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 15s. 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 6*s.* 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 chrono-

logically 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 10*s.* 6*d.* 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 philo-

sopher 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 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-

Louis Antoine de Bougainville. From "The Life of Philibert Commerson."

[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.

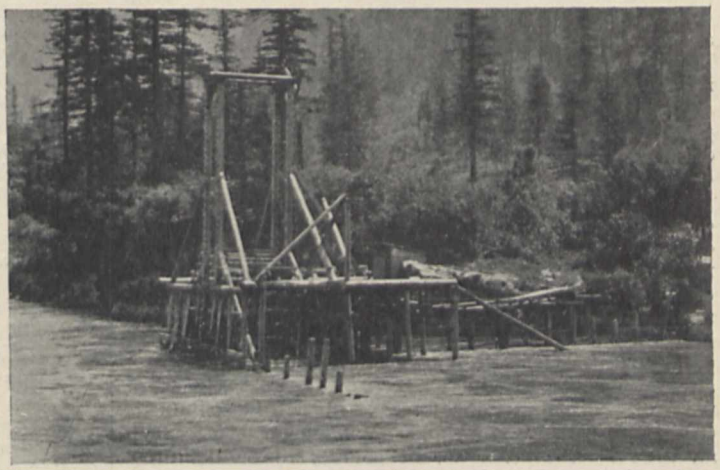
AN ANGLER IN NORTH AMERICA.[1]

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.

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 Walder-share 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 bore-holes 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	14·3

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 für 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	Kustner	Backlund
Vice-Pres.	Donner	Puiseux	André	Hough	Dyson
Secretary	Andoyer	Bourget	Hamy	Luc. Picart	Lagarde
,,	—	Azcarte	Valle	Kicco	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 overestimate 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 now 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.

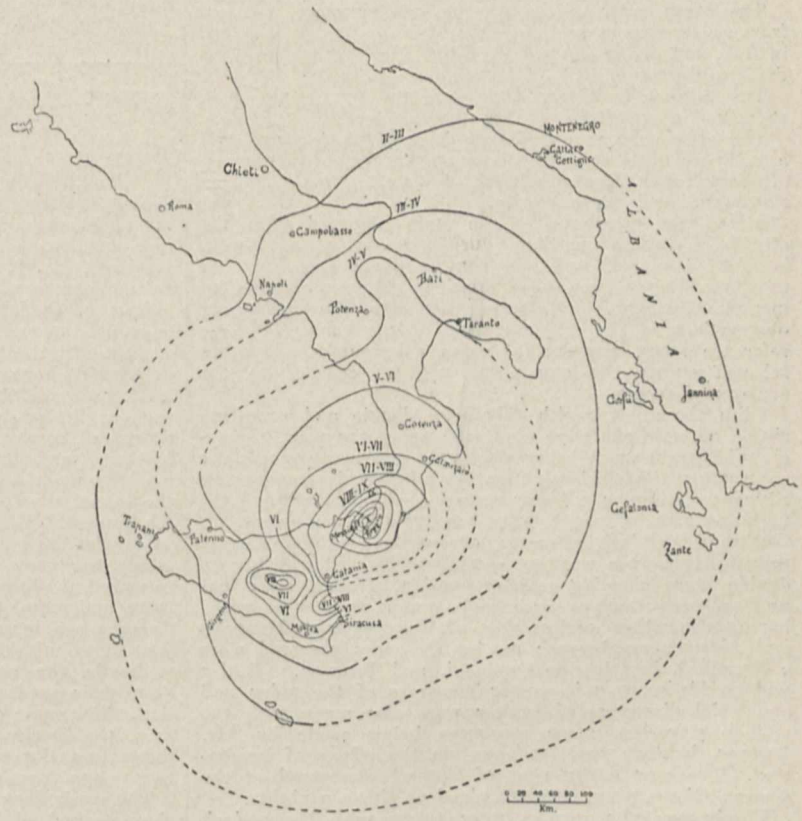
(2) Whereas earthquakes have been the cause of great loss of life and property within the territory of the United States and its possessions, as well as other countries, and whereas it is only through the scientific investigation of the phenomena that there is hope of discovering the laws which govern 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° 36′ 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. E. 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. **Sehnal.** 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 **Koebe.**—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, $(CrO_2)_3Cl_6$, 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. **Dinescu.**—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: Émile **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. E. 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 occidentalis*, sp.n.: L. Glauert.—(1) On some Reptilian Remains from the Trias of Lossiemouth: (2) On some Reptilian Tracks from the Trias of Runcorn: (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. Mossman.—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.

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