THURSDAY, FEBRUARY 16, 1911.

A PRACTICAL MODERN TREATISE ON GEOMETRICAL OPTICS.

The Principles and Methods of Geometrical Optics, especially as Applied to the Theory of Optical Instruments. By Prof. J. P. C. Southall. Pp. xxiii+626. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 25*s.* net.

IT is safe to assert that this volume will at no very distant date be in the hands of every serious English-speaking student of geometrical optics. We know of no other work in the English language in which the attempt has been made to give a thorough and systematic account of the fundamental principles and methods of geometrical optics, so far as these are necessary for dealing with the problems of the optical workshop. There are in existence several conscientious text-books of deservedly good repute, which, as Silvanus Thompson has said, serve—rather, perhaps, served—admirably to get up the subject for the tripos, and are dotted with ingenious and fascinating problems, *e.g.* to find the equation of the bright curve seen on the spokes of a bicycle wheel rotated rapidly in the sun; but these leave untouched a vast number of questions of fundamental importance to the practical optician. More recently Dennis Taylor, whose practical knowledge and experience are unquestionably of the highest order, has attempted to provide a handbook which would assist in practical lens calculations; unfortunately the methods employed are unnecessarily cumbrous, while, as originally published, the book was marred by accidental, but serious, errors. The need of such a work in English as the present has been often stated, and with sufficient emphasis; an Englishman may be pardoned for regretting that it now only reaches him from the other side of the Atlantic.

To the reader who is familiar with Czapski's "Grundzüge der Theorie der optischen Instrumente nach Abbe" and with "Die Theorie der optischen Instrumente" (vol. i.), published by the members of the Zeiss firm, a glance through the pages of Prof. Southall's volume will be sufficient to show how largely he is indebted to these works, both as regards method of treatment and detail; a debt, indeed, which he warmly acknowledges. The author exhibits, further, a wide acquaintance with recent French and German optical literature, to which most useful references are given throughout the work. But the book is no mere translation or compilation. It is a thorough, logical, comprehensive account of the fundamental principles of geometrical optics and of the theory of optical instruments, written by one who not only has an exceptionally extensive knowledge of the work done by others, but has also an unusually complete grasp of his subject and of the essentials necessary to its clear presentment.

In a work on geometrical optics nomenclature and notation are both of the greatest importance, and to these special attention has been given. The results are, we venture to think, on the whole conspicuously successful. The notation adopted is suggestive, clearly stated, agrees in most important respects with established usage, and is carefully held to throughout the work. Great assistance is given by an index and explanation at the end of the book of the symbols used. The use of thick face type to indicate points on the chief ray of a bundle is especially convenient. As regards nomenclature, it may be noted that the term pencil of rays is confined to rays in one plane, the word bundle being employed for a system of concurrent rays in space; the term "chief ray," Sylvanus Thompson's translation of "Hauptstrahl," has been adopted as denoting especially the ray which passes through the centre of the aperture-stop in an optical instrument, or, in the object space, through the centre of the entrance pupil; and the words "Eintrittsluke," "Austrittsluke," are well rendered by the terms "entrance-port," "exit-port," denoting the virtual apertures or windows which bound the field of view in the object space and image space respectively.

The general discussion of refraction through a prism or prism system is given early in the book. In the treatment much use is made of the work of Burmester. This is followed by chapters on the reflexion and refraction of paraxial rays at spherical surfaces and their refraction through thin lenses. The discussion of the relations between object and image in these simple cases leads up to the important chapter on Abbe's theory of optical imagery, of which a full account is given in Czapski's volume above referred to. In Abbe's theory the assumption is made of a point-to-point correspondence, by means of rectilinear rays, between object and image, and from this, without any hypothesis as to the image-forming optical instrument, the fundamental laws expressing the relationship between object and image are deduced, whether for a simple or a compound optical system. In his clear and full treatment of this part of his subject Prof. Southall makes great use of geometrical methods, which are, of course, specially appropriate. It is possible that some practical opticians who are unacquainted with the elements of modern geometry may find this a deterrent, but the amount of knowledge necessary is so slight and so easily acquired that it would be unreasonable to give such an objection serious consideration. The results are applied in the succeeding chapter to the Gauss system of centred surfaces.

The general discussion follows of the exact methods of tracing the path of a ray through a system of centred surfaces when the angles of incidence are not necessarily small. The computation formulæ given are those of Kerber and von Seidel, and some illustrations of their use are afforded. In the subsequent account of the approximate theory of the spherical aberrations the author has followed somewhat closely the plan adopted by König and von Rohr in the chapter devoted to this subject in "Die Theorie der optischen Instrumente." Thus the spherical aberration on the axis, distortion, astigmatism, curvature of field, and coma, are separately considered, while in conclusion a somewhat modified presentation is given of von Seidel's theory, of which an excellent account is provided in Silvanus Thompson's transla-

tion of Lummer's "Photographic Optics." A separate chapter deals with the reflexion and refraction of astigmatic bundles of rays, and in a further chapter the colour aberrations are discussed.

The last chapter, which is of considerable importance, reproduces Abbe's theory of the action of the "stops" in an optical instrument, and deals generally with questions depending on the aperture and the field of view.

The preceding notes will sufficiently indicate the scope of the book. It is confined to the discussion of general optical principles, and methods of calculation applicable to optical instruments, and does not actually deal with the application of these methods. It thus covers practically the same ground as vol. i. of "Die Theorie der optischen Instrumente" already referred to. The subtitle of that volume, "Image formation in optical instruments from the standpoint of geometrical optics," is, indeed, excellently descriptive of the present work. The range is sufficiently extensive, and it would hardly be possible, within the limits of a single volume, to include in addition the theory of lens design, or the application of the general principles to special types of optical instruments. On the other hand, a volume, or rather volumes, dealing with these applications are urgently needed. It is to be feared that there are many practical opticians in this country to whom it may appear that this work offers little of immediate practical importance, and to whom it would only be possible to work back, so to speak, to the present volume from one dealing with its immediate application to, say, the telescope or the photographic lens. It is earnestly to be hoped that Prof. Southall may be persuaded to provide them with the opportunity. There are few who have his equipment for the task, and the need is universally recognised. There can be no question that by the issue of the present volume Prof. Southall has rendered a great service to American and to English opticians.

It may be added that the general get-up of the book is excellent; the type is clear, and the figures well drawn. Some of the figures, however, would have been much improved if they had been reproduced on a somewhat larger scale.

MANCHURIA, KOREA, AND RUSSIAN TURKESTAN.

The Face of Manchuria, Korea, and Russian Turkestan. Written and illustrated by E. G. Kemp. Pp. xv+248+xxiv plates. (London: Chatto and Windus, 1910.) Price 7*s.* 6*d.* net.

THE facilities afforded by extended railway communication to remote regions of eastern Asia have rendered it possible for the leisured tourist to travel safely, and with comparative comfort, from Russia to the seaboard of Asia on the east in a direct line traversing a vast area, a great part of which still remains unexplored, especially in Korea and Russian Turkestan, although excellent work has been done within the last decade by intrepid travellers in crossing the deserts, and surveying the mountain chains in which this part of Asia abounds. Judging from previous work, the author, as an expert tourist, has had some useful training, and has not wholly confined descriptions of the route to the face of things, but has invested the work with unusual interest by historical and other notes concerning the races inhabiting the countries traversed. Four months covered the outward and return journeys, following the lines of the Transsiberian Railway, and onward by connecting lines to Korea, and home again.

The result is the volume under review, which forms an attractive addition to tourist literature, a picturesque guide-book so agreeably written as to captivate the reader who has neither time nor opportunity to follow in the author's footsteps. The historical notes are discriminating and sufficient for the purpose, while the accounts of various regions and races inhabiting them, their religion, social condition, &c., are not without interest. The political outlook created by the new alliance of Russia and Japan is painted in sombre colours. The Japanese determined by force, if necessary, to coerce the Chinese into throwing Manchuria open to Japanese colonisation, and the attitude of China to resist advances. On the other hand, there is Russia's demand to construct and control a railway direct from Irkutsk to Peking, and to prevent the Chinese running a line into Mongolia.

The position created for China is therefore not without the gravest peril, and in the future may lead to serious complications in view of China's progress as a military Power. The author acknowledges indebtedness for trustworthy information supplied along the route. The line into Manchuria joins the Transsiberian Railway with the continuation of the line to Mukden and Peking, enabling the traveller to reach the Chinese capital, starting from London, in about seventeen days. The Japanese appear to have been forestalled in their desire to colonise Manchuria, as the country is being rapidly overrun by Chinese immigrants, owing to its great fertility, and affording an excellent home to the settlers, who are more prosperous than elsewhere in the empire.

The first section of railway to Kharbin is under Russian control, having soldiers posted at intervals all along the line. Half-way from Kharbin to Mukden it becomes Japanese, having military officers on board the trains. The author's brief historical note on Manchu history may be rendered all the more interesting by a perusal of Mr. Meadows's "History of the Manchus." It goes back to the eleventh century B.C., and is full of adventure, enterprise, and war up to 1644, when the Manchus conquered and founded the present dynasty as rulers of China, when they settled down, adopting Chinese methods of government.

Mukden, the Manchu capital, a picturesque and famous old city, is visited and described. It has fallen into decay, although not without signs of renewed life by the transforming influence of the West. The old palace museum contains perhaps the finest collection of ancient Chinese bronzes and porcelain that exists. Some account is given of the Boxer rising and ravages. The hospital of the missions was wrecked, but has been rebuilt, and we are pleased to note that the Viceroy has promised to contribute 480*l.* annually in support of this beneficent institution. The

author's experiences in Korea are not the least interesting part of the book. Korea proves a most successful mission field in the East. The annual native contribution to the missions is estimated at 25,000*l*.

The quaint city of Seoul, under Japanese rule, leaves no doubt in the minds of visitors of the thoroughness of their governing methods as carried out in minute detail. One of the most serious losses sustained by the Koreans was the death of the wise Prince Ito, their governor. It was discovered when the murderer of the Prince was condemned to death that he was writing a poem, and the Japanese judge with grim humour, or Confucian regard for literature, granted him ten days' grace in order that he might finish the effusion.

We must now leave the reader to follow the author through Russian Turkestan, and in connection with this part of the route he might consult Dr. Stein's account of his recent exploration and wonderful discoveries in the Turkestan desert, and Mr. Carruthers's recent survey in the mountain region peopled by the Kurghiz. The author's attractive sketches add to the value of the book. J. T.

VARIABILITY IN "LOWER" ORGANISMS.

Die Variabilität niederer Organismen. Eine deszendenztheoretische Studie. By Hans Pringsheim. Pp. viii+216. (Berlin: Julius Springer, 1910.) Price 7 marks.

THIS book is an attempt to analyse and correlate the known facts regarding variations in certain so-called "lower" organisms. Among these, the Bacteria occupy the chief place, although the Fungi—especially the Saccharomycetes—and the Protozoa are also considered to some extent.

To anyone acquainted with the present state of the literature of this subject, it is unnecessary to point out the difficulties entailed in writing a book of this sort: yet from the admirably clear and concise manner in which the author has presented the facts, the average reader will obtain but a very faint idea of the large amount of patient labour which has been devoted to the task. Perhaps no greater praise could be given to a work of this sort—a work which is unique in that it attempts to correlate the variability of unicellular organisms with that of "higher" forms, and thus to supply biological facts in place of the *a priori* notions which are usually given regarding the "lower" organisms when considered in relation to the theory of organic evolution.

As a compilation of facts, the work leaves little to be desired. The omissions are, for the most part, unimportant. With the author's analysis and interpretation of the facts, however, we by no means always agree: but it is impossible to discuss these properly in a few words, as almost every paragraph in the analytical sections contains a significant idea. By the admirable method which the author has adopted of relegating the literature references and details to a separate section—thus eliminating a large mass of facts of great, but secondary, importance from the main body of the text—a very clear and readable statement of the facts and arguments has been achieved.

The author begins with a brief consideration of the significance and causes of variability in general, and of the heritability of variable characters. It may be noted that the term *mutation* is rejected, and the variations of "lower" organisms are designated *fluctuations*, when they arise from internal causes, and *adaptions* (*sic*) or *accommodations*, when they are called forth by external influences. After some discussion of the struggle for existence in "lower" organisms, and of the limits within which variations occur, the author passes to an enumeration of the observed facts regarding variations in these forms.

As already noted, most of the facts are derived from the Bacteria. They therefore relate chiefly to physiological variations. The author describes variations in colony formation, optimum growth temperature, motility, spore formation, metabolism, ferment and colour production, virulence, and a number of other variable characters. Morphological variations—arising naturally, from innate and unknown causes, or produced by temperature changes, poisons, &c.—are also briefly considered: but pleomorphism is dismissed in a few words, as the author regards it as a normal event in the life-cycle of those forms which display the phenomenon, and therefore properly to be eliminated from a discussion of true variations.

The author's general conclusions naturally constitute the chief feature of interest in the book. He believes "that all the observed cases of variability in micro-organisms may be interpreted as fluctuating variations" (*i.e.* arising from unknown and innate causes) "and functional adaptations": and further, that "there are heritable and non-heritable fluctuating variations in micro-organisms, just as in highly developed animals and plants."

Finally, the author considers the bearing of the facts upon Weismann's view of the relation between amphimixis and variability. From the recorded observations on the variability of "lower" organisms, he concludes that no reasonable grounds exist for supposing that amphimixis causes increased variability in the organisms possessing it, because a high degree of variability is found in non-sexual "lower" organisms which multiply by simple fission.

"One of the chief advantages of amphimictic reproduction is the exclusion of the inheritance of acquired characters and the enforced equalisation of the variable characteristics of special individuals."

A detailed criticism of this important work is not possible in the short space allotted to the present review. We would point out, however, that our chief personal criticism concerns the author's point of view—implied in the title of the book, and impressing itself upon all the author's biological ideas. We do not regard the so-called "lower" organisms as beings which are nearer the beginnings of life than the so-called "higher" forms. The Protista—even the Bacteria—display considerable morphological differentiation, and a physiological complexity which is not "low" in any sense. We believe that a much profounder analysis of fundamentals is required than that given in this book. It is also our opinion that the

non-sexual nature of unicellular organisms—tacitly assumed by the author—must be considered in an analysis of this sort. The majority of Protozoa present sexual phenomena in their life-histories, and sexual processes also occur in many yeasts. Although we believe that the Bacteria are truly non-sexual, we think that the possibility of amphimictic processes occurring in this group should at least have been considered, as a certain amount of work has already been published in this connection.

C. CLIFFORD DOBELL.

BIOCHEMISTRY OF FATS.

Monographs on Biochemistry. Edited by Prof. R. H. Aders Plimmer and Dr. F. G. Hopkins, F.R.S. The Fats. By Prof. J. B. Leathes. Pp. ix+138. (London: Longmans, Green and Co., 1910.) Price 4*s.* net.

PROF. LEATHES'S former book on the "Problems of Metabolism" proved him to be a writer with originality in his views and a capacity for stating them in a lucid and convincing manner. One therefore turned to his long-promised monograph on the fats with considerable interest, especially as the subject is one to which he has devoted so much experimental research work.

The first hundred pages are devoted to a description of the chemistry of fats and their constituents, and the various methods for separating, identifying, and analysing them. This section of the book is useful and necessary; the facts, moreover, are clearly put and well arranged. But this laying of the foundations affords little scope for the thinker, and no doubt could have been equally well done by any competent chemist. The real interest of the book is the superstructure built upon this, namely, the chapter on the physiology of the fats, and one's only regret is that it occupies only eighteen pages. Here the author is able to display his gift of making the dark ways of metabolism as plain as is possible with our present knowledge, and in suggesting explanations and stimulating research on the questions which are still largely hypothetical.

One word of criticism of a quasi-adverse kind appears to be necessary, and that relates to what, after all, is not the most important matter, namely, that of nomenclature. The Chemical Society has laid down certain rules for nomenclature in order to ensure uniformity among English-speaking chemists; such terminations as in, ine, ol, ole, ase, &c., have definite meanings assigned to them, and surely all writers should endeavour to follow the laws put forward by the society, which occupies the foremost place in the chemical world. Prof. Leathes, however, speaks of lecithine, cerebrone, nucleine, jecorine, &c., and the substance he terms phlorrhizine is recognisable, though this spelling does not occur so far as one knows in any other English chemical book.

He has also introduced an entirely new nomenclature for the principal lipoids, the phosphatides being dubbed phopholipines, the galactosides galactolipines, and the basic constituents of galactosides lipines.

A new nomenclature is always sure to cause confusion, especially among students, and so should never be introduced without careful consideration and with some prospect that it will at once "catch on," because it is manifestly appropriate. Prof. Leathes has no doubt very carefully considered his new terms, and everyone will agree with him that the existing terminology leaves much to be desired; but it is very doubtful whether his new terms are better than the older provisional names. The chemical constitution of most of the substances in question is still a matter of doubt and speculation. The proper time to introduce new names will be when their constitution is fully known, and terms can then be framed which will express their structure with accuracy. At present Prof. Leathes has only introduced a new set of provisional names, which, like the older ones, will disappear when our knowledge is more exact.

W. D. H.

BIRD OBSERVATION.

Unleitung zur Beobachtung der Vogelwelt. By Dr. Carl Zimmer. Pp. iv+134. (Leipzig: Quelle and Meyer, 1910.) Price 1.25 marks.

THE author of this work is Dr. Zimmer, keeper of the Royal Zoological Museum in Breslau. On the first zoological excursion he undertook with his pupils in the university of that town (where he is also lecturer, as well as museum custos) they fell in with a chaffinch singing in a tree. On his demanding from them the name of the songster, the word "nightingale" was ventured on after a prolonged silence! The little episode, which indicated, to his surprise, their lamentable lack of knowledge of the commonest local birds, induced Dr. Zimmer to prepare this *büchlein* as an introduction to ornithological observing. In some respects it reminds one of the section in "Hints to Travellers," issued by the Royal Geographical Society on the same subject, though directed to a somewhat different class of observers. One, however, lays the book down with the somewhat unsatisfactory feeling that it is assumed that the student will be *made* into an ornithologist by following the instructions—all of them excellent and the result of experience—therein contained, rather than that the observer, who must be born so, and is already, if that be his bent, an ornithologist, in embryo, before he is aware of it, requires proper guiding only.

Many of Dr. Zimmer's hints will assist in directing the young ornithologist's earlier methods, and suggesting interesting lines of observation, and so will be of considerable value. After some words of introduction, the author gives a list of helpful books on ornithology, especially those with good illustrations, in English as well as German. His next section deals with the subject of excursions into "the open" in quest of birds in their wild state—"the study of cage birds is a make-believe"—and the periods of the day when they can be observed to most advantage. The most suitable field-glasses for the purpose are described.

The larger portion of the book discusses bird life at the different seasons of the year, and directs atten-

tion to what should specially be observed during each of them. In spring to love-making, song, and nidification, in summer to incubation, nestlings, with their succession of plumages, and in autumn and winter to the congregating of birds in flocks, and to migration and the migratory instincts and such like. A further section is devoted to the added help to field observations to be obtained from the study of cage birds, and to the protection of birds by artificial nests, and in protected woods. The formation of collections, the methods of preserving eggs, skins, and skeletons, the description of the proper instruments for the purpose, and suggestions on the making of anatomical, systematic, faunistic, and specific observations occupy the penultimate sections. The final pages supply some hints on bird observation abroad.

The volume is illustrated by excellent blocks, many of them being reproductions of Kearton's well-executed photographs. There is also a good index.

ELECTRICAL ENGINEERING.

(1) *Electric Circuit Problems in Mines and Factories.* By E. H. Crapper. Pp. viii+159. (London: Colliery Guardian Co., Ltd., 1910.) Price 3*s.* 6*d.* net.

(2) *Exercises in Electrical Engineering for the Use of Second-year Students in Universities and Technical Colleges.* By Prof. T. Mather, F.R.S., and Prof. G. W. O. Howe. Pp. v+71. (London: E. Arnold, 1910.) Price 1*s.* 6*d.* net.

(1) THE publication of this little volume is very opportune. Although the matter does not differ essentially from that found in other books on electrical testing of circuits, the manner of presenting the subject is admirable, and particularly well adapted to the class of reader for which the book is intended, namely, the colliery or factory engineer. There is no padding and unnecessary scientific verbiage, but directness of treatment, which must be welcome to the busy engineer. In this sense the treatment may be called popular; there is only little mathematics used, and that is of an elementary character, yet there is no sacrifice of scientific accuracy.

After a short chapter dealing with the units of measurements we get a chapter on the determination of insulation resistance, including tests on live systems. Here the author might with advantage have included Russel's and other tests on three-wire systems. The following chapter, called "Circuit Testing," is mainly concerned with the location of faults on cables by bridge and potentiometric methods, the latter being preferred by the author. Then we come to the construction of cables, and what the author has to say on this subject is well worth reading.

Finally, there are some chapters on polyphase apparatus and working. The only adverse criticism which the present reviewer has to make is as to the appearance of this little book. To present so much excellent matter in so poor a guise is not doing the author justice. The paper is too thin and the illustrations are not neat. They are also of varying style, sometimes to a large scale, sometimes with fine lines, then again to a small scale, or with unnecessarily thick lines, making no distinction between lines that are intended to represent bodily objects, and others that are merely diagrammatic. These may seem unimportant matters to the reader who sits comfortably at his well-lighted writing-table, but let him take the book down a mine to consult it while he is making a test and he will begin to appreciate thick and non-transparent paper, large type, and a systematic method in illustrating electrical connections.

(2) In this little book the authors have collected the problems and exercises set in recent years at the Central Technical College, both as regards class work and examinations. All teachers know how important exercise classes are, especially if they are conducted in a similar manner to the everyday work of the practical engineer. Now in practical work problems seldom present themselves in the definite manner in which they must necessarily be given as examples in the lecture-room; the practical problem is often involved or obscured by side issues and part of the work of the practical man is to disentangle it and separate that which really is of importance from that which is merely a small disturbing influence, or without influence at all. To present to students exercises precisely in the same way as problems arise in practical work is, of course, impossible, for it would make the questions too long, but the authors have gone as far in this direction as may reasonably be expected. The questions are such that some preliminary consideration is required on the part of the student before he can translate the wording into mathematical form, and that is excellent training for his future work.

The 427 questions contained in the book are arranged in twenty-four chapters, ranging from the elementary conception of electric circuits to machinery and apparatus in practical use. Not all the questions are set in such way that a numerical answer can be given, many can only be answered in a general way, and these are specially useful, because of forcing the student to think instead of merely to calculate by some rule learned in the lectures or copied out of an engineering pocket-book. Where numerical answers are required the solution is given in an appendix, but the authors recommend that this appendix shall only be consulted after the solution has been found, not before. Some chapters would be the better for a more extended range of problems. Thus in the chapter on commutation we miss the subjects of influence of speed, brush contact resistance, and interpoles, while great stress is laid on shifting of brushes. But nowadays most machines do not require this shifting of brushes, sparkless commutation being obtained by interpoles, contact resistance, or some sort of compensating and commutating winding. Again, in the sections dealing with A.C. generators and transformers, nothing is found on the subject of heating or the predetermination of the inductive drop. The nomenclature is also peculiar. The authors distinguish alternators as of the "copper type," "iron type," and "inductor type." The last name is generally understood, but for the first two it would be better to retain the usual designation, namely, "without iron" and "with iron" in the armature. These are, however, quite minor blemishes; on the whole the

authors have given us an admirable collection of exercises, and if students will take the trouble to work through these 427 questions conscientiously they will find it excellent training for the solution of practical problems. GISBERT KAPP.

ASPECTS OF DARWINISM.

(1) *Darwinism and Human Life. The South African Lectures for* 1909. By Prof. J. Arthur Thomson. Pp. xii+245. (London: Andrew Melrose, 1909.) Price 5*s*. net.

(2) *Darwinism and the Humanities.* By Prof. James Mark Baldwin. Pp. xi+125. Second edition. (London: Swan Sonnenschein and Co., 1910.) Price 3*s*.

(1) PROF. J. ARTHUR THOMSON is well known as one of the ablest and most judicious of recent critics of the Darwinian position. Fully appreciative of the extraordinary value of Darwin's contribution to evolutionary theory, he is yet ready to give an impartial hearing to all genuine investigators in the field of bionomics, whether their results appear to be favourable or adverse to the views advanced by Darwin. Like some other writers who strive to maintain a candid and unbiassed attitude in the face of conflicting opinions, he is liable to the usual penalty of open-mindedness; the imputation, that is to say, of indecision—in homely phrase of "running with the hare and hunting with the hounds." Such an imputation, if meant as a reproach, would be in Prof. Thomson's case undeserved; if intended as a tribute to his faculty for seeing both sides of a question, it would be justified.

The present volume, which is a reproduction in permanent form of a series of lectures delivered under the auspices of the South African Association for the Advancement of Science, is a good example of the author's skill in popular exposition. He does not shirk difficulties, but deals with them in a lucid and popular manner. In most respects he may be trusted as a faithful interpreter of the views both of Darwin and of his successors; here and there, however, in our opinion, he goes somewhat astray. A notable instance of this is his treatment of Darwin's term, the "Struggle for Life." There can be no reasonable doubt that the leading idea in the mind of the originator of the phrase was competition—mainly between organisms of the same kind. Nothing is gained, and some confusion is introduced, by enlarging the conception so as to include resistance to adverse external conditions, or the strife between carnivorous animals and their prey. The evolutionary significance of these latter phases of organic existence lies in the fact that they necessitate competition, whether active or passive, and consequent selection, between generally similar individuals exposed to their influence. Here, in our opinion, Weismann, Haeckel, and Ray Lankester are right, and the author of "Darwinism and Human Life" is wrong.

On the question of the transmissibility of acquired characters or "somatic modifications," Prof. Thomson takes the line (and indeed he could scarcely do otherwise) that "we do not know of any clear case which would at present warrant the assertion that a somatic modification is ever transmitted from parent to offspring." At the same time he fully recognises that these somatic modifications are very common, that they are of much individual importance, that they may have an indirect influence through the body on the offspring, and, in short, may exercise an indirect control over evolution in several ways. But he rightly denies that evidence exists of their influencing the germ-plasm in a specific or representative manner. That the germ-plasm can in certain cases be permanently altered by external conditions artificially induced was surmised many years ago by Weismann (for *Chrysophanus phlaeas*), and shown by Fischer (in *Chelonia caja*). The same fact has now been demonstrated on an elaborate scale by the careful experiments of Tower on Leptinotarsa. But it is hardly necessary to point out that these results go no way towards proving the "Lamarckian" contention.

Not the least interesting passages of Prof. Thomson's book are those in which he deals with the relation of Darwinism to social and political questions. But the bearing of the doctrine of natural selection on human affairs in the widest sense receives a still more thorough and extended treatment in Prof. Mark Baldwin's volume, entitled "Darwin and the Humanities," of which a second edition has lately been published (2). The special value of Prof. Baldwin's contribution to Darwinian literature lies in the fact that he is not primarily a biologist with an interest in philosophy, but a philosopher who seeks in biological data the suggestion and justification of his philosophical method. Hence the importance of his conviction, reiterated in the course of the present and other treatises, that "natural selection is in principle the universal law of genetic organisation and progress in nature—human nature no less than physical nature." This, he affirms,

"is the conclusion to which the lines of evidence we now have distinctly point; and while this has somewhat the appearance of a forecast, it is one of those reasonable forecasts which give life and interest to the progress of science and philosophy alike."

The application of this view to the problems of psychology, the social sciences, ethics, logic, epistemology, philosophy, and religion, is the object of the present work, which, though it is in the author's words "no more than an outline or sketch," yet succeeds in conveying in a comprehensive and effective manner the suggestion of a philosophic method in reasonable harmony with scientific facts and values.

A characteristic and consistent feature of Prof. Baldwin's conception of Darwinian theory is the emphasis that he lays on the psycho-physical character of the material presented to the operation of natural selection. Bound up with this is the recognition of mental plasticity, or, to use Sir E. Ray Lankester's term, "educability," as an all-important factor in progressive development. One outcome of the view here spoken of is the rather unfortunately named principle of "organic selection"—a principle incidentally recognised, as the author shows, by

Darwin himself, though it was reserved for later investigators to discover how powerfully it reinforced the distinctively Darwinian doctrine against Lamarckian attack.

Throughout Prof. Baldwin's work we find that his vivid realisation of the dominant fact of adaptation keeps him faithful to Darwinian standards.

"It is well," he says, "to cast about for other principles—to work out Vitalism, Mendelism, Mutationism, &c.—in those sciences which do not have to deal with the problem of adaptation, or of the accommodation of the organism through its external characters. But wherever the question arises of the relation of organisms *inter se*, and to the environing conditions of their life, the foregoing [*i.e.* variation, accommodation, selection] are not only the fruitful principles, they are the only principles we are able to consider at all."

F. A. D.

OUR BOOK SHELF.

The Manuring of Market-Garden Crops. By Dr. B. Dyer and F. W. E. Shrivell. New edition. Pp. 144. (London: Vinton and Co., Ltd., 1910.) Price 1*s*.

MARKET-GARDEN crops play a considerable part in the agriculture of districts near to towns, especially on light soils in not too high or exposed a situation. Formerly the scheme of management was fairly straightforward: the grower sent in his vegetables in carts to the early markets, sold them, and reloaded his carts with dung from the town stables with which to fertilise the next crop. But with the introduction of the motor omnibus, the motor lorry and car, and the electric tram, the supply of town dung has fallen off, so that the grower has less available and has also to pay more for it. Increasing competition from abroad has forced down the price of his produce, and has placed him in the unpleasant position of seeing his income fall while his expenses have increased. In order to meet the position he has turned his attention to artificial manures, and there is every indication that they will cheapen the cost of production.

Although a large number of experiments have been made to show the effect of artificial manures on farm crops, few, if any, had been made with market-garden crops until recently. Dr. Dyer and Mr. Shrivell have for the past sixteen years been making trials at Hadlow, the cost of which is borne by the Permanent Nitrate Committee, and have summarised their results in the little volume before us. Practically all the crops in ordinary cultivation are grown here, and as each is the subject of at least half a dozen trials, the number of plots is very considerable. At no other place in the country, so far as the writer is aware, are so many trials of market-garden crops attempted, and this furnishes the most extensive demonstration we have of what artificial manures will do in this particular direction.

The plots are intended solely as demonstrations; they do not appear to be duplicated, and no determination seems to have been made of the magnitude of the experimental error. Hence the results have no precise quantitative significance, nor perhaps was it meant they should. Their chief value is to show the grower that he is not entirely dependent on town dung, but can use a mixture of artificial manures with smaller quantities of dung than hitherto, and can get as good a crop at less cost.

Guide to the Crustacea, Arachnida, Onychophora and Myriopoda exhibited in the Department of Zoology, British Museum (Natural History). Pp. 133+90 illustrations. (London: Printed by order of the Trustees of the British Museum, 1910.) Price 1*s*.

THIS guide admirably fulfils its functions; it is written in a clear style, and indicates tersely the main points of interest associated with the chief families and genera. The principal characters of each subdivision —class, order, tribe, family—are concisely stated, and those of its members are singled out for mention which most aptly illustrate points in morphology or distribution, or show some striking habit. The section on the Crustacea opens with a short account of the lobster—its external features and appendages, some of its internal organs, its development, moulting, and the asymmetry of its chelæ, following which are short notes on modifications caused by parasites and on adaptation to environment.

The systematic account of the Crustacea contains a large number of interesting references to morphological and distributional points, which make it valuable apart from the special purpose for which it was prepared. To give two instances—(1) the formation of a respiratory siphon by apposition of the antennules in the Albuneidæ and of the antennæ in Corystes, and (2) the appearance of Apus in Scotland in 1907, which is ascribed to the introduction of the eggs, perhaps on the feet of birds, from the continent. The Arachnida (including Limulus and the Eurypterines) and Myriopoda are dealt with in a similarly interesting manner, and short notes are added on the Trilobita, Pycnogonida, Pentastomida, and Onychophora. A little more space might well have been devoted to the Ixodidæ in view of their great importance in connection with the spread of disease in man and animals. The figures, many of which are new, are excellent and well support the text.

Life and Habit. By Samuel Butler. New edition, with author's addenda. Pp. x+310. (London: A. C. Fifield, 1910.) Price 5*s*. net.

PUBLISHED in 1878, this was the first—and the most important—of Butler's writings on evolution. The present volume is practically a re-issue of the original edition, though a few hitherto unpublished appendices have been added.

The central point of Butler's system—that heredity is memory—has been alluded to in our recent notice of the reprint of his later work, "Unconscious Memory"; and we may pass it over with the reminding remark that automatic action proves former practice in a pianist or knitter, therefore the apparently unpractised but perfect pecking of a newly-hatched chick proves that the chick has done it before (when it existed in the bodies of its parents) and now remembers how to do it again. This, then, is the point at which Butler continually hammers, and it brings up difficult and humorous questions, *e.g.* the question of personal identity. If a person at eighty is legitimately regarded as the same person as he was when he was an embryo, we cannot tell where to stop chasing him back, so to speak, for he is as much the impregnate ovum as he is the fœtus, and he is as much his parents, or part of them, as he is the ovum. The upshot is that all animal and vegetable life must be regarded as "nothing but one single creature, of which the component members are but, as it were, blood corpuscles or individual cells; life being a sort of leaven, which, if once introduced into the world, will leaven it altogether."

Butler was somewhat of a dilettante, and he admits, with his usual whimsicality, that he did not at first believe in his own theory!—that he only believed in

it when he gradually saw how astonishingly well it did fit the facts. But he was certainly serious, beneath his brilliant paradoxes; and, though a pariah in his own day, he is now recognised as a true if somewhat wayward and satirical genius.

Stars shown to the Children. By Ellison Hawks. Pp. xii+119+49 plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 2*s.* 6*d.* net.

To give a clear, comprehensive insight into present-day astronomy, in the "Shown to the Children" series, was no light task, but in doing it Mr. Hawks has approached nearly the ideal. To children "stars" implies every extra-terrestrial orb, save the sun and moon, and Mr. Hawks exhibits his ability to reach the child even in his title.

Thus the first twelve chapters describe the phenomena of the solar system, and very brief chapters they are. Yet the juvenile reader will become acquainted with practically all the broad principles of our knowledge concerning the sun, moons, and planets, and will find in the sky a new and inexhaustible interest.

Nor can any important omission be pointed out in the eight pages dealing with comets, yet the instruction is so interwoven with interesting "story" that it is sure to be eagerly assimilated. "Shooting stars," in three pages, should lead to many a night's watch, and produce a number of recruits for the still too small army of meteor observers: the page or two concerning the Green Flash and the Northern Lights will probably not prove so fruitful.

The stars themselves occupy seven chapters, thirty-three pages, and only the most striking constellations are described and drawn; but the text is so replete with interest and star-lore that the intelligent youth will find himself forced to fill in the details. The final chapters deal with the nebulæ, the Milky Way, and the appurtenances of an observatory, and should complete the feeling of being "at home" in the young recruit.

The forty-nine excellent illustrations will of themselves command the intelligent interest of most children. In one or two places it would appear that an effort has been made to meet the child, *e.g.* on plate xxxiv. "The Mighty Hunter" need not have been drawn as the pantomimic "Bowd Slasher," and his belt should have been properly directed; but with so much to commend, these blemishes are relatively few and insignificant. W. E. R.

A Treatise on Electro-Metallurgy: Embracing the Application of Electrolysis to the Plating, Depositing, Smelting, and Refining of Various Metals, and to the Reproduction of Printing Surfaces and Art-work, etc. By W. G. McMillan. Third edition, revised and enlarged. Revised by W. R. Cooper. Pp. xv+425. (London: Charles Griffin and Co., Ltd., 1910.) Price 12*s.* 6*d.* net.

THE work of revising the excellent treatise of the late Mr. W. G. McMillan has, on the whole, been admirably done by Mr. Cooper, although there still remain a few slight errors in the body of the work which might have been corrected. For example, it is manifestly an error to recommend for nickel deposition a solution of 8 *pounds* of nickel ammonium sulphate per gallon (p. 220). Some of the recent developments in the practice of electroplating might have been given more attention, such as electrolytic methods of cleaning which of late years seem to have come into favour; and the important uses of the sand blast are still, as in former editions, almost ignored. It is, however, impossible to deal adequately within the limits of a volume of reasonable size, with all the aspects of so wide a subject, and the general excellence of the treatise in its revised and enlarged form elicits warm approval.

The section devoted to electrolytic refining is much extended, and a very good summary on the smelting of iron ores and the manufacture and refining of steel by electrical means is a new feature in this edition. There are a considerable number of useful tables given as addenda, and chapter xx. consists of a convenient glossary of substances commonly employed in electro-metallurgy, with their more important properties, but the melting points of the metals might have been revised in the light of the great amount of laborious and excellent recent work done on these, such a standard temperature as silver 961° C. being given as 1740° F. (949° C.), and the ancient myth of antimony at 800° F. (427° C.) instead of 631° C.

The book must, however, be considered as a standard one on the subject, essential alike to students and practical electrometallurgists.

A. McWILLIAM.

Diptera Danica. Genera and Species of Flies hitherto found in Denmark. By W. Lundbeck. Part iii., Empididæ. Pp. 329. (Copenhagen: G. E. C. Gad; London: W. Wesley and Son, 1910.) Price 13*s.* 6*d.* net.

THE family treated in the present instalment of the "Diptera Danica" is one of considerable extent, numbering 675 palæoarctic and 440 North American species, eleven being recorded as common to both regions. The number of species described in the present volume is 164 (Mr. E. E. Austin estimates the number of British species as approximately 215), divided into five subfamilies and twenty-seven genera. The larvæ live in damp ground, under leaves, or in mud, or in decaying wood, and are believed to be carnivorous, like the perfect insects, the habits of which are very curious, as recorded on pp. 83 and 84. Sometimes the male catches an insect and presents it to the female, who sucks it during their union, and then drops it; and in other cases the male presents the female with a small dead fly enveloped in a kind of balloon of froth.

The long and detailed descriptions of genera and species appear to be very carefully written, and the 141 text-illustrations of antennæ, wings, &c., are excellent. The book deserves the patronage of all British entomologists who are interested in Diptera, especially as it is written and printed in English for their benefit. Although there are now more entomologists working at Diptera at present, the order has been less studied in Britain than any other, and we have not yet a sufficiency of works dealing with many large and important groups comprised in it.

Elementary Physiography. By Prof. R. D. Salisbury. Pp. xi+359. (New York: H. Holt and Co., n.d.)

THIS work is a reduction and simplification of the author's larger book for schools, which was reviewed in NATURE, vol. lxxxii., p. 335. It is expressly intended for schools that can give only half a year to the subject. The numerous illustrations retained will attract attention, and those dealing with types of glaciers and their products are unusually varied and effective. The Salton Sea (p. 96) has been utilised as an example of delta-flooding, and the buckling of tram-lines in San Francisco in 1906 is shown on p. 197. There is in all American work a desire to bring the present activity of the earth home to the general reader. The same spirit is seen in Prof. Walther's crusade on behalf of geology in Germany; and there are signs that the next generation will not grow up entirely ignorant of this strange rotating ball on which we live.

With the aid of maps and pictures from the British

Isles, Prof. Salisbury's present book could be utilised in English schools. Many geographical features can be best illustrated from the open lands of the United States; but the teacher will find in this volume a fair number of references to European countries. We can thus imagine a happy combination in a school course of Salisbury's Elementary Physiography" and, say, A. M. Davies's "Geography of the British Isles."

G. A. J. C.

Mentally Deficient Children, their Treatment and Training. By Dr. G. E. Shuttleworth and Dr. W. A. Potts. Third edition. Pp. xviii+236. (London: H. K. Lewis; Philadelphia: Blakiston's Son and Co., 1910.) Price 5*s.* net.

THE third edition of Dr. Shuttleworth's well-known and excellent handbook has the advantage of an up-to-date revision by Dr. Potts. It is not too much to say that Dr. Shuttleworth's small book prepared the way for the recent Royal Commission on Care and Control of the Feeble-Minded. The main conclusions of that commission are dealt with in the present edition. Many details from actual special schools are given. The book is indispensable to those engaged in the management and supervision of feeble-minded children. The eugenics of the feeble-minded are lightly touched upon; but, in a practical handbook, one looks rather for direction than for theory. The illustrations have been increased in number, the bibliography, already copious, has been substantially added to. There is a good index, both of subjects and of authors.

The volume as a whole is so well-balanced that it forms an excellent handbook to the study of this whole department, which, within the last five years, has grown enormously in extent and in interest.

The Flower Book: Being a Procession of Flowers, passing from Meadow and Coppice through the Hedge to the Garden, Pool, and Herb-Patch. By Constance S. Armfield. Pp. ix+153; illustrated. (London: Chatto and Windus, 1910.) Price 7*s.* 6*d.* net.

IT would be difficult to find a more direct contrast to the formal method of nature teaching than the imaginative yet fairly accurate presentation of episodes in plant-life charmingly depicted in the pages of "The Flower Book." The elements and flowers are endowed with voices to express the tale of their difficulties, their ambitions, and their victories. The distress of the stock seedlings when transplanted, the aspirations of the snowdrops and the buttercups, the spread of the pinks in the border, should appeal to the imagination of any bright child, and as natural reasons for the various incidents are cleverly worked into the arguments it may be expected that grains of knowledge will be instilled. One item calls for immediate refutation, that is, the suggested origin of the water plantain from the common plantain. There is a general theme linking together the five sections noted in the title. The illustrations are not an entire success, as some suffer from a want of proportion, but grace and truth are combined in the pictures of the rose, the bluebell, and the iris.

Hygiene and Public Health. By L. C. Parkes and H. R. Kenwood. Pp. xi+691. (London: H. K. Lewis, 1911.) Price 12*s.* 6*d.* net.

IN its original form, the first edition of this book was reviewed at length in our issue of January 30, 1890 (vol. xli, p. 290). The present is the fourth edition under the conjoint authorship; it has been carefully revised, and new matter has been introduced where necessary to bring the treatise up to date.

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.*]

Origin of Incense.

IT is natural that incense should interest a botanist. For at least 4000 years mankind has used for this purpose the product of several species of Boswellia, natives of S.E. Arabia and Somaliland (the land of Punt). The English name Frankincense, borrowed from old French, substantially means incense *par excellence*, and represents the fact that, except amongst the Hebrews, it has been the substance exclusively employed in ritual. At last Epiphany frankincense and myrrh, in accordance with custom, were offered at the altar of the Chapel Royal, St. James's, on behalf of the King.

The use of incense might have originated in two different ways, and it is not perhaps always easy to distinguish these developments. Fumigation with fragrant or pungent herbs would easily arise as a sanitary expedient. The Greeks called this θυμίαμα, which connects with *fumus*; the plant name, thyme, derives from the same root. This, as there is evidence it did, would develop into the notion of ceremonial purification and then of consecration and honour. For such purposes it would be natural to burn frankincense on a fire-pan or censer. This was the Egyptian practice. Mr. Arthur Evans has discovered in Crete censers of Minoan age with lumps of some undetermined incense still adhering. Much of the use of incense in modern religious ceremonies has only a sanitary significance. Thus, at the coronation of George III., an official held a fire-pan on which frankincense was burnt, and this appears to have had no ritualistic meaning. It was not until the seventh century B.C. that frankincense was exported to Mediterranean countries. It doubtless carried with it is religious significance, and from this period dates the use of incense both by the Greeks and the Hebrews. That incense was of exotic origin is shown by the fact that the Hebrews called it *lebōnāh* and the Greeks λιβανωτός, names which, like the Arabic *lubān*, probably all derive from some local name at the place of production.

The sacrificial use of incense developed gradually and from a different source from the sanitary. Sacrifices were primarily offerings of food to the gods. It was a later development to burn them so as to present them in an ethereal form. Starting from the idea that the gods were to be propitiated through the sense of smell, frankincense was sprinkled on the burnt offerings to make them more fragrant. The latest refinement was to burn incense on the altar alone. The former the Greeks called λιβανωτὸν ἐπιτιθέναι, the latter λιβανωτὸν καθαγίζειν. Aristophanes in the fifth century B.C. carefully distinguishes (Clouds, 426) the three sacrificial acts: the sacrifice proper (θύος), the libation, and the addition of incense.

The use of frankincense spread to Italy, where it was used much as in Greece. The Romans called it *tus*, which is the equivalent of θύος. The substitution of the letter *r* in the oblique case, *tus*, *tur-is*, shows that θύος could not have found its way into Latin later than the fourth century B.C. In Greece θύος was always a sacrificial offering. Mr. Christopher Cookson, who has taken much kind trouble for me in this matter, informs me: "I can find no passage where θύος need mean 'incense' and many where it cannot." Now, the Romans had their own word for a sacrifice, *sacrificium*. When they began to use frankincense, instead of borrowing its Greek name, they used *tus*, the latinised form of θύος, substituting the name of the whole rite for that of a mere incident in it.

The confusion so produced has existed for some 2000 years. There have been several notices in NATURE of the so-called "Incense Altar of Aphrodite" at Paphos. This is apparently based on the passage in the Odyssey (8.363), where Homer calls it βωμὸς θυήεις. But this is merely one of his common forms. He uses it of the altar of Jupiter on Mount Ida (Iliad, 8, 48), and (Il., 23, 148) of the altar of Sperchius, on which Peleus had vowed that Achilles should offer fifty rams. It is quite true that θυήεις has been translated "smelling with incense"; it

really has its obvious and simple meaning of "reeking with sacrifice." Virgil was, however, misled, and paraphrases the passage in the Odyssey (Æneid, 1, 416) with his usual amplification into: "centumque Sabaeo ture calent arae." But it is evident that this was not accepted at the time. The elder Pliny more than once discusses the question and asserts emphatically "Iliacis temporibus . . . nec ture supplicabatur" (N. H., 13, 1, 1). Whatever, therefore, may have been the development in later times, the Homeric altar of Aphrodite at Paphos could not have been an incense-altar. It is true that it has been contended that sacrifices of blood were not offered to Aphrodite. But this is not sustainable. Victims were offered to the Paphian Venus in the time of Horace.

W. T. THISELTON-DYER.

The Electromotive Force of Standard Cells.

AT the International Conference on Electrical Units and Standards, held in London in October, 1908, it was decided that the electromotive force of the Weston normal cell should be taken provisionally as 1·0184 international volts at 20° C. until further measurements, made under the auspices of the International Scientific Committee on Electrical Units and Standards, should enable a more accurate value to be assigned.

Measurements of a high degree of accuracy have now been completed, and show that the Weston normal cell made according to approved specifications has an electromotive force of 1·0183 international volts at 20° C., *i.e.* 1 part in 10,000 less than the provisional value assigned in 1908.

In consequence, the International Committee has passed a resolution expressing the desire that from January 1, and until a further recommendation, electrical standardisation in the standardising laboratories of all countries should be based on the value of 1·0183 international volts for the electromotive force of the Weston normal cell at 20° C.

Accordingly, all standard cells tested at the National Physical Laboratory will be compared with Weston normal cells of which the electromotive forces have been determined by direct measurement to be 1·0183 international volts at 20° C. These latter cells, together with new ones, will from time to time be remeasured in terms of the international ohm and the international ampere in order to ensure a constant standard of voltage.

It was assumed in the National Physical Laboratory certificates for 1909 and 1910 that the electromotive force of the Weston normal cell was 1·0184 international volts at 20° C., and therefore these certificates may be corrected for the change now introduced by subtracting 1 part in 10,000 of the value stated on the certificate.

R. T. GLAZEBROOK (*Director*).

The National Physical Laboratory, January 1.

Klaatsch's Theory of the Descent of Man.

THERE appeared in NATURE of December 15, 1910, p. 206, a letter from Prof. Keith on Klaatsch's theory of the descent of man. As this letter is likely to give great discredit to the work of Klaatsch, in this country at least, I find myself, as a pupil of Klaatsch, justified in saying a few words more about it.

Klaatsch gives an account of his theory in a paper, entitled "Die Aurignac-Rasse und ihre Stellung im Stammbaum der Menschheit," in the *Zeitschr. f. Ethnologie*, 1910, Heft 3 and 4. After a short description of the skeleton of the Aurignac man, described by O. Hauser and himself in detail before, and after some general remarks about morphological methods in comparing the fossil man with anthropoid apes, Klaatsch goes on to consider in some detail the comparative anatomy of the humerus, ulna, and radius, and the skeleton of the hind limb of Aurignac and Neanderthal man, orang-utan, and gorilla. As Prof. Keith in his letter says that this basis is "flimsy in the extreme," we may very well examine it again. In the skull, the resemblance between Neanderthal man and gorilla (called the N.-G. group), on one hand, and the Aurignac man and orang (called the A.-O. group) on the other, is hardly visible at all, only in the supraorbital ridges there are still some traces of it. But the resemblances are very well marked in the skeleton of the limbs, especially of the arms. A superficial glance will show that the bones of A.-O. are slender, whilst those of the N.-G. are "clumsy." But this is no basis for exact scientific research; the important point is that there are differences in morphological details. The caput humeri, which articulates with the scapula, has a greater longitudinal diameter in A.-O. and a greater transversal diameter in N.-G. There is a sulcus intertubercularis between two ridges for the insertion of muscles. This runs straight down in A.-O., whilst it is somewhat **S**-shaped in N.-G. At the distal end, N.-G. shows a much greater mesial epicondyle, so that there results a sort of incision (incisura supracondyloidea, Kl.). In A.-O. the contour of the bone is much straighter; there is no sharp corner at all.

Very interesting differences are found at the proximal end of the ulna, but as this especially is a point where very detailed descriptions and technical terms are necessary, I shall pass at once to the radius. The shaft of that bone —the same holds good in both groups for the ulna—is almost straight in A.-O., but is distinctly bent in N.-G., so that the proximal and distal parts stand to each other in a well-marked angle. In the lower limbs the differences are not so well marked, although there, too, they exist. Differences are observed in the position of the trochanter major and minor, in the formation of the posterior intertrochanteric lines, in the angle between the collum (neck) and the shaft of the femur, in the shape of the malleolus and of the caput of the tibia, and so on. But they are not so striking as in the upper limb. This is quite clear, because the hind-limbs in man are highly specialised for the purpose of supporting the body, so that the influence of function is here much stronger than it is in the arms, which are free, and not always submitted to the same mechanical influences. So the differences are more hidden. But they can be seen by everyone who takes the care of studying the bones thoroughly.

I hope that even this short glance at the facts will have shown to the reader that there are two distinct groups of fossil man, the Aurignac man and the Neanderthal man, the Aurignac man resembling in many points the orang, the Neanderthal man resembling the gorilla.

In the first part of his paper Klaatsch only gives these "rather dry morphological facts." In the second part he proceeds to offer an explanation of these facts. As there is a close resemblance in morphological details of the Neanderthal race and the gorilla, and of the Aurignac race and the orang, he thinks that there must be a real blood-relation between the respective races. Klaatsch's idea, then, as to the descent of man is this. There was, originally, one group of primates, "propithecanthropoi," which, according to Klaatsch, resembled man more closely than any other now living primate. These gave origin, among others, to one group, out of which sprang the Neanderthal race and the gorilla. The Neanderthal man followed an upwards line in his development, the gorilla sank back, having become specialised in one direction, and by this being unfit for higher development. Klaatsch regards the gorilla and the other man-like apes as "failed experiments of man" (misslungene Versuche zur definitiven Menschwerdung).

In much the same way there sprang up another group, which developed into the Aurignac race and into the orang. So "the Aurignac man did not spring up from the Orang, just as the Neanderthal man did not spring up from the Gorilla" (p. 568, *loc. cit.*). How these two races of mankind reached Europe, Klaatsch tries to show in a sort of scheme, which has been published in NATURE already (November 24, 1910). The Neanderthal race came *via* Africa and Gibraltar, whilst the Aurignac race came *via* Asia.

Further on, Klaatsch thinks it possible that there are races who are related in the same way to the chimpanzee and to the gibbon. Other suggestions Prof. Klaatsch makes about the existing races and the other prehistoric races. According to him, the Galley Hill and "Brünn I" skull belong almost certainly to the Aurignac race, very likely also Chancelade and Engis! As to the existing races, Klaatsch thinks to have found a relation of negroes to the Neanderthal race. Otherwise his suggestions are very hypothetical, and only meant as a working hypothesis, so that it is no good now to consider them closely.

We first have to examine the theory itself thoroughly, and then draw the conclusions.

Now, when Prof. Keith states that Klaatsch speaks about a descent of man *via* the gorilla or *via* the orang, this is wrong, as I hope to have made clear by the quotations of Klaatsch's paper. But when Prof. Keith speaks about "convergence phenomena," to which has to be ascribed a great deal, he no doubt touches the point most exposed to criticism. It is, indeed, very difficult to believe in two races, so much one like the other as man is to man, and yet so unlike in some minute morphological detail, as Aurignac is to Neanderthal, without supposing that they once were very much more unlike, and that they afterwards got more alike again by convergence. But this difficulty of Klaatsch's theory must never make us forget the facts. The problem is this. There are two distinct "races" each possessing distinct morphological characters, the one resembling the orang in these characters, the other the gorilla. How can these differences and likenesses be explained? It is certainly a very difficult problem, but a very interesting one too, that is well worthy to receive serious consideration. In any case, we must be grateful to Klaatsch for having directed attention to this fact, and for offering us an explanation—even if the latter should be only a preliminary one.

GERHARDT V. BONIN.

Breslau, January 28.

WHILE admiring the manner in which Herr Bonin states the case for his Professor, I do not think he has produced any evidence that requires me to alter my statement that Prof. Klaatsch's latest theory of the origin of human races is founded on a "flimsy" basis. To understand the nature of Prof. Klaatsch's "pan-anthropoid" theory of the origin of human races, it is necessary to know the circumstances which led him to formulate it. He found that the recently discovered Quaternary individual, which he has dignified with the name of *Homo aurignacensis hauseri*—quite a modern type of man—followed closely in point of time the individual he described in 1908 as *H. moustieriensis hauseri*—a man of the Neanderthal type. To account for the manner in which these two quickly succeeding types differ, Prof. Klaatsch propounded the "theory" that the Aurignac man is descended from the orang stock, while the Neanderthal has arisen in the gorilla line of descent. Now the characters which separate those two types are exactly of the same nature and of the same degree as separate a blood-horse from a Shire stallion. Every one of the points cited to differentiate these two types of men are dependent on the degree of muscular development. Bones, especially limb bones, react sensitively to the muscles which move them; muscular impressions and processes for the insertion of muscles vary from individual to individual, and from their nature are most untrustworthy for the purpose of tracing affinities.

There is thus, in my opinion, no need to have recourse to such a theory as Prof. Klaatsch has formulated to explain the contrasted characters of the Aurignac and Neanderthal types of men; the problem is of the same nature as meets us when we seek to explain contrasted breeds among dogs and horses. Further, from a study of acromegaly, that most interesting disease of growth which I have had opportunities of examining of late, it is quite apparent that an alteration in the action of the glands of internal secretion—especially of the pituitary—will change in the course of a few years a man of the Aurignac type into one of the Neanderthal type—not an exact replica, but near enough to leave no doubt that the characters of acromegalics and of Neanderthal men are of the same nature.

Prof. Klaatsch also realised that if his theory were applicable to two races of men, it should hold true for all. Hence his suggestion that some may have arisen from the chimpanzee and some from the gibbon. His theory—a "pan-anthropoid" theory—of the origin of human races is designed to account for the various features which characterise and differentiate human races.

To those acquainted with the great mass of evidence which has accumulated in recent years relating to the structure, development, and habits of living and extinct anthropoids, Prof. Klaatsch's theory must appear altogether untenable. From 1890 to 1900 I devoted myself to an investigation of the Higher Primates, making complete dissections of more than eighty animals, and collected all descriptions which had been published at the close of that period, with the intention of tracing, from the mass of facts thus collected, the evolutionary history, not only of man, but of each of the anthropoids. An extensive analysis was made of the structural characters of each of these animal forms. Characters are found in them which also occur in lemurs, in South American monkeys, in old-world monkeys. Some characters are common to all the members of the Higher Primates (man, gorilla, chimpanzee, orang, and gibbon); others which are common to the Giant Primates (man, gorilla, chimpanzee, and orang); others which are found only in man, the gorilla, and chimpanzee; and then a considerable number which are peculiar to each member, and may be regarded as late acquisitions.

The characters I relied on were not such as Prof. Klaatsch has used—the highly variable muscular impressions on bones—they were points such as, I believe, most anatomists would regard as of morphological worth. Publication of my results was suspended owing to several circumstances; and I do not regret the fact, because since then much additional evidence has been discovered, such as the affinities shown by blood tests and by susceptibility to disease, and much of an anatomical and physiological nature, which I hope to gather and systematise. Meantime, I merely state briefly the results reached more than ten years ago. Whatever theory is propounded of the origin of the several members of the Higher Primates must account for their structural and functional characters. It is certain that Prof. Klaatsch's theory is altogether inapplicable for their explanation.

Table giving an Analysis of the Structural Characters of the Higher Primates.

Nature and Character	A Man	B Gorilla	C Chimpanzee	D Orang	E Gibbon
Peculiar to the genus (generic characters)	312	75	109	113	116
Common to A, B, C...	93	93	93	—	—
,, B, C ...	—	78	78	—	—
,, A and C..	98	—	98	—	—
,, A and B.	87	87	—	—	—
,, A, B, C, D	112	130	133	130	—
,, A and D..	56	—	—	56	—
,, C and D..	—	—	65	65	—
,, B and D..	—	78	—	78	—
,, A, B, C, D, E...	93	132	132	132	133
Common to E and A, B, C, or D	84	56	93	74	—
Common to Old World Monkeys and A, B, C, D, or E	53	144	172	213	323
Common to New World Monkeys and A, B, C, D, or E	60	33	32	38	76
Lemuroid Characters.	17	41	37	50	50
	1065	1004	980	949	1002

The manner in which I seek to explain the distribution of these characters is the following. The gibbon is regarded as the representative of the basal stock of the Higher Primates, and this Hylobatian stock is looked upon as an offshoot of a basal stock (late Eocene probably), which also gave rise to the Old and New World monkeys. The distribution of characters of these groups is thus explained in the modern representatives of the Higher Primates. The evolution of the Hylobatian form marks the first and most important stage in that process which led to man's upright posture. The body of the gibbon shows all the adaptations for an upright posture (perhaps downright would be a better term) in which the weight is more suspended from the arms than supported by the legs.

The next stage in the evolution of the Higher Primates is clearly the appearance of a form which, compared to all that had gone before, may be regarded as a "giant" stock. There can be no doubt the Giant Primates (man, gorilla, chimpanzee, and orang) arose from the Hylobatian stock, and that Dryopithecus (a Miocene form) is a very good example of an early Giant Primate. The first stage in the evolution of the Higher Primates is the acquisition of a new posture, the second the acquisition of a new stature. The orang does not possess a number of characters which are held in common by man, the gorilla, and chimpanzee, and I therefore suppose that the orang

was the first to break off from the basal stem of the Giant Primates. The orang, although it has the giant size, has retained the brachiating or arm locomotion of the gibbon stock, his thumb and great toe have become vestiges; the process of shortening of the spinal column, which set in during the Hylobatian stage, has progressed, so that now the lower limbs are attached to the body one or two vertebræ higher than in man, the gorilla, and chimpanzee. It has retained a primitive arrangement of the air cavities of the nose and face, whereas man, the gorilla, and chimpanzee have the same elaborate arrangement of cells which differentiate them from all other primates.

The orang's lower limbs are in a state of retrogression—as opposite to human limbs as could be. The Aurignac man, which Prof. Klaatsch assigns to the orang stock, is remarkable for his narrow and long head, whereas the orang's head is the most rounded of all primate forms. The resemblance between the humerus of the Aurignac man and that of the orang is fanciful, in my opinion. If we may judge the basal orang stock from its modern descendants, the one thing we can be certain of is that it is the last of the Higher Primate stocks which is likely to give rise to the human race. On the other hand, the chimpanzee, and especially the gorilla, are evidently the descendants of a stock from which it is not difficult to suppose the primary human stock may have arisen. The tendency to a greater use of the lower limbs was evidently already present in that primitive stock.

The conclusion I reached in 1900 simply confirmed the statements made by Huxley in 1863.

Nothing is impossible in nature, but there are some things which are highly improbable. A multiple origin for a single species is one of the most improbable, and, so far as the human species is concerned, there is no need to suppose a multiple origin. Prof. Klaatsch's opinion of anthropoid apes throws an interesting light on his theory. He has reverted to a slight modification of the very ancient view of the anthropoids—that they are representatives of retrograde humanity. In Herr Bonin's words, Klaatsch regards the gorilla and the other man-like apes as "failed experiments of man." There is no scientific basis for such a statement—the gorilla fills its place in nature quite as satisfactorily as man.

This view of the nature of the anthropoids only affects us so far as it may help us to understand Prof. Klaatsch's theory of the "pan-anthropoid" origin of human races. If that opinion is well founded, the opinion that the Higher Primates were designed as experiments in "Menschwerdung," then, of course, it follows that the experimenter may have succeeded on several occasions, and that each of the primitive primates may have given rise to races of men. In reality, we are being again introduced to the old theory of design, and hence the statement in my last letter that Prof. Klaatsch's theory exceeded "the limits of rational speculation."

A. KEITH.

Royal College of Surgeons, England, February 4.

"In Forbidden Seas."

"D. W. T.," who writes a review of the sea-otter, or rather of a book called "In Forbidden Seas," in NATURE of January 26, tells us that he is not aware that any living naturalist has ever seen this animal in its natural state. Now, Captain H. J. Snow, who is the author of "In Forbidden Seas," is, from my point of view, a first-class field naturalist, who by his collections and observations has added considerably to zoological and geological knowledge. I may add that he is also a keen surveyor, and his maps of the islands in these "Forbidden Seas" were so far back as 1895 published for the use of sailors by our Admiralty. By the publication of these charts, the shortest routes between Vancouver and certain ports on the Asiatic coast have been freed from uncertainties and dangers. Canadian and other vessels crossing the North Pacific, in cases of emergency have new harbours of refuge which can be approached with comparative safety. Snow's charts show new rocks and shoals, take out others, adjust islands in longitude, indicate anchorages, tide rips, watering places, seal and seal-lion rookeries, and, in short, make the unknown known. Sailing directions go with the charts.

By reason of their knowledge of these Forbidden Seas and our ignorance of them, in 1855 the Russian fleet was enabled to evade that of the French and English allies. H.M.S. *Rattler* was wrecked in these seas, and the Japanese man-of-war *Tabor* was totally lost. The disabling of several gunboats which have attempted to survey these islands, and the numerous wrecks of British and other schooners which are to be found along their shores, testify to the difficulties which surround the navigation of these waters before the advent of Captain Snow. The Royal Geographical Society were so impressed by the value of his work that they awarded him one of their annual grants, and approached the Lords of the Admiralty to obtain for its author substantial recognition. Had the work been carried out by one of our surveying vessels it would have cost this country many thousands of pounds. All that was learnt was to the effect that no rule existed for the payment for work of this description. At a subsequent date the Rt. Hon. Arthur J. Balfour was approached. Among the signatories to the petition I see the name of the president of the Royal Geographical Society on behalf of the council, the Admiral of the Fleet, Rudyard Kipling, and those of many other well-known persons. Captain Snow gave up his working tools and received no recognition. I know that captains and admirals of British ships, like commissioners sent out to study seal fisheries, have sought and obtained valuable information from Captain Snow. JOHN MILNE.

Shide, Newport, Isle of Wight, January 30.

I AM surprised and sorry that Prof. Milne should think, as he seems to do, that I sought to belittle Captain Snow's achievements, for I not only based my article on the sea-otter upon Captain Snow's additions to zoological knowledge, but I also paid an unstinted compliment to Captain Snow's romantic and adventurous career. I mentioned briefly that Captain Snow had won the reputation of an authority on the geography of the Kuriles; but that brief statement, brief because I was not dealing with, and was, indeed, very imperfectly acquainted with, his geographical work, was necessarily inadequate. Prof. Milne has done proper justice to this part of Captain Snow's work.

As regards the valuable information that Captain Snow has given to persons charged with the inspection of the seal-fisheries, I can bear testimony of my own. Still better testimony can be found, for instance, in Dr. L. Stejneger's report of 1898 on the Asiatic fur-seal islands, for Dr. Stejneger not only draws his description of the Kurile seal-rookeries chiefly from Captain Snow, but pays tribute to his "invaluable additions to the authentic history of the Kuriles," and to himself as "a man of unusual ability, literary and scientific, for the profession he had chosen to follow."

D'ARCY W. THOMPSON.

An Apparently hitherto Unnoticed "Anticipation" of the Theory of Natural Selection.

IN Louden's *Magazine of Natural History*, 1835, pp. 40–53, there appears an article entitled "An attempt to classify the 'Varieties' of Animals, with observations on the marked Seasonal and other Changes which naturally take place in various British Species and which do not constitute Varieties," by Mr. Edward Blyth. Certain passages contained therein seem to indicate that the principle of natural selection, or the survival of the fittest, was clearly understood by Blyth in 1835, and, further, that he recognised its application to artificial selection. Moreover, he demonstrates the idea of sexual selection in one of its bearings. I have therefore considered them of sufficient interest to be made public, as it appears they have hitherto escaped notice.

"When two animals are matched together, each remarkable for a certain peculiarity, no matter how trivial, there is also a decided tendency in nature for that peculiarity to *increase*; and if the produce of these animals be set apart, and only those in which the same peculiarity is most apparent, be selected to breed from, the next generation will possess it in a still *more* remarkable degree; and so on, till at length the variety I designate a *breed*, is formed, which may be very unlike the original type." . . . "It is worthy of remark, however, that the original and typical

form of an animal is in great measure kept up by the same identical means by which a true *breed* is produced. The original form of a species is *unquestionably* better adapted to its *natural* habits than any modification of that form; and, as the sexual passions excite to rivalry and conflict, and the stronger must always prevail over the weaker, the latter, in a state of nature, is allowed but few opportunities of continuing its race. In a large herd of cattle, the strongest bull drives from him all the younger and weaker individuals of his own sex, and remains sole master of the herd; so that all the young which are produced must have had their origin from one which possessed the maximum of power and physical strength, and which, consequently, in the struggle for existence, was the best able to maintain his ground and defend himself from every enemy. In like manner, among animals which procure their food by means of their agility, strength, or delicacy of sense, the one best organised must always obtain the greatest quantity, and must, therefore, become physically the strongest, and be thus enabled, by routing its opponents, to transmit its superior qualities to a greater number of offspring. The same law, therefore, which was intended by Providence to keep up the typical qualities of a species, can be easily converted by man into a means of raising different varieties; but it is also clear that, if man did not keep up these breeds by regulating the sexual intercourse, they would all, naturally soon revert to the original type. Farther, it is only on this principle that we can satisfactorily account for the degenerating effects said to be produced by the much censured practice of 'breeding in and in.' There would almost seem, in some species, to be a tendency, in every separate family, to some particular kind of deviation, which is only counteracted by the various crossings which, in a state of nature, must take place, and by the above-mentioned law, which causes each race to be chiefly propagated by the most typical and perfect individuals" (pp. 45–46).[1]

On the suggestion of Prof. Cossar Ewart, the above quotation was submitted to Mr. Francis Darwin, who has kindly informed me that he agrees with my remarks in general, but is unable to state definitely the identity of the author.

In his introduction to the "Origin" Darwin notices several such "anticipations," but no reference is made to Blyth's name in this connection.

It seems indeed strange that Darwin should have been unacquainted with this article, and, what appears stranger still, that Blyth himself should have failed to direct attention to his paper, or that there should be no mention of these passages in either Darwin's or Blyth's correspondence. Mr. Francis Darwin has, however, indicated ("More Letters," i., p. 62) that much of Darwin's correspondence with Blyth has not been forthcoming. This is to be regretted.

Curiously enough, in a letter to Lyell, Darwin says:—"Blyth says (and he is in many respects a good judge) that his ideas on species are quite revolutionised. . . ." ("Life and Letters," ii., 1887, p. 316.)

At this juncture the question naturally arises, viz., Is the Edward Blyth of the article *the* Edward Blyth of Calcutta? On turning to Grote's "memoir" (Journal Asiatic Soc. Bengal, August, 1875, part ii., supplement), we find (p. 5) that Blyth contributed to both Louden's and Charlesworth's series of the *Magazine of Natural History* from the year 1833. From the titles of the various articles which appear under Edward Blyth's name in Louden's Magazine, there is no evidence to indicate that all these contributions did not originate from the same writer. On Grote's evidence we are therefore justified in concluding that our author is the naturalist who afterwards made himself famous by his writings on, and profound knowledge of, the mammals and birds of India. Moreover, this conclusion is substantiated by our author's address, given in the same volume of Louden in several instances as "Tooting, Surrey," and we learn ("Dict. National Biog., London, 1886, vol. v., p. 276, art. Blyth, Edward) that Blyth purchased a druggist's business at Tooting on coming of age.

Mr. J. Ritchie, of the Royal Scottish Museum, has suggested to me that Blyth, in 1859, may quite easily have forgotten what he had written twenty-four years previously, the more so as he failed in the true application of his "principle." The association of his ideas with those of Darwin would, therefore, be incomplete or entirely wanting.

Though Blyth seems clearly to have recognised the principle of natural selection, he fails in its true application in that he regards *his* "principle" as operating for the conservation rather than the progression of the type, whereas the two really go hand in hand, the one being a complement of the other in the successive stages of evolution. Moreover, proof of Blyth's inability to recognise the logical issue of his theory is exhibited in some of his remarks, which appear to disagree, or are incompatible with, one another. For instance, it is hard to reconcile the sentence commencing "Farther," and ending "breeding in and in," with some of his previous statements.

Blyth was a staunch supporter of Darwin's views, and his early theorisings are of interest in connection with his projected work on "The Origination of Species," which, however, was never completed, even in manuscript form (Grote, *loc. cit.*, p. xiv). H. M. VICKERS.

81A Princes Street, Edinburgh, February 3.

[1] The italics in this quotation are Blyth's.

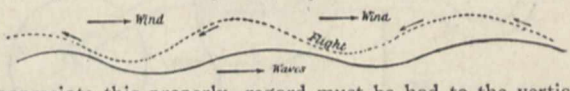
The Sailing-Flight of Birds.

IN NATURE of February 2, Mr. Mallock remarks that the skimming of some birds near the surface of the waves, where the variations in the velocity of the wind are great, may be dependent only on the inequalities of a horizontal breeze, and that an upward current is not absolutely necessary. My own observations have led me to the conclusion that whenever a bird glides for any distance without losing altitude he is, no less than the soaring kite or eagle, utilising an upward current of air. But it is possible that Mr. Mallock may be thinking of the albatross, who is perhaps without peer in his power of profiting by the vagaries of the wind. Unfortunately, I have had no opportunities of observing the albatross, and from those who have I get very conflicting accounts, some maintaining that he will glide for long distances under conditions which make it almost certain that the wind is horizontal, others holding that, though he brings the art to greater perfection, he does nothing different in kind from what the gull, that hangs with outstretched wings over the stern of a steamer, is able to achieve.

My object in writing this is to urge any of your readers whose good fortune gives them opportunities of watching the albatross on the wing to make careful observations on this very interesting subject. F. W. HEADLEY.

I AGREE with Mr. Headley that observations of the various conditions under which flight with fixed wings can be accomplished are desirable, but it is quite as important to determine the motion of the air in any particular case as to observe the behaviour of the bird.

In the case of a bird skimming close to the surface of waves, the action is presumably that sketched below. To



appreciate this properly, regard must be had to the vertical motion of the air in respect to time as well as to the wave surface. It is assumed that the speed of the wind is greater than that of the waves, and that the bird is flying to windwards. In these circumstances, the mean velocity of the air is less in the lee of each wave-crest than it is on the windward slope (indeed, when the waves are steep, the flow on the lee side may be reversed).

If a bird follows the course indicated by the dotted line, it gains, not only from the ascending current off the windward slopes, but also from the increased velocity it can acquire by dropping to a low level in the slower wind to the leeward of them.

The question of possible flight by variations of horizontal velocity has been treated by Lord Rayleigh and Mr. R. E. Froude. A. MALLOCK.

IN the flight of birds, besides the change in the inclination of the wing planes noted by the Rev. R. Abbay in NATURE of February 9, there must surely be some movement either of the wing, tail, or body which takes the place of the screw of the aëroplane. The seagull, for

instance, gives an occasional quivering motion to one or both wings which is clearly perceptible to the unaided eye, although propulsion and change of position relatively to air currents seem to be accomplished by strokes of the wings resembling sculling strokes.

It is not the birds, but certain insects, which exhibit quiverings of the wing imperceptible to the eye. The hoverer-fly, Syrphus, for example, can remain in one spot in the air while the wings are vibrating at such a rate as to be invisible, and at the approach of danger, or at will, it may suddenly by some movement, also invisible, transfer itself to a distance of a yard or more, and there continue the wing quiverings, which maintain the body almost stationary.

Is not motion in all flying and swimming things attained by presenting the wings or fins at a suitable angle to the air or water, while at the same time giving a propelling motion to the tail or dorsal fin and body, and also by a sculling motion of the wings or side fins, in the case of some insects and fishes, invisible to the human eye?

Derby, February 9. EDWARD D. HEARN.

Demonstration of Peltier and Thomson Effects.

THE following method of demonstrating the Peltier and Thomson effects may be of interest. In Fig. 1 the current passes through an *Sb*-*Bi*-*Sb* bar, the points of contact being amalgamated to reduce the resistance. Two coils of No. 36 covered copper wire are wound on the bismuth

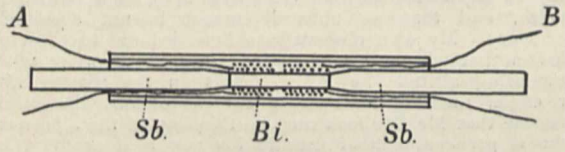


FIG. 1.

one near each junction, and by means of the leads A and B are placed in the gaps of a metre bridge, and a balance produced. On passing a current of 1 ampere through the bars, one junction is heated and the other cooled, which is indicated by a galvanometer deflection of about 40 mm. due to the change in resistance of the copper coils. The direction indicates a heating where the current flows from *Sb* to *Bi*, and *vice versa*.

Fig. 2 shows a similar arrangement for exhibiting the Thomson effect. The bent iron rod is heated to red heat at C, and the ends A and B dip into vessels of mercury,

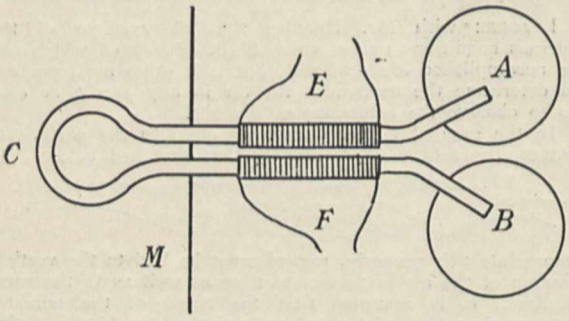


FIG. 2.

thus ensuring a large temperature gradient. On passing a current of 10 amperes in the direction ACB, AC is warmed and CB cooled, showing that the Thomson coefficient is negative. The part EF must be packed in asbestos wool to prevent heating disturbances from outside.

S. G. STARLING.

Municipal Technical Institute, Romford Road,
West Ham, E., January 28.

The Formation of Spheres of Liquids.

IN conducting Plateau's experiment for the formation of spheres of liquid in a medium of equal density, it is still customary to use oil of some kind in a mixture of alcohol and water. The following method will be found much simpler and more effective. A glass beaker about 10 cm. diameter and 15 cm. high is filled with water at 22° C. to two-thirds of its height. By means of a pipette, 100 c.c. of a solution of 30 grams of common salt in 1 litre of water are discharged at the bottom of the beaker, so as to form a lower layer slightly denser than the water above. A large funnel furnished with a tap, and having a stem 1 cm. or more in diameter, is now placed centrally in the beaker so that the stem terminates about 7 cm. from the bottom of the vessel. A quantity of commercial orthotoluidine, at a temperature less than 22°, is poured into the funnel, and the tap turned so as to allow the liquid to flow gradually into the water. A sphere of orthotoluidine forms on the end of the stem, the growth of which resembles that of a soap-bubble blown from a pipe.

It is quite easy in this way to make spheres 6 or 8 cm. in diameter, and the red colour of the orthotoluidine renders the procedure visible from a distance. The funnel may be lifted out and the sphere left floating in the water; and on surrounding the beaker by a square glass vessel, also containing water at 22°, the true spherical shape of the drop is seen. If the beaker be surrounded by cold water at 15°, the sphere will elongate in its horizontal diameter and sink, whereas if the surrounding water be at 27° or more, a vertical elongation will take place, and the sphere will rise and attach itself to the surface of the water in the form of a hanging drop. This behaviour is due to the fact that orthotoluidine and water are equal in density at 22°, but owing to the former liquid possessing a higher coefficient of expansion, it becomes less dense than water above 22°, and more dense at a lower temperature.

It may be added that all the usual experiments with liquid spheres can be carried out in the beaker, and the method of formation has the advantage that a sphere of any desired size may be formed by closing the tap when the requisite quantity of liquid has run out. In the course of a general investigation of liquids which are lighter or denser than water, according to temperature, the writer has found several which may be made to produce spheres at certain temperatures in the manner described, but has found orthotoluidine to be best suited to the experiment.

CHAS. R. DARLING.

City and Guilds Technical College, Finsbury, E.C.

Colliery Warnings.

I HAVE read the letters which have appeared on this subject with considerable interest. We have two theories before us. Both theories connect the presence of firedamp with changes of atmospheric pressure, but the one considers a time of high pressure as being most likely to cause an outrush of gas, whilst the other regards a falling barometer as the period of greatest danger. It does not seem at all reasonable to suppose that the atmospheric pressure would compress the rock and force out the gas as the Author of the Warnings suggests. Rather would air enter the rock cavities in such circumstances. The tendency for firedamp to escape during a falling barometer would be greater than during a rising barometer, but the evidence only shows a very slight connection to exist between the rise or fall of the barometer and colliery disasters.

The firedamp generated in certain coal measures exists in the rock, apparently, under considerable pressures, and its escape does not appear to be likely to be much affected by atmospheric pressure changes. The Author of the Warnings remarks:—"There was a time when no one guessed that the earth's surface was always on the move. . . ." In colliery districts the earth's crust is always on the move, owing to the colliery workings themselves. This movement is not a bodily oscillation—it is an actual rending of the strata for some distance below as well as above the seam being worked. Is it not likely that it is to the formation of fissures in the rock in this way that the gas owes its liberation? Considerable spaces may also be formed by the settling and creep in front of a working face; the firedamp would collect in such spaces and be forced out by further settling. At any rate, it seems clear that the escape of firedamp in quantity is more likely to be the result of some local change rather than to changes of atmospheric pressure.

R. M. DEELEY.

Inglewood, Longcroft Avenue, Harpenden,
February 3.

THE OCEANOGRAPHICAL INSTITUTE AT PARIS.

THE inauguration of the Oceanographical Institute of Paris, which took place on January 23, marks not only the completion of the foundation of the Prince of Monaco's institute in Paris and Monaco, but an era in the history of the science of oceanography. If Britain led the way in initiating the systematic scientific investigation of the sea by the dispatch of the *Challenger* expedition in 1874 under the leadership of Sir Wyville Thomson, and by the publication of the results of that remarkable expedition under the direction of Sir Wyville Thomson and Sir John Murray, no country or individual has done more to establish oceanography as a science than His Serene Highness the Prince of Monaco.

Mr. J. Y. Buchanan has for so many years been associated with the Prince of Monaco and his oceanographical researches, and one sees as an outcome of his influence the present methods of the physico-chemical investigations, that are being carried out on board the *Princesse Alice*, in the museum at Monaco, and the institute in Paris. This valued help and guidance the Prince has recognised, not only conferring on Mr. Buchanan the Order of St. Charles, but also by making him vice-president of the "Comité de Perfectionnement."

FIG. 1.—View of the Oceanographical Institute at Paris.

Mr. Buchanan has given an impression of the life-work of the Prince of Monaco, which found expression in the solemnities[1] connected with the inauguration of the Oceanographical Museum of Monaco in April last year,[2] and it is now proposed to add a further impression of the Prince's work on the occasion of the inauguration of the Oceanographical Institute of Paris.

When the Prince commenced to build the museum at Monaco he was determined that the institution should yield the best possible scientific returns. To ensure this he has created the Oceanographical Institute of Paris, where courses of instruction to students of the university, and public lectures of a popular character are given. Thus the Oceanographical Institute is composed of (1) the "Institut Océanographique" of Paris, and (2) the "Musée Océanographique" of Monaco. The Prince has familiarly described the museum at Monaco as the workshop or factory, and the institute at Paris as the retail house. At Monaco is carried on the work of a laboratory, and an exhibition of products of the sea in an interpretative, scientific, and yet attractive manner. At Paris there are lectures and demonstrations which, it is hoped, will diffuse a taste for oceanography among industrious youths, who would ultimately complete their studies by personal research work at Monaco, and afterwards give their successors at the institute in Paris the fruit of their labours. Thus the two establishments form one institute with an unbroken interchange of work—experimental on the one hand, didactic on the other, all co-ordinated and concurrent with the same aim—the advancement of oceanographical science.

The institute, as has already been pointed out, is at the same time French and international. French because its seat is in Paris, with a French "Conseil d'Administration"; international because the men in whose hands the Prince of Monaco has placed the technical scientific direction are chosen from the whole world, without distinction of nationality, amongst savants who are qualified oceanographers. The Prince himself is president, Mr. J. Y. Buchanan, F.R.S., vice-president, and Sir John Murray, K.C.B., F.R.S., and the writer, are, along with Mr. Buchanan, the British representatives. Among others on this "Comité de Perfectionnement" are Dr. Jules Richard, who has so long been the chief of the Prince's scientific staff on board his ships, and who is now director of the museum at Monaco, which, as Mr. Buchanan has pointed out, owes so much to his "strenuous and unselfish work"; Dr. Paul Regnard, administrator of the institute in Paris; Prof. Dr. K. Chun, of Leipzig; Prof. Hergesell, of Strassburg; M. Forel, of Lausanne; Dr. F. Nansen, Christiania; Commandant F. A. Chaves, director of the meteorological service at the Azores, and several others. The late Prof. Agassiz represented the United States on the committee. It will be seen from these few names mentioned how international this committee is.

Situated in the heart of the Latin quarter, in Rue St. Jacque, the institute is destined to fulfil an important *rôle* in the educational life of Paris. The site chosen is the old property of the "Dames de Saint-Michel," which was acquired in 1906 by the University of Paris with the help of the State, of the city of Paris, and of the Prince of Monaco, and the university has ceded the part occupied by the institute to the Prince of Monaco.

In selecting M. Nénot as architect, the Prince has been able to combine art with science in the erection of the institute at Paris.

The central feature of the institute is a large lecture theatre, accommodating eight hundred people,

[1] NATURE, April 14, vol. lxxxiii., p. 191.
[2] *Ibid.*, November 3, vol. lxxxv., p. 7.

in which it is intended to give courses of popular lectures on oceanography. This large lecture theatre is ingeniously combined with a smaller one, which

FIG. 2.—The large Lecture Theatre. View from Platform

is suited to accommodate eighty persons, and is suitable for conducting systematic scientific courses of lectures to university students. The auditorium of one theatre faces that of the other, and the screen which forms the lantern screen for each theatre, divides the one from the other. The small lecture room also forms additional seating accommodation should the large one be at any time crowded.

The administrator of the institute is Dr. Paul Regnard, who has for many years been associated with the Prince's work. His house forms part of the building, so that the administrator is always on the spot. Under him are three professors—Prof. Berget, for the study of physical oceanography; Prof. Joubain, for biological oceanography; and Prof. Portier for the study of physiology of marine animals and plants. Each professor has a very comfortable private room of his own, and attached to it a large well-equipped laboratory, with every scientific requirement, and even many scientific luxuries, including a spacious and well-fitted photographic dark room to each of the three departments. These private laboratories are each large enough to accommodate several research students if the professor of the department so desires. There are, besides, a few small laboratories, which are set apart for specialists of any nationality to carry out any special research.

There is a good library which will be subsidiary to the important library that already exists at the museum at Monaco. Two large rooms are set apart for aquaria, one contains four large tanks, and the other is to contain a large number of small aquaria, where living animals can be observed. The septic dissecting chamber and theatre forms a novel and interesting part of the institution, and close by is a crematorium for the disposal of organic waste products. There is an excellent mechanic's workshop, fitted up with every possible requirement, and in charge of a capable mechanic of the French Navy. Already, as an example of work that can be done in this workshop, it may be mentioned that a small sounding machine, which is used on board one of the Prince's ships, was entirely constructed here.

There is also a special room fitted to contain some 96,000 lantern slides.

The "secretariat" is an important part of the institution as well as a handsome council chamber, in which the "Conseil d'Administration" and the "Comité de Perfectionnement" meet. The secretary's room is decorated in a very beautiful and original manner by a young artist, M. Laugier, who has passed several years studying in the museum at Monaco, at the Sorbonne, and at Roscoff. He has thus become thoroughly familiar with the forms and colours of many living marine animals and plants. He has represented on the walls of the "secretariat" a scene below the sea, so that the secretary lives in a

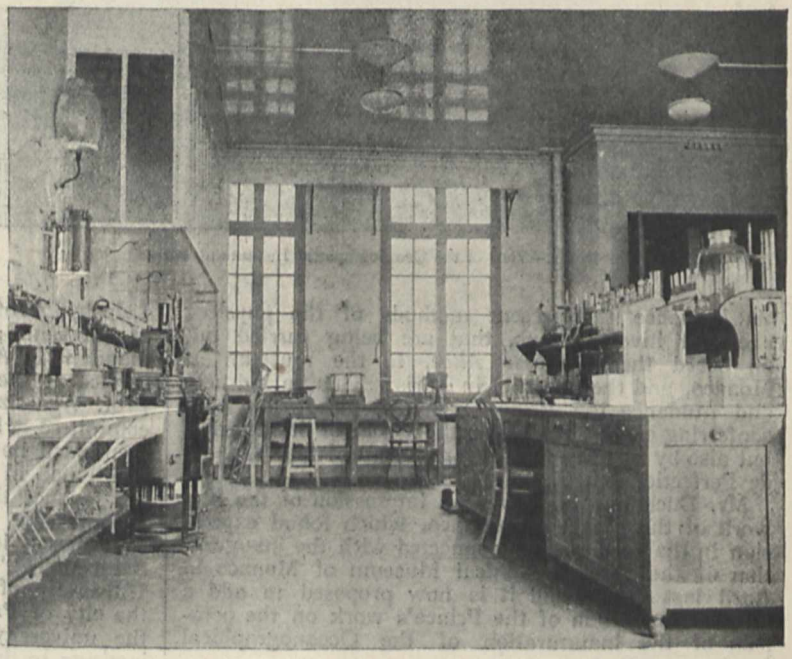


FIG. 3.—Prof. Portier's Physiological Laboratory.

veritable aquarium—wonderful molluscs, crustacea, and strange fish swimming round among rocks and waving sea-weed, and the whole culminating in a

whirlpool in the centre of the ceiling, in which is figured a cuttle-fish with its outstretched arm.

The council chamber is richly but gracefully ornate, though more orthodox. The large lecture theatre is of excellent Florentine architecture, with fine panels by M. Louis Tinayre, who has accompanied the Prince on board the *Princesse Alice* during several voyages, not only in the Mediterranean and tropics, but also in Spitsbergen. One panel represents oceanographical operations on the deck of the *Princesse Alice*, especially the taking on board of a trawl and a trap from the deep sea. Another represents a whale-boat in charge of the Prince, who is fast to a whale. A third represents the selection of the larger material from the trawl on the deck of the ship, while a fourth pictures finer work being carried out below, inside the scientific laboratory.

The inauguration was presided over by the Prince of Monaco himself, and was graced by the presence of the President of the Republic, M. Fallières, and many members of the Government, and by Ambassadors and Ministers of Foreign Powers at Paris. There were also the members of the "Conseil d'Administration" and of the "Comité de Perfectionnement." A guard of honour, formed from the Republican Guard, lined the streets outside the building, and the band of the Republican Guard played the "Marseillaise" and the Monagasque national anthem as the President of the Republic and the Prince of Monaco entered the lecture theatre.

The proceedings were opened by an eloquent address by the Prince of Monaco, who pointed out that the opening of the institute was the crowning of the work he had devoted his life to during the last twenty-five years. He then proceeded to give an account of the aims and objects of the museum and institute, which have already been given in the pages of NATURE. Finally, he gave the reason why he had chosen Paris as the seat of the institute, and it is best to quote the Prince's own words in his fine peroration, which left a deep impression on the audience.

"Si j'ai choisi cette capitale pour y centraliser mon œuvre, c'est que Paris a gagné la reconnaissance du monde intellectuel: les lettres lui doivent un rayonnement incomparable, les arts ont chez lui une de leurs plus généreuses patries, la science lui doit l'affranchissement qui ouvre à la pensée des champs sons bornes. Mais c'est aussi parce que certaines âmes demeurent toujours sous l'influence de l'atmosphère où sont nées leurs premières affections et où leurs vieilles tendresses sont mortes; où des peines ont fortifié leur courage et où les contingences de la vie ont orienté leurs efforts.

"Le musée océanographique de Monaco semble un vaisseau ancré sur la côte avec des richesses extraites de tous les abîmes; je l'ai donné comme une arche d'alliance aux savants de tous les pays.

"L'édifice où nous sommes recueillera la quintessence du travail élaboré par l'océanographique qui planera idéalisée sur ce vaste domaine universitaire, au milieu du flot grandissant de la science. Et je le confie à cette ville de Paris qui m'a enseigné le travail et dont l'esprit et le cœur ont si souvent dirigé l'esprit et le cœur de l'humanité entière."

The Prince was followed by M. Maurice Faure, Ministre de l'Instruction Publique, speaking in the name of the Government, who eloquently thanked the Prince on behalf of France and the University for his gift.

Others who spoke were M. Armand Gautier, president de l'Academie des Sciences, and M. Liard, vice-recteur à l'Academie de Paris, as well as M. Perrier, directeur du Museum d'Histoire naturelle.

Finally, M. Henri Bourée, aide-de-camp to the Prince of Monaco, gave some very excellent photographs and kinematograph views of work on board the *Princesse Alice*. These included some very marvellous colour photographs of living invertebrates that had been gathered during some of the cruises—the most striking of which was a brilliant physalia, glittering with translucent violet in the sun. The kinematograph also showed the movement of the physalia in a glass tank. WILLIAM S. BRUCE.

THE OBSERVATORY AT MESSINA.

IN connection with seismological investigations, Italy is the possessor of a prestige which we trust will grow. It was the first European country in which the study of earthquakes received special recognition and Government support. It systematised seismometry, and through M. di Rossi published the *Bollettino del Vulcanismo Italiano*, which, I believe, was the first journal ever issued which dealt specially with hypogenic activities. The work commenced in Italy was extended in Japan, and at the present time every civilised country in the world has established earthquake observatories and recognises the scientific and practical importance of what is now a new science. From the knowledge we now possess of earthquake motion new rules and formulæ for the use of builders and engineers have been established. These have been extensively applied, and we see that the new types of structure withstand violent movements, while ordinary types in their vicinity have failed. The new science has already justified its existence by thus minimising the loss of life and property. A side issue of seismometry has led to the localisation of faults on railway lines and to alterations in the balancing of locomotives. The result of the latter has been to reduce the consumption of fuel.

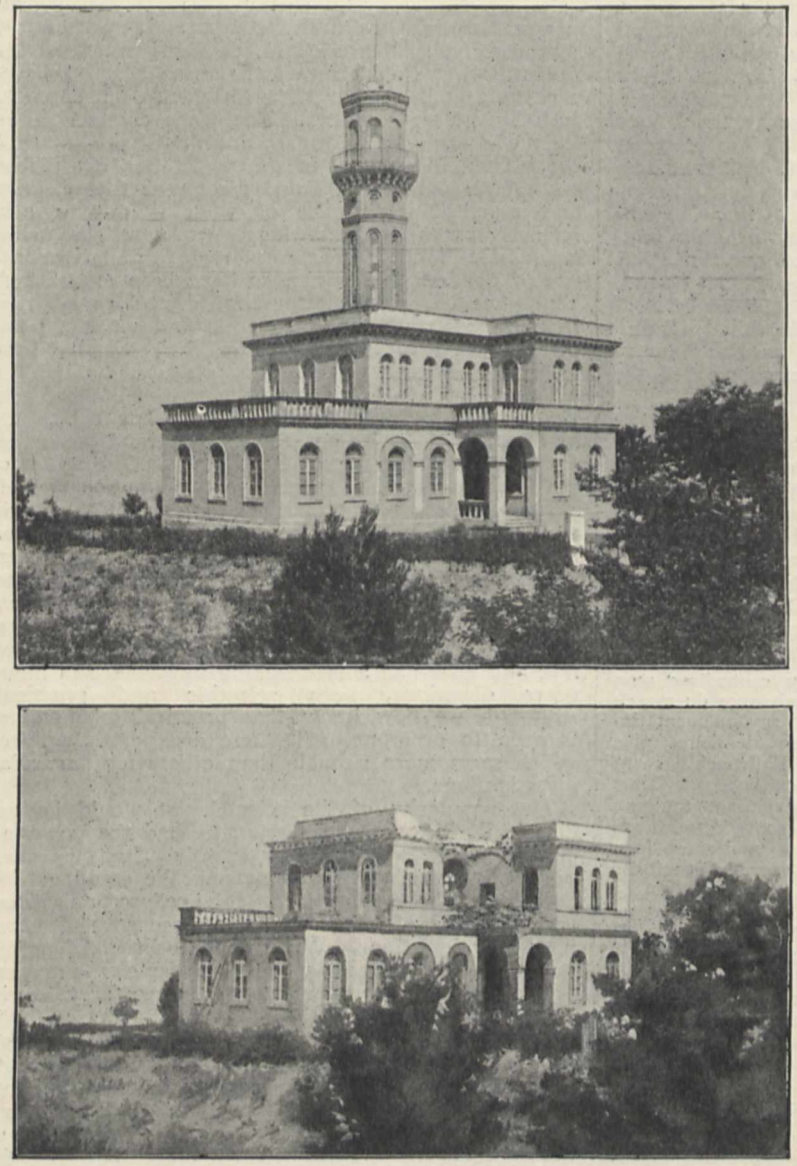
Now we know that in whatever part of the world we live it is possible to record large earthquakes, even if their origins are so far removed as our antipodes. These teleseismic records have increased our knowledge respecting the interior of our planet, thrown light upon the cause of certain cable interruptions, indicated suboceanic regions where depths are changing, and have had a far-reaching importance in many other directions, both scientific and practical. Although we now know that practical seismometry is open to everyone, still there are particular sites which seem more suitable than others for particular investigations.

The popularity of the seismologist would be enhanced if, like the astronomer, he had the power to predict. The latter tells us exactly when we shall see the next eclipse of the moon. We stand outside our door at the appointed time; the eclipse takes place, and we are again reminded of the accuracy of astronomical calculations. Whether the eclipse did or did not occur at the minute specified, so far as the general public are concerned, might not matter very much, but it would matter if the eclipse really meant, as it was supposed to mean in the Middle Ages, a portent of a great disaster. What the public imagine they would like to know about an earthquake is the time at which it might occur. If this could be stated, and at the same time something about the character of the expected disturbance in earthquake districts, seismology would be liberally supported. Astronomers have received the support of nations since the days of astrology, while seismology is in its childhood seeking for more extended recognition, and it is only as this is afforded that the public should look for replies to their difficult inquiries.

Through the Straits of Messina there is a fault or line of faults in the earth's crust, and from time to time, as in 1783, and in 1908, along these, sudden yieldings have taken place. It has been suggested by many seismologists that before such reliefs of strain take place a measurable amount of rock-bending may

be produced; rock-yielding or distortion of this character seems to have been measured in California before the earthquake of 1906, which ruined San Francisco and other towns.

With properly equipped observatories on two sides of the Straits of Messina, the existence or non-existence of such brady-seismical movements might be demonstrated and limits be recognised which preceded a crash. Kövislegethy has suggested other lines dependent upon the hysteresis of rock masses, along which we might conduct investigation which may possibly lead to the prediction of disaster. The dividing line between Calabria and Sicily is a theatre of hypogenic activity, and is a place above all others in Europe to be watched and studied carefully. As a site on which to make investigations respecting certain changes which are taking place beneath our feet it is of importance not only to Italy but to the world. We see from a paper we have recently received that the observatory at Messina in 1908 suffered severely, the disaster being chiefly due to the fall of a tower. The extent of this damage is shown in the accompanying figures. If it is only on account of the unique position of this observatory I feel certain that it is the wish of all seismologists to see it restored and re-equipped to extend its useful work. J. MILNE.



The Messina Observatory before and after the Earthquake of December 28, 1908.

SYNCHRONISATION OF CLOCKS.

DURING the past two years a committee consisting of the following members of the British Science Guild, Sir Hugh Bell, Bart., Hon. Sir John Cockburn, K.C.M.G. (chairman), Sir Norman Lockyer, K.C.B., F.R.S., Major O'Meara, R.E., C.M.G. (representing H.M. Postmaster-General), Sir Alexander Pedler, F.R.S., Dr. F. Mollwo Perkin, Prof. J. Perry, F.R.S., Sir William Ramsay, K.C.B., F.R.S., and Mr. St. John Winne, has been engaged upon the consideration of a problem which has often been referred to in the Press, both lay and technical; that is, the question as to how best may be achieved a systematic observance of absolute Greenwich mean time.

The problem is not altogether one affording opportunities for easy solution, for, as stated in the recently published second annual report of the committee, it is apparently beyond the power of human ingenuity to produce two clocks which will go together for one week. Nor is the problem a new one. In past years there have been many endeavours to utilise the services of electricity for the correction of clocks, so that a number of such may be uniform in their indications. Some time about 1840 Alexander Bain devised an electrically-driven pendulum, the principle of which was adopted by Mr. R. L. Jones, of Chester, to cause the pendulums of a group of clocks to beat in sympathy with a regulator, a system of synchronisation which met with some degree of success, but which was very limited in scope. Since that date the problem has been investigated by many with varying degrees of success.

Greenwich mean time has been for many years, and is yet, the standard time for Great Britain and Ireland, and the facilities afforded by the network of wires under the control of the Post Office authorities have been made use of for the distribution of standard time to those to whom the possession of means for ascertaining at any moment exact Greenwich mean time is a *sine qua non*. The distribution over the wires has hitherto resolved itself into the transmission from Greenwich Observatory—where the standard mean time solar clock is corrected daily about 9 a.m. to accord with the results of the preceding nocturnal stellar observations—of an electrical signal to the Central Telegraph Office in London, whence it is radiated over the telegraph wires to offices in distant towns, and thence over direct circuits to the subscribers who require the intelligence,

the main wires being temporarily connected to the subscribers' circuits by a switch. The Greenwich signal is transmitted to the Central Telegraph Office every hour, and it is therefore available for the use of such persons in London as require it, some few of whom exist.

For the temporary connection of the wires converging on London, which are normally associated with telegraph apparatus, to the Greenwich wire, a unique automatic switching device, called the *Chronopher*, is in use, a portion of which has existed since the early days of the telegraph companies. The apparatus consists of a multiple switch the movements of which are governed by a clock which, by means of certain electrical contacts, is arranged to operate the switch at the proper time. The clock itself is automatically corrected or synchronised by the Greenwich signal, and this clock, which seems to be cœval with the *Chronopher*, in common with certain others of a similar type, is probably one of the earliest successful endeavours to achieve *automatic* synchronisation, by a system which seems to have been introduced by Mr. C. V. Walker, of the Electric Telegraph Company. About 1876 Ritchie, of Edinburgh, introduced an improvement on a synchronising system (as distinguished from a sympathetic system), invented by Bain in 1842, and later appears to have improved on Walker's system, and many clocks synchronised on this principle, as well as Walker's, one of which is yet used at Aldershot for military purposes, are believed to be still in use.

There appear to have been one or two other synchronising methods introduced during the past few decades, but with the exception of the Standard Time Company, the operations of which are confined to London, and a system invented by Mr. Lund, none seems to have achieved a large measure of success; in fact, the Greenwich time signal transmitted by the Post Office is, in general, used to drop time ball, fire guns, or to give other visible or audible signals, the correction of clocks being performed by means of human intervention. A noteworthy method for accomplishing the latter is that introduced by Sir George Airy, sometime Astronomer Royal, which is still used by the Admiralty for correcting the standard clocks at their various dockyards. Each clock, in addition to its ordinary compensated seconds-beating pendulum, is provided with an auxiliary free pendulum, arranged to swing behind the clock pendulum. Normally the latter is latched to one side on a trigger which, at the proper time, is released by the Greenwich signal. When both pendulums are swinging, observations are made to ascertain the phase relationship, and a current of electricity is passed through a fixed electromagnet in such direction as to attract or repel the poles of a permanent magnet attached to the clock pendulum, thereby accelerating or retarding the latter until both pendulums are swinging in synchronism.

The British Science Guild Committee, however, mentions that the correction of clocks by hand is quite out of date and untrustworthy, and is unanimously of opinion that some form of direct physical control of public clocks by electrical synchronisation signals from a central time authority is essential. It seems strange that in a city like London, the largest in the world, and the most important commercially, where exact timekeeping would seem to be of the utmost importance, there should be so few clocks really to be relied upon. The committee refers to "Big Ben," which automatically reports its timekeeping performance to Greenwich Observatory, and the large clock in the portico of the old Post Office in St. Martin's-le-Grand, which is already electrically synchronised, as being probably the two large public clocks in London which can best be relied upon to indicate Greenwich time.

The committee has approached the London County Council, the City Corporation, H.M. Office of Works, the Local Government Board, the Post Office, and the various railway companies, but the response to its inquiries seems to be very discouraging. It appears that the question is treated rather apathetically by all save the Post Office authorities, who alone appear to realise the immense importance of the matter, and who have, within recent years, adopted a simple system applicable for the correction of large and small clocks, as well as public turret clocks, and who are extending the system as circumstances permit. It is stated that the cost of synchronising apparatus is small for any size or type of clock, so that it is possible that one of the main objections to the use of the Greenwich time signal, as at present transmitted, is the amount of the subscription to the Post Office which it involves. It is to be hoped therefore that, if the synchronisation of clocks is to be effected to any considerable extent, the authorities will see their way to provide a synchronising signal at a rate which will not appear to be prohibitive to those who have public clocks under their control.

It is clear from other reports which have appeared from time to time in the Press that municipal authorities and the public are not quite so apathetic as it might appear at first sight, for recently, public clocks have been installed by the local authorities at Aberdeen and Sheffield, and are about to be erected at Liverpool and at Taunton, which are, or will be, all electrically synchronised to Greenwich time. The fact that most of the makers of electric clocks, too, arrange for their master or controlling clocks to be synchronised as required, seems to indicate that they appreciate the feeling that there is some public demand in this direction.

The committee makes a comparison between the practice in this country and the practice abroad, where the importance of correct time seems to be more fully appreciated than here; but, no doubt, although progress in the matter has been somewhat slow in the past, given a reasonably cheap synchronising service, London and the rest of the country will ere long awake to the fact that, as the committee expresses it, a meretricious clock is equally as dangerous as a false yard measure, and then the observance of absolute time, once fairly started in operation, will be a recognised factor in our daily existence.

JULIUS WILHELM BRÜHL.

IT is with much regret that we have to record the death at Heidelberg, on February 5, of Prof. Brühl, the distinguished chemist. He was of Jewish parentage, and was born at Warsaw in February, 1850, and studied from 1868 to 1873 at Zurich and Berlin. In 1873, on completion of his studentship, he became assistant to Prof. Landolt at Aachen, and in 1879 was appointed professor in the University of Lemberg, which chair he resigned in 1884 on account of ill-health brought on by the unsuitability of the climate. After some sojourn at Freiburg (in Breisgau) he was induced by Bunsen to transfer his services to Heidelberg, where, in 1887, he became honorary professor in the high school, and took over the private laboratory of Prof. Bernthsen, who had then entered the service of the Badische Anilin und Soda-Fabrik at Ludwigshafen. In 1889 he commenced lecturing as Bunsen's representative, and was given full title as honorary professor in 1908. Brühl's contributions to science will be appraised in due course: they are

numerous and important and cover a wide range of subjects, chiefly on the border-land of physics and chemistry. His main work, and that with which his name will be always associated, is unquestionably his exhaustive and protracted series of researches on the relationship between the refractivity and the chemical constitution of organic compounds. Following the pioneering work of Gladstone and Dale in this country, Brühl made this subject for many years essentially his own, and he has always been regarded as the leader and chief authority in this branch of physical chemistry. It will be remembered that he was the first to bring optical evidence to bear upon the question of the constitution of the benzene "ring."

Brühl first made his mark in 1880 in that department of physical chemistry in which he laboured with such conspicuous success throughout the latter part of his life. His predecessors in this field had prepared the way by showing that some relationship existed between refractivity and chemical composition, but real progress only began to be made when, by his researches, he showed that the mode of linkage of the atoms, *i.e.* the chemical constitution, was all important in determining this physical property of the chemical molecule. Following up the fruitful line of work thus opened out, he showed further, that not only could the degree of unsaturation of an organic compound be determined by the refractivity method, but that the apparent anomalies between observed and calculated results were referable to the relative positions of the unsaturated groups, and so he invested the method with increased powers as a means of attacking the all-important problem of chemical constitution. Not the least important application of his method, and one which he himself developed towards the end of his career, is the determination by the optical method of the constitution of tautomeric compounds in solution—a problem which eludes ordinary chemical methods. It was this and other developments of his labours which brought him into contact with the researches of the late Sir William Perkin, with whom he was in constant communication and who had the greatest admiration for his work. Perkin was, in fact, attacking this and analogous problems by his method of magnetic rotation, and the influence of the two pioneers upon each other's results is acknowledged in their scientific publications.

A few years ago Brühl underwent a serious operation which crippled his activity and from the effects of which he never completely recovered. By his death science suffers a heavy loss, and this country is deprived of a warm friend, for the Heidelberg professor's Anglophile sentiments are well known. He was a familiar figure here, and highly esteemed by all who had the privilege of his friendship. His knowledge of our language, and of English literature generally, was both wide and deep, and his chief recreation was the reading of the works of English poets and novelists. Many letters by Brühl addressed to the present writer are distinctly high-class literary productions, which would put to shame many of our university graduates. It will be remembered that he was responsible for the German edition of the organic portion of Roscoe and Schorlemmer's treatise. He gave a Friday evening discourse on his own subject at the Royal Institution in May, 1905. He was an honorary member of that Institution, and the University of Cambridge bestowed upon him the honorary degree of Sc.D. during one of his visits to this country. The life-work of Brühl furnishes another illustration of the principle, so generally ignored here, that practical applications follow the development of pure science pursued for its own sake. Out of a series of researches prompted by no immediate practical requirements, but carried out solely with the object of ascertaining how far a particular physical property could be made available for the solution of some of the most abstract of chemical problems, there has arisen a method of the greatest practical utility to manufacturers for the determination of the purity or the value of many products used in chemical industry. Thanks to Brühl the "refractometer" has become a recognised laboratory instrument for technical as well as for scientific purposes.

R. M.

NOTES.

THE second reading of the Government Bill for the adoption of Greenwich time as the official time in France was adopted by the French Senate on February 10. In the discussion of an amendment to the measure, reference was made to the Daylight Saving Bill, and it was suggested that the question of introducing Greenwich time into France ought to be deferred until it was known whether our House of Commons would adopt the seasonal change of time-standard proposed in that Bill. The amendment was, however, rejected by 213 votes to 73, and the Bill passed into law, to take effect after the President's signature. France will thus be brought into the international or zone system of time-reckoning, and its official time will differ from other standard times in the system by a definite number of hours. The time of the Paris meridian will, however, be retained for naval purposes.

BY the instructions of the London County Council, a blue tablet of encaustic ware has been affixed to No. 32 Soho Square, W., at one time the residence of Sir Joseph Banks, who was elected president of the Royal Society in 1778, and held that office for forty-one years.

THE Helmholtz medal of the Berlin Academy of Sciences has, says the *Revue scientifique*, been awarded to Prof. van 't Hoff.

THE annual conversazione of the Institution of Civil Engineers will be held on Thursday, June 29, in the Royal Albert Hall.

THE next meeting of the Institute of Metals will be the second May lecture, which is to be delivered in London on Friday, May 12, by Dr. G. T. Beilby, F.R.S., on "The Hard and Soft States in Metals." The autumn meeting of the institute will be held this year at Newcastle-on-Tyne on Wednesday and Thursday, September 20 and 21.

DR. C. R. BEAZLEY, professor of history, University of Birmingham, has been elected a corresponding fellow of the Academy of Sciences of Lisbon, in recognition of his work on mediæval history, and especially on the explorations of the Portuguese.

THE gold medal of the Institution of Mining and Metallurgy has been awarded to Sir Julius Wernher, in recognition of his great personal services in the advancement of technological education and in the promotion of the highest interests of the mining and metallurgical professions.

THE *British Medical Journal* states that, in response to the request of the Chinese Government for an international commission to proceed to China at an early date to investigate the present outbreak of plague in Manchuria, and to devise means for the prevention of its further spread, the British Government has instructed Dr. Reginald Farrar, one of the medical inspectors of the Local Government Board, to proceed to China at an early date.

SIX Hunterian lectures on "The Fossil Remains of Man and their bearing on the Origin of Modern British Types" are to be delivered in the theatre of the Royal College of Surgeons, Lincoln's Inn Fields, by Prof. Arthur Keith, at 5 p.m. on Mondays, Wednesdays, and Fridays in the fortnight beginning on February 20. The lectures are designed to serve as an introduction to the study of the anthropological collection in the museum of the college.

THE Lannelongue prize, founded last year by Prof. Lannelongue, of Paris, has been presented to Sir Victor Horsley, F.R.S. The prize is a gold medal and the sum of 200*l.*, and it is awarded to the person who had contributed most to the progress of surgery in the ten years before the date of the award. It is open to surgeons of all nations, and is to be awarded every five years during the annual meeting of the Société de Chirurgie.

AT the anniversary meeting of the Malacological Society of London on Friday, February 10, held (by permission) at the Linnean Society's rooms, the following officers and council were elected for the ensuing year:—*President*, Mr. R. Bullen Newton; *vice-presidents*, Rev. R. Ashington Bullen, Mr. G. C. Crick, Prof. H. M. Gwatkin, Mr. B. B. Woodward; *treasurer*, Mr. J. H. Ponsonby; *secretary*, Mr. G. K. Gude; *editor*, Mr. E. A. Smith; *other members of the council*, Mr. S. Pace, Mr. H. B. Preston, Dr. W. G. Ridewood, Mr. H. O. N. Shaw, Mr. E. R. Sykes, and Mr. J. R. le B. Tomlin. The president delivered an address entitled "A Sketch of the Chief Geological Zones and their Mollusca."

THE current number of the *Revue scientifique* announces the election of the officers for the present year of several French scientific societies. In the case of the Physical Society, Prof. L. Poincaré is the president, M. B. Baillaud vice-president, M. H. Abraham general secretary, and Prof. Jean Becquerel secretary. Prof. Béhal has been elected president of the Chemical Society. M. Léon Teisserenc de Bort becomes president of the Meteorological Society, MM. Lemoine and Maillet vice-presidents, M. Goutereau general secretary, and M. Besson secretary.

THE *Kainan Maru*, with the members of the Japanese Antarctic Expedition on board, left Wellington, New Zealand, on February 11 for the Antarctic. It is stated that the only chart of the far south possessed by the expedition is a reduced copy of Sir Ernest Shackleton's map, and that the only means of transport on land consist of very light sledges and twelve dogs. A Press message from Hamburg states that the German South Polar Expedition will start from there on May 2. The expenses of the expedition, estimated at 68,000*l.*, have been partially guaranteed by Hamburg charterers.

AT the anniversary meeting of the Royal Astronomical Society on February 10, the following officers and council were elected:—*President*, Prof. F. W. Dyson, F.R.S.; *vice-presidents*, Sir W. de W. Abney, K.C.B., F.R.S., Mr. E. B. Knobel, Dr. W. H. Maw, Prof. H. H. Turner, F.R.S.; *treasurer*, Major E. H. Hills, C.M.G.; *secretaries*, Mr. A. R. Hinks, Mr. S. A. Saunder; *foreign secretary*, Sir David Gill, K.C.B., F.R.S.; *council*, Sir W. H. M. Christie, K.C.B., F.R.S., Dr. P. H. Cowell, F.R.S., Dr. A. C. D. Crommelin, Mr. A. S. Eddington, Prof. A. Fowler, F.R.S., Dr. J. W. L. Glaisher, F.R.S., Prof. E. W. Hobson, F.R.S., Mr. H. P. Hollis, Mr. Thomas Lewis, Prof. H. F. Newall, F.R.S., Rev. T. E. R. Phillips, and Mr. F. J. M. Stratton.

AT a meeting of the Institution of Civil Engineers on January 24, the influence of ocean currents along a coastline on the movement of sand was discussed by Mr. G. H. Halligar in describing the conditions on the coast of New South Wales. A permanent southerly ocean current having a velocity of about 1 to 1½ knots per hour inshore causes a sand movement in the direction of its flow which the heaviest seas or gales only temporarily disturb. Observations showed that even the most violent gales from the south only reverse the current during their continuance, while the more frequent northerly winds increase its velocity. The run-off of the rivers is not sufficient to scour out the river-mouths except in heavy flood, and stress is laid on the necessity for so designing harbour entrances that the velocity of the flood-tide entering it may be less than that of the littoral current, in order that the sand in suspension may be carried past the entrance instead of entering the estuary at each tide.

ON February 8 a portrait of Prof. W. Boyd Dawkins, F.R.S., by Mr. W. Llewellyn, was presented to the Whitworth Hall of the University of Manchester by a large number of friends and admirers who wished to show their appreciation of his long and distinguished services to the University, the Manchester Museum, and the City of Manchester generally. The portrait was unveiled by Prof. S. J. Hickson, F.R.S., dean of the faculty of science in the University, and was received on behalf of the University council by Sir Frank Forbes Adam, C.I.E., and the Vice-Chancellor, Sir Alfred Hopkinson. In unveiling the portrait, Prof. Hickson directed attention to the fact that largely through Prof. Dawkins's energy and enthusiasm the present museum has been transformed from the condition of an unclassified local collection of curiosities to be an important reference museum, meeting the wants of students and teachers, the general intellectual public, as well as those workers in science who have to rely on trustworthy material for reference. He also reviewed Prof. Dawkins's contribution to the early history of man, and the vertebrate palæontology of the Tertiary and post-Tertiary ages, as well as his activity in the problems of applied geology. Although Prof. Dawkins has now retired from the chair of geology, he still shares the work of the University as an honorary professor and as a museum lecturer and member of the committee, and thus his retirement from university work is more formal than real.

"THE Academic Aspect of the Science of National Eugenics" (Eugenics Laboratory, Lecture Series, vii. London: Dulau and Co., Ltd., 1911) is the title of a lecture delivered to undergraduates by Prof. Karl Pearson. Its main purport is to emphasise the need for the study of social questions in the same manner that scientific questions are studied. To quote the words of the lecturer:—"You cannot settle such essential problems of society as alcoholism, tuberculosis, mental defectiveness, or the changing status of women, by oratory in the market-place. I claim that these things must be studied in university laboratories, where Oxford shall check the results of Cambridge, and London correct both of them, if need be."

A LIST of publications of the Bureau of American Ethnology, with index to authors and titles, has been published by the Smithsonian Institution at Washington. These publications consist of contributions to North American ethnology, annual reports, bulletins, introductions, and miscellaneous publications. The issue of annual reports began in 1880, and the present maximum edition of an annual report is 9850 copies. With the exception of a few copies of the publications of the Bureau disposed of by the U.S. Superintendent of Documents, the editions are distributed free of charge.

IN *Man* for January, Mr. H. S. Cowper describes the exploration of a flint implement factory on a site at Hilwan, Lower Egypt, previously examined by Mr. A. J. Jukes Brown, who contributed papers on the subject to the Journals of the Cambridge Antiquarian Society and the Anthropological Institute in 1877. He discusses the theories that this type of implement may have been used for arming the edges of serrated weapons or for fishing, and, deciding in favour of the latter supposition, suggests that the sites where implements of this type are found should be studied in relation to the fishing industry. He asserts that they have no connection with the Neolithic implements found in such large numbers in recent years in various parts of the desert of Lower Egypt.

THE habits of the common American mole, *Scalops*, or *Scalopus*, *aquaticus*, are discussed in two papers, respectively by Mr. F. E. Wood and Mr. J. A. West, published in vol. ix., of the Bulletin of the Illinois State Laboratory of Natural History. This mole, which—despite its name—is not aquatic, undoubtedly does much damage to newly sown cornfields by burrowing along the lines of the drills. From such tunnelled rows the seed is often found to have more or less completely disappeared, and farmers charge the mole with being the culprit. The accusation is proved by Mr. West to be true, the stomachs of many of the moles examined by him containing corn in various proportions to the rest of the food. For the greater part of the year, however, these moles feed on worms and insects.

"THE Sudden Origin of New Types" is the title of an article communicated by Dr. F. Oswald to the January number of *Science Progress*. After adducing evidence in support of this theory from plants, the author observes that the sudden rise and predominance of mammals in the Tertiary must be due to rapid development of some part of their organisation, and that this part was the mammary glands. These glands, it is suggested, may have been derived from the lateral-line system of amphibians, since both are developed in the Malpighian layer of the skin. Having stated that such a derivation is "within the range of probability," Mr. Oswald proceeds to regard it as a demonstrated fact, and to argue that, "as a necessary corollary to the absence of the lateral line in all reptiles, it is evident that—contrary to the received and general opinion—the mammals must have taken their origin directly from Amphibia, not from anomodont reptiles." Then follows a review of apparent instances of the sudden rise of certain groups (such as graptolites) or certain organs among invertebrates, special stress being laid on a suggested origin of tracheæ from the gills of a hypothetical fresh-water trilobite by the transformation of the latter into lung-books sunk in the body and communicating with the exterior by means of stigmata.

MUCH interest attaches to the description by Prof. H. F. Osborn, in the January number of the *American Museum Journal*, of a "mummy" of the iguanodont dinosaur from the Kansas Cretaceous, known as *Trachodon annectans*. The specimen includes, not only the greater part of the skeleton, but likewise a large portion of the epidermis, which "is shrunken around the limbs, tightly drawn along the bony surfaces, and contracted like a great curtain below the chest-area." In the opinion of its describer, the reptile, after dying a natural death, lay for a time on a river-bank, without being molested by birds or crocodiles, until it became thoroughly desiccated, after which it was carried down by a flood, and buried in sediment of a character suited to retain a cast of the surface sculpture. The skin was covered with tubercles, varying in size on different parts of the body. The tenuity of the epidermis favours the theory, according to Dr. Osborn, that these reptiles "spent a large part of their time in the water, which theory is strengthened by the fact that the diminutive fore-limb terminates, not in claws or hoofs, but in a broad extension of the skin, reaching between the fingers and forming a kind of paddle. This marginal web, which connects all the fingers with each other, together with the fact that the lower side of the fore-limb is as delicate in its epidermal structure as the upper, tends to support the theory of the swimming rather than the walking or terrestrial function of this fore-paddle." The article is illustrated with pictures, not only of the "mummy," skin, and skeleton, but likewise of the restored animal, the length of which was about 30 and its height between 15 and 16 feet.

ACCORDING to the report on the Botanic Station Experimental Plots and Agricultural Education, Antigua, 1909–10, there are indications that the cotton industry may regain some of its late importance. Experiments are reported on the flower-bud maggot and the leaf-blister mite; hybridisation work has also been begun. The production of cocoanuts and limes is increasing, and becoming an important industry; onions are also being more and more grown. Experiments are reported on broom corn and other crops likely to be useful. The report on the Botanic Station, St. Kitts-Nevis, shows that the sugar-cane season has been successful; early planted cotton also did well, and planters are learning to control the pests; there also seems the prospect that cacao and rubber may be successfully grown. Experiments are recorded on yams, sweet potatoes, and onions. The Montserrat report shows useful work is being done in connection with cotton selection and the cultivation of limes. Other lines of investigation deal with the improvement of ground nuts and Indian corn by selection, and the determination of the best varieties of certain provision crops.

AN investigation into the effect of coloured light on the development of pure cultures of the green alga *Stichococcus bacillaris* is described by Prof. G. A. Nadson in the *Bulletin du Jardin Impérial Botanique*, St. Petersburg (vol. x., part v.). The cultures raised in reddish-yellow light showed weak growth and colour; those in bluish light showed at first rather weaker development, but eventually the filaments assumed a purer green colour than those in white light, and the improvement was maintained through successive generations grown in blue light. The same author, with Mr. S. M. Adamovic, describes the experiment of adding to a culture solution for *Bacillus myocides* a proportion of the products of catabolism taken from a previous culture of the organism. This produced a marked change in the Bacillus, inhibiting its powers of liquefying gelatin and producing spores, and causing it to form special membranes round its cells.

THE International Association of Tropical Agriculture and Colonial Development has issued, in pamphlet form, the report on the present position of cotton cultivation, which was presented to the congress in Brussels in 1910 by Dr. Wyndham R. Dunstan, F.R.S. The reports which Dr. Dunstan has brought together, as reporter-general to the congress on cotton cultivation, relate to all those countries in which cotton cultivation is an established and important industry, and also to those in which cotton cultivation is still in an experimental stage. The writers of the reports were requested to pay special attention to the present position and prospects of the industry, any

special difficulties met with, and the nature of the experimental work in progress. Summaries of all these reports are given here, and Dr. Dunstan discusses generally the more important questions involved, and considers the problems of cotton production as a whole. Copies of the publication can be obtained from the Imperial Institute at 1*s.* each, or 1*s.* 1½*d.* post free.

THE Colonial Annual Report, No. 644, deals with survey work accomplished in British Africa, Ceylon, Cyprus, Fiji, Jamaica, Trinidad, and British Honduras during the year ending March 31, 1910. It is essentially a progress report, and the methods of work employed in the different Crown colonies are therefore not described, and no comparison of them is possible. In several areas triangulation, topographical detailed surveying, and cadastral surveying are in hand, and the last-named is often urgently needed for the settlement of native owners and the allotments of Government lands. The long list of directors and inspectors of survey already engaged on this important work, which is presented at the end of the report, would seem to indicate that the study of advanced surveying may be worth the attention of physical and mathematical students.

METEOROLOGICAL material is rapidly accumulating in Africa, and a valuable contribution is published in the *Mitteilungen der deutschen Schutzgebieten* (Heft 5, Band 23). Tables of the rainfall recorded at fifty-one stations in the Cameroons during 1909 are given detailing the total and maximum in twenty-four hours for each month, as well as the distribution of rainy days. On the whole, the rainfall in the north and south of the colony was not markedly greater than in the previous year, but at a group of stations in the central portion, especially in the Cameroon mountains, the rainfall of 1909 was considerably greater. From the eastern coast of Africa we have the whole of the meteorological observations taken at forty-seven stations in 1907 and 1908 throughout German East Africa from the coast so far inland as Lake Tanganyika.

AN interesting question of geological nomenclature is raised by Prof. J. W. Gregory, F.R.S., in an article in the *Geographical Journal* for February. The terms "denudation," "erosion," "corrosion," and "corrasion" are dealt with, and after an examination and discussion of the uses of these terms by various geological writers, Prof. Gregory makes several suggestions. He thinks it would be convenient, with a view particularly to secure uniformity in Europe and America, to use the terms as follows:—denudation for the wearing down of the land by any agency; erosion for the widespread lowering of the land by wind, rain, and weather, and by rivers and glaciers acting laterally; corrosion for the excavation by rivers and glaciers of their beds; corrasion dismiss as a synonym of corrosion; abrasion for the attack of the sea on the land, though when used in this restricted sense it is well to refer to the process as marine abrasion; solution for the action of solvents.

ON February 13 Major P. H. Fawcett, R.A., lectured before the Royal Geographical Society on the exploration which had to be undertaken in Bolivia before the delimitation of the new frontier between that country and Peru could be carried out. Situated in the extreme north-west of Bolivia, and watered by the Madre de Dios and its tributaries, this plain at the foot of the eastern slopes of the Andes is largely covered by dense forest, and the natives have always been intensely hostile to all parties who have attempted the exploration of this region. The Heath river, previously hardly known, was ascended in canoes, and by gaining the friendship of the natives much assistance was gained. These Guarayos use the milky juice of the "manuna" or "soliman" tree, which is perhaps to be identified with *Hura crepitans*, to capture fish in the lagoons of the forest; it is poured into the water, and every fish coming in contact with it is rendered incapable of movement, though still alive, and in no way impaired as food. Exploration being the object of the expedition, little time could be given to scientific observation, and the weather rendered all astronomical observations for the determination of position impossible. Gold is stated to occur in many parts of the foothills, and copper, antimony, galena, and silver to exist abundantly in a region which is still largely inaccessible.

MR. N. A. KOROSTELEF has collected meteorological observations recorded by various expeditions to Novaia Zemlia, among which those from Malyia Karmakuly extend over sixteen years (Bulletin of the Imperial Academy of Sciences of St. Petersburg, No. 11, 1910). The climate is exceedingly cold and damp, the sky is generally overcast, and exceedingly strong winds are frequent, accompanied by only slight precipitation. The variableness of the weather and of the monthly means of the meteorological readings is very marked. The temperature of March was 19·4° F. in 1907 and −18° F. in 1902. Again, the mean for the winter half of the year (November–April) was 18° F. in 1906–7 and −4° in 1901–2. Cyclones following one another, with occasionally more permanent anticyclones, account for the variableness of the climate. The highest temperatures during the whole period of observation occurred in all the months of the year, that is, a thaw is possible in any month. On the other hand, there was no month without frost; once the thermometer fell in July to 14° F.; 1898 was remarkable for the range of pressure, when the barometer in the short interval from February 8 to March 16 passed from the absolute minimum of the whole period of observation, 28·31 inches, to the absolute maximum, 31·22 inches. There is great humidity in the air in all months, the average being 84 per cent., or 5 per cent. higher than in St. Petersburg. The cloudiness is, on an average, three-fourths, declining to nought in winter and rising so much the higher in summer. The number of days in the year with precipitation was 181; in October the average number was twenty, and in one year there was in March only one day without precipitation. The prevailing winds are south-east and east; only in June do they blow chiefly from the north and north-west. The winds are very high, and the greatest velocity recorded was 131 feet a second. Not infrequently, however, the anemometer was unable to withstand the force of the wind.

A RECENT contribution of Mr. Alfred W. G. Wilson to *Economic Geology* (vol. v., No. 7) gives a descriptive account of the organisation and work of the Department of Mines of Canada. The department dates from 1907, while the Geological Survey of Canada, the forerunner of the present department, was first constituted in 1842. The paper provides interesting particulars as to the development and growth of the work of the department. In past years the funds voted by Parliament for the service of what is now the Department of Mines have usually been little more than 20,000*l.* It is only within the last few years that there has been any notable increase; for 1909–10 the total amount available was 101,000*l.*, being slightly more than one half of 1 per cent. of the annual value of the industry for the same year. For the fiscal year 1910–11 the total vote at the service of the department for all purposes is about 124,000*l.*, which includes

a special grant for the investigation of processes for producing zinc. In this connection, attention may be directed to an advance chapter of the annual report on the mineral production of Canada during 1909, which has been received from the department, dealing with structural materials and clay products. The chapter is by Mr. J. McLeish, chief of the division of mineral resources and statistics. The subjects considered are cement, clay products, lime, sand-lime brick, sands and gravels, slate and stone for building. It appears that 1909 was one of record activity in the building trades. The value of cement sales in 1909 showed an increase of 44 per cent. over 1908, clay products 43 per cent., and lime 58·8 per cent. The total value of the increase in production amounted to well over a million pounds sterling.

THE Bryn Mawr College Monographs continue to show the activity of the institution in scientific research. Vol. viii. of the reprint series contains sixteen mathematical and two physical papers. Miss C. A. Scott contributes an elegant note on the construction of certain regular polygons with the help of an auxiliary hyperbola; and among the numerous papers by Mr. J. E. Wright, those on differential invariants may be mentioned as specially interesting. The physical papers (both by ladies) are on the spectra of sulphur dioxide and on the electric spark in a magnetic field.

IN his presidential address to Section A of the South African Association for the Advancement of Science, delivered on November 2, 1910, Prof. J. C. Beattie gives an historical account of the growth of our knowledge of terrestrial magnetism, dealing more especially with the magnetic elements in Africa. Prof. Beattie regards the establishment of one or more fixed magnetic observatories in South Africa as an object of great scientific importance, and in this he undoubtedly has the support of all the leading magneticians of Europe. An appendix deals with terrestrial lines of declination, dip, and horizontal intensity for South Africa, based on the recent survey by Profs. Beattie and Morrison, and contains a chart for each of the three elements.

THE December (1910) number of *Terrestrial Magnetism and Atmospheric Electricity* contains a report of the Berlin meeting of the Commission on Terrestrial Magnetism and Atmospheric Electricity, and a useful reprint of the whole of the resolutions passed by the commission since the Munich meeting in 1891. Many of these refer to the steps to be taken to facilitate the comparison of the results obtained at different observatories. For this purpose, it is desired that the curves of variation of declination be reproduced to the scale of 1 minute of arc to 1 millimetre, those of horizontal and vertical intensities to the scale of 0·00005 C.G.S. unit to 1 millimetre, and that for disturbances the time scale be 1 hour to 15 millimetres. The importance of regular and frequent comparisons of the instruments used at the various observatories is insisted on. So far, nothing appears to have been done to carry out the suggestion of the commission that magnetic observatories be established along the magnetic meridian passing through the centre of Africa.

SEPARATE copies have been received of two communications made by Dr. F. Jentzsch, of Wetzlar, to the meeting of the German Naturforscher und Arzte at Königsberg in September last, which have appeared in the *Verhandlungen der Deutschen Physikalischen Gesellschaft*. They deal with appliances designed by the author for improving the ultramicroscope. It will be remembered that in the ultramicroscope as used hitherto the light has impinged on one side only of the object. Dr. Jentzsch's concentric condenser and ultracondenser receive the light along the axis of the microscope. It is reflected by a surface underneath the object, and, after further reflection, crosses the axis at right angles at the point at which the object is placed. An intense beam of light is thus produced, and the arrangement has the advantage that it can be fitted to an ordinary microscope.

ACCORDING to a circular issued by the Bureau of Standards at Washington in December, 1910, the Bureau on January 1 adopted the value 1·0183 international volts for the electromotive force of the Weston normal cell at 20° C. This is equivalent to an increase of 0·08 per cent. in the value of the international volt as used by the Bureau. The above value has been arrived at by an international investigation carried out at the Bureau of Standards by representatives of the Bureau, the National Physical Laboratory, the Reichsanstalt, and the Laboratoire Central, and is to be adopted by all these institutions so soon as the various Governments pass the necessary legislation (see p. 508). The international ohm, our readers will remember, is the resistance of a mercury column at 0° C., 106·3 centimetres long, of uniform cross-section, and of mass 14·4521 grams, and the international ampere deposits 0·001118 gram of silver per second.

IN a paper read at the February evening meeting of the Pharmaceutical Society, Dr. W. H. Martindale suggested that rounded-off atomic weights should be adopted in the new "Pharmacopœia." The atomic weights of elements employed in the pharmacopœias of different nations show considerable variation in magnitude, especially with regard to the first, second, and third place of decimals. The figures for such important elements as arsenic, bismuth, bromine, chlorine, iodine, lithium, silver, and sodium vary particularly, and the variations are not accounted for by the fact that the oxygen standard is adopted by some and the hydrogen standard by others. Dr. Martindale's opinion is that, with the exception of the weights for chlorine, copper, and strontium, it might be better to do away with the decimal proportions altogether, and that a rounded-off series of figures like those in the French "Pharmacopœia" would be sufficiently accurate for pharmaceutical purposes. If rounded-off international standards could be arranged, so much the better.

THE Journal of the Chemical Society for January contains the reply of Prof. Komppa, of Helsingfors, to the criticisms of Messrs. Leblanc and J. F. Thorpe on his synthesis of camphoric acid. The critical point in the synthesis depends upon the point of attachment of the last methyl-group introduced into the molecule, which Komppa regards as attached to carbon (as in camphoric acid), whilst Leblanc and Thorpe have urged that its ready removal by alkalies proves it to be attached to oxygen. The original proof that the methyl-group was attached to carbon was based very largely on the fact that camphoric acid was actually prepared from the methylated compound, but it is now shown, further, (1) that the ester contains the group —CO—CO—, because it forms a colouring matter with *o*-phenylene diamine, resembling in this respect the whole series of ortho-quinones, but contrasting sharply with an isomeric ester in which the grouping is changed in the manner suggested by Leblanc and Thorpe to —CO—C(OCH_3)=, and (2) that the Zeisel method of analysis indicates the presence of only two —OCH_3 groups in the ester, although the isomeric ester actually gives the three —OCH_3 groups postulated by Leblanc and Thorpe. So much interest has attached to this synthesis, as settling

beyond all question the structural formula of camphor, that the confirmation now given of the validity of the synthesis is of considerable value and importance.

AN article on petrol-engine ratings appears in *Engineering* for February 10. It has never been altogether clear why so much ingenuity has been expended in the invention of formulæ which will give the horse-power of a petrol engine in terms of its physical dimensions, especially as most builders of such engines are quite prepared to state the actual brake-horse-power which has been given by any of their engines. In 1906 the Royal Automobile Club settled on the well-known formula $B.H.P. = 0{\cdot}4D^2N$. This formula is founded on an assumed mean effective pressure of 67·2 lb. per square inch and a piston speed of 1000 feet per minute. A report was presented at the meeting of the Incorporated Institution of Automobile Engineers on February 8, drawn up by the horse-power-formula committee. A new formula is given which avoids the objections raised to that given above, viz. the assumption of values for both the mean pressure and the piston speed, and the form being such that no correction can be applied for the increase of mean pressure which takes place with increase in the diameter of the cylinders, or for the increase in piston speed which occurs with an increased stroke-bore ratio. The committee's formula is based on the results of tests on 144 actual engines, and is as follows:—

$$B.H.P. = 0{\cdot}45(d+s)(d-1{\cdot}18)N,$$

where d is the bore of the cylinder in inches, s the stroke of the piston in inches, and N is the number of cylinders.

WE are informed that, owing to an alteration in the publications, papers read before the Physical Society of London in future will appear, in general, only in the Proceedings of the society, and not in the *Philosophical Magazine*. The Proceedings and other publications are now obtainable by the public from the publishers to the society, *The Electrician* Printing and Publishing Company, Ltd., 1, 2, and 3 Salisbury Court, Fleet Street, London, E.C.

THE eighteenth report of the Leicester Museum and Art Gallery Committee to the Town Council for the year ended March 31, 1910, has been received. The long-projected extension and reconstruction of the museum and art gallery buildings have now been commenced. Important additions were made to the museum during the year; in the department of Coleoptera and economic entomology, a collection of 6000 specimens of 1300 species was presented by Mr. C. B. Headly, and 408 specimens of 356 species, chiefly from Leicestershire, were given by Mr. F. Bouskell.

OUR ASTRONOMICAL COLUMN.

NOVA LACERTÆ.—Several further notes on Nova Lacertæ appear in the *Astronomische Nachrichten*. In No. 4470 Prof. Pickering gives particulars concerning the earlier history of the star, according to the Harvard collection of photographs, and states that spectrum photographs by Mr. E. S. King showed eleven bright lines. Prof. Nijland gives the results of magnitude observations at Utrecht showing a gradual decrease in the nova's brightness from 7·40 on January 1 and 2 to 8·30 on January 16; the colour was fairly constant at 3·7, and is found to be similar to that of the long-period variables R Arietis, T Cassiopeiæ, and S Ursæ Maj. at their maxima. Photographic magnitude observations at Munich, reported by Dr. Kühl, agree with the above in showing a somewhat similar decrease over the same period

In No. 4471 Dr. Max Wolf gives the measures of the nova's position on plates taken on January 17 and in 1904, and raises the question whether the slight difference of 0·10s. in R.A. may be ascribed to proper motion.

Mr. P. M. Ryves has communicated to us his observations of the nova's magnitude, made at Zaragoza, Spain, between January 5 and February 5. The observations were made with a 3-inch telescope, Harvard and D.M. magnitudes being taken for the comparison stars, and show a steady decrease from 7·2 to 8·6 in the observed magnitudes.

A further note concerning the spectrum of the nova, as photographed at the Meudon Observatory, is contributed by M. Idrac to the *Comptes rendus* for February 6. Three fine nights, January 28–31, permitted him to secure photographs with from one to three hours' exposure on panchromatic plates. The very broad, bright hydrogen lines are seen to be divided into two components, of which the brighter show a "shift" of 7 Angströms towards the red, while the fainter are displaced 16 Angströms towards the violet; a dark line, possibly double, occurs on the violet side of $H\gamma$. In the yellow there are three bright bands, at about λ 587·4 (probably helium, 587·6), λ 575·4, and λ 567·5, while the green shows a band, about 30 Angströms broad, having its centre near λ 500, and a bright line at λ 493·7. The band at λ 465, mentioned in the earlier communication, is shown to be multiple, having maxima at λ 462 and λ 466, with a fainter component at λ 470; the bright lines near λ 437·4 and λ 458·3 are also shown, but appear less marked than previously. Other maxima and minima mark the continuous spectrum, and are probably indicative of lines or bands beyond the separating power of the spectrograph; such maxima are well marked in the neighbourhood of λ 425 and λ 445. The presence of nebula lines in the spectrum is open to question, but the strong band near λ 500 suggests the possible presence of the chief nebula line; its great width, however, prevents any definite solution of the question; in fact, all the wave-lengths given may only be accepted as approximations.

EPHEMERIS FOR FAYE'S COMET.—To No. 4469 of the *Astronomische Nachrichten* Dr. Ebell contributes a daily ephemeris for Faye's comet, based on the elements published in No. 187 of the Lick Observatory Bulletins, and extending to March 27. At present the object is very near to π^2 Orionis, and is calculated to be a little fainter than the thirteenth magnitude; its motion is easterly, with a slight northern trend.

STANDARD ASTROMETRY.—An important suggestion as to the publication of results obtained in accordance with the scheme of the International Astrographic Conference is made by Mr. W. E. Cooke in No. 4470 of the *Astronomische Nachrichten*. This scheme embodies the observation of a definite list of fundamental stars by observatories equipped to carry out such work with the greatest possible accuracy. Other stars, *étoiles de rèpere*, will be connected with these by careful differential observations through a third set of stars employed as "intermediate standards." Mr. Cooke's suggestion is that while the differential observations should be made with the greatest possible accuracy, the results should be published in such a manner as to show the standards upon which each catalogued position depends.

The value of the suggestion is obvious. Although the international fundamental catalogue will probably be far superior to any now existing, future improvements in the standards are inevitable, and if Mr. Cooke's plan is followed, future observers will be able to reduce the individual published observations to the improved standards.

Mr. Cooke has followed this plan in vol. iv. of the Perth Observatory Meridian Observations, 31° to 33° S. (1900), recently received, and in an appendix he gives blank columns in which the corrections, dependent upon the future improvement of the places given in the "Perth Catalogue of Standard Stars, 1905·0," can readily be inserted.

NEW SPECTROSCOPIC BINARIES.—Lick Bulletin No. 182 gives the measures of a number of stars of which the radial velocities have recently been discovered to be variable. The following were discovered on plates secured at Santiago, generally with the two-prism instrument, and are described by Mr. J. H. Moore:—λ Hydri, γ Mensæ, ξ Columbæ, h^1 and h^2 Puppis, δ Antliæ, θ_1 Crucis, ξ^2 and h Centauri, and d Lupi; for h Centauri Mr. Paddock finds a period of about 16·7 days. Observations made during

1904–7 show that ζ Gruis is a binary with a range of velocity from −8·7 to +1·7 km.

Variations in the radial velocities of the following stars have also been detected from Lick and Santiago observations, and are reported by Prof. Campbell:—16 Aurigæ, o_2 Canis Maj., 12 Comæ Berenices, 4 Ursæ Min., *i* and 36 Ophiuchi, *f* Draconis, A Sagittarii, and α Cygni. In the case of *i* Ophiuchi, a plate taken on April 28, 1910, shows that the line at λ 4481 distinctly double, giving radial velocities of −77 km. and +9·2 km. for the two components. Fifteen plates of α Cygni, taken between August, 1896, and December, 1909, show that the variability of the velocity is not great, the range being from 0 to 7·9 km.

OBSERVATIONS OF JUPITER'S GALILEAN SATELLITES.—In No. 5 of the Transvaal Observatory Circulars, Mr. Innes gives an account of the observations of Jupiter's satellites made at the observatory during December, 1909, to August, 1910. The observations were made with the 9-inch refractor, and, in addition to the times of occultations and transits, remarks are added as to the appearance of the satellite, the phenomena of its disappearance or reappearance, and the appearance of various belts on the planet itself. Mr. Innes records that on February 16, 1910, the final occultation of J III was long drawn out; whereas five-sixths of the satellite was occulted in 6½ minutes, the remaining one-sixth took another 6m. 10s. When half the satellite was occulted, the remaining half had the appearance of a close double star alongside Jupiter's edge. Satellites I and III were occasionally remarked to be oval rather than round, and several spots and markings were seen on their discs. An unpredicted partial transit of IV across the N. pole of Jupiter occurred on August 14, 1910.

A CONFIRMATION OF THE DISINTEGRATION THEORY.[1]

IT is probable that the transition from radium through the emanation to radium D involves the loss of four α particles, that is, four atoms of helium. The atomic weight of radium may now be taken to be 226·4, and if, on changing into niton, one α particle is lost, it is to be expected that the atomic weight of niton should be 222·4, for 226·4−4=222·4. But attempts to estimate the density of niton by determinations of its rate of diffusion have in most cases yielded the value 176 to 180, though Perkins, comparing the diffusion-rate with that of mercury vapour, obtained the value 235; and Debierne, using Bunsen's method of causing the gas to issue through a minute hole, arrived at the value 220. Undoubtedly the emanation belongs to the series of the inactive gases, and to complete the series—helium, 4; neon, 20; argon, 40; krypton, 83; and xenon, 130—there is room for two higher members with atomic weights 178 and 222·4.

It might happen that, in the disintegration of radium to niton, a non-radio-active substance might be produced of atomic weight 44; the change would then be:—radium (226·4)=helium (4)+(say) scandium (44)+niton (178·4).

The only certain method of ascertaining the molecular weight of a gas is the determination of its density; and in this case it is almost certain that the gas is monatomic, and that its molecular and atomic weights are identical. This constant has now been determined by the help of a balance closely resembling one recently described by Steele and Grant in the Proceedings of the Royal Society.

For details of the construction and use of the balance, the original paper must be referred to; suffice it to say here that its sensibility is about two or three millionths of a milligram. The weight is ascertained by the alteration of the pressure in the balance-case, thus altering the buoyancy of a small bulb of silica containing about 20 cubic millimetres of air, the weight of which is 0·027 milligram, or 27,000 millionths of a milligram.

A preliminary experiment, in which 0·0977 cubic millimetre of xenon was weighed, gave its weight as 578 millionths of a milligram instead of the calculated 577; it was thus shown that fairly good results might be expected in determining the density of the emanation.

In a month, the emanation may be taken as having wholly changed into its degradation products, the chief of which is radium D; and an experiment was made in which a minute density-tube was left on the balance for three months before it was opened, evacuated, and reweighed. The loss was helium, and its weight was 27 millionths of a milligram; the calculated weight, on the assumption that the density of niton is 222·4/2=111·2, and that each volume of the emanation yields three volumes of niton on disintegrating, should have been 38 millionths. This helium, judging from previous experience, had probably penetrated the glass of the density-tube and been retained there. The tube was therefore heated *in vacuo*, and the evolved helium washed out with a cubic centimetre of oxygen; the gases were transferred to a measuring apparatus, and after absorbing the oxygen by charcoal cooled with liquid air, the helium was measured. Calculating the volume to weight, its weight must have been 8 millionths; and the sum of 8 and 27 gives 35, instead of the calculated 38 millionths of a milligram. A further proof is thus given of the conclusion drawn by Ramsay and Soddy from the measurement of the volume of niton, and of the helium into which it changes, that the latter is three times the former.

Five determinations of the density of niton were made; stated as atomic weights, the figures are:—227, 226, 225, 220, and 218; the mean is 223. This number is the one calculated on the assumption that when radium disintegrates, the only immediate products are niton and helium, 226·4=222·4+4.

In suggesting the name niton for the cumbrous expression "radium emanation," the authors point out that it is advisable to indicate by a similar name the fact that this gas belongs to the argon series; were its radio-active relations to be emphasised, as in the term "radium emanation," it would be necessary to rename radium as a derivative of uranium by some such name as would introduce the word uranium.

The authors regard the work as a further proof, if any were needed, of the beautiful disintegration theory of Rutherford and Soddy.

[1] "The Density of Niton (Radium Emanation) and the Disintegration Theory." By R. Whytlaw Gray and Sir William Ramsay, F.R.S. Abstract of paper read before the Royal Society on January 12.

SAFETY LAMPS AND THE DETECTION OF FIRE-DAMP.

WE have received from the Home Office a leaflet and a card in a convenient form for carrying about in the pocket, upon which are shown, reproduced in colour, the appearances presented by the miner's lamp in the presence of fire-damp. The difficulty of reproducing the appearances presented by a fire-damp "cap" in the safety lamp is very great, but it must be admitted that the illustrations issued by the Home Office are of a very high standard of excellence, whether considered from the artistic or from the technical point of view. Necessarily, these illustrations suffer from various defects: the Home Office does not state what class of lamp was employed or the nature of the oil burnt in it, and it is a well-known fact that these conditions influence greatly the nature and appearance of the cap. It is, for example, very well known that the Wolf lamp, burning benzene, is more sensitive than an ordinary Massant lamp burning, say, colza, or a mixture of colza and mineral oil.

We very much doubt whether one man in ten would be able to see 1½ per cent. of fire-damp, as indicated on the card, the lower limit of visibility with most men being about 2 per cent. It is, of course, well known that men's eyes differ very considerably in the power of seeing these faint caps, and the representations here given are of caps as they appear to a man whose eyesight is well developed by training and well fitted by nature for seeing these delicate phenomena. It is a pity that the Home Office has not directed the attention of miners more strongly upon the card, in the same way as it has done in its leaflet, to the danger attending far smaller proportions of fire-damp than the lamp can detect in the presence of coal-dust.

It is to be feared that the issue of the card without such a caution as we have referred to, will induce among miners the fixed opinion that they are perfectly safe so long as their lamp shows no cap. But it is well recognised that a

rar smaller percentage of fire-damp than any lamp will detect may be the source of the gravest danger in the presence of coal-dust, and we hope that, in subsequent issues, the Home Office will see its way to lay the strongest possible stress upon this fact. The average pitman is only too prone to believe that anything which the Home Office does not distinctly declare to be dangerous, must be absolutely safe, and every care should be taken to dispel so fatal a confidence.

FLIES AS CARRIERS OF INFECTION.[1]

THE reports referred to below include the results obtained in the further investigations concerning flies as carriers of infection. These are considered under the following heads:—(1) observations on the ways in which artificially infected flies (*Musca domestica*) carry and distribute pathogenic and other bacteria, by Dr. G. S. Graham-Smith; (2) summary of literature relating to the bionomics of the parasitic fungus of flies (*Empusa muscae*), by Mr. Julius Bernstein; (3) note as to work in hand, but not yet published, and as to proposed further work in reference to flies as carriers of infection, by Dr. S. Monckton Copeman, F.R.S.

Dr. Graham Smith gives the results of an elaborate series of experiments in connection with the *rôle* which house-flies are supposed to play in the dissemination of disease. He has proved conclusively (*a*) that in artificially infected flies non-spore-bearing pathogenic bacteria do not survive on the legs and wings for more than a few hours (five to eighteen); (*b*) that these bacteria (*a*) frequently survived within the crop for several days, and usually for a longer period in the intestine; (*c*) that the fæces and regurgitated fluids ("vomit") often contain the organisms (*a*) in considerable numbers, and that they may remain infective for varying periods; (*d*) that "the only spores (*B. anthracis*) with which experiments were made survived on the legs and wings, in the crop and intestine, and also in the fæces, for many days.

His somewhat premature conclusions regarding naturally infected flies are that cultures of pathogenic organisms may occasionally be obtained from them, but that this does not "afford conclusive evidence that such flies are a frequent source of disease in man by infecting food materials." Several of the photographic illustrations accompanying this memoir are extremely poor and of little scientific value.

Dr. Bernstein's contribution consists of a short *résumé* of the literature relating to the fungus *Empusa muscae* (Cohn).

Dr. Monckton Copeman has elaborated an excellent organisation for the elucidation of the question as to the range of flight of house-flies, and trials will also be made of the respective value of various baits that have been proposed from time to time for attracting and killing flies. The results of these investigations will doubtless prove of great value, and materially assist in the methods of controlling this ubiquitous pest.

REPORTS OF METEOROLOGICAL OBSERVATORIES.

MADRID OBSERVATORY (1902–5).—The meteorological observations for these four years are included in one volume (recently published). The data for each year are divided into three sections:—(1) daily observations and monthly means; (2) monthly and annual summaries, with differences from normal values; (3) daily sunshine observations, with monthly and yearly summaries. This volume completes the series of these valuable observations, which for subsequent years have been published in yearly volumes. The observations call for no special remark, except that they appear to have been very carefully made, and that full information of instruments and methods is supplied. The average amount of sunshine during the four years was 66 per cent. of the possible amount, as compared with twenty-five years' normal of 44 per cent. at Jersey.

Royal Magnetical and Meteorological Observatory, Batavia (1907).—The observations include hourly readings and results, and a list of the earthquakes and tremors registered by Milne's seismograph and Ehlert's horizontal pendulum. The mean temperature of the year was 26·0° C., which is practically normal. The month with highest mean of daily maximum was October, 31·0° C., and that with lowest mean minima August, 22·6° C. The absolute maximum was 34·5°, in October; minimum, 20·4°, in June. The mean magnetic results were:—declination, 0° 52·21′ E.; horizontal intensity, 0·367105 (C.G.S.); dip, 30° 55·17′ S.; vertical force, 0·219877 (C.G.S.). A new series of observations of upper clouds was started in 1907, and the observatory is cooperating with the Zürich astronomical observatory for the observation of sun-spots. A regular service of kite and balloon ascents has also been recently established.

Odessa Observatory (1908).—The meteorological observations for this year have been published by Prof. B. V. Stankevitsch, who has been appointed director in the place of Prof. Klossovsky. In addition to the usual observations for the year, a useful summary of the results for 1870–1908 is given. The mean annual temperature is 50·2°; January 26·6°, July 73·8°; absolute maximum, 96·4° in July, minimum, −18·8° in February. The average number of days of frost is 91. The average annual rainfall is 15·98 inches; the wettest year, 24·62 inches, the dryest, 8·97 inches. The greatest fall in one day was 3·1 inches. An appendix contains an account of magnetic determinations made by the director in the summer of 1908 in the governments of Smolensk and Kaluga.

Mysore, Rainfall Registration (1909).—The tables show monthly, seasonal, and yearly values for stations and districts, also averages extending over many years. The values for 1909, and average annual values, are also exhibited on maps. The rainfall of 1909 was very favourable as compared with that for 1907 and 1908. For the whole province, the year's aggregate was 42·44 inches, being 5·50 inches, or 15 per cent., above the normal. On the whole, the excess was greatest in January, caused by a cyclonic storm crossing the south of the peninsula to the Arabian Sea. The greatest falls in twenty-four hours were 11·10 inches in Shimoga district (July 12) and 13·96 inches in Kadur (June 6).

ASSOCIATION OF TECHNICAL INSTITUTIONS.

THE eighteenth annual conference of the Association of Technical Institutions was held at the Stationers' Hall on February 10 and 11. Sir Henry Hibbert, the president for the forthcoming year, delivered his address in the afternoon of Friday. In the course of the address he pointed out that modern labour conditions render it difficult for a boy to learn every branch of his trade. It is therefore necessary that workshop practice should be supplemented by the technical school. Day training classes must be developed in order that those who are to take the leading positions in great industrial concerns—the master, his sons, managers, and foremen—may be scientifically equipped, but the bulk of the provision of technical education must be made by and through evening classes. He would like to extend the day-school life—no boy to leave school before the age of fourteen, and then to have a part-time system up to seventeen. Students should not be allowed to specialise too early. He would make preparatory classes compulsory before students were allowed to join trade classes. To avoid irregularity of attendance, employers of labour must be got thoroughly in sympathy with the organised efforts of education authorities. Conditions have changed since the time when a man could say he had succeeded without education. The education provided at the secondary schools under the regulations of the Board of Education is not that required by children who are able to remain at school for a limited period prior to entering on industrial pursuits. For these special schools are required. He believed that British employers are not awakening to the necessity of strengthening their producing power by the employment of highly skilled workmen.

[1] Further Reports (No. 3) on Flies as Carriers of Infection. Reports to the Local Government Board on Public Health and Medical Subjects (new series, No. 40). Pp. 48+7 plates. (London: Printed for His Majesty's Stationery Office, 1910.) Price 9*d*.

The first part of the meeting on the Saturday morning was occupied in a severe criticism of the Board of Education. The association has frequently had to complain in previous years of the late issue of the regulations, but this last time the Board issued the regulations only just before the commencement of the session, and at the same time it suddenly insisted upon the substitution of a new and complicated system of registration for the systems which had previously been used by local authorities throughout the country. Strong letters of protest were sent by the council of the association to the Board, and at the meeting on Saturday a discussion upon the subject was opened by Mr. Crowther (Halifax), who pointed out that the multiplication of registers which the Board's regulations required rendered accurate registration almost impossible, and it appeared as though they considered educational efficiency a matter of small moment so long as statistics were obtained. Other speakers followed, all condemning the Board's action, and the meeting unanimously passed a resolution approving of the action of the council and of the request made by the council that the Board should receive a deputation upon the subject.

During a discussion which followed upon the Course System, speakers from different parts of the country showed that, by insisting upon the junior students taking properly organised courses, although at first there was usually some diminution in the number of individual students, this was more than compensated for by the better work and the greater regularity of attendance which always followed. Very striking statistics were furnished by more than one speaker. Mr. Reynolds, of Manchester, said that local education authorities, who bore not only the lion's share of the expense, but the lion's share of the hard work, would not submit to the Board's ukase in these matters. Local effort was the very essence of success in educational administration. He had no sympathy with the idea that a boy or girl who had been irregular in attendance at one class of a particular course should be required to discontinue the whole course. The difficulties and exigencies of life were such that it was often very difficult for boys and girls to maintain a continuous attendance. Educationists must fight for the principle that boys and girls between the ages of fourteen and seventeen should work a limited number of hours a week in order that they may be able to continue the education which up to the age of fourteen had cost the country so much. He was strongly opposed to insisting upon any rigid course system in the case of adult students. At a school of technology there were so many varieties of students that it was impossible to force them into courses. Several other speakers emphasised this point of view, and at the close of the discussion the following resolution was moved by Dr. Clay and carried unanimously :—

"While it is desirable that, as a rule, young students should be required to take systematic courses of study, the enforcement of similar courses in the case of adult students is strongly to be deprecated, and a large discretion should be left in the case of all courses, so that special conditions and local circumstances may receive due consideration."

The members of the association were entertained at luncheon by the Stationers' Company on Friday, February 10. The master acted as host, and proposed the toast of the Association, to which Dr. Glazebrook, the retiring president, replied. Sir Philip Magnus, in proposing the toast of the Board of Education and Local Education Authorities, remarked upon the great development of the Board's work which had occurred during the time in which Sir Robert Morant had been in charge, which he said had increased by some four-fold. Sir Robert Morant, and Mr. Hastings Jay, the chairman of the London County Council Education Committee, replied.

PROGRESS OF THE SMITHSONIAN INSTITUTION.[1]

DURING the past year the institution's activities have been increased to some degree by gifts for the promotion of certain special lines of study, particularly in biological research. Among the important works that might be undertaken, I would especially direct attention to the great advantage to the United States and to the world that would result from the establishment of a national seismological laboratory under the direction of the Smithsonian Institution.

Proposed National Seismological Laboratory.

The immense destruction of life and property by certain large earthquakes emphasises the importance of investigations which may lead to a reduction of the damage of future earthquakes. The science of seismology is in its infancy, and it is not always evident what lines of investigation will yield the most important results, hence the importance of developing larger knowledge of seismology in all directions. As an example: It was not at all realised that the accurate surveys of the Coast and Geodetic Survey in California would demonstrate that the great earthquake there in 1906 was due to forces set up by slow movements of the land which have probably been going on for a hundred years. We have learned that slow movements of the land must precede many large earthquakes, and monuments are now being set up in California to enable us to discover future movements of the land, and thus to anticipate future earthquakes. This, I think, is the most important step so far taken toward the prediction of earthquakes.

Seismological work is too large to be prosecuted successfully by the universities, but requires some central office under Government supervision to encourage theoretical and observational studies and to collect and study information from all available sources. The seismological laboratory would serve as a clearing house for the whole country. It would also be the link to connect seismological work in the United States with the work done in other parts of the world.

The work of the laboratory would thus be :—(1) Collection and study of all information regarding earthquakes in the United States and its possessions. The preparation of maps showing the distribution of earthquakes and their relation to geological structure. (2) The study of special regions which are subject to frequent earthquakes to determine, so far as possible, where future earthquakes are likely to occur. (3) The study of the origins of earthquakes occurring under the neighbouring oceans. (4) An organisation of commissions to study in the field the effects produced by large earthquakes. (5) The study of proper methods of building in regions subject to earthquakes. This will require experiment. (6) The improvement of instruments for recording earthquakes. (7) Other theoretical studies. (8) The dissemination of information regarding earthquakes by bulletins or otherwise.

Smithsonian African Expedition.

In the last report there was given an account of the setting out of the expedition to Africa in charge of Colonel Theodore Roosevelt, and of the results accomplished prior to June 30, 1909. This expedition, which was entirely financed from private sources through contributions by friends of the Smithsonian Institution, landed at Mombasa on April 21, 1909, and arrived at Khartoum on March 14, 1910. The collections made by it reached Washington in excellent condition, and are now deposited in the National Museum. The series of large and small mammals from East Africa is, collectively, probably more valuable than is to be found in any other museum of the world. The series of birds, reptiles, and plants are also of great importance, and the study of the material representing other groups will furnish interesting results. Colonel Roosevelt reports on the work of the expedition as follows :—

"We spent eight months in British East Africa. We collected carefully in various portions of the Athi and Kapiti plains, in the Sotik and around Lake Naivasha. Messrs. Mearns and Loring made a thorough biological survey of Mount Kenia, while the rest of the party skirted its western base, went to and up the Guaso Nyero, and later visited the Uasin Gisbu region and both sides of the Rift Valley. Messrs. Kermit Roosevelt and Tarlton went to the Leikipia Plateau and Lake Hannington, and Dr. Mearns and Kermit Roosevelt made separate trips to the coast region near Mombasa. On December 19 the expedition left East Africa, crossed Uganda, and went down the White Nile. . . .

[1] From the report of the Secretary of the Smithsonian Insttution, Dr. C. D. Walcott, for the year ending June 30, 1910.

"On the trip Mr. Heller has prepared 1020 specimens of mammals, the majority of large sizes; Mr. Loring has prepared 3163, and Dr. Mearns 714, a total of 4897 mammals. Of birds, Dr. Mearns has prepared nearly 3100, Mr. Loring 899, and Mr. Heller about 50, a total of about 4000 birds. Of reptiles and batrachians, Messrs. Mearns, Loring, and Heller collected about 2000.

"Of fishes, about 500 were collected. Dr. Mearns collected marine fishes near Mombasa and fresh-water fishes elsewhere in British East Africa, and he and Cuninghame collected fishes in the White Nile. This makes in all of vertebrates: mammals, 4897; birds, about 4000; reptiles and batrachians, about 2000; fishes, about 500; total, 11,397.

"The invertebrates were collected carefully by Dr. Mearns, with some assistance from Messrs. Cuninghame and Kermit Roosevelt. A few marine shells were collected near Mombasa, and land and fresh-water shells throughout the regions visited, as well as crabs, beetles, millipeda, and other invertebrates.

"Several thousand plants were collected throughout the regions visited by Dr. Mearns. . . . Anthropological materials were gathered by Dr. Mearns, with some assistance from others."

Cambrian Geology and Palaeontology.

During the field season of 1909 I continued my investigations in the geology of the Cambrian and pre-Cambrian rocks of the Bow River Valley, Alberta, Canada, and on the west side of the Continental Divide north of the Canadian Pacific Railway in British Columbia.

The measurements of the Cambrian section were carried down to a massive conglomerate which forms the base of the Cambrian system in this portion of the Rocky Mountains. This discovery led to the study of the pre-Cambrian rocks of the Bow River Valley. These were found to form a series of sandstones and shales some 4000 feet in thickness, that appear to have been deposited in fresh-water lakes prior to the incursion of the marine waters in which the great bed of conglomerate and the Cambrian rocks above were deposited.

Study of American Mammals.

Through the generosity of a friend of the institution, Mrs. E. H. Harriman, there has been provided a trust fund yielding an income of 2400*l.* a year, which is placed under the direction of the Smithsonian Institution for the specific purpose of carrying on scientific studies, particularly of American mammals and other animals, the donor specifying Dr. C. Hart Merriam as the investigator to carry on the work during his lifetime.

Biological Survey of the Panama Canal Zone.

It is gratifying to state that it now seems possible that an exhaustive biological survey of the Panama Canal Zone will be undertaken in the winter of 1910–11. Definite plans for this survey have not been decided upon at present, but these are now under consideration, and it is hoped that all the arrangements may be completed and the work put in hand in a few months.

It is particularly important to science that a biological survey of the Canal Zone be made at this time, as it appears, without question, that it would yield important scientific results, both as regards additions to knowledge and to the collections of the United States National Museum and other museums. While the Isthmus is not so well endowed with large forms as the great continental areas, such as Africa, southern Asia, and some other regions, yet its fauna and flora are rich and diversified. The collecting which has been carried on there has been on such a rather limited scale, and chiefly along trade routes, that an extensive and thorough survey would surely produce new scientific information of great value.

A part of the fresh-water streams of the Isthmus of Panama empty into the Atlantic Ocean and others into the Pacific Ocean. It is known that a certain number of animals and plants in the streams on the Atlantic side are different from those of the Pacific side, but as no exact biological survey has ever been undertaken, the extent and magnitude of these differences have yet to be learned. It is also of the utmost scientific importance to determine exactly the geographical distribution of the various organisms inhabiting those waters, as the Isthmus is one of the routes by which the animals and plants of South America have entered North America, and *vice versa*. When the canal is completed, the organisms of the various watersheds will be offered a ready means of mingling together, the natural distinctions now existing will be obliterated, and the data for a true understanding of the fauna and flora placed for ever out of reach.

By the construction of the Gatun dam, a vast fresh-water lake will be created, which will drive away or drown the majority of the animals and plants now inhabiting the locality, and quite possibly exterminate some species before they become known to science.

Antiquity of Man in South America.

In March, 1910, the institution directed Dr. Ales Hrdlička, curator of the division of physical anthropology, United States National Museum, to proceed to South America and Panama Canal Zone for the purpose of making anthropological researches, and particularly to undertake investigation into the question of man's antiquity in Argentina. Dr. Hrdlička was accompanied by Mr. Bailey Willis, of the United States Geological Survey.

The subject of man's antiquity in South America dates from the meagre reports concerning the scattered remains in the Lagoa Santa caves in Brazil, the casual Seguin finds in the province of Santa Fe, Argentina, and the Moreno collection of old Patagonian material in the valley of Rio Negro, and it has assumed a special importance during the last decade through a relatively large number of reports by Argentinian men of science, but particularly by Prof. F. Ameghino, of new finds of the remains of ancient man and of traces of his activities. Some of these more recent finds were so interpreted that, if corroborated, they would have a most important bearing, not merely on man's early presence in the South American continent, but on the evolution and the spread of mankind in general.

Under these conditions, and in view of the fact that some of the reports were not fully satisfactory as to their anatomical or geological details, it was deemed necessary to send down competent men who might subject the whole matter to critical revision.

The researches occupied nearly two months. Every specimen relating to ancient man that could still be found was examined, and every locality of importance where the finds were made was visited and investigated. The evidence gathered, unfortunately, does not sustain a large part of the claims that have been made. The human bones and the archæological specimens which should represent geologically ancient man agree in all important characteristics with the bones and work of the American Indian; and the finds, while often in close relation with early Quaternary or Tertiary deposits, bear, so far as observed, only intrusive relations to these deposits. Furthermore, there are specimens the original sources of which are not so well established that scientific deductions of great consequence can be safely drawn therefrom, even though they present some morphological peculiarities.

The expedition secured numerous geological, palæontological, and anthropological specimens, some of which throw much light on the question of the antiquity of the finds to which they relate. These specimens are being identified and described in the National Museum. Dr. Hrdlička and Mr. Willis will present in due time a detailed report on their investigations.

Following the researches in Argentina, Dr. Hrdlička visited several of the anthropologically important localities on the coast of Peru and made large collections of skeletal material, which will help to settle definitely the racial problems of these regions, and will have an important bearing on the anthropology of the western part of South America.

Astrophysical Observatory.

The work of the Astrophysical Observatory during the year has brought two important results:—

(1) The first result is the establishment of an absolute scale of pyrheliometry within three parts in one thousand as the result of a long series of experiments with various

pyrheliometers. The establishment of this scale through Mr. Abbot's standard pyrheliometer has been supplemented by the distribution abroad and at home of several secondary pyrheliometers constructed through a grant from the Hodgkins Fund. The constancy of the scale of these secondary pyrheliometers has been established, and it is desirable to compare this scale with those in use elsewhere. It is hoped that finally all pyrheliometric observations will be made on the same scale as that used here.

(2) The second result of the year's work is the agreement within 1 per cent. of the "solar-constant" observations obtained by Mr. Abbot at the Smithsonian Mount Whitney station in California at an elevation of 14,500 feet with those obtained simultaneously at the Mount Wilson station in California at an elevation of only 6000 feet. This determination, in combination with the above-mentioned establishment of an absolute scale of pyrheliometry, gives 1·925 calories per square centimetre per minute as a mean value, for the period 1905–9, of the rate at which the earth receives heat from the sun when at its mean distance. Determinations made with various forms of apparatus show no systematic difference in this value of the "solar constant." In 1905 this "constant," according to various authorities, was stated at values ranging between 1·75 and 4 calories.

It is improbable that observations would have been continued since 1902 on "solar-constant" work but for a suspected variability of the radiation sent to us from the sun. The laws governing this variability are of extreme importance for utilitarian purposes apart from their interest to astronomers. While confident of the existence of variations of this value extending over somewhat long periods, and of the probability of short-period variations as shown by the observations obtained on Mount Wilson, yet, in order to establish full confidence in the minds of others of this variability of the sun's heat, there is a very pressing need of observations made simultaneously at some other place where they could be made over a longer period than is possible at Mount Whitney. This new station should be so situated that observations could be continued there while the winter rainy season prevents them at Mount Wilson. A station in Mexico would best fulfil such conditions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The University of Birmingham has for some years been in considerable financial difficulties, for, in addition to the great outlay incurred in erecting and equipping the new buildings, it has been faced with an annual excess of expenditure above income. On last year's working the loss was about 12,000*l.*, and it is estimated that, even with most rigid economy, there will be a deficit of 10,000*l.* on the present year. This fact, combined with the additional circumstances that the University has practically reached the limit of its power to borrow money, has been a cause of grave anxiety to those responsible for the management of the finances. At present the situation is critical, and it is felt that unless further help is forthcoming, not only must further development be out of the question, but even a retrograde movement will be inevitable. Indeed, in the existing state of affairs economy is being exercised to such an extent as to imperil efficiency. The response of the Chancellor of the Exchequer to the recent appeal of English universities brought matters to a crisis, for, as is well known, the allotment of the increase of the Treasury grant is to be determined largely by the extent to which local support is forthcoming. At this juncture a letter was sent by the Chancellor (the Rt. Hon. Joseph Chamberlain) to the Lord Mayor asking for further assistance from the City Council in the form of an addition to the halfpenny rate already granted for the support of the University. The matter was referred to the Education Committee, with the result that the committee recommended the City Council to increase the rate to an amount equivalent to "one penny in the pound for the year 1911–12 . . . and so from year to year until the council shall otherwise direct. Further, that it be a suggestion to the authorities of the University that they should increase the number of maintenance scholarships available for persons who would not otherwise be able to take advantage of university teaching." This recommendation has now been approved by the council, with the exception that the grant is for the one year only. In view of the probability that the "Greater Birmingham" scheme will have come into effect by next year, it was deemed advisable that the matter should then be open to discussion by the enlarged council resulting from that scheme. An interesting feature in the discussion of the question throughout was the evidence of a widespread desire that further facilities, in the nature of scholarships, should be provided for poor students.

CAMBRIDGE.—The special board for biology and geology has nominated Mr. K. R. Lewin, Trinity College, to use the University table at Naples for six months from March 1.

Sir Francis E. Younghusband, K.C.I.E., will deliver a lecture in Cambridge on Thursday, February 23, on "Practical Geography."

The Secretary of State for India in Council has informed the Vice-Chancellor that, as the result of careful consideration of the existing regulations as to the training of probationers for the Indian Forest Service, he has decided to modify them in accordance with the following decisions at which he has arrived:—(1) Any university which possesses a forest school approved by the Secretary of State shall be permitted to train forest probationers. (2) The Secretary of State is prepared to approve for this purpose the forest schools existing at the Universities of Oxford, Cambridge, and Edinburgh. (3) A course of training in practical forestry in Germany or elsewhere, a certain standard of knowledge in an Indian vernacular, and any other special qualifications that the Secretary of State may prescribe, shall be imposed upon all probationers. (4) The studies of the probationers shall be controlled on behalf of the Secretary of State by the director of Indian forest studies (hereafter styled the director). (5) The director shall be a selected officer of the Indian Forest Service, shall be paid such salary as the Secretary of State may determine, and shall hold office for a term of five years.

LONDON.—It is understood that the residue under Sir Francis Galton's will is bequeathed to the University for the encouragement of the study of eugenics. During his lifetime the testator gave a considerable sum of money to the University for the establishment and maintenance of the eugenics laboratory at University College, and it is presumed that permanent provision will now be made for the continuance of the work of the laboratory.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting Prof. Edgeworth David for the degree of D.Sc. *honoris causa* on February 7:—"Adest Tannatt Willelmus Edgeworth David, Geologiae praeclarus auctor. Huic viro accepta referenda sunt fere omnia; quae de ratione geologica et antiquis caeli vicissitudinibus, quibus usa est Australia, comperta habemus. Velut hic inventus est qui doceret continentem illam glacie oppletam fuisse eo tempore cum silvae densissimae, in carbonem hodie conversae, Britanniam nostram tegerent. Huius etiam laus est, quod, cum corallinum quoddam dorsum Oceano Australi supereminens usque in mille pedes terebraret, et omnia saxi frusta, summa, media, infima inspiceret, rationem Darwinianam de eiusmodi insularum ortu confirmare potuit. Quattuor abhinc annos novis Argonautis interfuit continentem Antarcticam exploraturis, quibus id potissimum munus propositum erat ut Australis Zonae magneticum, quem vocant, polum accuratissime definirent. Cuius rei causa itinere periculoso et laboris maximi suscepto huius praesertim viri scientia atque constantia feliciter navata sunt omnia. Nescio an nulli vel Borealis vel Australis poli exploratores tantos scientiae fructus reportaverint, quem eventum huic nostro David imprimis deberi censeo."

Prof. H. H. Turner, F.R.S., has been appointed Halley lecturer for the year 1911.

The statute on faculties and boards of faculties was again taken into consideration by Congregation on February 14, and the remaining amendments, thirty in

number, were disposed of. The statute as amended has now to pass the ordeal of Convocation, in which assemblage both non-residents and residents have a vote.

THE Board of Education is arranging to hold the Imperial Education Conference on April 25–28 next. The conference will be attended by representatives of all the Home Education Departments, English, Scotch, and Irish, and from most British dominions. It is proposed to devote the first two days of the conference to the consideration of problems connected with school education and the training of school teachers, and the last two days of the conference to the consideration of problems connected with education after the school stage and of certain administrative problems.

WE learn from *Science* that the Smithsonian Institution is about to come into possession of a bequest by the recent death of Mr. George W. Poore, of Lowell, Mass. His will provides, after certain minor legacies, that the residue of his estate be given to the Smithsonian Institution to form the Lucy T. and George W. Poore Fund, the income of which is to be used for the purposes for which the institution was founded. Mr. Poore explains in his will that he makes this bequest in the hope that "it will form an example for other Americans to follow by supporting and encouraging so wise and beneficent an institution as I believe the Smithsonian Institution to be."

SIR HENRY ROSCOE, chairman of the Appeal Committee for the new chemical laboratories at University College, London, has issued a further letter with reference to the appeal. As announced in NATURE of February 2, the sum of 25,000*l*. required for the site of the laboratories has fortunately been acquired. It is now desirable to make use of the site as quickly as possible by erecting the chemical laboratories on it. The estimated cost is about 50,000*l*. The president and committee are particularly anxious that this amount should be raised by Easter in order that the building may be begun this year, and may in this way be associated with the year of the King's Coronation. Gifts and promises can be addressed to his Royal Highness Prince Arthur of Connaught, or to Sir Henry Roscoe at University College, London.

A MEETING was held at Aligarh on January 10 at which it was decided to form a committee to be called "The Committee for the Foundation of a Mohammedan University," and to ask his Highness the Aga Khan to accept the office of president. We learn from *The Pioneer Mail* that many distinguished persons in India have accepted the office of vice-president, and that a representative committee has been appointed. The members of the committee include all trustees of the M.A.O. College, all members of the college and school staffs of Aligarh, all members of the central standing committee of the All-India Shia Conference, all editors of Mohammedan journals, and many representatives of other public bodies. Provincial committees are to be formed in each province, and the local committees of the M.A.O. Educational Conference are to be asked to become local branches of this committee. An appeal in various languages has been widely circulated, and the movement seems likely to be successful. A Reuter message from Calcutta on February 12 states that his Highness the Aga Khan and the Nawab of Rampur have each given 10,000*l*. towards the scheme for the foundation of this Mohammedan university at Aligarh. The donations to the fund now amount to about 66,660*l*. The Aga Khan confidently expects that the subscriptions will amount to twice this amount by March.

THE ninth annual report, for the year 1909–10, of the executive committee of the Carnegie Trust for the Universities of Scotland was adopted at the annual meeting of the trust on February 7. In connection with the endowment of research, the reports of the independent authorities who have examined the records of the year's work under the research scheme of the trust give evidence that its past success is being well maintained. The committee acknowledges the assistance rendered by the universities in providing the scheme with so many able workers, and in affording accommodation and supervision in their various laboratories. In the laboratory of the Royal College of Physicians, which in the department of medicine has taken a prominent share in the trust's scheme, the record of work for the past year is equally encouraging. The expenditure for 1909–10 upon the scheme of fellowships, scholarships, and grants, and upon the laboratory, was respectively 6824*l*. and 2454*l*., towards the latter of which the Royal College of Physicians and the Royal College of Surgeons together contributed 1025*l*. The class fees paid in the universities and extra-mural colleges amounted during the year to 48,540*l*., an increase of 1184*l*. as compared with the preceding year. The average amount paid per beneficiary was 12*l*. 12*s*. 9*d*. The expenditure left a balance of 1240*l*. to the credit of the scheme of payment of class fees, but as the statistics already to hand show an excess of expenditure of 2552*l*., it is unlikely that any credit balance will remain at the close of the current year. The committee thinks a stage has been reached in the administration of the scheme of payment of class fees at which it becomes the duty of the committee to direct the special attention of the trustees to its operation in the past, and the modifications which now appear to be necessary. The committee is of opinion that it cannot secure itself against a deficit in future years under the present system, and that the scheme must be amended without delay. The first step it has taken is to announce that after the close of the current year it cannot continue to pay the fees in full, but must avail itself of the provision in the trust deed to pay in whole or in part. It follows that the system of paying for separate classes must be abandoned, and it is suggested that some scheme of paying a portion of the composite or inclusive fees for the several faculties shall be considered. A table published as an appendix to the report shows that up to September 30 seventy-five beneficiaries had voluntarily refunded the class fees paid by the trust on their behalf, amounting in all to 1689*l*.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 9.—Sir Archibald Geikie, K.C.B., president, in the chair.—V. H. **Veley** and W. L. **Symes**: Certain physical and physiological properties of stovaine and its homologues. The bodies in question comprise the methyl-, amyl-, phenyl-, and benzyl-homologues of stovaine, and in addition a new compound recently prepared by M. Fourneau, viz. the propyl ester of dimethyl-amino-oxy-benzoyl-isobutyric acid. The densities of these diminish with increasing molecular weight, and the affinity value of the last-named is less than that already found by the former of the authors for stovaine and for its methyl homologue. Fourneau's new compound abolishes the contractility of muscle less rapidly than does stovaine or methyl-stovaine. It has also less effect on blood pressure and on respiration. Amyl-, phenyl-, and benzyl-stovaine appear to act more slowly on muscle than does stovaine, presumably on account of partial precipitation of their bases. On blood pressure, amyl-stovaine has rather more effect than has stovaine. The pronounced local anæsthetic properties possessed by all these bodies are discussed in the following paper.—W. L. **Symes** and V. H. **Veley**: The effect of some local anæsthetics on nerve. The bodies dealt with in the preceding paper have been compared with one another, and also with cocaine, as to their effects in blocking the physiological conductivity of frog's nerve. The anæsthetic block produced by these bodies, when complete for maximal single stimuli (Berne coil at 400 mm.), is also complete for single stimuli many times more intense (Berne coil at 200–100 mm.). A block complete to maximal single stimuli (coil at 400 mm.) is usually also complete to repeated stimuli with the same disposition of the coil. Partial blockage of individual nerve fibres has not been detected. Stovaine, its homologues, and Fourneau's new salt all block more actively than does cocaine. Stovaine, methyl-stovaine, and Fourneau's new salt block more rapidly than do the remaining bodies. Amyl-, phenyl-, and benzyl-stovaine block more slowly, and the resulting block is less rapidly washed out. Considered as local anæsthetics, phenyl- and benzyl-stovaine offer no advantage over the remaining bodies. Amyl-stovaine may

be of value on account of the relatively long duration of its effect. Methyl-stovaine is the least readily decomposed by faintly alkaline fluids such as lymph and cerebro-spinal fluid. Fourneau's new salt has the least effect on circulation and on respiration.—F. F. **Blackman** and A. M. **Smith**: Experimental researches on vegetable assimilation and respiration. VIII.—A new method for estimating gaseous exchanges of submerged plants. The plant is enclosed in a glass chamber, a current of water is kept flowing through the chamber, and samples of the affluent and effluent liquid are analysed at frequent intervals. The alteration in the amount of CO_2 in solution which the liquid undergoes in passing over the plant in the chamber is the measure of the respiration or assimilation that is taking place. For experiments on assimilation, the liquid supplied to the chamber can be enriched with any desired amount of CO_2, and by a special use of a CO_2 generating tower the amount of this gas dissolved can be kept constant for a long period of time. The glass chamber containing the plant is sunk in a large copper water-bath with a glass window, and the temperature and illumination can be controlled. When the conditions allow vigorous assimilation, much oxygen is given off as bubbles from the plant in the chamber, and these bubbles take up an appreciable amount of CO_2 from the solution. It is therefore necessary to collect and measure this gas and use it as a correction to the apparent diminution in the dissolved CO_2. The gas is separated from the liquid by a valve at the highest point of the apparatus, and collected automatically for analysis. This method has none of the limitations of the bubble-counting procedure exclusively employed previously for the investigation of the assimilation of water-plants, and, since it takes account of the CO_2 in solution and also of that in the gas bubbles, critical measurements can now be made of the assimilation throughout the whole range of the external factors that primarily control this function.—F. F. **Blackman** and A. M. **Smith**: Experimental researches on vegetable assimilation and respiration. IX.—On assimilation in submerged water-plants and its relation to the concentration of carbon dioxide and other factors. The experiments were carried out by a new method, which takes account of the alteration of the gases in solution as well as of the gases liberated as bubbles. The aim is to demonstrate the *nature* of the relation between assimilation and the chief environmental factors—CO_2 supply, light-intensity, and temperature. The relation is such that *the magnitude of this function in every combination of these factors is determined by one or other of them acting as a limiting factor.* The identification of the particular limiting factor in any definite case is carried out by applying experimentally the following general principle:—*When the magnitude of a function is limited by one of a set of possible factors, increase of that factor, and of that one alone, will be found to bring about an increase of the magnitude of the function.* From the data obtained, a new type of diagram is constructed, by which it is possible to foretell what value of assimilation in Elodea will be attained in any combination of medium magnitudes of the three factors of the environment. In this diagram, against the different values of assimilation as ordinates, are ranged three separate curves showing the degrees of CO_2 supply, temperature, and illumination, which are respectively essential for the attainment of each value of assimilation. For any hypothetical combination of the factors, it follows, by the principle of limiting factors, that if the three functional values corresponding potentially to these be ascertained from the diagram, then the actual magnitude of assimilation attained with that combination of factors will always be *the smallest of the three potential values.* The last section contains a critical account of the work of previous investigators who interpreted their results on the assumption that there was *a primary optimum* in the relation between assimilation and each external factor. The substantial work of Pantanelli led him to the conclusion that the position of the optimum for any one factor shifts with the magnitude of the other concurrent factors. This can only be a transitional point of view, and from this we have advanced to the standpoint that *the whole conception of optima in this connection is inapplicable*, and breaks down completely on careful analysis. The authors show in detail that all the experiments of previous workers are more harmoniously interpreted from the point of view of interacting limiting factors than by the conception of optima.

Geological Society, January 25.—Prof. W. W. Watts, F.R.S., president, in the chair.—H. H. **Thomas**: The Skomer volcanic series (Pembrokeshire). The rocks are traceable on the mainland from near St. Ishmaels on Milford Haven to Wooltack Head, and on the west occupy the islands of Midland, Skomer, and the Smalls. The thickness exposed is some 3000 feet, and the lateral extension some twenty-five miles. The chief evidence indicates that the rocks are of pre-Upper Llandovery age, but, from a consideration of the geology of the neighbouring country, it is probable that their true age is Arenig. The rocks are chiefly subaërial lava-flows, frequently interstratified with red clays They are separated into two main groups by a mass of sedimentary rocks barren of fossils. The lavas form well-defined groups. The rocks fall into eight chief types, two of which are of necessity new; in order of increasing basicity they are:—soda-rhyolites, soda-trachytes, keratophyres, skomerites, marloesites, mugearites, olivine-basalts, and olivine-dolerites. The first five types may be included in the alkaline class; they are rich in soda, and most of the felspars belong to albite-oligoclase varieties. The last three types are normal subalkaline rocks, in which the felspars range from oligoclase to labradorite.

February 8.—Prof. W. W. Watts, F.R.S., president, in the chair.—Prof. T. W. Edgeworth **David** gave an account of the researches pursued by him, in conjunction with Mr. R. E. Priestley, geologist to the British Antarctic Expedition of 1907–9, in the course of that expedition, more especially the investigations connected with glacial geology.

Physical Society, January 27.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—Prof. F. T. **Trouton**: A demonstration of the phase difference between the primary and secondary currents of a transformer by means of a simple apparatus. The apparatus is a primitive induction motor consisting of two horseshoe electromagnets with their axes coincident and vertical, and their planes at right angles. Above the poles a copper disc is pivoted. The primary current from a transformer is sent through one magnet and the secondary current through the other. With a suitable phase difference a rotating magnetic field is thus obtained. Inserting an iron core into the transformer diminishes the speed of rotation. A steel core will produce a greater negative rotation than an iron one. To demonstrate the hysteresis effect, it is necessary that the core should consist of a bundle of fine wires, otherwise the Foucault currents set up will introduce a lag. The effect of Foucault currents can be shown by introducing another coil within the transformer in place of the iron core and closing its circuit with a variable resistance.—Prof. J. A. **Fleming**: A note on the experimental measurement of the high-frequency resistance of wires. The author refers to a paper read by him in December, 1909, before the Institution of Electrical Engineers, on quantitative measurements in connection with radio-telegraphy (Journal Inst. Elec. Eng., vol. xliv., p. 349, 1910), in which he described an apparatus consisting of a differential air thermometer having tubular bulbs into which similar wires could be placed, and by means of which a comparison could be made of the high-frequency (H.F.) resistance R′ of a straight wire and its steady or ohmic resistance R. If two equal wires have passed through one a steady current A, and through the other a H.F. current A_1, then if these currents are adjusted until the rate of heat evolution in each case is the same, we have $A^2R=A_1^2R'$. Certain precautions are described in the paper for eliminating inequalities, but by means of correct reading H.F. ammeters as devised by the author, the ratio of the resistances R′/R can be determined from the ratio of the mean square currents A^2/A_1^2.—Prof. J. A. **Fleming** and G. B. **Dyke**: The measurements of energy losses in condensers traversed by high-frequency electric oscillations. In this paper an arrangement of apparatus is described for the purpose of measuring the internal energy losses in condensers traversed by high-frequency (H.F.) currents. It is shown that these energy losses in condensers may be considered as if they were due to a resistance loss in a hypothetical resistance in series with the condenser, the

condenser itself being supposed to have a perfect non-dissipative dielectric of the same dielectric constant.—Prof. J. A. **Fleming** and G. B. **Dyke**: Some resonance curves taken with impact and spark-ball dischargers. In the course of the experiments described in the previous paper on the measurement of energy losses in condensers, a large number of measurements had to be made with the cymometer of the frequency of oscillations in, and the inductance of, the secondary or condenser circuit. It was then an easy matter to draw complete resonance curves in each case, and this has accordingly been done with both the impact and spark-ball dischargers in the primary circuit, and for various resistances in the secondary circuit.

Mathematical Society, February 9.—Dr. H. F. Baker, president, in the chair.—E. **Cunningham**: The application of the mathematical theory of relativity to the electron theory of matter.—G. B. **Mathews** and W. E. H. **Berwick**: The reduction of arithmetical binary forms which have a negative determinant.—H. **Bateman**: Certain vectors associated with an electromagnetic field and the reflection of light at the surface of a perfect conductor.

CAMBRIDGE.

Philosophical Society, January 23.—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—W. A. D. **Rudge**: (1) A constant temperature, porous plug experiment; (2) observations on the surface tension of liquid sulphur.—A. E. **Oxley**: The magnetic susceptibilities of certain compounds.

MANCHESTER.

Literary and Philosophical Society, January 24.—Mr. Francis Jones, president, in the chair.—Dr. A. N. **Meldrum**: The development of the atomic theory: (5) Dalton's chemical theory. The paper deals first with the principles, and afterwards with the genesis, of Dalton's chemical atomic theory. It is shown that it is impossible to suppose that the hypothesis of Avogadro had any influence on Dalton whilst engaged on the theory, the main principles of which are:—(1) that atoms of different kinds tend to combine in the proportion 1 : 1 rather than in any other, that the next proportion to occur is 1 : 2, then 1 : 3, and so on, and (2) that when two compounds of the same two elements are gaseous, the lighter is binary and the heavier tertiary. Dalton's explanation of them shows that Newton's postulate of similar particles, which are "mutually repulsive," was the fundamental idea of the chemical as it had been of the physical atomic theory. The author concurs with Roscoe and Harden in rejecting the account of the genesis of the theory which connects it with the discovery of the composition of marsh gas and olefiant gas, but is unable to accept their view, the gist of which is that Dalton first satisfied himself that the atoms of different gases have different sizes, and then devised the chemical theory. He concludes that it was Dalton's experiments on the combination of nitric oxide and the oxygen of the air that aroused his attention and made him apply his physical theory to the purposes of chemistry.—Prof. A. H. **Gibson**: The behaviour of bodies floating in a free or a forced vortex. The main conclusions drawn from the experimental results embodied in the paper are:—(1) In a free vortex. (*a*) Very small floating particles rotate in spiral paths, approaching with a continually increasing velocity, and finally disappearing down the funnel of the vortex. (*b*) If of moderate dimensions, the behaviour depends on the shape, size, weight, and position of the centre of gravity of the object, the lighter particles approaching more rapidly than those of a lower specific gravity. With homogeneous bodies of the same specific gravity, depth of immersion, and shape of plane of flotation, the larger shows the greater tendency to approach the centre. (2) In a forced vortex:—(*a*) Small bodies approach the centre with a radial velocity which is greater the greater the radius of rotation. (*b*) In homogeneous bodies of the same size and shape, the heavier shows the lesser tendency to approach the centre. (*c*) A non-homogeneous body shows a lesser tendency to approach the centre than does a homogeneous body of the same size, shape, and weight. If the centre of gravity of the non-homogeneous body is sufficiently low, the body works out to the outer edge of the vortex. (*d*) The shape of the body in itself has no effect on its behaviour so long as the vortex is a true forced vortex. As in the case of the free vortex, the knowledge of the forces called into play is adequate for an explanation of all the observed phenomena.

DUBLIN.

Royal Irish Academy, January 23.—Dr. H. F. Barry, vice-president, in the chair.—D. R. **Pack-Beresford** and Nevin H. **Foster**: The woodlice of Ireland, their distribution and classification. Twenty-five species of woodlice (Crustacea Isopoda Terrestria) are found in Ireland, and of these four species have been recorded from and are common in every county. Sketch-maps are given which show at a glance the various Irish county divisions in which each species has been taken. A series of synoptical tables is also included in the paper, which should prove useful in enabling students to diagnose any British species. Two plates illustrating *Metoponorthus melanurus*, B. L., and *Eluma purpurascens*, B. L. (species which have not yet been found in England), and a comprehensive bibliography, are also included.—John **MacNeill**: The early population-groups of Ireland, their nomenclature and chronology. The object of the paper was to distinguish the different classes of group-names found applicable to Irish population-groups in early times, and to assign an approximate period of origination to each class of names. The formulæ of the earlier names were distinguished and discussed, and a list drawn up under each formula. The paper dealt with the classification of the groups as free, tributary, and unfree, and identified the civil and military organisations of the petty States in ancient Ireland with the earliest traditional form of the Roman State.

Royal Dublin Society, January 24.—Prof. T. Johnson in the chair.—Prof. W. **Brown**: Mechanical stress and magnetisation of nickel, part ii., and the subsidence of torsional oscillations in nickel and iron wires when subjected to the influence of longitudinal magnetic fields. The results of experiments on magnetisation and torsion of nickel wire showed that a limit to the twist of the free end of the wire is reached with a certain definite longitudinal load. It was also shown by means of the subsidence of torsional vibrations that the greatest internal friction in the wire took place when it was surrounded by a longitudinal magnetic field of the same value as that in which the maximum twist occurred with a given load on the wire.—Dr. W. E. **Adeney**: The estimation of the organic matters in unpolluted and polluted waters with potassium bichromate and sulphuric acid. The investigations have been made with the view of discovering a rapid and accurate method of estimating the total oxidisability of the organic matters in unpolluted and polluted waters. The water is treated under suitable conditions, which are detailed in the paper, with a decinormal solution of potassium bichromate and sulphuric acid, and, after evaporation and digestion for a sufficient time in the water bath, the excess of bichromate remaining is determined by means of a decinormal solution of ferrous sulphate. The results of a number of estimations of a variety of waters are given, and they show that the method is capable of yielding concordant and accurate results.—Prof. Henry H. **Dixon**: The thermo-electric method of cryoscopy. The apparatus used in this method was devised in order to determine the freezing points of small quantities of solutions. With special devices for eliminating thermo-electric errors, it has been found possible, using one pair of junctions formed of copper and "eureka" alloy, to determine the freezing points of a 1 c.c. of solution with accuracy to 0·01° C. With a greater number of junctions greater accuracy may be attained. The method is particularly suitable for detecting very small differences of freezing point.

PARIS.

Academy of Sciences, February 6.—M. Armand Gautier in the chair.—P. **Idrac**: New observations on the spectrum of Nova Lacertæ (see p. 523).—Henri **Villat**: The discontinuous motion of a fluid in a canal containing an obstacle.—A. **Korn**: The helicoidal state of electrical matter: some new hypotheses for explaining mechanically electromagnetic phenomena.—Gaston **Gaillard**: Researches on the influence of velocity on the compass. At the high speeds attained in modern destroyers there is a possibility that the velocity may affect the indications of the compass. Some experiments in this direction have been carried out on a railway at speeds

between 80 and 120 kilometres per hour. The results obtained, so far, are inconclusive.—G. **Sagnac**: Optical systems in motion and the translation of the earth.—A. **Leduc**: The application of the Lenz principle to the phenomena accompanying the charge of condensers.—L. **Décombe**: A physical interpretation of non-compensated heat.—A. **Lafay**: A method of observation of the trajectories followed by the elements of an air current deflected by obstacles of variable forms. As an indicator, a gas is used the refractive index of which is higher than that of air, but approximately the same density. Such a gas casts a sharp shadow on a screen, and hence the motion of the air currents can be followed. Acetylene, a mixture of acetylene and carbon dioxide, and ethylene are suggested as suitable for this method of working.—MM. **Chéneveau** and **Heim**: The extensibility of vulcanised indiarubber.—G. **Friedel** and F. **Grandjean**: The structure of liquids with focal conics.—Louis **Matruchot**: A new fungus pathogenic to man. This fungus, to which the name *Mastigocladium Blochii* has been given, has been obtained in pure cultures direct from the lesions in man, and hence appears to be the sole cause of the diseased condition observed.—T. **Klobb**: The dextrorotatory phytosterols (anthesterols) from *Anthemis nobilis*.—Gabriel **Bertrand** and R. **Veillon**: The action of the Bulgarian ferment on the monobasic acids derived from reducing sugars.—A. **Marie** and M. **MacAuliffe**: Comparative measurements of individuals of both sexes from lunatic asylums with normal men and women. The inmates of the asylums are generally smaller than the normal, especially in the bust. Details of the comparison of various limbs and parts of the body are also given.—E. **Deschamps**: The treatment of epilepsy of gastro-intestinal origin. Remarks on a recent note of M. Doumer on the same subject.—A. **Bonnet**: Researches on the causes of the variations of the aërial entomological faunule.—M. **Gignoux**: The layers containing *Strombus bubonius* in the western Mediterranean.—J. **Bosler**: The relations between the earth currents and magnetic disturbances.—M. **Birkeland**: The zodiacal light.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 16.

ROYAL SOCIETY, at 4.30.—The Constitution of the Alloys of Aluminium and Zinc: Dr. W. Rosenhain and S. L. Archbutt.—The Production and Properties of Soft Röntgen Radiation: R. Whiddington.—Experiments on Stream-line Motion in Curved Pipes: Prof. J. Eustice.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Some Antarctic Problems: Prof. Edgeworth David, F.R.S.

LINNEAN SOCIETY, at 8.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

ILLUMINATING ENGINEERING SOCIETY, at 8.—*Discussion* on School Lighting. Openers: Dr. James Kerr and Dr. N. Bishop Harman.

FRIDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 9.—The Stimulation of Digestive Activity: Prof. H. E. Armstrong, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting. *Further discussion*: Modern Electrical Dock-equipment, with Special Reference to Electrically-operated Coal-hoists: W. Dixon and G. H. Baxter.

MONDAY, FEBRUARY 20.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Composition of the Acids flowing from the Thompson Displacement Apparatus for the Manufacture of Guncotton: G. W. MacDonald.—(1) Ammonium Sulphate and its Instability; (2) The Hydrolysis of Ammonium Salts: Watson Smith.—A Study of some Reactions in Gels: Emil Hatschek.—A New Still Water Calorimeter: J. H. Coste and B. R. James.

ROYAL SOCIETY OF ARTS, at 8.—Brewing and Modern Science: Prof. Adrian J. Brown.

VICTORIA INSTITUTE, at 4.30.—Science in Relation to Christian Missions: Rev. F. Baylis.

TUESDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—Report on the Deaths which occurred in the Zoological Gardens during 1910: Dr. H. G. Plimmer, F.R.S.—On *Tragelaphus buxtoni*, an Antelope from Abyssinia: R. Lydekker.—A Contribution to the Study of the Variations of the Common Salamander (*Salamandra maculosa*): E. G. Boulenger.—On a Collection of Fishes from the Lake Ngami Basin, Bechuanaland: G. A. Boulenger, F.R.S.—Observations on different Gibbons of the Genus Hylobates now or recently living in the Society's Gardens, and on a *Symphalangus syndactylus*, with Notes on Skins in the Natural History Museum: Dr. F. D. Welch.

ROYAL ANTHROPOLOGICAL SOCIETY, at 8.15.—Prehistoric and Aboriginal Pottery Manufacture: Rev. J. W. Hayes.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Coast Erosion: W. T. Douglass.

ROYAL STATISTICAL SOCIETY, at 5.—The Fatality of Fractures of the Lower Extremity and of Lobar Pneumonia. A Study of Hospital Mortality Rates, 1751–1901: M. Greenwood, jun., and R. H. Candy.

WEDNESDAY, FEBRUARY 22.

ROYAL SOCIETY OF ARTS, at 8.—Water Finders: Prof. J. Wertheimer.

GEOLOGICAL SOCIETY, at 8.—The Geology of the Districts of Worcester, Robertson, and Ashton (Cape Colony): R. H. Rastall.—Geology of Northern Albania: Baron Ferencz Nopcsa, Jr.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, FEBRUARY 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Transmission of Flagellates living in the Blood of certain Freshwater Fishes: Miss M. Robertson.—Report on the Separation of Tonium and Actinium from certain Residues and on the Production of Helium by Tonium: Dr. B. B. Boltwood.—The Secondary γ-Rays produced by β-Rays: J. A. Gray.—The Specific Heat of Water and the Mechanical Equivalent of the Calorie at Temperatures from 0° to 80° C. With Additional Note on the Thermoid Effect: W. R. Bousfield and W. E. Bousfield.—On the Measurement of Specific Inductive Capacity: Prof. C. Niven, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. B. Matthews and C. T. Wilkinson.

FRIDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 9.—Mouvement Brownien et Réalité Moléculaire: Prof. Jean Perrin.

PHYSICAL SOCIETY, at 5.—Flames of Low Temperature supported by Ozone: Hon. R. J. Strutt, F.R.S.—The Movement of a Coloured Index along a Capillary Tube, and its Application to the Measurement of the Circulation of Water in a Closed Circuit: Dr. Albert Griffiths.—An Optical Lever of High Power suitable for the Determination of Small Thicknesses and Displacements: E. H. Rayner.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Works for the Bacterial Purification of Sewage: R. J. Samuel.

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