, furnish a means of checking the accuracy of the now highly authenticated theory by which the various known radio-active products of radium are connected and related.

The existence of this radiation, moreover, would afford a means of ascertaining whether the rest-atoms of radium G are the final products of radium or not, for it should be possible to obtain, through bombardment, a coating of these rest-atoms on a body such as the plate B in the experiments described above. This plate could then be placed in a high vacuum and investigated for the acquisition of an electrical charge. Any gain of charge which it might experience could be taken as proof of the formation of a new product, while the absence of such gain might be taken as evidence that radio-activity had ceased, and that in the rest-atoms of radium G stability is finally attained. J. C. McLENNAN.

Physical Laboratory, University of Toronto, June 7.

Molecular Effusion and Transpiration.

ONE of Maxwell's most famous laws is his law on the distribution of velocities, to the effect that all the molecules of a gas do not possess the same velocity, but that the various velocities of the molecules group about a certain average velocity Ω in a definite way, which was further theoretically determined by Maxwell. This law has not, however, hitherto been directly proved by experiment, and I am therefore of opinion that the following may be of some interest to English readers.

The flow of the gases through very small apertures and narrow tubes at ordinary pressure has been investigated by Graham and several others, and definite laws (the effusion and transpiration laws) which apply to these flows have been found. My experiments now show that if the area of the aperture or the transverse section of the tube are small compared with the mean free path of the gas molecules, then other and still simpler laws than those mentioned will apply, and that these laws are easily deducible from the kinetic gas theory and Maxwell's law on the distribution of velocities. Detailed reports of the experiments have been published in *Annalen der Physik*, Bd. xxviii., 1909.

Molecular Effusion.—According to the kinetic gas theory, the number of molecular shocks which the surface-area A of a wall receives during a second from the surrounding gas is equal to $\frac{1}{4}NA\Omega$, where N is the number of gas molecules in each cm.^{3} and Ω the average velocity of the molecules. If there is an aperture in the wall having an area A, and if N' and N'' are the numbers of gas molecules at each side of the wall respectively, $\frac{1}{4}A\Omega(N'-N'')$ more molecules are flying through the aperture in the course of a second in one direction than in the other. Taking m as the weight of each molecule, the weight G of the gas flowing through the aperture during a second would be

$$G=\tfrac{1}{4}A\Omega(N'm-N''m)=\tfrac{1}{4}A\Omega(\rho'-\rho'')=\tfrac{1}{4}A\Omega\rho_1(p'-p''),$$

where ρ is specific gravity, p the pressure, and ρ_1 the specific gravity of the gas at the pressure 1 dyn./cm.^{2} and the temperature of the gas. According to Maxwell's law on the distribution of velocities we get $\Omega=\sqrt{\frac{8}{\pi\rho_1}}$, which gives

$$G=\frac{A}{\sqrt{2\pi}}\cdot\sqrt{\rho_1}\cdot(p'-p'').$$

The fact that the weight found is proportional to, and therefore the volume of gas is inversely proportional to, the square root of the specific gravity has been shown by numbers of experiments made by different investigators; but the factor $\frac{A}{\sqrt{2\pi}}$ and the proportionality with the difference of pressure have not been experimentally found earlier, and they prove to apply only when the mean free path is more than about ten times greater than the diameter of the aperture. By a series of experiments with an aperture in a plate of platinum 0·0025 mm. thick, where the area of the aperture was found by means of the microscope to measure $5{\cdot}21\pm0{\cdot}16$ millionth square centimetres, I found the following proportions between the observed quantity and that computed from the above formula:—hydrogen, 0·978; oxygen, 0·981.

From another aperture, the area of which was $66{\cdot}0\times10^{-6}$ cm.^{2}, the following proportions were found:—hydrogen, 1·021; oxygen, 1·038.

Consequently, the difference between theory and observation is 2 per cent. to 3 per cent., which is considered chiefly to be due to the difficulty of making an exact determination of the areas of such small apertures. If by computation of the above formula no attention had been paid to Maxwell's law on the distribution of velocities, and all the molecules had been considered as moving with the same velocity, we should have taken $\Omega=\sqrt{\frac{3}{\rho_1}}$, the effect of which would be that the computed values would become 8·6 per cent. greater than if we used Maxwell's formula, and the difference between theory and experiment caused thereby could scarcely be explained as an error of observation.

By the above-mentioned experiments the pressures were measured with McLeod's manometer, and the determinations of pressures checked each other, so that there was not found the slightest indication of a real or apparent deviation from the laws of Mariotte and Gay-Lussac.

The formula may be used for determination of $p'-p''$ if A and G are measured for some gas. In this way I have made an experimental determination of the maximum pressure of mercury vapour at 0°, and a series of higher temperatures up to 46°. By 0° the pressure was found to be 0·0001846 mm. mercury pressure. From the measurements I have obtained the following formula for the vapour-pressure p, given in mm. mercury (common system of logarithms, T = absolute temperature):—

$$\log p=10{\cdot}5724-0{\cdot}847\log T-3342{\cdot}26/T.$$

The mean deviation between the values derived from this formula and those observed amounts to 0·003 of the value, which shows that the constants of the formula are determined with fairly great accuracy. It is seen that if the formula is used for extrapolation to pressures at higher temperatures we get now positive, now negative deviations from the determinations made by other experimentalists, so that the formula in reality expresses the vapour-pressure of the mercury up to 880°, which is the highest temperature at which Cailletet and his collaborators have determined the pressure. At this temperature he found a pressure of 162 atmospheres where my formula gives 158 atmospheres.

Molecular Transpiration.—A series of experiments I have made with relation to the flow of gases through narrow tubes at low pressures has also confirmed Maxwell's law on the distribution of velocities. The calculation of the quantity of gas flowing through the tubes cannot, however, be made without using a new theory for the reflection of gas molecules from a wall. My theory for this reflection of gas molecules, which has been fully confirmed by the experiments, is as follows:—

A gas molecule meeting a wall is reflected in a direction which is absolutely independent of the direction in which it is moving against the wall, and a great number of molecules, meeting a wall, are reflected in every direction according to Lambert's law (the cos. law on the emission of light from a hot body). Consequently, the gas molecules may be considered as having strayed into the wall or as having been absorbed by it, to be emitted afterwards therefrom, provided that the gas and the wall have the same temperature. The calculation of the quantity of gas streaming through the tube is quite simple, though, however, too extensive to be given here. For the weight of gas flowing through the tube in each second we get the following expression:—

$$G = \frac{4}{3}\sqrt{2\pi}.R^3\sqrt{\rho_1}\frac{p'-p''}{L},$$

where R is the radius of the tube, L its length, and p' and p'' the pressures at the ends. By a series of experiments with a tube, the length of which was 2·00 cm., the radius 0·00333 cm., the proportions between the measured values and those calculated from this formula were found to be, for hydrogen, 1·04; oxygen, 1·01; carbonic acid, 1·01.

The formula will, however, only apply correctly when the radius of the tube is small compared with the mean free path. With increasing pressure $\frac{p'+p''}{2}$ (decreasing mean free path), the gas flow of a given value for $p'-p''$ decreases to a minimum, and afterwards increases in order to approach the value which it should have according to Poiseuille's well-known law. That this must be the case may easily be inferred from the kinetic gas theory in connection with the above-mentioned theory as to the interaction between gas molecules and a wall.

Martin Knudsen.

The University, Copenhagen.

The Germ-layer Theory.

The germ-layer theory as stated on p. 428 of Nature (June 10) by Mr. Stanley Gardiner appears in a rather extreme form. Probably all will agree that, not only the germ-layer theory, but every theory of development, presupposes a certain definiteness in structure of germ cells. But if that much is granted, it is not necessary to suppose that the differentiation of protoplasm has proceeded at so early a stage to such an extent as to preclude absolutely the possibility of protoplasm, which has been so far misplaced by experiment as to find itself in a new environment, responding to the influences of the new environment and so developing along a path it would not have followed had the experiment not been performed.

It seems difficult to comprehend what reason can be assigned for regarding those organs of the early phase of the life-cycle which we call germinal layers as being less capable of showing homology than the organs of later phases which we speak of as adult.

Surely the biological principles—whatever they may be—must apply equally throughout all periods of the life-cycle.

The argument from regeneration is hardly conclusive, because one essential of regeneration and budding seems to be the regression of differentiated protoplasm into undifferentiated protoplasm (or, at any rate, the origin in some way or other of an undifferentiated cell mass), that is to say, a regression to a state equivalent to a segmenting egg, namely, a state really prior to that of germ-layer formation.

Finally, it must be remembered that visible differences and resemblances are much less obvious in these early phases of the life-cycle than later, and that the difficulty of observation, owing to the minute size of the objects, is so great that errors of observation, which delay correct interpretations, are far more frequent than is the case with work upon the grosser phases of the life-cycle.

It cannot be conceded that the "anomalies in the formation of the layers in vertebrates" which are "patent to every student" are all capable of substantiation.

Grantchester, June 15. Ric. Assheton.

The Pollination of the Primrose.

It appears that in a previous note on this subject (Nature, June 17, p. 457) clearness may have been sacrificed to brevity. It is not meant that humming-bird and bee hawk-moths can be regarded as usual or frequent agents in the pollination of the primrose. They are mentioned in proof that some moths do, now and then, visit the flowers, and may presumably aid in their cross-pollination. There can be little doubt, however, that the humble-bee is herein the chief agent, and in this district, I should say, more particularly *Bombus hortorum*.

W. E. Hart.

Kilderry, Londonderry, June 19.

FROST AND ICE CRYSTALS.[1]

During the past quarter of a century Mr. Wilson J. Bentley has devoted himself with a patient industry deserving of all praise to securing permanent records of the multitudinous forms assumed by water in its crystallised condition. The work has been executed at his home, a farmhouse, situated sixteen miles east-north-east of Burlington, Vermont, near the Canadian border, at an altitude of 1500 feet above sea-level, where the low temperatures experienced every winter are very favourable for the study of these forms. Seven years ago we directed attention (Nature, 1902, vol. lxv., pp. 264–6) to his beautiful series of photomicrographs of snow crystals; a selection of them was reproduced in the *U.S. Monthly Weather Review*, and was accompanied by a paper in which Mr. Bentley described the methods used for obtaining the photographs, and the facts that could be established from a study of the almost bewildering variety of the forms represented. At the same time, but mainly during the subsequent years, Mr. Bentley has been further engaged in preparing a companion and complementary series of frost and ice crystals, *i.e.* the forms assumed by water that has crystallised immediately upon the surface of the earth. A large number of different types were reproduced in successive numbers of the *Monthly Weather Review* from August to December, 1907, and Mr. Bentley again contributes a description of the apparatus used, and full details with regard to the circumstances under which the several pictures were obtained.

Nearly the whole of the present series represents crystals that were formed during the winters of 1904–5, 1905–6, and 1906–7. For several reasons fewer difficulties were experienced in obtaining photographs of these crystals than was the case in the investigation of snow crystals; they could invariably be photographed in the positions in which they were found, and since, owing to the greater duration of growth, their size is usually much larger, smaller magnifications were required, and, indeed, in pictures of groups of crystals actual reductions were called for. The apparatus used was consequently simpler in character. For the majority of the photographs, in which the magnification did not exceed eight diameters, an ordinary portrait-lens was used in a camera which was fitted with a home-made extension arrangement, and the crystals were illuminated obliquely. For higher magnifications a microscope-objective, of $\frac{3}{4}$- or $\frac{1}{2}$-inch focal length, was employed, and the illumination was direct. The second method, which was required for the minute flakes deposited on windows, entailed more trouble in manipulation, because, while the camera was indoors, the diaphragm for cutting off all but direct light was on the other side of the window, and had, of course, to be adjusted for each position of the camera.

The series is divided into three principal groups—hoar-frost, window-crystallisation, and ice—a few sections dealing with hail being appended, and for convenience each group is split up into divisions and subdivisions, according to the shape or the grouping of the crystals. The hoar-frost group is divided into two main divisions—tabular and columnar—but the distinction is apparently one of degree only, and cannot be pressed. We have selected as an illustration of this group a beautiful example of the "open branch or tree-like" structure (Fig. 1). It will be noticed that the stems broaden out into well-developed plates at their terminations. The study of the crystals deposited on windows obviously admits of greater ease of observation, and, since the conditions of the atmo-

[1] "Studies of Frost and Ice Crystals." By Wilson J. Bentley. Pp. 22; with 273 figures on 31 plates. (Reprinted from the *Monthly Weather Review*, 1907.)

sphere obtaining within a dwelling provide more extensive ranges of temperature and humidity, greater diversity in the type of crystals is to be expected; it is not surprising, therefore, to find that three-fourths of the illustrations record forms that appeared on windows. This group is, of course, distinguished from the frost and ice groups, not by any essential difference in the characters of the crystals, but merely by their site. Crystallisation which has resulted from sublimation shows greater variety, and by far the larger number of examples are devoted to window-frost; but the window-ice forms, which occur in comparatively mild weather when a film of dew has first condensed on the surface of the glass, are not without interest. Mr. Bentley has greatly enhanced the value of the series by noting for each example the temperature out of doors and the temperature and degree of humidity within doors. Fig. 2 represents a beautiful example of "branching" window-frost. Its symmetry has been slightly affected by the disposition of the surrounding crystals, one arm exceeding the others in size; indeed, the limitations set by the chance position of adjacent crystals rarely permit of the almost perfect symmetry characteristic of snow-crystals. These fern- or tree-like forms are frequently seen on the windows of both warm and cold rooms, but are most common in unheated rooms of which the temperature ranges from 32° to 5° F. (0° to −15° C.) and the percentage of humidity from 55 to 70. Fig. 3 illustrates a nearly perfect example of the stelliform of window-frost, a slow-growing type that occurs only in cold weather when the temperature indoors is as low as 20° F. (−6·6° C.). The two crystals which we illustrate are fairly typical of the delicate crystallisation that embellishes the windows in frosty weather. Even in photographs their beauty is evident, but, to quote Mr. Bentley, "Only those who have seen frosted window-panes lit up by a bright winter moon, or seen them flash and sparkle under the rays of a winter sun, have seen the full beauty of the frost." Ice, though in appearance a uniform, solid mass, is really composed by the accretion of innumerable discrete crystals. The separate individuals are generally indistinguishable in the mass, but certain of them may be brought to light by slight heating—such as the warmth due to the sun's rays.

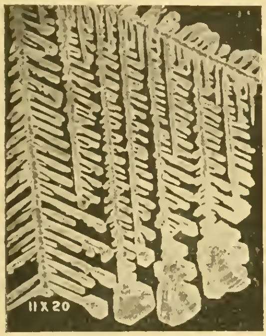

Fig. 1.—Tabular hoarfrost.

Fig. 2.—"Branching" window-frost.

Fig. 3.—Stelliform window-frost.

Fig. 4.—"Ice-flowers" in solid ice.

Fig. 5.—"Ice-flowers" in freezing water.

Fig. 6.—Pear-shaped hailstone.

Mr. Bentley includes in his series reproductions of three admirable photographs—one is shown in Fig. 4—of "ice-flowers," Tyndall's appropriate term for them, embedded in solid ice; these particular photographs were taken by Prof. Benjamin W. Snow, of Wisconsin University. One of the more elaborate ice-flowers that form on the surface of freezing water is illustrated in Fig. 5. Mr. Bentley closes his paper with an interesting discussion of the occurrence and cause of hail in both summer and winter, and of the structure of hailstones. Hailstones have various shapes; they are commonly round, but egg- and pear-shapes are not rare. They invariably contain air-tubes and bubbles; a typical arrangement, shown by a stone which fell in the winter of 1906–7, is depicted in Fig. 6.

Thanks to Mr. Bentley, it is now possible to compare and study every variety of snow, frost, and ice crystals, and the way is clear for the next step, viz. to determine the factors and the conditions governing the several forms. It is strange how little is precisely known of the crystalline form of what in its three different phases is one of the most familiar, necessary, and conspicuous substances in nature. The system is undoubtedly hexagonal, possibly hemimorphic; but the axial ratios quoted in mineralogical text-books are based merely upon exceedingly rough observations made by Nordenskiöld on some snowflakes which fell during the severe winter of 1860. So far as we are aware, no crystal of water has yet been measured with a goniometer, and there is an opportunity for a crystallographer zealous enough to invade a refrigerator for the purpose of measuring a crystal grown under conditions that have been kept as uniform and as favourable as possible. In the course of his paper Mr. Bentley comments upon the curious changes that have often occurred during the growth of certain of the crystals. For instance, in Fig. 1 the crystals were at first narrow, but afterwards became broad and well-defined. This phenomenon may probably be explained as due to a change from the labile to the metastable condition. As Principal Miers has shown, in the labile condition the growth is rapid, and the crystals are narrow and ill-formed; whereas in the metastable condition the growth is slow, and the crystals are large and well-formed. We anticipate that experiments conducted under conditions of humidity and temperature which were accurately determined would be productive of results of considerable interest. It is clearly impossible to be sure of the temperature of a window even when those of the room and of the outer air are known; a slight gust of wind might cause a lowering of some degrees.

G. F. H. S.

WATER POWER IN THE UNITED STATES.

IN many of the States of North America water is regarded as one of the most valuable of the natural resources. Unlike timber or minerals, it is inexhaustible, and so long as the rain continues to fall the water resources are being continually replenished. This fact has been more fully realised since the transmission of power to long distances has become practicable owing to the development of electricity.

The State of Wisconsin is probably as favourably situated as any of the States with reference to its water power. Realising this fact, the legislature, in conjunction with the Geological Department of the United States, undertook the surveying of the rivers of the State and the investigation of their adaptability to the generation of power. Six hundred miles of rivers have already been surveyed, and the results recorded in a report issued by the Wisconsin Geological and Natural History Department.

This report states that at the time of its publication water-power installations to the extent of 130,000 horse-power had been developed, this being only a small instalment of the resources of the rivers.

The average grade of the water surface of the rivers surveyed varies from 3 to 8 feet per mile. The average yearly rainfall is 32·30 inches. Dry periods occur in cycles of about twenty-five years, when the rainfall drops to 24·20 inches, and exceptionally dry periods occur about once in fifty years, when the lowest rainfall recorded was 13·50 inches. Owing to the storage effects of lakes and swamps, the low-water run-off is as high as 0·3 to 0·8 foot per square mile of the drainage area. The cutting down of the forests is, however, having a considerable effect on the yield of the rainfall; where clearances have been carried out the rain being less absorbed by the soil and the water reaching the streams more quickly.

The Fox River Paper Company's Mills, Appleton, Wis. Middle Dam.

The most important purposes to which the water power is applied are the paper and woollen mills and for electric light and traction. An example of the extended use of water power for generating electricity is to be found in the works of the small town of Kilbourn, on the Wisconsin River, and its distribution to places 50 miles distant. On the Saint Croix River, where a fall of 50 feet is available, the power developed is equal to 27,000 horse-power, and the transmission extends to a distance of 40 miles. The instalment on the Saint Louis River, when fully developed, will be equal to 200,000 horse-power, and the distance of transmission 75 miles. This instalment, when in full working order, will only be second to the great hydraulic plants at Niagara. On the Fox River there are three dams, and water power is supplied to a large number of paper and pulp factories, and also for factories and electric light and traction, the aggregate power being equal to 35,000 horse-power. The illustration, taken from the report of the Wisconsin Geological Department, gives some idea as to the extent of the factories the works of which are actuated by water power.

SCIENTIFIC RESEARCH IN THE SUDAN.

IT is hardly possible within the short compass of this review to give more than the briefest account of the contents of the very interesting volume referred to below.[1] One of the most important subjects from the point of view of the maintenance of stock and transport is animal trypanosomiasis. Thus, in camels in the French Sudan we have the disease known as Mbori; in dromedaries of the Upper Niger, le Tabaga; in Algerian dromedaries, El debab. A camel disease is also noted in this report at El Obeid, Kordofan, and another occurs in the Sinai peninsula close to the Mediterranean. The elucidation of the problem of the specific character of these trypanosomes and the mode of their transmission is not an easy matter. Trypanosome diseases are by no means confined to camels, but we find them also existing in horses, mules, and donkeys. The losses from these diseases appear to be considerable, but at present little can be done in the way of prophylaxis.

The report indicates that investigation into these various forms is being prosecuted on all sides. Different kinds of piroplasmosis (red-water) of cattle also exist, but researches on this point are at present not far advanced.

Another disease not of insignificance is spirochætosis of domestic fowls. It exists in poultry, geese, and guinea-fowl, and probably will be found common in wild birds, as ten years ago the present writer encountered spirochætes in birds in West Africa. The disease is, so far as is known, transmitted by ticks, of the genus Argas, which abound in the hen-runs. An important peculiarity of the hen spirochæte is the abundance of intracorpuscular forms of these parasites, a condition which does not prevail in other spirochæte diseases.

Dinkas of the White Nile, showing stork-like attitude. From the "Third Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum."

To turn to human diseases, it is uncertain at present whether sleeping sickness exists in the Bahr-el-Ghazal, but unfortunately there is a possibility, if not probability, of it being introduced from the Congo Free State. A useful suggestion is that chiefs should be paid for keeping the watering places near their villages free from trees and scrub, the haunts of *Glossina palpalis.*

Kala-azar, an extremely fatal disease, occurs in the vicinity of Abyssinia. The disease also exists in the Kassala province. A disease known as "Egyptian cirrhosis of spleen and liver," which closely resembles kala-azar, but the nature of which is unknown, is also recorded.

[1] Third Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum. By Andrew Balfour. Pp. 477. (London: Baillière, Tindall and Cox, for the Department of Education, Sudan Government, Khartoum, 1908.) Price 21s. net.

Three interesting sections then follow on protozoal investigations, largely carried out on the floating laboratory; on the helminthes collected in the Sudan; and on the reptiles and poisonous snakes. In the latter we note that the author speaks of "saliva" in connection with the fluid ejected by the spitting cobra (*Naja nigricollis*). The writer has often made these cobras spit on to the glass roof of their cage, but never could convince himself that the secretion came from the fangs. The expectoration, on drying, gives a white powder, whereas snake-venom is usually a pale yellow. The report by the economic entomologist is especially interesting, recording as it does the misdeeds of such pests as the cigarette beetle, that eats cayenne pepper; the white ants, that eat leather camel-bags—though they will not touch green Willesden canvas, "Solignum" also appearing to be an absolute preventive against them—the teredo, that attacks the timber in Port Sudan; the horn beetle, the enemy of the sportsman and trophy hunter; the clothes-beetle, the weevils, the cotton boll-worms, and the locusts, veritable plagues of Egypt.

A complete list of Sudanese mosquitoes, including several new species, is contributed by Theobald.

In an article on the healing art as practised by the Dervishes, the following effective method of amputation is described:—"The limb is stretched out of an opening in the wall or out of a window, and it severed with one stroke of a sharp sword, the stump being then plunged into boiling oil to stop the bleeding." The native belief that the wearing of high pattens is a protection against guinea-worm should be noted by those investigating the mode of entry of this crippling parasite. The physical characters of the Nilotic Negroid tribes, based on the work of the late Dr. Pirrie, forms a fascinating section, and "the call of Africa" is insistent on every page.

The work concludes with chemical investigations into the food-stuffs and very interesting work on the gums. We have said enough, perhaps, to give a slight idea of the interest and value of this report, not only to the scientific, but also to the general reader, and we heartily congratulate the director and his collaborators on the result. It is a magnificent volume, profusely illustrated, but it is just to this magnificence that we venture to raise objection. Its price and bulk will deter many from purchasing it to whom it would be of value. We think it might be possible to issue the work in a number of sections, medical, entomological, ethnological, &c., otherwise we are afraid that the next volume may be twice as bulky and twice as expensive.

J. W. W. S.

THE DARWIN COMMEMORATION AT CAMBRIDGE.

THE celebrations in commemoration of the centenary of the birth of Charles Darwin and of the fiftieth anniversary of the publication of "The Origin of Species" are being held at Cambridge this week. The programme commenced on Tuesday, June 22, with a reception of delegates and other invited guests by the Chancellor of the University, Lord Rayleigh, O.M., F.R.S., in the Fitzwilliam Museum. By the kind permission of the master and fellows of Peterhouse, the college gardens were accessible from the museum. On the following day, Wednesday, there was a presentation of addresses by delegates of universities, colleges, academies, and learned societies in the Senate House. After an address by the Chancellor, and the presentation of delegates and addresses, there were a few short speeches. During the afternoon visits were made to the various colleges, and these were followed by a garden party, given by the master and fellows of Christ's College, in the college grounds. In the evening a banquet was held in the new examination hall; after which the master and fellows of Pembroke College gave an at home in the college hall and gardens. To-day (Thursday), the concluding day of the celebration, honorary degrees are to be conferred upon some of the delegates in the Senate House; the Rede lecture is to be delivered by Sir Archibald Geikie, president of the Royal Society, upon "Darwin as Geologist"; and a garden party is to be given at Trinity College by members of the Darwin family.

The delegates upon each of whom the degree of Doctor of Science *honoris causa* is to be conferred are:—Prince Roland Bonaparte, member of the Paris Academy of Sciences; Édouard van Beneden, professor of zoology at Liége; Geheimrat Hofrat Bütschli, professor of zoology and palæontology at Heidelberg; Robert Chodat, professor of botany at Geneva; Francis Darwin, F.R.S., honorary fellow of Christ's College, and formerly reader in botany; Karl F. Goebel, professor of botany at Munich; Ludwig von Graff, professor of zoology and comparative anatomy at the University of Graz, and president-elect of the International Zoological Congress which meets at Graz next year; Richard Hertwig, professor of zoology and comparative anatomy at Munich; Harold Höffding, professor of philosophy at Copenhagen; Jacques Loeb, professor of physiology in the University of California; Edmond Perrier, a member of the Institute of France, distinguished by his able organisation of the Natural History Museum of Paris, over which he presides; Gustav Albert Schwalbe, professor of anatomy at Strassburg; Hermann Graf zu Solms-Laubach, professor of botany at Strassburg; Clement Timiriazeff, professor of botany in Moscow; Frantisek Vejdovsky, professor of zoology in the Bohemian University of Prague; Max Verworn, professor of physiology at Göttingen; Hermann Vöchting, professor of botany at Tübingen; Hugo de Vries, professor of botany at Amsterdam; Charles Doolittle Walcott, secretary of the Smithsonian Institution at Washington; Edmund Beecher Wilson, professor of zoology in Columbia University, New York; and Charles René Zeiller, professor of palæobotany in the École des Mines, Paris.

During the celebration there was an exhibition of portraits, books, and other objects of interest in connection with Darwin, in the old library of Christ's College. The exhibition will remain open until the end of this week. All the many objects exhibited are directly connected with Charles Darwin or his ancestors. In the outer room are all the important portraits made of Charles Darwin during the time he lived. Of these mention should be made of the painting by Sir W. B. Richmond, K.C.B., which shows Darwin in his LL.D. gown, lent by the university; the well-known portrait by the Hon. John Collier, showing Darwin in his long black cloak and holding his hat in his hand, lent by the Linnean Society of London; and the well-known profile by W. W. Ouless, a replica of which hangs in Christ's College Hall, lent by W. E. Darwin. The larger portraits also include two of Mrs. Charles Darwin, by C. Fairfax Murray; one of Robert Waring Darwin, father of the naturalist; and others of Darwin's ancestors, amongst them the painting of his grandfather, Erasmus Darwin, by J. Wright, of Derby. Two crayon sketches of Darwin in middle life, by S. Laurence; water-colour drawings of Down, and of various scenes connected with the voyage of H.M.S. *Beagle*, are also represented here, together with the instruments used by Darwin on board the *Beagle*, and some specimens of birds and fish collected during that voyage.

In the further room are Woolner's bust; a bust, medallion, and miniature of the Shrewsbury statue, by Horace Montfond; and a large bronze head, by William Couper, of New York, which the American delegates to the Darwin centenary are presenting to Christ's College. The large series of paintings, photographs, and sketches in this room represent Charles Darwin from the age of four to old age, and include Pelligrini's *Vanity Fair* cartoon of the naturalist in his high chair, similar to the one exhibited. Manuscripts, letters, copies of first editions, with Darwin's own notes, and medals and diplomas awarded to him, are present in great numbers, as also are many pictures of Down, Charles Darwin's home.

By the kindness of Mr. Francis Darwin, Charles Darwin's library was on view at the Botany School during the celebration. A few of the most interesting volumes were displayed in the Botanical Museum. The rock-specimens collected by Charles Darwin during the voyage of the *Beagle* were exhibited in the Sedgwick Museum, and the librarian of the University Library arranged an exhibition of MSS. and books illustrating the progress of scientific study.

The delegates selected by universities, academies, colleges, learned societies, and other bodies abroad to attend the celebration included the following:—

America (United States).—University of Michigan, Prof. H. S. Carhart; Johns Hopkins University, Prof. J. Mark Baldwin; University of California, Prof. Jacques Loeb; Brooklyn Institute of Arts and Sciences, Prof. C. B. Davenport; Boston Natural History Society, and Harvard University, Prof. Theobald Smith; Cold Spring Harbour Station for Experimental Evolution, Prof. C. B. Davenport; University of Ohio, Prof. G. Wells Knight; Cornell University, Dr. J. Gould Schurman; University of Wisconsin, Dr. F. B. Power; Mexican Government, Department of Public Instruction, Dr. J. Mark Baldwin; University of Minnesota, Prof. E. Van Dyke Robinson; Yale University and the Peabody Museum of Natural History, Prof. R. H. Chittenden; the Connecticut Academy of Arts and Sciences, Prof. Tracy Peck; New York Academy of Sciences, Mr. C. F. Cox, president; Columbia University, Prof. E. B. Wilson; New York University, Prof. H. M. Biggs; American Museum of Natural History, Prof. D. G. Elliot; University of Pennsylvania, Mr. C. C. Harrison; Philadelphia Academy of Natural Sciences, Dr. A. E. Brown; American Philosophical Society, Dr. H. F. Osborn; Carnegie Institute, Colonel Church; Princeton University, Prof. W. B. Scott and Prof. O. W. Richardson; Smithsonian Institution, Dr. C. D. Walcott; Carnegie Institution, Washington, Dr. R. S. Woodward; National Academy of Sciences, Dr. G. E. Hale; George Washington University, Dr. H. W. Wiley; Academy of Sciences, Washington, Dr. L. O. Howard; Woods Hole, Prof. E. B. Wilson.

America (South).—Universidad de Chile, Domingo Gana.

Austria-Hungary.—Magyar Tudományos Akadémia, Prof. S. Apáthy; Kir. Magyar Tudomány-Egyetem, Prof. Jules Dollinger; Graz Universität, Prof. Ludwig von Graff; Kolozsva Universität, Prof. S. Apáthy; Prague Universita, Prof. F. Vejdovský; Kaiserl. Akad. der Wissenschaften, Vienna, Dr. F. Steindachner and Prof. R. Wettstein; Vienna Universität and the Anthropologische Gesellschaft, Prof. V. Ebner; Zoologisch-botanische Gesellschaft, Vienna, Prof. R. Wettstein; Naturhistorisches Hof-Museum, Vienna, Dr. F. Steindachner.

Belgium.—Université libre de Bruxelles, M. Auguste Lameere; Académie Royale des Sciences, Prof. E. van Beneden; Musée Royal d'histoire naturelle de Belgique, M. E. Gilson; Ghent Université, M. H. Leboucq; Louvain Université, Prof. H. de Dorlodot.

Denmark. Copenhagen Universitet and Det Kongelige Danske Videnskabernes Selskab, Prof. H. Höffding; National Museet, Prof. H. F. E. Jungersen.

Egypt.—Cairo School of Medicine, Mr. H. P. Keatinge.

France.—Société Linnéene de Normandie and Caen Université, Prof. L. Brasil; Lille Université, Prof. A. Malaquin; Montpellier Université, Prof. O. Duboscq; Nancy Université, Prof. L. Cuénot; Université de Paris, Prof. F. Le Dantec; Institut de France, M. E. Perrier and Prince Roland Bonaparte; École d'Anthropologie, Prof. G. Papillault; Musée d'Histoire Naturelle, M. E. Perrier; Institut Pasteur, Prof. Élie Metchnikoff; École des Mines, M. R. Zeiller; Société d'Anthropologie, Dr. Manouvrier; Société de Biologie, Dr. Eugène Dupuy and Prof. L. Lapicque; Société géologique de France, M. de Margerie.

Germany.—Berlin Universität, Prof. C. Stumpf; Königl. Preussische Akademie der Wissenschaften, Prof. Waldeyer, Prof. Diels, Prof. Engler, and Prof. O. Hertwig; Königl. Museum für Naturkunde, Prof. A. Brauer; Deutsche Botanische Gesellschaft, Prof. A. Engler; Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, Dr. F. von Luschan; Bonn Universität, Prof. Schultze; Breslau Universität and the Schlesische Gesellschaft für vaterländische Cultur, Prof. Kükenthal; Frankfurt, Senckenbergische Naturforschende Gesellschaft, Dr. Ernst Roediger; Freiburg i. B. Universität, Prof. R. Wiedersheim; Giessen Universität, Prof. Spengel; Göttingen Königl. Gesellschaft der Wissenschaften, Prof. M. Verworn; Göttingen Universität, Prof. Berthold; Greifswald Universität, Prof. Erich Kallius; Halle Leopoldinisch-Carolinische Akademie, Dr. R. Hertwig; Halle Universität and Naturforschende Gesellschaft, Prof. J. Walther; Heidelberg Universität, Prof. Bütschli; Jena Universität, Prof. L. Plate; Kiel Universität, Prof. Brandt; Leipzig Universität and Königl. Sächsische Gesellschaft, Prof. Rabl; Marburg Universität, Prof. Korschelt; München Universität, Prof. R. Hertwig; München, K. Bayerische Akademie der Wissenschaften, Prof. Goebel; Münster Universität, Prof. E. Ballowitz; Rostock Universität, Prof. H. Spemann; Strassburg Universität, Prof. Solms-Laubach; Tübingen Universität, Prof. H. von Vöchting; Würzburg Universität, Prof. Theodor Boveri.

Holland.—Koninklijke Akademie van Wetenschappen, Prof. H. de Vries; Koninklijk Zoologisch Genootschap "Natura Artis Magistra," Dr. C. Kerbert; Groningen Universiteit, Prof. J. F. van Bemmelen; Hollandsche Maatschappy de Wetenschappen, Dr. J. P. Lotsy; Leyden Universiteit, Prof. G. C. J. Vosmaer; Utrecht Universiteit, Prof. A. A. W. Hubrecht.

Java.—Buitenzorg, Departement van Landbouw, Dr. J. C. Koningsberger.

Italy.—Catania Università, Prof. W. Bateson, F.R.S.; Genoa Università, Prof. R. Issel; Modena, Società di Naturalisti e Matematici, Prof. A. C. Seward, F.R.S.; Naples, Stazione Zoologica, Dr. R. Dohrn; Società Geografica Italiana, Marchese di San Giuliano; R. Accademia dei Lincei, Conte Ugo Balzani, Lord Rayleigh, O.M., F.R.S., and Sir George Howard Darwin, K.C.B., F.R.S.; Siena Università, Prof. C. Achille Sclavo; R. Istituto Veneto, Dr. G. Veronese.

Japan.—Kyoto University, Prof. G. Kuwaki; Tokyo University, Prof. C. Ishikawa.

Norway.—Christiania Universitet, Prof. H. Mohn.

Portugal.—Coimbra Universidade, Prof. J. A. Henriques; Lisbon, Sociedade de Geographia, Dr. S. Telles; Oporto, Academia Polytechnica, A. F. de Lacerda.

Russia.—Dorpat Universitet, Prof. A. I. Jarotskij and Prof. N. I. Kuznetsov; Helsingfors Universitetet and Finska Vetenskaps Societet, Prof. F. Elfving; Moscow Universitet and Société Impériale des Naturalistes de Moscou, Prof. C. A. Timiriazeff; St. Petersburg Universitet, Prof. V. M. Schimkewitsch; St. Petersburg, Imperatorskaja Akademija Nauk, Prof. V. V. Salensky and Prof. I. P. Borodin.

Sweden.—Lund Universitetet, Prof. J. Forssman; Lund, Kungl. Physiografiska Sällskapet, Prof. O. Nordstedt; Stockholm, Kungl. Svenska Vetenskaps-akademien, Prof. H. Théel and Dr. Svante Arrhenius; Stockholms Högskola, Prof. W. Leche; Stockholm, Naturhistoriska Riksmuseet, Prof. A. G. Nathorst; Stockholm, Kungl. Karolinska Medico-Kirurgiska Institutet, Count K. A. H. Mörner; Uppsala Universitetet and K. Vetenskaps Societeten, Prof. S. G. Hedin.

Switzerland.—Bern Universität, Prof. H. Strasser; Geneva Université, Prof. R. Chodat; Neuchatel Académie, Prof. Edmond Béraneck; Schweizerische Naturforschende Gesellschaft, Dr. P. Sarasin.

Africa.—University of the Cape of Good Hope; South African College, Prof. H. H. W. Pearson; Grahamstown, Rhodes University College, Bouchier F. Hawkesley; Transvaal University College, Sir Richard Solomon, K.C., K.C.B., K.C.M.G.; Geological Society of South Africa, Prof. A. C. Seward, F.R.S.

Australia.—Adelaide University, Prof. W. H. Bragg, F.R.S.; University of Tasmania, J. Sprent; Royal Society of Tasmania, the Hon. J. McCall; Melbourne University, Dr. C. J. Martin, F.R.S.; Royal Society of Victoria, Prof. A. Dendy, F.R.S.; Sydney University and Royal Society of New South Wales, Prof. A. Liversidge, F.R.S.

Canada.—University of New Brunswick, Dr. C. C. Jones; Nova Scotian Institute of Science, Dr. H. S. Poole; Kingston, Queen's University, Prof. N. F. Dupuis; McGill University, Prof. E. W. MacBride; Royal Society of Canada, Prof. W. H. Ellis; Toronto University, Dr. R. A. Falconer and Prof. T. G. Brodie, F.R.S.; University of Manitoba, Prof. A. H. R. Buller.

India and Ceylon.—Allahabad University, Prof. A. W. Ward; Bombay University, Sir E. T. Candy; Calcutta University, Prof. S. Chandra Mahalanobis; Geological Survey of India, R. D. Oldham; Asiatic Society of Bengal, Lieut.-Colonel H. H. Godwin-Austen, F.R.S.; Punjab University, the Hon. Sir Lewis Tupper, K.C.I.E.; Madras University, Edgar Thurston; Peradeniya, Royal Botanic Gardens, Dr. J. C. Willis.

New Zealand.—Auckland University College, the Hon. W. Pember Reeves; Canterbury University College, Prof. E. Rutherford, F.R.S.; Philosophical Institute of Canterbury, T. V. Hodgson; New Zealand University, the Hon. Sir Robert Stout, K.C.M.G., Prof. Sale, and Prof. J. M. Brown; Wellington, Victoria, University College, H. D. Bell.

Straits Settlements.—Royal Asiatic Society (Straits Branch), J. B. Carruthers.

In addition to these representatives of institutions abroad, delegates were appointed by our own universities, university colleges, and scientific societies to take part in the celebration, and many other distinguished guests were present. The invitations to men of science were, except in a few cases, confined to naturalists, the committee having decided not to invite representatives of the physical sciences as such. Had it not been necessary, on account of space, to make this limitation, there is no doubt the celebration would have been even more remarkable in character than it was. The spirit of Darwin is the spirit of modern science, and every investigator who has been inspired by it would have welcomed an opportunity to assemble with the object of commemorating the greatness of the man and his work. No more brilliant assembly of representatives of the biological sciences throughout the world could, however, have been brought together than that which met on Tuesday at the opening of the celebration. The committee, and particularly the honorary secretaries, Prof. A. C. Seward and Mr. J. W. Clark, are to be congratulated upon the plan of the celebration, and the very successful way in which it has been carried out. Not for many years can Cambridge be the focus of so many investigators of animate nature from far and near as it has been this week. The celebration is of great historic significance, and will long be remembered as a worthy expression of the high estimation in which Charles Darwin's memory is held throughout the scientific world.

NOTES.

ON June 28, 29, and possibly June 30, the third meeting of the Solar Commission of the International Meteorological Committee will be held, under the presidency of Sir Norman Lockyer, K.C.B. The Royal Society has placed a room at the service of the commission, and the meetings will commence at 11 a.m. each day. The following members have notified their intention of being present:—M. A. Angot (France), Prof. H. Birkeland (Norway), Prof. E. von Everdingen (Holland), Sir Norman Lockyer (Great Britain), Dr. W. J. S. Lockyer (Great Britain), Captain H. G. Lyons (Egypt), M. E. Marchand (France), Prof. H. Mohn (Norway), Dr. W. N. Shaw (Great Britain), M. A. Silvado (Brazil), and M. Teisserenc de Bort (France). This commission, it may be remembered, was originated by the International Meteorological Committee at the meeting in Southport in 1903, when Dr. W. N. Shaw proposed that a commission should be appointed to review and discuss meteorological observations from the point of view of their connection with solar physics. Dr. Shaw's motion was adopted, and Sir Norman Lockyer, Dr. Shaw, Prof. Pernter, and M. Angot were elected to serve on this commission, with power to add to their number and to elect their officers. Since then two meetings have been held, one at Cambridge in 1904 and the other at Innsbruck in 1905, with Sir Norman Lockyer as president and the late Sir John Eliot as secretary. The forthcoming and third meeting of the commission will be devoted chiefly, among other items, to the actions taken with regard to previous resolutions concerning the collection and publication of meteorological and solar data, and also to an important statement submitted by Dr. Shaw in relation to the selection of stations from ten-degree square areas.

OF the many scientific organisations, few have made more rapid progress than the Association of Economic Biologists. Founded in November, 1904, it has already held conferences in Birmingham, Liverpool, London, Edinburgh, and Cambridge, and on July 13, 14, and 15 it will meet at Oxford. According to the programme, the annual general meeting will be opened by the president, Dr. A. E. Shipley, F.R.S., on July 13, with an address on some diseases of fish and birds associated with the presence of parasites. The programme is a lengthy and interesting one. Prof. G. H. F. Nuttall, F.R.S., and Dr. Hadwen will read a communication on the successful curative treatment of piroplasmosis, to be followed by others by Prof. E. B. Poulton, F.R.S., on predaceous insects and their prey, and Prof. W. Somerville, on injurious fungi. "The Winter Breeding of the House-fly" is the title of a paper by Mr. F. P. Jepson; Mr. A. D. Darbishire will contribute an important paper on the application of recent discoveries in heredity to economic problems, and Dr. S. A. Neave on the distribution of *Glossina palpalis* and sleeping sickness. Other communications will be made by Messrs. W. E. Collinge, A. J. Grove, C. Gordon Hewitt, C. H. Hooper, R. S. MacDougall, G. W. Smith, and C. Warburton. On the afternoon of Wednesday, July 14, Prof. Somerville and Mr. G. H. Grosvenor will lead an excursion to Bagley Wood. Further particulars of the meeting may be obtained from Mr. Walter E. Collinge, Uffington, Berkhamsted.

THE annual general meeting of the Research Defence Society will be held at the Royal Society of Medicine, 20 Hanover Square, W., on Friday, June 25, at five o'clock. The Earl of Cromer, president of the society, will take the chair. Other speakers will be Sir James Dewar, Sir A. Conan Doyle, the Hon. Walter Guinness, and Prof. Starling.

THE sixth International Congress of Psychology will be held in Geneva on August 3–7. M. Flournoy is to be the president of the congress, and the general secretary is Dr. E. Claparède, 11 Avenue de Champel, Geneva.

The council of the Royal Society of Arts, with the approval of the Prince of Wales, president, has awarded the Albert medal of the society for the current year to Sir Andrew Noble, K.C.B., F.R.S., "in recognition of his long-continued and valuable researches into the nature and action of explosives, which have resulted in the great development and improvement of modern ordnance."

The council of the Royal Society has awarded the Mackinnon studentships for the year 1909 as follows:—one in physics to Mr. R. D. Kleeman, of Emmanuel College, Cambridge, for the continuation of his researches on radio-activity, which he proposes to conduct at the universities of Cambridge, Leeds, and Manchester; the other, in biology, has been renewed for a second year to Mr. D. Thoday, of Trinity College, Cambridge, for research into the physiological conditions of starvation in plants and its relation to the responsiveness of protoplasm to stimulation, especially to stimuli affecting respiration.

We regret to see the announcement of the death of Dr. G. F. Deacon, member of the council of the Institution of Civil Engineers, and president of the engineering section of the British Association in 1897.

Dr. W. Stirling, professor of physiology in the University of Manchester, has been elected a foreign corresponding member of the Turin Royal Academy of Medicine.

It is announced that Mr. E. H. Shackleton has been elected a Younger Brother of Trinity House, with the approval of the Prince of Wales, who is the master of this corporation. This is the second time only in the history of Trinity House that this honour has been conferred by the master.

M. J. Vallot has been elected by the Société des Observatoires du Mont Blanc director of the observatory founded by the late M. Janssen, so that he is now director of two observatories on Mont Blanc. He has decided to present to the society the observatory founded by himself. Men of science anxious to carry out researches in the Mont Blanc meteorological observatories are requested to communicate either with the general secretary of the society in Paris, or with M. Vallot at Chamonix during the summer, and at 5 rue François Aune, Nice, or in Paris, during the winter. Publications are invited towards the library in connection with the observatories, and may be sent to M. Vallot at Nice.

The Institute of France has awarded the Osiris prize, of the value of 4000*l.*, to M. Louis Blériot and M. Gabriel Voisin, for their experiments and achievements in aërial navigation. The prize is awarded every three years for the most remarkable contribution to the cause of human progress during that period.

The first annual dinner of the Society of Tropical Medicine and Hygiene was held on June 18. Colonel Seeley, in proposing the toast "Success to the Society," said that from information he had obtained at the Colonial Office it appeared that half a million people have died of sleeping sickness alone in Uganda, but, owing to the discovery of the method by which it is propagated, the ravages of that disease have been at least reduced to one-tenth of what they were formerly. Sir Alfred Jones, in supporting the toast, remarked that in Liverpool 100,000*l.* has been spent on the work and 28,000*l.* in sending out expeditions. Sir Rubert Boyce, who followed, pointed out that yellow fever is practically a disease of the past in the West Indian group. In the Isthmian Canal zone, in the time of M. de Lesseps, 48,000 men employed on the canal works died, but during the last three years there has not been a single case of yellow fever in that zone. Prof. Ronald Ross, C.B., F.R.S., who occupied the chair, responded, and said that the members of the society now number nearly 350, most of whom are doing their duty in the tropics. This country has, he continued, led the way in research in tropical medicine, and he expressed the hope that it will now lead the way in the practical application of the researches.

The May number of the *National Geographic Magazine* contains an article by Mr. G. Shiras, illustrated with a large number of reproductions from the photographs of bird-life by Mr. F. M. Chapman which originally appeared in his "Camps and Cruises of an Ornithologist." Among the most striking photographs are those of the great colonies of flamingoes in the Bahamas. Specially interesting are Mr. Chapman's observations on the manner in which young flamingoes feed. For the first three weeks, during which the beak is straight, they pick up their food in the normal manner. After this the beak begins to bend, and feeding is effected by turning the end upside down and scooping up the nutriment. Unlike most birds, flamingoes have the upper half of the beak movable, and by moving this rapidly the mud and water taken into the mouth are strained off, leaving the small bivalves on which these birds feed.

Subjects connected with evolution continue to occupy a prominent place in the *American Naturalist*, the contents of the June number including an article on heredity and variation in the simplest organisms, by Prof. H. S. Jennings, and a second, by Dr. J. A. Harris, on variation in the number of seeds in the pods of the broom (*Cytisus scoparius*). In the former of these the author points out that low unicellular organisms, such as Paramecium, are divisible into races differing by minute but constant features. In each of these races great individual variation in the matter of size is noticeable, but such differences are not inherited. The fundamental constitution of each is almost unaffected by external influences, observations extending over hundreds of generations of thousands of individuals of Paramecium revealing scarcely a single instance of such a change. Systematic and continued selection is without effect in a pure race, and in a mixture of races its effect consists in isolating the existing races, and not in producing anything new.

In continuation and amplification of the study by Mr. W. C. Hossack of the rats of Calcutta, Captain R. E. Lloyd has undertaken an elaborate investigation into the racial and specific characters of those of India generally, the results of which are published in vol. iii., part i., of the Records of the Indian Museum. The investigation includes, not only the brown and the black rat and their local forms, but likewise *Mus mettada* and its allies, together with the various species formerly included in the genus Nesocia, but now split up into three generic groups. The great feature of the investigation is the enormously large series of specimens of the various forms which have passed through the author's hands, and have furnished materials for elaborate tables of measurements. One result of these extensive comparisons has been to raise in the author's mind grave doubts as to the validity of certain so-called species which have been described of late years. Captain Lloyd is also doubtful as to the advisability of the above-mentioned splitting of the old genus Nesocia, the members of which, by the way, he designates as "mole-rats," a name usually restricted to the representatives of the genus Spalax. A better title is bandicoot-rats, taken from the ordinary name of the largest species. Captain Lloyd's investigations were undertaken as supplemental to those dealing with rats and plague, and certain very interesting deductions are drawn in connection with this aspect of the investigation. It is shown, for instance, that the brown rat, the great disseminator of plague, is absent from Madras, the only Indian port at present free from plague, where its place in the sewers of the city is taken by the great bandicoot-rat. The inference from this feature in distribution is obvious, although in some degree discounted by the occurrence of plague in districts where the brown rat is rare or unknown.

From the report of the director for 1908, we learn that the aquarium of the New York Zoological Society is becoming more and more attractive as a place of popular resort, the number of visitors during the year under review being considerably more than two and a half millions, forming a daily average of nearly seven thousand. During 1908 a sea-water system was installed, with an underground reservoir capable of holding 100,000 gallons, and the result of this has rendered it possible to keep a number of marine animals never previously exhibited in the establishment. It is stated that the difficulties encountered in the heating of sea-water by means of iron and bronze heaters, which corrode and break down, have apparently been solved by the employment of a heavy coiled heater made of chemical lead, which has lasted much longer than others previously tried. No other aquarium has problems to contend with like those which have developed in New York, where sea-water is heated in winter for tropical species and fresh-water refrigerated in summer for northern forms. With warm and cold tanks of both fresh and salt water, there are four distinct water-systems in use. About 200 species of fishes are usually kept in the ninety-four glass-fronted tanks, including from 3000 to 4000 specimens of native marine and fresh-water species and tropical species from the Bermudas. These figures do not include the product of the fish-hatchery. The collection of invertebrates is at present limited to local marine forms. The large ponds contain seals, sea-lions, alligators, crocodiles, turtles, and sturgeons, while in the table tanks are usually shown about twenty species of fresh-water tortoises. During September the large central pond contained two porpoises, and a leathery turtle weighing 840 lb. Unfortunately, some of the lung-breathing marine animals are ill adapted to indoor life, and it may prove undesirable to repeat experiments with those affected by the warm air when the building is heated.

Prof. E. Gaupp, the eminent comparative anatomist of Freiburg, has turned aside, as so many past and present anatomists and physicians have done, to investigate the problem of man's right-handedness. His essay, in which he brings together the best that is known concerning the preeminence of the right hand, has just been published by Mr. Gustav Fischer, of Jena, as the first part of a "Sammlung anatomischer und physiologischer Vorträge und Aufsätze," edited by himself in conjunction with Prof. W. Nagel. He regards right-handedness as a human characteristic, and agrees with those who seek an explanation in the preponderance of the left hemisphere of the brain. This preponderance he thinks may be explained by the asymmetry of the blood-vessels and other organs of the body. The essay, while adding little that is new to the subject, is a clear and useful summary of its literature. English writers are very fully cited, with one notable exception—no mention is made of Prof. Elliot Smith's paper, the most important that has yet appeared. Advocates of ambidextry will be glad to learn that they have gained a supporter in the professor of comparative anatomy of Freiburg.

Dr. Max Hartmann discusses the meaning of sexuality in relation to the formation of gametes in a very interesting little work ("Autogamie bei Protisten") published by Mr. G. Fischer, Jena, as a reprint from the well-known *Archiv. f. Protistenkunde*. The author briefly describes the various forms which the sexual elements assume, and points out the importance of paying due regard to the sexual fusion of very nearly related gametes. He gives a useful summary of the various forms of sexuality, and traces the gradual disappearance (apomixis) of the latter in extreme cases of parthenogenesis and apogamy. He regards these types as derived from originally differentiated sexual conditions, and supports his view by an interesting review of the protista regarded from this standpoint. Dr. Hartmann very rightly insists on the fact that the sexual process as it presents itself in the higher forms is not a simple function, urging that it includes several distinct processes. He disagrees with Hertwig's views, which would imply a mere restoration of a specific relation between nucleus and cytoplasm, and seems to consider that the essence of sexuality consists in the union of nuclei which have distinct properties, the one more especially related to trophic, the other to kinetic, functions. But he expresses himself with great reserve, and concludes by admitting that, while this conception of the dual nature of the sexual nuclei is a good working hypothesis, it is hardly likely to prove the master key to all the problems of sexuality and fertilisation.

A striking array of new plants is presented by Dr. J. N. Rose in the sixth of his studies of Mexican and Central American plants, published as vol. xii., part vii., of the Contributions from the United States National Herbarium. A new species of Dioon with both kinds of cone, and an Ephedra, were collected in southern Mexico. Four species are added to the strange parasitic genus Pilostyles, making a total of eight American species; all have been found growing on leguminous plants, generally on species of Parosela. The Cactaceæ received special attention on collecting trips, and illustrations are given of *Echinocactus palmeri*, which has a stem 5 feet high; *Opuntia Lloydii*, an arboreal species; and a dwarf creeping plant, *Opuntia vilis*. The author proposes to split up the genus Lopezia with the formation of three new genera, Pseudolopezia, Pelozia, and Jehlia.

An ecological sketch of the Streletz steppe in the neighbourhood of Kursk is presented by Mr. W. Alechin in the botanical section (series iv., fasc. 1) of *Travaux de la Société des Naturalistes*, St. Petersburg. The area is described as a meadow steppe, in which bushes form the chief feature, while grasses are of subsidiary importance; plants of the composite family are in great abundance. Around the steppe are woods, consisting chiefly of oak trees. The author comes to the conclusion that it is part of an ancient and original steppe formation, and that the woods are innovations. The succeeding fascicle is assigned to a paper, by Mr. W. P. Sawitsch, on the lichen vegetation in the south-west portion of the government of St. Petersburg. A study of the factors regulating distribution points to the importance of light and shade and moisture conditions, combined with the physical nature of the substratum.

It will be readily understood that bacteria do not lend themselves to ordinary standards of classification. According to two systems adopted, they have been massed into certain main groups or have been arranged according to their reactions in a few standard media. Mr. C. E. A. Winslow contributes an article on the subject to the Bulletin of the Torrey Botanical Club (vol. xxxvi.), in which he advocates a statistical method derived from the analysis of quantitative measurements extending over a large series of cultures. The characters or properties employed for discrimination are first selected by means of a preliminary survey. A special point in the paper is the argument in favour of a classification based on physiological as opposed to morphological characters.

Two communications dealing with the flora of Prince Charles Foreland, Spitsbergen, are published in the Transactions and Proceedings of the Botanical Society of Edinburgh (vol. xxiii., part iv.). Mr. R. N. R. Brown deals with the flowering plants and ferns collected by Dr. W. S. Bruce on the island in the years 1906 and 1907. *Saxifraga oppositifolia* is the first plant to flower as soon as the snow disappears in June; in early September the autumn falls of snow begin and close over the flowers of *Cardamine pratensis*, *Saxifraga aizoides*, and other late bloomers. The genera Saxifraga and Ranunculus supply thirteen out of a total of fifty-five species. Gamopetalous plants are limited to two composites, a Campanula and a Pedicularis. The mosses and liverworts are described by Mr. J. Hagen. Owing to the short growing period, only one species, *Oncophorus Wahlenbergii*, was found in fruit, and three others bearing antheridia or archegonia.

Reference has already been made in Nature to the method brought forward by Prof. H. Molisch for using a warm-water bath as a means of forcing plants when in a dormant condition. In response to inquiries, the author has elaborated his paper for publication, with additional illustrations, as a separate pamphlet published by Mr. Gustav Fischer, Jena (price 1.20 marks). The method consists in plunging the plants, preferably inverted, so as to immerse the stems but not the roots, into a water bath maintained at a temperature ranging, according to the plant, from 15° C. to 30° C. After soaking in the bath for about ten to fifteen hours, the plants are placed in a warm, moist chamber, and eventually transferred to the greenhouse. Forsythia, Spiræas, Syringas, and other plants that are usually forced give good results. *Azalea mollis* and *Camellia japonica* did not respond to treatment, and there was no practical result in the case of Narcissus bulbs. The precise nature of the action has not been determined, although it is suggested that the stimulus may be compared with that produced by ether vapour.

The ninth volume of the *Bulletin du Jardin impériale botanique*, St. Petersburg (parts i. to iii.), contains, amongst other papers, a preliminary communication by Mr. A. A. Elenkin on the plankton, mosses, and lichens in and around Lake Selguer, in the government of Tver. The more important algæ collected in the lake included species of Anabæna, *Ceratium hirudinella*, *Tabellaria fenestrata*, and *Staurastrum gracile*. Some rare lichens were found, notably *Rhizocarpon postumum* and *Acarospora oligospora* growing on rocks, and the type of a new genus, *Placynthiella arenicola*, gathered on sandy soil. A short notice is communicated by Mr. N. A. Busch of a botanical expedition in the Caucasian province of Kuban, when he determined the north-western limit of *Fagus orientalis* and the western limit of *Acer tataricum*.

In the *Fortnightly Review* for June Mr. E. Clodd discusses the pre-animistic stages in savage religion. He finds these in the conception of the Algonquin Manatou, the Oki or Orenda of the Iroquois, and in the better-known Mana of the Melanesians, which last is defined by Dr. Codrington to mean a supernatural power or influence which operates to effect everything beyond the ordinary power of men, outside the common processes of nature. At the back of the barbaric mind Mr. Clodd finds that in the evolution of the idea of God the passage is made from a vague, inchoate Naturism to a definite, concrete Animism, which draws its support from divers causes, among which he groups "the Opinion of Ghosts, Ignorance of second causes, Devotion towards what men fear, and taking of things Casuall for Prognostique"—to use the classification of the philosopher Hobbes. He does not go farther, as recent speculation is inclined to do, in tracing the origin of the savage conception of Deity to a primitive Monotheism, while Animism is held to explain only the dead material of savage religion—that which concerns the human, the natural, the world of the dead, animated nature, ancestor worship, and so on.

The Huxley memorial lecture by Prof. W. Z. Ripley, on the subject of the European population of the United States, is published in the current number of the Journal of the Royal Anthropological Institute. He observes that, in contrast to the population of Europe, the white race in America is "artificial and exotic. It is as yet unrelated to its physical environment. A human phenomenon unique in the history of the world is the result." At present the information is too scanty to enable us to judge of the tremendous effects of the introduction into a new country of about twenty-five millions of immigrants since 1820. These hosts have been drawn, not only from the higher races, "but we have tapped the political sinks of Europe, and are now drawing large numbers of Greeks, Armenians, and Syrians." The primary question is whether these various racial groups are to coalesce to form a more or less uniform American type, or whether they are to maintain a separate existence as members of a single government. The process of fusion is aided by the mobility of the American population and by the inequality of sexes among the immigrants, some 70 per cent. of whom are males, a fact which encourages alliances between them and American women. On the other hand, there is considerable concentration among some of the foreign colonies. After an interesting discussion of the problems of race amalgamation, the lecturer points out that the "white man's burden" imposed upon the rulers of India and the Americans in relation to negroes and Filipinos is much less serious than that laid on the statesmen of Canada and the United States of maintaining amidst this engulfing flood of foreigners the ideals of Anglo-Saxon culture and civilisation.

In an interesting paper entitled "Réflexions d'une Artiste sur les Dessins de la Caverne d'Altamira," M. Lotus Péralté reviews the artistic character of the wall paintings in this cave as described by MM. E. Cartailhac and H. Breuil. He dwells with enthusiasm on these admirable delineations of animal forms as contrasted with the infantile productions of the Hyperboreans, Australians, and Bushmen. The Magdaleneans who produced these drawings are, in his view, the successors of a long-established art school, the "ethnical débris" of a profoundly cultured race, of which the last vestiges disappeared before the inroad of the Neolithic people. The artistic capacity of this earlier race may be readily admitted, but at present we have no materials to justify the conclusion that they represent a degradation of culture, even though the steps by which this artistic capacity was acquired may remain one of the unsolved problems of ethnology. The evidence of this "cultural break" between the art of the Palæolithic people and its comparative absence in the Neolithic people has been recently discussed by Mr. W. Johnson in his "Folk-memory, or the Continuity of British Archæology," which offers as reasonable a solution of this tangled problem as is possible at present

Mr. I. M. Casanowicz, in the thirty-sixth volume of the Proceedings of the United States National Museum, gives an account of the collection of rosaries under his charge. It is rather disappointing in numbers and interest when compared with more than one collection in this country, containing only 105 examples, of which twenty-seven belong to the Roman Catholic Church. Strange to say, there is no example of a Brahmanical rosary, while those from Japan, Tibet, and China are of some importance. The rosary in its present form is believed to have started among the Hindus, from whom it was adopted by the Maháyána, or northern and most advanced school of Buddhism. Apparently from them it was adopted by the Mohammedans, and some believe that it came to Europe with the returning Crusaders. Some rude mode of counting the repetitions of prayers is recorded by the historian Sozomen to have been in use in Egypt in the fifth century A.D., but the Roman Church attributes its introduction to St. Dominic (1170–1221). Mr. Casanovicz believes that, though the Buddhist and Mohammedan bead chaplets preceded the Christian in order of time, there is not necessarily a causal connection between them. In any case, both in Islam and the early Christian Church the primitive mode of counting the prayers was by means of pebbles or date-stones, and the idea of replacing these by beads threaded on a string may be due to imitation of the practices of eastern religions.

The U.S. Weather Bureau has favoured us with specimen copies of its meteorological charts of the North Atlantic and North Pacific oceans for July, and seasonal chart for the South Atlantic for June to August, corresponding very closely to the pilot charts issued by the London and Hamburg offices, to which we have frequently referred. The Weather Bureau took over the control of meteorological work on the oceans from the Navy Department a few years ago, and now receives reports from more than 2000 observers on vessels of every nationality. From these reports it prepares daily synoptic charts for the purpose of tracing storm tracks, percentage of fogs, prevailing direction of wind, trade-wind limits, pressure and temperature. It is proposed to include a seasonal chart of the South Pacific Ocean in September next; no charge is made for any of these useful publications, which are of great benefit to the seafaring community.

In the course of an extended investigation on the residual charges of condensers with dielectrics of various materials, Mr. C. L. B. Shuddemagen, of the Jefferson Physical Laboratory of Harvard University, has discovered a method of making condensers with pure paraffin wax instead of waxed paper. Such condensers, he finds, show no residual charge, and on this account are likely to be of great importance in future electrical work. In order to prepare the thin sheets of paraffin required, Mr. Shuddemagen dips a thin, smooth board which has been soaked in water for a few days, and is rinsed with water immediately before use, into a bath of liquid paraffin wax. On withdrawing the board it is found to have on either side a thin sheet of paraffin, which is readily detached, and allowed to hang in the air to get rid of all moisture. The thickness of the sheet is determined by the temperature of the bath and of the board, and by the time the board is immersed but 0·5 millimetre has been found most suitable. Any irregularities in the surface of the sheet are smoothed with the blade of a safety razor before the tin foil is placed on the sheets. Mr. Shuddemagen's paper forms Memoir No. 18 of vol. xliv. of the Proceedings of the American Academy of Arts and Sciences.

OUR ASTRONOMICAL COLUMN.

Discovery of a Comet, 1909*a*.—A telegram from the Kiel Centralstelle announces the discovery of an eleventh-magnitude comet, by Mr. Daniel, at Princeton (N.J.) on June 15.

At 14h. 0m. (Princeton M.T.) on that date the position was R.A. = 1h. 39·9m., dec. = 28° 55′ N., and the motion of the comet was recorded as northerly and rapid.

A second telegram states that this object was observed by M. Javelle at Nice on June 16, when at 13h. 13·3m. (Nice M.T.) the position was R.A. = 1h. 41m. 54s., dec. = 29° 58′ 18″ N.

Thus it appears that the comet is now in the constellation Triangulum, apparently travelling, in a direction a little east of north, towards Andromeda and Perseus; this position rises about four hours before the sun. It is interesting to remark that comet 1907*d*, subsequently a naked-eye object, was discovered by Mr. Daniel on June 14 (1907), and was then of the eleventh magnitude.

A set of elements and an ephemeris, computed by Prof. Kobold, are given in Circular No. 109 of the Centralstelle.

Ephemeris (*12h. M.T. Berlin*).

1909		α (h. m.)		δ		Brightness
June 22	...	1 59·5	...	+38 3·9	...	0·8
26	..	2 12·7	. .	+42 53·0	...	0·7
30	...	2 27·1	...	+47 4·7	...	0·6
July 4	...	2 42·7	...	+51 0·9	...	0·5
8	...	2 59·4	...	+54 22·9	..	0·4

Perihelion is given as June 3.

A supplement to *Astronomische Nachrichten*, No. 4331, informs us that this comet was discovered independently by M. Borrelly, at Marseilles, on June 14, 14h. 30m. (*Marseilles* M.T.). It should therefore be known as comet 1909*a* (Borrelly-Daniel).

Elements and Ephemeris for Winnecke's Comet, 1909.—As Winnecke's comet is due at perihelion in October, Prof. Hillebrand has computed a set of elements and an ephemeris for this return, and publishes them in No. 4330 of the *Astronomische Nachrichten*.

The time of perihelion is given as 1909 October 4·0 (M.T. Berlin), and the ephemeris covers the period June 31 to October 12. During July the comet should apparently travel in a south-east direction through Leo nearly parallel to a line joining δ and β Leonis; on July 18 it should be about 1° south of the former, and on August 2 about 15′ north of the latter, star. The position given for June 31 is α (app.) = 10h. 32m. 46s., δ (app.) = 24° 51·7′ N.

The Recent Lunar Eclipse, June 3.—Owing to the persistent clouds, the total eclipse of the moon which took place on June 3–4 was unobservable in London, but that it was well observed in other localities is shown by the reports now published.

MM. Borrelly and Coggia made observations at Marseilles, the results of which are published in No. 23 (June 7) of the *Comptes rendus*.

The former noted the exceptional intensity of the penumbra at the beginning of the eclipse, and a seamy appearance of the umbra which gave the front line of the shadow a sinuous appearance. In the telescope the eclipsed moon appeared rose-coloured, but to the naked eye it was red; many of the lunar circles were visible despite the shadow.

M. Coggia observed that on the approach of the shadow's edge, at 12h. 45m. (Marseilles M.T.), Plato took on a red tint, which became redder until, at 12h. 50m., it appeared like glowing charcoal.

Mr. J. H. Elgie writes that, according to his observations, at Leeds, the eclipse was a "light" one; although at its first encroachment the shadow was dead black, when the disc was fully eclipsed many features could be perceived by the naked eye. The shadow was first seen, without a telescope, at about 11.45 p.m. Mr. Elgie also directs attention to a curious glow in the northern heavens throughout the night, almost suggestive of an auroral display.

THE PHOTOHELIOMETER.—In No. 4, vol. xxix., of the *Astrophysical Journal* (May, p. 313), Prof. Poor describes, and gives the results of, some experiments carried out at the Yerkes Observatory in order to determine the feasibility of employing the heliometer method in the endeavour to detect differences in the solar diameters, polar and equatorial, at different epochs.

Photographs were obtained with two lenses of 2 inches aperture and 25 feet focal length, mounted side by side in the same cell, so as to give overlapping images of the sun. Then two methods of measurement were tried, one in which the diameter passing through the centres of the two images was determined directly, the other in which the solar radius was determined from measurements of the chord common to the two overlapping images. Prof. Poor discusses both methods, and concludes that the second will give the better results. Finally, he concludes that for his researches the photoheliometer is better than the direct photographic method, and gives some practical working hints, *e.g.* wet plates should be used on account of the sharper, clearer images they give. A series of six trial plates, taken during October and November, 1907, gave a mean excess of equatorial over polar radius of 0·95″.

THE ERRORS OF POSITION OF IMAGES PHOTOGRAPHED THROUGH GLASS.—For some time past photographs of star areas have been taken at Harvard College Observatory with the film side of the plate turned away from the object, so that when compared, film to film, with normal negatives of a different epoch, changes occurring during the interval might be readily detected.

So far these have only been used for light changes, and not for changes of position produced by proper motion and parallax. Tests recently carried out by Dr. Schlesinger at the Allegheny Observatory show, however, that such plates may safely be used for determinations of changes of position, for observing through the glass has, in the plates tested, produced no serious error, the mean value of the possible error being of the order of 0·001 mm. On such plates, taken at an interval of ten years, a proper motion of 0·025″ per annum could be readily detected (Publications of the Allegheny Observatory, vol. i., No. 14).

THE NEW INSTITUTE OF PHYSIOLOGY AT UNIVERSITY COLLEGE, LONDON.

BY the completion of the Physiological Institute at University College, London, which has been erected within the past twelve months upon the site of the playground of University College School, the University of London possesses what is probably the finest laboratory of its kind in the country, and one which is perfectly equipped both for teaching all branches of physiology and for the pursuit of original research work. The erection of this institute marks an epoch, not only in the history of the re-constituted University of London, but in the development and advancement of the British school of physiology, a school which was practically non-existent a few decades ago, when nearly all research in this subject was carried out in the laboratories of France and Germany.

It is a matter for congratulation to those who have been instrumental in founding this institute that the subject of physiology is to be both taught and advanced by original work, for in the creation of this science University College may fairly claim to have played a

FIG. 1.—Institute of Physiology, north elevation.

most important part. British physiologists have long recognised the paramount influence exerted by William Sharpey during his tenure of the professorship of anatomy and physiology, which lasted from 1837 until his retirement in 1873, and the men who came under his influence may be considered to have demonstrated by their work the methods and lines of research along which physiology was in the future to be developed if this science was to take rank with allied experimental sciences and cease to be a subject overladen with speculative views. Michael Foster, Burdon-Sanderson and Newell Martin all acquired their physiological training in the laboratory of University College, and each succeeded in establishing a school of physiology in Cambridge, Oxford, and Baltimore. The study of this science, which is now pursued so successfully in no less than thirteen universities in Great Britain, may indeed be said to have spread over England from Sharpey's laboratory, for a considerable number of those who are at present furthering the progress of experimental medicine received a part, and in some cases the whole, of their training in the physiological laboratory of the college.

The institute of physiology is to be part of an institute of medical sciences which shall include anatomy and pharmacology. The erection of this was possible owing to the generous donations of Dr. Aders Plimmer and Dr. Ludwig Mond, while the expenses of equipment have been met partly by subscriptions and partly by a legacy left by the late Mr. Thomas Webb for the purposes of research. The building is from the designs of Prof. F. M. Simpson, who has admirably carried out the arrangement of the various special laboratories and rooms which Prof. Starling, to whose energy and initiative the institute is really due, has planned and suggested, and in this he has introduced all the most recent improvements that experience gained by visits to other laboratories in this country and abroad has shown are of such importance for the efficient study of physiology.

The development of organic chemistry, and with this of physiological chemistry, has been so great in recent years that the whole ground floor of the building is entirely devoted to rooms and research laboratories in this subject. Owing to the foresight of Prof. Starling, ample provision has been made for the present and future requirements of this part of physiology, which has virtually become a branch of physiology somewhat sharply separated off from purely experimental work. That the solution of many problems must ultimately lie in the hands of those physiologists who are highly trained chemists and physicists is an obvious truth, and in the institute of physiology the importance of this branch of study has been kept in view.

The large laboratory in the west wing will accommodate 100 students. Separate rooms, such as a balance room, distillation room, and one for carrying out four combustions at the same time, occupy part of the east wing. Several other rooms, which can be completely darkened, and are furnished with first-rate apparatus for the purpose, are devoted to special purposes, and in these work can be carried out which requires the use of the spectroscope, polarimeter, or spectrophotometer. A large refrigerating chamber and a "Fabrik-Raum" for the working up of material on a large scale are also provided in the basement. Rooms for experimental physiology and the library occupy the first floor, on which there is also a lecture theatre with seating accommodation for 200 students. A large students' room for histology and experimental physiology occupies the whole of the west wing of the second floor, while the upper wing comprises a demonstration theatre, so arranged that forty students can obtain a full view of any experiment, and a suite of four rooms devoted to the aseptic department.

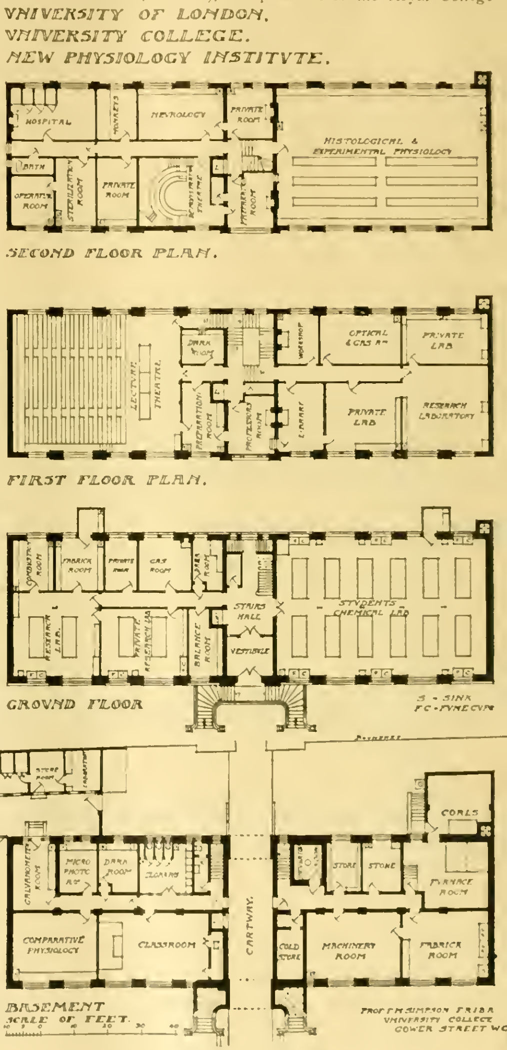

FIG. 2.—Plan of the arrangement of laboratories on the basement and floors of the Institute.

On June 18 the institute was formally declared open by Mr. Haldane. Among those who received him were the following:—the Vice-Chancellor (Prof. M. J. M. Hill, F.R.S.), the chairman of the college (Lord Reay, G.C.S.I.), the president of the Royal Society (Sir Archibald Geikie, K.C.B.), the president of the Royal College of Physicians (Sir R. Douglas Powell, Bart., K.C.V.O.), the president of the Royal College of Surgeons (Mr. Henry Morris), the president of the Royal Society of Medicine (Sir William Church, Bart., K.C.B.), the principal (Dr. H. A. Miers, F.R.S.), the provost of University College (Dr. T. Gregory Foster), the treasurer of University

College (Sir Felix Schuster, Bart.), the dean of the faculty of science (Prof. Millar Thomson, F.R.S.), the dean of the faculty of medicine (Prof. Sidney Martin, F.R.S.), the chairman of the military education committee (Prof. D. S. Capper), the secretary of the Royal Society (Dr. J. Rose Bradford), the dean of the college faculty of medical sciences (Prof. G. D. Thane), and the Jodrell professor of physiology (Prof. E. H. Starling, F.R.S.).

In his address, given to an audience which filled the lecture theatre, Mr. Haldane outlined the gradual growth of the facilities for the highest education in science which has been witnessed in this country during the past twenty years, a growth which, he pointed out, has completely upset the somewhat pessimistic prognostications of Matthew Arnold, who, as an authority on this question, expressed the opinion that any extension of the facilities offered by the older universities was most improbable. It is, however, only fair to state that it was with reference to the arts rather than the science side of education that he took this somewhat gloomy view of affairs. Mr. Haldane, who admitted that he appeared to others to be obsessed with a passion for organisation, while avoiding some of those debatable questions which were so intimately bound up with the work of many of those who listened to him, indicated with exceptional lucidity that if any civilised country is to continue to hold its own, abundant facilities must exist for the pursuit of knowledge by research, and that it was unnecessary to support this by arguments must have been apparent to his audience. That in the institute of physiology full provision for the highest teaching in this subject is available, not only for our own countrymen, but for those from American and foreign universities, was also indicated by Prof. Starling, who, after speaking of the international bonds of friendship which the study of science does so much to foster, made clear the truism that in such places as this institute the real work is carried out which supplies the medical profession throughout the world with the knowledge requisite for their successful treatment of disease. Those who have the best interests of their profession at heart know that this is so.

The erection of this institute is largely due to Prof. Starling, whose ideas have been carried out in this building, which, with its admirable arrangements for work and excellent equipment, forms a great addition to the opportunities for teaching and research offered by the University of London.

THE INVESTIGATION OF GASEOUS EXPLOSIONS.[1]

AT the Leicester meeting (1907) of the British Association it was suggested that the investigation of gaseous explosions was a matter which might suitably form the work of a committee of Section G (Engineering), and although the subject is chiefly of interest to engineers because of its bearing on the theory of the internal-combustion engine, the committee appointed has not confined its attention to questions of a purely practical character, but has discussed many questions of scientific importance which might properly be considered of interest to the physical and chemical sections.

In order that the labours of the committee might lead to some result within a reasonable time, the work so far undertaken has been mainly a critical examination and discussion of the results of previous investigations with a view to further research, and to this end the report discusses, at some length, various interesting and important matters which in their opinion require further investigation.

The essential feature in the operation of an internal-combustion engine is the explosion of a mixture of inflammable gases by which is formed a complex mixture of nitrogen, carbon dioxide, steam and oxygen, and the performance of the engine depends primarily on the changes of pressure and volume of the gas, and is only influenced in a slight degree by the nature of the chemical changes and the velocity with which these take place.

The problem is mainly that of the behaviour of gases at high temperatures, and the properties of such gases are completely defined when the relation between pressure and volume at constant temperature is known, and the internal energy is given as a function of the temperature and the density. The first relation is substantially that expressed by Boyle's law for all gases with which we have to deal, while it is sufficient for the present if the internal energy can be expressed as a function of the temperature, and it is with this internal-energy function that the report chiefly deals.

Measurements of the internal energy have been carried out, as a rule, with the gas at either constant pressure or at constant volume, and the experiments of Holborn and Austin and Holborn and Henning on air, steam, and CO_2, at constant pressure, have shown that, with increasing temperature, there is an increase in the internal energy, which is probably not a linear function of the temperature. The principal part of our knowledge of the behaviour of gases at high temperatures has, however, been obtained by explosion experiments in closed vessels, and if we could accurately make the necessary corrections for deducing from the observed pressures in a real explosion the pressures reached in an ideal one, we could obtain an accurate value of the internal-energy function.

The difficulties of making corrections due to the disturbing influences are very great, but in spite of this the study of explosion pressures has been mainly responsible for the knowledge we possess of the energy function, and the committee therefore considers this method and the possible inaccuracies in detail.

If the calorific value of a mixture before combustion is known, and the heat lost at any time after the explosion is determinate, the remaining disturbing causes are due to the want of thermal and chemical equilibrium, and possibly to the motion of the gases; we must therefore determine what effect all these disturbing factors have in altering the observed pressure from which the temperature is inferred.

Much of the loss of heat appears to be due to direct conduction to the walls of the enclosing vessel, but it is probable that loss by radiation is also important, as in some of the experiments considered, where loss by conduction was improbable, the pressures obtained were consistent with a considerable loss by radiation.

The thermal state of the exploded charge has been the subject of much investigation. In a closed vessel the combustion at the point of ignition is completed before any appreciable rise of pressure takes place, and the flame spreads outwards at a velocity which has been estimated at from 120 to 150 centimetres per second, accompanied by a rise of pressure due to the progress of the combustion. The flame, therefore, spreads in an increasingly denser gas, and since the rise of temperature on explosion is nearly independent of the pressures before ignition, the temperatures attained at those places which are reached last by the flame are much below the mean owing to the final adiabatic compression and consequent rise in temperature of the already ignited gas.

At the moment of maximum pressure the temperature varies enormously, as is shown by the measurements of Hopkinson in an approximately cylindrical vessel of 6 cubic feet capacity, where, with a mean temperature of 1600° C., the maximum temperature at the point of ignition was 1900° C., and near the walls about 1200° C.

The temperature of the wall surface in such a vessel is much lower, and in a gas engine, working under normal conditions with a water-jacketed cylinder, the usual temperature is about 200° C., with a fluctuation of rarely more than 10° C. during the whole cycle. Up to the time of maximum pressure there appears to be no appreciable equalisation of temperature, but convection and conduction rapidly obliterate these initial differences. If the specific heat of the gas were constant, the attainment of thermal equilibrium would make no difference to the

[1] First Report of the British Association Committee appointed for the Investigation of Gaseous Explosions, with Special Reference to Temperature. Presented at the Dublin meeting, 1908.

pressure, but, owing to variation of specific heat with temperature, a correction must be made, which in the present state of knowledge is very uncertain, as the distribution of temperature and the variation of the specific heat are not accurately known.

The condition of the gas as regards chemical equilibrium has been the subject of much speculation and research. Calculations by the pv/τ law of the rise of pressure due to the amount of thermal energy liberated give very much greater pressures than are found by experiment, and various theories have been put forward to account for this.

The view that dissociation of the constituents of the ignited charge will account for the discrepancy appears improbable, as there is no conclusive evidence to show that either steam, CO_2, or nitrogen are split up to any extent at the temperatures and pressures obtained, while the fact that in weak mixtures the discrepancy between calculation and experiment is about the same lends no support to the dissociation theory. The cooling effect of the walls plays some part, but the experimental evidence of explosions in vessels of various forms and capacities shows that this cause alone is quite insufficient to account for the difference.

Another view, due to Clerk, is that the combustion of the gas is not complete at maximum pressure, so that in mixtures of all strengths, but especially in weak ones, there is a suppression of heat which materially affects the maximum explosion pressure, and the cooling effect of the walls will have a considerable time effect on the combustion process. It cannot be doubted that combustion is greatly retarded in the neighbourhood of cold metal walls, and some direct evidence is available that such phenomena are mainly of a surface character. Profs. Bone and Dixon are of the opinion that if the effect of cold bodies may be disregarded, the combustion of the charge in the presence of air is practically complete before the attainment of maximum pressure.

The effect of the explosion is also to set up intense vibratory motion in the gas, but it appears unlikely that this has any effect on the mean pressure shown by the gauge. Although the difficulties which arise in the determination of the internal energy are so great, the results of independent observers are in very fair agreement, as is shown by the accompanying diagram, Fig. 1, in which various determinations of the internal energy of a gas-engine mixture are marked and compared with the values for an ideal gas having an internal energy of 4·9 calories per gram molecule per degree.

The experiments of Clerk are particularly interesting, as he used a method of a novel character, which permitted the study of the working fluid in the gas-engine cylinder itself.

An indicator diagram of a gas-engine cycle gives information as to the time of ignition, the work done, and the compression and expansion of the charge. It is possible by rearranging the valve gear to shut in an exploded charge, and the indicator card obtained while the engine is coming to rest affords further information concerning the specific heat and the rate of heat loss to the walls.

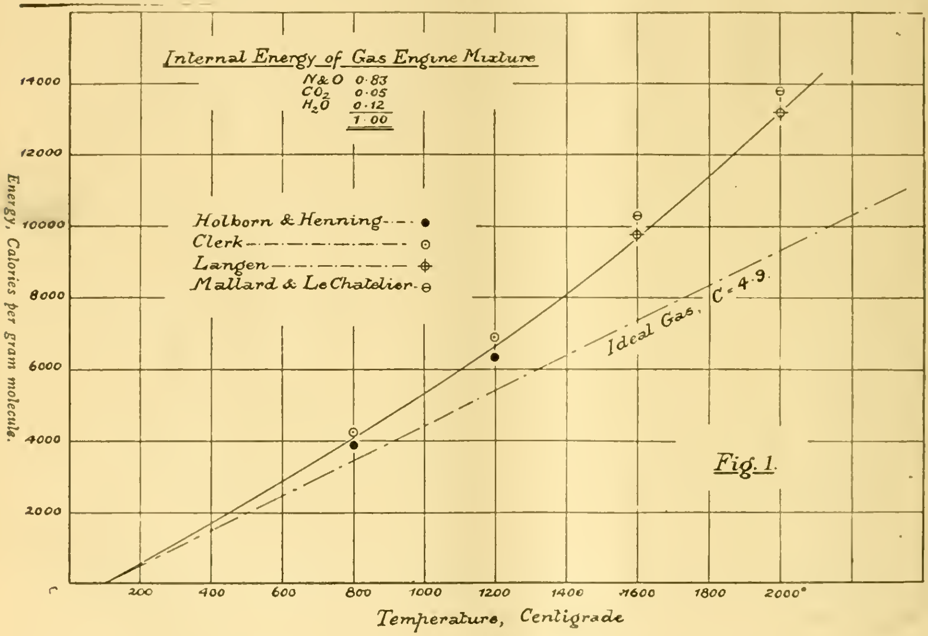

Fig. 1.

A portion of such a diagram is shown in Fig. 2, in which the curve BC represents the first compression of the charge after the valves are shut down, and CD represents the following expansion curve. Usually, the first five or six cycles are distinct, but they ultimately merge into one another as the engine comes to rest. If the gas be compressed or expanded without gain or loss of heat, the specific heat at constant volume can be readily obtained by a consideration of the work areas of the diagram and the end temperatures, but on account of the heat flow to the walls a correction must be made, which can be obtained by a successive approximation process. This heat loss is divided between the expansion and compression, and Mr. Clerk divides it on the assumption that if the mean temperatures in compression and expansion are the same, the heat loss will be the same. The mean temperature in expansion is rather less than in compression, and therefore the loss is not divided equally between the two.

The results of experiments made in this way give values of the specific heat at constant volume which increase more than 30 per cent. in the range from 100° C. to 1500° C., and tend to a limit at high temperatures, while the observations indicate that this apparent change is accompanied by continued combustion.

Experiments made since the report was issued show that, relative to the mean temperature, the heat loss for air during compression is greater than the loss during expansion; these experiments will be continued to ascertain if such is the case for a gas-engine mixture.

In concluding its discussion of explosion experiments the committee expresses the opinion that "values of the energy obtained from explosion records are not subject to any very great errors on account of heat loss by conduction to the walls of the vessel, or on account of incomplete combustion, but that they are affected by errors of quite unknown amount due, first, to heat radiated, and, secondly, to the want of thermal equilibrium at the time when the pressure is measured. For the purpose of testing the first of these conclusions it is very desirable that further experiments should be made on explosions in vessels of greatly different size, but of similar form. The opinion entertained by the committee that incomplete combustion is a surface-phenomenon, on which this conclusion

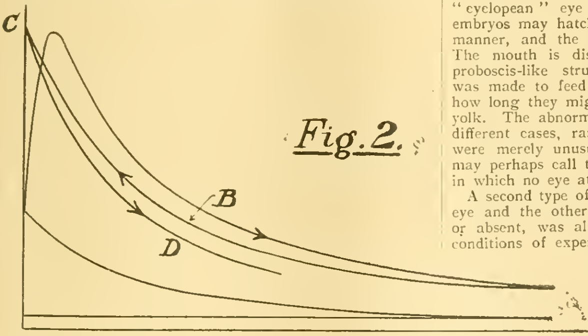

Fig. 2.

as to the validity of the method is based, also requires further confirmation. As regards the second conclusion, further experiment on the actual amount of heat radiated by burning gas is urgently required, and also experiments to confirm or negative the effect of the nature of the wall surface upon the pressure reached in an explosion. The effect of want of thermal equilibrium can be determined up to a point by calculation; but before such calculation can be usefully made, it is desirable that further information should be obtained as to the temperature distribution after an explosion, especially in the neighbourhood of the walls."

In view of the importance of measurements of temperature in connection with gas explosions, the committee considers it desirable that the relations between pressure, volume, and temperature of gas thermometers should be determined at very high temperatures. The nitrogen thermometer has been used with an iridium bulb up to 1600° C., but no other gas has been tested beyond 1100° C. The chief difficulties in carrying out comparisons of gas thermometers have been the absence of any material which is impervious to the gas and sufficiently refractory to withstand very high temperatures. Dr. Harker believes that he is now in possession of a material suitable for gas thermometry up to 1800° C., and he has suggested that an attempt be made to compare thermometers using nitrogen and argon at the highest temperatures possible. If they agree, the probability is in favour of both being in substantial agreement with the thermodynamic scale, but if it is found that they differ, the presumption will be that the argon thermometer is in closer agreement with the thermodynamic scale, as this gas is supposed to be monatomic and incapable of dissociation. The committee hopes that it will be possible to carry on a research of this kind, and that the resources of the National Physical Laboratory will be available for the inquiry.

The report concludes with a note by Prof. Callendar, printed in full as an appendix, and containing a critical examination of the experimental work on "the deviations of actual gases from the ideal state, and on experimental errors in the determinations of their specific heats."

E. G. COKER.

"CHEMICAL" EMBRYOS.

SOME very remarkable observations have been made from time to time during the last twenty years on the effect of chemical stimuli in bringing about abnormalities in developing embryos. The "Lithium larvæ" of the sea-urchin and of the frog, obtained by Herbst and Morgan, are familiar examples of this class of phenomena, but perhaps the most remarkable is the "Magnesium embryo" of the fish, *Fundulus heteroclitus*, described by Charles R. Stockard in the February number of the *Journal of Experimental Zoology*. A large percentage of the embryos of this fish, when subjected during their development to the influence of magnesium salts dissolved in sea-water, are found to possess a single median or "cyclopean" eye in place of the ordinary pair. These embryos may hatch and swim about in a perfectly normal manner, and the single eye is evidently fully functional. The mouth is displaced ventrally, and gives rise to a proboscis-like structure, but, unfortunately, no attempt was made to feed the embryos, so that we do not know how long they might live after the absorption of the food-yolk. The abnormality was present in varying degrees in different cases, ranging from embryos in which the eyes were merely unusually close together, through what we may perhaps call the typical cyclopean condition, to others in which no eye at all was developed.

A second type of monster, with one perfect asymmetrical eye and the other eye of the normal pair either reduced or absent, was also frequently met with under the same conditions of experiment. The author claims that this is the first instance of repeatedly causing, by the use of chemical substances, vertebrate monstrosities such as are known in nature, and his results seem to indicate that the monstrous Cyclops of man and other mammals may not be due to germinal variation, but to some effect of environment during development.

Incidentally, the researches may also throw some light upon another extremely interesting result of recent investigation in the domain of experimental embryology. Several observers, notably Spemann and Lewis, have shown that in amphibian embryos the formation of the lens of the eye appears to be dependent upon stimulation of the superficial epiblast by the developing optic cup. Lewis, for example, has found it possible to transplant the optic cup of a frog embryo, and thereby cause the development of a lens from superficial epiblast quite remote from the normal lens-forming region. Stockard, however, concludes from his researches on Fundulus that lens-formation does not in all cases depend upon a direct stimulus from the optic cup, for his abnormal Fundulus embryos sometimes showed a supernumerary lens developing without any relation to an optic cup.

Why the presence of magnesium salts should cause abnormal eye-development is one of the numerous mysteries of biology which seem likely to remain unsolved for a long time to come. Experimental embryology is still in its infancy, and it is too soon to expect any adequate explanation of such phenomena, but we are beginning to realise that the nature of the environment counts for a very great deal in determining the course of individual development. The most encouraging feature of modern biology is, undoubtedly, the adoption of experimental methods, and such methods bid fair to be as productive in this branch of science as they have already been in chemistry and physics. It would probably be too much to ... that the interpretation of vital phenomena is merely a question of the successful application of chemistry and physics to living protoplasm, but it is certain that in the future chemistry and physics will play a part of constantly increasing importance in the solution of biological problems.

A. D.

SPECTROSCOPIC RESEARCHES.

Two useful papers on the arc spectra of iron and titanium, respectively, appear in the March number of the *Astrophysical Journal*. At the suggestion of Prof. Fowler, Mr. E. J. Evans, of the Imperial College of Science and Technology, undertook the investigation of the less refrangible portions of these spectra, which are especially important because of the sun-spot visual observations made in the red end of the spectrum. Mr. Evans now gives the wave-lengths for the iron lines between λ 6855 and λ 7412, and for the titanium lines from λ 5866 to λ 7364. For the iron spectrum Rowland had previously given wave-lengths to 6855, whilst Hasselberg had fully investigated the titanium spectrum more refrangible than 5899; Rowland's and Thalén's lists of lines beyond 5899 are incomplete, and it was to fill the *lacunae* that the present investigation was prosecuted. The photographs were taken, either with a Littrow prismatic spectrograph of 12 feet focal length or with a Rowland concave-grating spectrograph of 10 feet radius and 14,500 lines, on "panchromatic" plates, and in the iron spectrum show about ninety lines less refrangible than λ 6855, for sixty-seven of which wave-lengths and intensities are given. Wave-lengths and intensities are similarly tabulated for 100 titanium lines less refrangible than λ 5866, and in both cases the nearest lines in Rowland's list of solar wave-lengths are given for comparison. Of the titanium lines, only twenty-four were ascribed to titanium, or titanium mixtures, by Rowland, and some of those now given are recognised as "fluting" lines found by Hale and Adams in the red end of the sun-spot spectrum.

Until the publication of a recent research by Prof. Wood, the greatest number of lines recognised in the series of spectral radiations of any one element was twenty-nine, which Evershed found in the hydrogen spectrum of the solar chromosphere. In the case of sodium, only seven lines belonging to the principal series were known previously to the results now published by Prof. R. W. Wood. In a paper recently published in the *Philosophical Magazine* he gave provisional wave-lengths for twenty-four lines, and suggested that a large increase of dispersion might reveal many more lines of this series. Having employed greater dispersion, he now gives, in No. 2, vol. xxix., of the *Astrophysical Journal* (p. 97), the wave-lengths of forty-eight lines, thus enabling the Balmer formula to be tested up to $n=50$. Even now there are indications that a yet larger dispersion would extend the series still further. The need for a large dispersion in this work is strikingly illustrated by the fact that the last twenty-two lines now given fall in a region of the spectrum not wider than the distance between the D lines; the wave-length of the twenty-ninth line of the series is 2420·02, whilst that of the fiftieth is 2414·50. One point of special interest disclosed by Prof. Wood's research is that, with very dense sodium vapour, there is an exceptionally strong general absorption extending from the head of the Balmer series to the end of the ultra-violet, that is to say, the vapour is much more transparent to the light between the absorption lines than it is beyond them. So marked is this that the head of the series actually shows *brighter* than the rest of the more refrangible spectrum.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Miss Mary T. Fraser, student at the South-Western Polytechnic Institute, Chelsea, has been elected to the Lindley studentship, University of London. The studentship is awarded to a student qualified to undertake research in physiology, and is held in the physiological laboratory of the University. The amount of the studentship is 100*l*.

Under the terms of the charter of the University of Bristol, the faculty of engineering of the University will be provided and maintained by the Society of Merchant Venturers in their technical college. The principal of that college, Prof. J. Wertheimer, will be *ex officio* dean of the faculty, and will also hold the post of professor of applied chemistry in the University, while the following professors in the technical college will hold corresponding posts in the University, viz.:—Prof. J. Munro, professor of mechanical engineering; Prof. E. S. Boulton, professor of applied mathematics; Prof. D. Robertson, professor of electrical engineering; and Prof. W. Morgan, professor of motor-car engineering. Mr. F. R. B. Watson will hold the post of lecturer on mechanical engineering, and Mr. H. A. M. Borland that of lecturer on applied chemistry.

This year St. Paul's School reaches her 400th anniversary. The event will be celebrated by an addition of large and excellently furnished new laboratories to the present buildings. These are already nearing completion, and will be officially opened on July 7 by Lord Curzon. The distant separation of the existing physical and chemical laboratories has always been a difficulty, and the limits of the former have been tried to their utmost. The new building has a frontage of 100 feet. It is of red brick, and forms a handsome annex to the big school; its inner walls are lined with white tile. The ground floor will be devoted to physics, the upper floor to chemistry. There are three working rooms on both floors, and each will play the several parts of class-room, lecture-room, and laboratory. Between the large and the two small laboratories there are preparation and store rooms. Two large rooms, one on each floor, measure 40 feet by 50 feet, the smaller ones 40 feet by 25 feet. They will be equipped, respectively, to meet the requirements of beginners, more advanced students, and those preparing for the universities and hospitals. There will thus be accommodation for 130 students, with everything immediately at command. Especial care has been taken to keep the chemical rooms free from noxious fumes; air circulation is kept up by powerful fans, while all the draught cupboards have immediate communication with the outer air. Experiences gained in many of our new laboratories have been freely drawn upon in constructing and furnishing this building, and neither time nor money have been spared to assure fulfilment of its object.

The Board of Education has published (Cd. 4691) its regulations for secondary schools, which are to come into force from August 1 next in England, excluding Wales and Monmouthshire. The regulations do not vary substantially from those of last year, except with regard to some points on which Sir Robert Morant lays special emphasis in his prefatory memorandum. The tendency of the regulations is towards allowing the school authorities greater liberty in planning the curriculum. The Board insists that the course of education shall be of a generous and civilising type, neither unduly specialised nor defective in essential elements. It must in all cases make adequate provision for instruction, among certain other subjects in physical science, including practical work by the pupils; and, as regards girls, must likewise include practical instruction in the elements of domestic subjects. For older girls science may be dropped, and mathematics restricted to arithmetic, in order to make room for a fuller course in these domestic subjects. It is indicative of the growth of broader views among educationists and teachers to find the permanent secretary writing about the Board that it not only permits, but encourages, "such differentiation of type in relation to local needs as is consistent with a broad and sound general education, and such variation of instruction towards the particular needs and capacities of the pupils as does not interfere with the function of the school as a common organism directed towards the production of trained citizens."

The annual report of the council of the City and Guilds of London Institute for the year 1908 is provided with a series of exhaustive appendices containing reports by the dean of the City and Guilds Central Technical College, the principal of the Finsbury Technical College, the honorary secretary of the South London Technical Art School, the committee of the Department of Technology, and the committee of the Leather Trades School. It includes also the address delivered last January at the annual distribution of prizes by Mr. Gerald Balfour. The report of the council summarises the growth in the recent activities of the institute, and provides a clear statement of the precise relations of the Central Technical College with the Imperial College of Science and Technology and with the University of London. The report of the Department of Technology shows convincingly the great extent of the work accomplished by the institute in the direction of improving and extending the facilities for technical instruction throughout the country. During the session under review, that for 1907–8, 3604 classes were registered in one or other of the seventy-six different subjects in technology included in the institute's programme. These classes were held at 402 centres in 299 towns, and were attended by 48,223 students, or 2175 more than in the previous session. There are, it appears, two main causes which impede progress in the technical instruction of artisans; first, there is the difficulty of finding competent teachers, and, secondly, the unduly large proportion of artisan students who enter technical classes without the preliminary knowledge necessary to take full advantage of the instruction they receive. The report points out at the same time that there is no doubt that the teaching of technology has improved greatly during the past decade, and it is satisfactory to find that there is no relaxation of effort on the part of the institute to raise the standard of work in the classes under its care.

SOCIETIES AND ACADEMIES.

London.

Physical Society, June 11.—Dr. C. Chree, F.R.S., president, in the chair.—The Arthur Wright electrical device for evaluating formulæ and solving equations: Dr. **Russell** and Arthur **Wright.** Special slide resistances are used. If R be the resistance of one of these, and a metallic finger make contact with it at a point where the scale-reading is x, the resistance between this finger and the terminal of the slide is R/x. The scales are graduated as in the ordinary slide-rule. If a number of these slide resistances be connected in parallel, the sum of the currents through them will be proportional to the sum of the readings of the contact fingers. By a null method this current can be balanced against the current going through a single slide resistance X by means of a Wheatstone's bridge arrangement. The reading on X when there is a balance gives the sum of the readings on all the other slides. Similarly, numbers can be subtracted by putting slides representing these numbers in parallel with X, and then obtaining a balance by altering the reading on X. By clamping the contact fingers inclined at certain angles to a rod which can be moved at right angles to the slides, it is easy to obtain the values on X of $f(x)$ when

$$f(x)=ax^m+bx^n+cx^p+\ .\ .\ .\ ,$$

where the indices m, n, p, . . . may be positive, negative, or fractional, and the coefficients may be positive or negative numbers. A model of this device for solving an equation of any degree consisting of not more than four terms was shown. The inaccuracy of the results found by means of this model is of the order of 1 per cent. Approximate values of the imaginary roots of numerical equations can be found by the device, which can be employed also to solve very complicated equations.—The echelon spectroscope, its secondary action and the structure of the green mercury line: H. **Stansfield.** An investigation of the action of an echelon spectroscope and the results obtained as to the structure of the green mercury line given by an Arons lamp. The echelon spectroscope employed was arranged so that the auxiliary prism could be mounted next to the echelon. The dispersion of the prism may be added to or subtracted from the dispersion of the echelon, and the change in the dispersion obtained gives a method of determining whether two lines in the spectrum belong to the same order. Fabry and Perot spectra are produced by the secondary action of the echelon. When the echelon is tilted the secondary light may be separated from the primary, and parts of the Fabry and Perot circles observed with a wide slit. The secondary light also undergoes the primary echelon treatment, and, with a narrow slit, is confined to the points of intersection of the two systems of spectra. When the echelon is in the ordinary position the secondary spectra are lines similar to the primary echelon lines, and may be observed moving across the broad central line when the echelon table is rotated slowly.—The proposed international unit of candle-power: C. C. **Paterson.** The paper discusses the units of candle-power at present officially accepted in Great Britain, France, the United States of America, and Germany. The authorities in the gas and electric interests in the United States are prepared to adjust their units of candle-power to bring them to a single value, which is to be the same as the British and French units. The paper gives the results of comparisons showing that, within the limits of experimental error, the British and French units are identical. The change involved in the unit maintained at the Bureau of Standards, Washington, is 1·6 per cent. The Hefner unit is almost exactly nine-tenths of the new unit.—Inductance and resistance in telephone and other circuits: Dr. J. W. **Nicholson.** A general formula for the effective inductance of a circuit consisting of two long parallel wires has been given previously, and is suitable for cases in which the current distribution in either wire is affected greatly by the frequency of alternation. Important cases are examined in detail here, and formulæ are obtained capable of immediate use. A calculation of the effective resistance is also made in each case. Throughout the investigation only iron and copper wires as the two extreme cases are considered. The large permeability of iron completely changes the character of the effect of frequency on its self-induction. To all metals greatly used in practice, except iron, the formulæ developed for copper wires may be applied with a nearly identical order of accuracy.—Note on terrestrial magnetism: G. W. **Walker.**—The form of the pulses constituting full radiation or white light: A. **Eagle.**

Paris.

Academy of Sciences, June 14.—M. Bouchard in the chair.—Some remarks on integral equations of the first species, and on certain problems of physical mathematics: Emile **Picard.**—Some earthquakes which have devastated Provence and Dauphiné: G. **Bigourdan.** A chronological list of the earthquakes on record as happening in these districts between 1282 and 1812.—Presentation of three new sheets of the map of the edible molluscs of the coasts of France, established by M. Joubin: the **Prince of Monaco.**—Observations of the sun made at the Lyons Observatory during the first quarter of 1909: J. **Guillaume.** Observations were made on forty-four days during the quarter; the results are summarised in three tables, showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—The latitude of the Observatory of Athens: D. **Eginitis.** A discussion of the cause of a systematic error of about 1·26″ in the meridian-circle readings.—Observation of the total eclipse of the moon of June 3, 1909, at the Observatory of Toulouse: L. **Montangerand.** A special photographic study of totality.—The pseudo-elliptic or hyper-elliptic integrals of the form $\int_0^x \frac{x^p dx}{\sqrt{X_{2p+2}}}$: E. **Vallier.**—A recent note of M. S. Bernstein: S. **Zaremba.**—Differential equations with fixed critical points: J. **Chazy.**—The study of the variations of statistical quantities: Emile **Borel.**—A law permitting the immediate calculation of the approximate profile of a watercourse of given flow when the section of the liquid and the wetted perimeter are algebraic functions of the height of the water: Philippe **Bunau-Varilla.**—The condensation of the radium emanation: A. **Laborde.** After condensing the emanation by cooling in tubes of copper, iron, tin, silver, glass, and silvered glass, the temperature at which the emanation was evolved was measured, and was found to be −153° C. to −155° C. for the four metals, −175° to −179° in glass. The absorptive properties of meerschaum, charcoal, platinum black, and spongy platinum for the emanation were also studied.—A new wave detector for wireless telegraphy and telephony: G. E. **Petit.** The detector consists of a very fine conducting point resting with a fixed pressure on natural pyrites. It works without a battery, and has the advantage of not being injured by strong waves.—The observation, made parallel to the lines of force, of the unsymmetrical positions and intensities of the magnetic components of certain lines of emission: a new type of position dissymmetry: A. **Dufour.**—The physical origin of the evolution of electricity in chemical reactions: M. **de Broglio** and L. **Brizard.** The production of an electric charge in the cases studied is altogether independent of the chemical reaction.—The magnetic dichroïsm of the rare earths: Georges **Moslin.** An arrangement for controlling signals at a distance with or without wires: M. **d'Ivry.** A detailed description with diagrams.—Comparisons between nitriles and carbamines: P. **Lemoult.** A thermochemical paper.—Some double sulphates of calcium: M. **Barre.** Owing to the formation of the double sulphate $CaSO_4.(NH_4)_2.SO_4.H_2O$, a salt which is stable between 0° C. and 100° C. in presence of an excess of ammonium sulphate, the solubility of calcium sulphate is largely increased in the presence of ammonium sulphate. Similar results are obtained with potassium sulphate.—The metallic character of an organic group: R. **Fosse.** The pyryl group,

$$\left[C_{10}H_6 \overset{CH}{\underset{O}{\diagdown\ \ \diagup}} C_{10}H_6\right]',$$

forms compounds which behave with mineral acids, picric acid, and sulphuretted hydrogen in a manner strikingly resembling metallic salts. Pyryl bromide with hydrochloric acid gives pyryl chloride and hydrobromic acid; pyryl chloride is precipitated by hydrogen sulphide, pyryl sulphide forming the precipitate. Boiling hydrochloric acid acting on this sulphide regenerates the chloride, sulphuretted hydrogen being given off.—The action of cacodylic and methylarsinic acids on antimony trichloride: L. **Barthe** and A. **Minet.**—Aromatic alcohols and hydrocarbons derived from fenone: J. **Leroide.**—The β-naphthane diols: Henri **Leroux.**—Results of the geological and mineralogical exploration of Eguéï: G. **Garde.**—The extension in Chaouid of the *tirs*, or fertile lands of western Morocco: Louis **Gentil.**—The possibility of keeping animals alive, after complete ablation of the thyroid apparatus, by adding salts of calcium or magnesium to their food: Albert **Frouin.**—A method permitting the measurement of the dehydration of the organism by the lungs and the skin. The variations of this dehydration with altitude: H. **Guillemard** and R. **Moog.** The loss of weight of the body in unit time is smaller in the mountains than in the plains, and this is also the case with the amount of water eliminated.—Cardiac arythmia and d'Arsonvalisation: E. **Doumer** and G. **Lemoine.**—The treatment of intermittent claudication and of gangrene of the lower extremities by d'Arsonvalisation: A. **Moutier.**—Some biological properties of the *Bacillus endothrix*: Fernand **Guéguen.**—A new case of hermaphroditism in *Oersteidia rustica*: Mieczyslaw **Oxner.**—Demonstration of the existence of an artificial deformation of the skull at the Neolithic epoch in the Paris basin: Marcel **Baudouin.**—The geosynclinals of the chain of the Alps during Secondary times: Émile **Haug.**—The earthquake of June 11, 1909: Alfred **Angot.** This earthquake was completely registered by the seismograph at Parc Saint-Maur, and communications have been received from nine other observatories giving the times recorded.

DIARY OF SOCIETIES.

THURSDAY, JUNE 24.

ROYAL SOCIETY, at 4.30 (Meeting at the Royal Astronomical Society).—(1) On Pressure Perpendicular to the Shear Planes in Finite Pure Shears, and on the Lengthening of Loaded Wires when Twisted; (2) The Wave Motion of a Revolving Shaft, and a Suggestion as to the Angular Momentum in a Beam of Circularly Polarised Light: Prof. J. H. Poynting, F.R.S.—The Effect of a Magnetic Field on the Electrical Conductivity of Flame: Prof. H. A. Wilson, F.R.S.—Studies of the Processes Operative in Solutions. XI.—The Displacement of Salts from Solution by Various Precipitants: Prof. H. E. Armstrong, F.R.S., and Dr. J. V. Eyre.—Electrical Conductivity of Air and other Gases: George W. Walker.—The Possible Ancestors of the Horses living under Domestication: Prof. J. C. Ewart, F.R.S.—The Alcoholic Ferment of Yeast-juice. Part IV.—The Fermentation of Glucose, Mannose, and Fructose by Yeast-juice: Dr. A. Harden, F.R.S., and W. J. Young.—The Electrical Reactions of Certain Bacteria and an Application in the Detection of Tubercle Bacilli in Urine by Means of an Electric Current: Charles Russ.—The Effect of the Injection of the Intracellular Constituents of Bacteria (Bacterial Endotoxins) on the Opsonising Action of the Serum of Healthy Rabbits: Prof. R. T. Hewlett.—On the Occurrence of Protandric Hermaphroditism in *Crepidula fornicata*: J. H. Orton.—Sensitive Micro-balances, and a New Method of Weighing Minute Quantities: B. D. Steele and Kerr Grant.—The Polarisation of Secondary γ Rays: Dr. R. D. Kleeman.—On the Absorption of Homogeneous β Rays by Matter, and on the Variation of the Absorption of the Rays with Velocity: W. Wilson.—Experimental Researches on Vegetable Assimilation and Respiration. V.—A Critical Examination of Sachs' Method for Using Increase of Dry Weight as a Measure of Carbon Dioxide Assimilation in Leaves: D. Thoday. And other Papers.

FRIDAY, JUNE 25.

PHYSICAL SOCIETY, at 5.—A Transition Point in Zinc Amalgam: Prof. Carhart.—A Method of Producing an Intense Cadmium Spectrum, with a Proposal for the Use of Mercury and Cadmium as Standards in Refractometry: Dr. T. M. Lowry.—On the Measurement of Wave-length for High Frequency Electrical Oscillations: A. Campbell.—An Electro-magnetic Method of Studying the Theory of and Solving Algebraical Equations of any Degree: Dr. A. Russell and J. N. Alty.—The Sine Condition in Relation to the Coma of Optical Systems: S. D. Chalmers.—Exhibition of a new Féry Thermo-electric Calorimeter: C. V. Drysdale.—An Instrument for Measuring the Strength of an Intense Horizontal Magnetic Field: F. W. Jordan.—On a Method of Determining the Sensibility of a Balance: Prof. Poynting, F.R.S., and G. W. Todd.—The Balance as a Sensitive Barometer: G. W. Todd.

MONDAY, JUNE 28.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45 (In the Albert Hall).—Exploration in the South Polar Region: Lieut. E. H. Shackleton.

TUESDAY, JUNE 29.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Social Organisation of the Andamanese: A. R. Brown.

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