THURSDAY, APRIL 7, 1910.

CRYSTALLOGRAPHY BY A PHYSICIST.

Cours de Physique. By Prof. H. Bouasse. Sixième partie, Etude des Symétries. Pp. 424. (Paris: Ch. Delagrave, n.d.) Price, 14 francs.

THIS sixth volume of the course of physics, prepared by the author to conform "aux programmes des Certificats et de l'Agrégation de Physique," deals with the subject of symmetry, both from the general physical standpoint and as it concerns crystals. The previous volumes have treated of mechanical physics, thermodynamics, electricity and magnetism, optics, and electro-optics. Besides actual symmetry, this sixth volume also discusses symmetrical deformation, double refraction in relation to the symmetry of crystals, the bearing of optical rotation on crystal symmetry, and a concluding brief account of liquid crystals. It presents many of the phenomena dealt with by the expert crystallographer from the very different outlook of the pure physicist, and such an outside view, by a competent authority, of a more or less special branch of science is usually of value, although one must not look either for specialised knowledge or intimate acquaintance with the phenomena described. In these days of specialists there are very few men able to deal without error with so many subjects as are included in the comprehensive course of Prof. Bouasse.

The reader is very much handicapped at the outset by the lack of any index, either of authors or subjects, but it is impossible not to be struck with the fact that the references to original investigations are almost entirely confined to those of French men of science. With the exception of a brief inevitable reference to Miller, whose notation was bound to be mentioned, we look in vain for any recognition of the many important contributions to our knowledge of both general and crystallographic symmetry which have been made during the last twenty years by British investigators, such as Maskelyne, Miers, Barlow, and Hilton, or of the large additions to chemical crystallography effected in this country. The work of Sohncke and Schönflies is referred to, and a passing mention of von Fedorow made, but anything approaching appreciation of the later most important work of the latter investigator and of Barlow is not forthcoming. Nor could any reference be found to the work on symmetry and crystal structure of Von Lang, Becke, Groth, or Muthmann. Gadolin is referred to, as he published in the French language, but the omission of British and Continental work to such an extent is a serious defect, as is also the fact that no references whatever to the literature of any original memoirs are vouchsafed.

Having accepted these limitations, however, and the further fact that practical details of crystallographic experimental work is not a feature of the book, an admirable summary of the work of Haüy, Lévy, Fresnel, Mallard, Bravais, Curie, Friedel, Bertrand, Sénarmont, and other French men of science, will be found. Moreover, when the author is on his own ground of pure physics, and especially in the discussion of such parts of his subject as are not affected by recent foreign work, his matter is excellent, vigorously and interestingly expressed, incisive and clear. One of the most valuable parts of the book is the chapter on space-lattices, which includes a capital account of the immensely important, even fundamental, work of Bravais, work which only increases in value as the years roll on. It is followed by a good description of the theory of "groups of movements," which has resulted in our knowledge of the 230 types of homogeneous structures, based chiefly, however, on the treatise of Schönflies.

A considerable part of the book is also occupied with the physics of homogeneous deformations, although all mention of work on the thermal dilatation of crystals subsequent to that of Fizeau is omitted, and the treatment of elasticity and elastic deformations is purely theoretical and lacks any reference to recent experimental work.

When the author enters the domain of the crystallographer it is, unfortunately, to display a complete want of knowledge of the immense progress which has been made, largely by British workers, in experimental methods, in the preparation of crystals of a high degree of perfection for the purposes of investigation, and of the highly accurate measurements which have been made during the last twenty years on such perfect crystals. The important laws governing the relations between crystalline structure and chemical constitution, especially those relating to the effect of the interchange of the variable elements in isomorphous series, which has been the main outcome of this work, is entirely ignored. It is with great surprise that we read, referring to the use of even an ordinary goniometer provided with telescope and collimator:—

"Ce procédé de haute précision n'est presque jamais employé. C'est que les faces d'un cristal sont loin d'être des miroirs parfaits. Elles sont souvent de très petites dimensions. Elles présentent souvent des irrégularités, des stries. . . . Les faces sont souvent courbes. Enfin, c'est un fait remarquable, les angles des cristaux cristallographiquement les plus beaux ne sont les mêmes d'un échantillon à l'autre ou d'un angle à son homologue qu'avec une tolérance souvent énorme. Il faut entendre par là que, mesurant, avec toute la précision possible, le même dièdre sur une série d'échantillons, ou les dièdres homologues d'un échantillon, on trouve des résultats qui peuvent différer de plus de dix minutes. Pour toutes ces raisons, une précision extrême est illusoire; l'emploi du goniomètre ordinaire, toujours inutile, est dans bien des cas absolument impossible."

It is difficult to understand how anyone holding such opinions as to the value of exact work in crystallography should wish to write a text-book on the subject. It is not by disseminating such opinions that the study of crystallography can be advanced, and young students attracted to a richly repaying and almost unopened branch of scientific investigation. If the worker in crystallography is content to take the first crystal he alights upon as the best sample procurable, he will, of course, conclude as the author has done. But if he takes the trouble to obtain the most perfect

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procurable crystals for his investigations, and, if they are artificial chemical preparations, if he has followed and makes use of the recent work on the preparation of perfect individual crystals, and the precautions to be taken to avoid disturbance during growth, there will be a very different story to tell, and the deformations, striations, curvings, and lack of constancy of ten minutes or more will all disappear, and the angles will inform him, if he employs the most accurate goniometer in the market, of their constancy to the last minute. To speak, moreover, of "petites dimensions" as being a drawback is even more enlightening as to the author's lack of familiarity with practical crystallography. For it is precisely small crystals, varying from a very small pea to a pin's head in size, that the crystallographer chooses by preference for his measurements. For the liability to distortion is then at its minimum.

Sufficient will have been said to indicate the excellences and the defects of this volume, both striking in their way. Indeed, in spite of the aggravating defects which it has been essential to point out, the writer possesses so original and lively a style, and his remarks are often so well worth reading, that with all its shortcomings, the book has good and valuable qualities, and in the portions where the author is on his own domain is both well written and instructive.

A. E. H. TUTTON.

THE ORIGIN OF THE DIAMOND.

Diamonds. By Sir William Crookes, F.R.S. Pp. xvi +146. (London and New York: Harper and Brothers, 1909.) Price 2*s.* 6*d.* net.

ALL who have had the pleasure of hearing Sir William Crookes's lectures on the diamond and its origin will be glad to find the valuable information contained in them put into a permanent form in the little book before us.

The author has had exceptional opportunities for studying the subject. During two visits to South Africa, in 1896 and 1905, he was allowed by the managers of the De Beers mines to have unrestricted access to valuable sources of information; and, as is so well known, his own physical and chemical researches have been largely concerned with questions connected with the properties and origin of the most remarkable, as well as the most highly prized, of the gems.

Concerning the Kimberley diamond mines, as well as the alluvial deposits of South Africa, Sir William Crookes can write with authority from his personal observations. As illustrating "the kind of speculative gambling" which goes on in the former class of workings, we are told of a claim where the owner had not seen a diamond for a fortnight, but just before then he had picked out a diamond worth 300*l.*! On the other hand, the systematic work at the mines of the De Beers Company enables the management to regulate the annual supply with the greatest nicety, so as not to cause any fall in the price of the gem. In 1907 more than two and a half million carats were raised, which realised 6,452,597*l.* The mode of occurrence of the diamonds, the methods of working adopted at different times in the wonderful pipes that yield the gems, and the ingenious methods of treating the "blue ground" and sorting out the stones, are described and illustrated by photographs taken by the author himself.

Sir William Crookes had the opportunity of handling and taking a photograph of the celebrated "Cullinan diamond" before it was cut, and his description of it is of much interest. He tells us that:—

"A beam of polarised light passed in any direction through the stone, and then through an analyser, revealed colours in all cases, appearing brightest when the light passed along the greatest diameter—about 4 inches. Here the colours were very fine, but no regular figure was to be seen. Round a small black spot in the interior of the stone the colours were very vivid, changing and rotating round the spot as the analyser was turned. These observations indicated internal strain. The clearness throughout was remarkable, the stone being absolutely liquid like water, with the exception of a few flaws, dark graphitic spots, and coloured patches close to the outside. At one part near the surface there was an internal crack, showing well the colours of thin plates. At another point there was a milky, opaque mass, of a brown colour, with pieces of what looked like iron oxide. There were four cleavage planes of great smoothness and regularity. On other parts of the surface the crystalline structure was very marked. The edges were rounded in parts, and triangular markings (depressions) were to be seen. I also noticed square depressions, nearly as sharp and perfect as the triangular ones."

Interesting as this description undoubtedly is, we cannot but regret that, before this unique specimen was deprived of its interest for mineralogists by being cut, no opportunity was afforded to the author, or any other scientific investigator, of carrying out such a series of observations in the laboratory as would have enabled him to place on record all the facts about it which it was desirable to obtain.

A full account of the Cañon Diablo meteorite, with its enclosed diamonds, and of the vast crater-like depression in Arizona where it was found, is given in the concluding chapter. The author, in discussing the genesis of diamonds, is clearly of opinion that, whether of inter-terrestrial or of extra-terrestrial origin, the conclusion is established, both by observation and experiment, that the solvent from which the carbon has crystallised must have been molten iron.

In conclusion, we cannot but commend, to all desirous of learning what is known about the most beautiful and interesting of gems, this terse and attractive—but withal trustworthy and complete—summary of all the information on the subject which has up to the present been acquired.

J. W. J.

DIFFERENTIAL GEOMETRY.

A Treatise on the Differential Geometry of Curves and Surfaces. By Prof. L. P. Eisenhart. Pp. xii+474. (London and Boston: Ginn and Co., n.d.) Price 20*s.*

THE well-known works of Darboux and Bianchi are so excellent, each in its own way, that one might be inclined to doubt whether another text-book on the subject was really required—at least, for the

present. But Prof. Eisenhart's work will be acceptable to those who prefer English to other tongues, or who wish to have the main results in a more condensed form than that in which Darboux and Bianchi present them.

The author of this book has been remarkably successful in giving a large amount of matter without an appearance of stodginess. The main reason for this is that, besides having a crisp style, he is very judicious in omitting those links of connecting analysis which the reader can easily supply for himself, or take for granted as calculations which have been done once for all. Without any attempt to enumerate even all the principal topics discussed, it may be said that we have a sufficient account of curvilinear coordinates, conformal and other representations, differential parameters, and the Christoffel (or Riemann) symbols; chapters on the deformation of surfaces, including Minding's problem, and the method of Weingarten; a very compact account of geodesics, minimal and other special surfaces; and finally chapters on rectilinear congruences, cyclic systems, and triply orthogonal systems of surfaces. Incidentally, many elegant special applications are given; thus, for instance, there are several interesting theorems due to Bonnet.

One remark is almost sure to occur to the reader of the book, namely, that the use of the differential parameters of the linear element is, in some parts of the theory, a very powerful engine, at any rate, for purposes of condensation and lucidity. An instance of this will be found in the chapter on geodesics (pp. 215–8). No serious student of differential geometry can fail to read Gauss's famous memoir and the early papers by Lagrange and others on minimal surfaces; few things are more instructive than a comparison of these "path-breaking" memoirs with the compact and symmetrical methods of the present day. The contrast is so great that the student who hopes to do something himself is more than ever bound to read original papers besides text-books and treatises; otherwise he will be tempted to imagine that new results fall out of the sky, so to speak, in their final and clearest and most elegant shape.

Fortunately Prof. Eisenhart's book contains a partial antidote in the shape of a very useful collection of unsolved examples. These are of all grades of difficulty, ranging from simple corollaries to adjacent bookwork to important theorems extracted from original papers. It would, perhaps, have been a help in these latter cases to give a reference; but the author has been sparing in his bibliography, as indeed mathematical writers can now afford to be, when the "Encyclopædie d. Math. Wiss." and the Royal Society's "Subject Index" are available.

In conclusion, a word on notation may be permitted. The Christoffel symbols are so essential in some parts of the theory that they ought to be of a simpler character than they are; for instance, the formulæ on p. 155 may, in a sense, be expressive, but they are cumbrous and ugly in the extreme. Could not the Mathematical Congress, or some other body, suggest a simplified notation, with some chance of its being generally adopted? G. B. M.

THE INSPECTION OF FOOD.

Food Inspection. By Hugh A. Macewen. Pp. viii + 256. (London: Blackie and Son, Ltd., 1909.) Price 5*s.* net.

THIS work has been written with the object of giving a clear and concise account of the inspection of meat and other foods, and of the principles underlying the hygienic production of prepared foods. It embodies the author's personal experience of the methods employed in Berlin and other German towns, America, and Great Britain. The book, which is well illustrated, includes chapters upon meat inspection; the inspection of live animals, and the symptoms of the more important diseases from which they suffer; the methods of slaughter; the diseases commonly met with in the abattoir; the construction and management of slaughter-houses and abattoirs; the inspection of fish, poultry, game, fruit, and vegetables; the preservation and storage of food; the inspection of prepared foods; and the law relating to the above subjects. In the anatomical description given the ox is taken as the type, and whenever any of its organs or parts differ markedly from those of other animals which concern the meat inspector, a special description is given. Important anatomical facts include a clear statement and good illustrations of the situation of the principal lymphatic glands in cattle and pigs.

An interesting and useful appendix deals with the German method of meat inspection as carried out in Berlin, and another appendix furnishes a short description of Chicago stockyards and packing-houses, and of American methods of meat inspection. The writer condemns the private slaughter-house which is so general in this country. If inspection is to be efficient it is essential that the inspector should be present while the slaughtering is going on. This is impossible in all the private slaughter-houses; and therefore no adequate system of meat inspection is possible where they are suffered to exist. The organs of unsound animals may be concealed or destroyed before the inspector appears on the scene, and the writer testifies to the fact that there is often a marked want of cleanliness in the methods of dressing and preparing the meat in private slaughter-houses, which is not to be witnessed in public abattoirs.

The work will not serve as a reference book. The information offered is not comprehensive enough for that purpose; but it is admirably designed to provide what the average food inspector and public-health student requires from a text-book. In parts the matter will be judged by the medical reader as very elementary, but the book has been written mainly to meet the needs of non-medical readers; the former, however, will find a very great deal to interest and instruct. Indeed, it may be read with profit by all who are interested in the public food supply, and it will probably prove to be the most serviceable text-book which candidates preparing for the examinations for the food inspector's certificate, granted by the Royal Sanitary Institute and other bodies, may consult. Both in respect of the matter it contains and

to the manner in which the work has been produced by the publishers, it is a satisfactory and remarkably cheap publication, but the illustration of the head of *Cysticercus bovis* on p. 112 is quite unworthy of the book, and more information should be given on the important subject of the inspection of canned food.

A NEW CATALOGUE OF HEMIPTERA.

Catalogue of the Hemiptera (Heteroptera), with Biological and Anatomical References, Lists of Food-Plants and Parasites, &c. Prefaced by a Discussion on Nomenclature, and an Analytical Table of Families. Vol. i., Cimicidæ. By G. W. Kirkaldy. Pp. xl+392. (Berlin: Felix L. Dames, 1909.)

NOW that the study of entomology has become so widely extended, and of so much more importance, both medically and agriculturally, than was even suspected a few years ago, the publication of catalogues of the various orders and families of insects at frequent intervals has become an absolute necessity, for monographs and catalogues have become as indispensable to the study of any group of natural objects as are grammars and dictionaries to the study of a language. Often when a catalogue is published in several volumes, the stimulus to the study of the groups with which they deal is so great that the earlier ones are practically almost out of date before the later ones can be issued.

The last catalogue of the Hemiptera Heteroptera, by Lethierry and Severin, was not completed, though three volumes were published in 1893, 1894, and 1896, and therefore a new and complete catalogue was much wanted. Mr. Kirkaldy expected to complete it in six or seven volumes, of which this is the first. The second volume is stated to be in the press, and the third in active preparation.

Some years ago, the energetic author (who was a Scotchman) left the British Islands and went out to Honolulu, where he broke his leg, and it was probably this accident which gave him sufficient leisure to carry out so long and tedious a work as the present catalogue. We much regret that since the present volume was placed in our hands for review, we have received news of the death of the author at San Francisco, whither he had proceeded for an operation, which has terminated fatally.

Although we may not agree with all the author's dicta respecting nomenclature, his remarks on this difficult and intricate subject will be read with interest by students of other branches of zoology than that immediately concerned. There is also much information given respecting the bibliography, determination of types, and classification of the insects with which the author deals; and a table is given of the twenty-six families into which he divides the Heteroptera, of which only the first, Cimicidæ, is included in the present volume. The Cimicidæ are divided into ten subfamilies, as follows:—Cimicinæ (=Asopinæ), Pentatominæ, Phyllocephalinæ, Phlœinæ, Dinidorinæ, Cyrtocorinæ, Scutellerinæ, Aphylinæ, Coptosominæ (=Plataspinæ), and Tesseratominæ. Four more families were intended to be included in vol. ii., and three more in vol. iii.

In addition to full references to genera and species (the latter arranged in alphabetical order under each genus), references are given to biological, anatomical, and general notes, and to descriptions of metamorphoses; lists of food-plants, parasites, predators, prey, &c., are added. Fossil species are included. The range is also given at unusual length, and tables are added giving the number of species of each genus found in the various geographical regions and subregions.

On the whole, this is an unusually comprehensive catalogue, and we hope that it will be possible to make arrangements for its completion, notwithstanding the untimely death of the author. W. F. K.

OUR BOOK SHELF.

British Wild Flowers in their Natural Colours and Form. By the Rev. Prof. G. Henslow. Pp. xii+318; with more than 200 coloured illustrations by Miss Grace Layton. (London: S.P.C.K., 1910.) Price 8*s*.

Flowers of the Field. By the late Rev. C. A. Johns. Entirely rewritten and revised by Prof. G. S. Boulger. 32nd edition. Pp. lii+926. (London: S.P.C.K., 1910.) Price 7*s*. 6*d*.

IT appears that the publishers of Anne Pratt's "Wild Flowers," issued many years ago in two small volumes, have deemed it advisable to arrange a complete revision, which has resulted in the thick octavo volume forming the subject of this notice. The new title suggests that the illustrations, about 200 in number, are regarded as the leading feature of the book, but the descriptive text will be found no less attractive and well adapted for the less professional student of flowers for whom the book is chiefly intended. Apart from the fact that the Royal Horticultural Society awarded a silver flora medal to the artist, Miss Layton, it would be gathered from observation that the original drawings were correct and graceful representations of the wild flowers, but several of the reproductions are not very satisfactory in the matter of colour; to get the best effect, the plates should be examined by artificial light.

With regard to the subject-matter, so far as the plants described in the earlier work have been re-illustrated, the author has incorporated much of the original material; beyond that, he has drawn on his extensive store of botanical knowledge for the text to accompany the figures of plants now introduced, and for the additional space consequent upon the increased size of the book. The information supplied refers to the characters of the selected and allied plants, and to the etymology of their names; also medicinal or economic uses and striking morphological features are noted. There are some discrepancies in the details regarding cultivated plants. Thus, the tree from which gamboge is obtained now passes as *Garcinia morella*; the pistillate plant of Garrya has been introduced into this country and cultivated at Kew for some years; further, there is reason to hope that the cultivation of indigo in India will not go under, as some users of the dye find it superior to the synthetic article.

Two more important features should be noticed; these are the inclusion of a synopsis of the families represented and the arrangement which follows the sequence of Bentham and Hooker; the glossary of technical terms will also be useful. It will be found that the reconstructed work is fuller and more scien-

tific than the original, which, however, served a very useful purpose in the past.

A new edition of Johns's "Flowers of the Field" differs only from the last remodelled version, published in 1905, by the addition of the coloured plates. This addition is obviously a concession to the modern practice of supplying illustrations in colour. The drawing of the plants is good, but the colour and printing are uneven in the reproduction.

Dynamo Laboratory Manual for Colleges and Technical Schools. Vol. I., Direct-current Studies and Tests. By W. S. Franklin and W. Esty, with the cooperation of S. E. Seyfert and C. E. Clewell. Pp. viii+152. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 7*s.* 6*d.* net.

THE advisability of publishing a laboratory manual which consists practically only of a reprint of the instructions given to the students in a particular college or university is a matter that is open to question. It may be objected that the instructions can only be of real value to those who have an equipment exactly the same as that in the laboratory of the authors, a coincidence that is likely to be rare, and that each teacher will preferably use instructions of his own, drawn up to suit the circumstances of his case. On the other hand, it may fairly be contended that such publications are of special value to teachers in that they enable them to compare their own methods with other people's, and to modify and improve their own courses as a result. From this point of view this volume, in common with others of the same kind, must be regarded as rather of value to the teacher than to the student. Indeed, as the instructions without the experiments are like the white of an egg without salt, the student can gain little from the present volume unless it is adopted by his teacher.

The volume deals only with direct-current machines. There is a short introduction dealing with general methods of measurement, &c., and the remainder of the book is divided into three parts, each describing sixteen tests. The experiments seem well chosen so as to bring out the more important points in direct-current dynamo work, and the instructions are full, if anything too full. There are a large number of clear diagrams.

The authors admit in their preface that their leaning is towards the purely pedagogical aspects of laboratory work; it is hardly the place in a review of a book written frankly on this basis to discuss whether this aspect is the best one, and it need only be said that, granting this premise, the course indicated in the volume before us seems admirably suited to get the most out of the laboratory training.

Mona's Records of the Earth's Changes. By Joseph Lewin. Pp. iv+100. (Douglas: Brown and Sons, Ltd., 1909.)

THIS is not, as might be supposed, a popular sketch of the geology of the Isle of Man. It is a description of certain highly hypothetical changes in the relations of sea and land that are held to have taken place within historic times. Five successive lowerings of the sea are said to have left their traces in wave-worn terraces, and these records were all formed in the last 2000 years (p. 39). Seeing that the Mona of Tacitus (p. 2) is moved by the author from Anglesey to the Isle of Man, we may well have doubts as to his historic judgment. One of the withdrawals of the sea is placed in 1538, so as to coincide with the enlargement of the shore near Pozzuoli; and such changes are attributed to movements of the axis of rotation of the earth, or to movements of the shell of the earth over the axis of rotation. The author does not seem quite clear as to which of these he adopts; but his context usually conveys the latter impression. His style may be gauged from the following portion of a sentence, the whole being too long for quotation (p. 94):—"But, according to the wobbling state of the poles of our earth at present, as described by our scientists at the earthquake, that caused so much damage and loss of life at Messina, as described in the *Daily Mail*, our earth at any moment, with another great earthquake, may lose its centre of gravity at the Poles, and move again slightly in the same direction as it has already done. . . ."

The general underlying conception is that the British Isles are being carried nearer to the North Pole, and away from the bulge of waters round equatorial regions. Palestine (p. 99) is to profit by the next change, which is due in a few years. There are some interesting scraps from old chronicles throughout the book, which save it from being judged too severely as a scientific treatise. G. A. J. C.

Ancient Angling Authors. By W. J. Turrell. Pp. xiii+239. (London: Gurney and Jackson, 1910.) Price 3*s.* 6*d.* net.

IT is fortunate that our English ancestors did not all agree with Plutarch in regarding fishing "as a filthy, base, illiberal employment," for the works which they have left us in praise and honour of the angler's art contain a valuable history of both tackle and methods. The fisherman has for a long time enjoyed a poor reputation for truthfulness, and Mr. Turrell exposes the angling author as a most unblushing plagiarist; but in spite of these shortcomings they are both excellent companions.

The respectable antiquity of many methods, reputable and otherwise, practised to-day is certainly remarkable; in 1657 one Barker had already discovered the use of salmon-roe as a bait, and salmon-fishing with the prawn was known in 1740. While Cotton (1676) may claim the credit of first describing how to take trout in clear water with the worm, the exact history of dry-fly fishing appears obscure, and cannot be definitely traced beyond the early part of the eighteenth century. So long ago as 1600, Taverner was recommending that fish-ponds should lie dry every other year, as is, we believe, the modern German practice, and ten years earlier Mascall had discussed the best methods of preserving fish.

There is, however, one habit of our ancestors which we have fortunately abandoned, to wit the anointing of our baits with strange and horrible unguents to attract the fish; from the beginning of the seventeenth to the middle of the eighteenth century recipes for the compounding of these form part and parcel of the current angling literature, and it is small wonder that these medleys of man's fat, cat's fat, assafœtida, mummy dust, and turpentine called forth the anger of Dr. Martin Lluelyn on those whose

> "pastes fox Rivers throat, . . .
> That from May to parcht October
> Scare a Minew can sleepe sober."

With the help of Mr. Turrell's little work and its really admirable index, much further information as to the early history of various parts of the angler's equipment and the different forms of his art may be readily gleaned, and the various subjects touched upon will be found to be explained by copious extracts from contemporary books. Nor must it be supposed that we are dealing with a mere compilation; Mr. Turrell has obviously gone to the very fountain-head for his information, and he is at times able to correct the errors of his predecessors and to throw fresh light upon doubtful points.

LETTERS TO THE EDITOR.

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

The Term "Radian" in Trigonometry.

FROM a recently published part of the "New English Dictionary" it is to be inferred that the first authority for the use of the word "*radian*" was the "Treatise on Natural Philosophy" of Thomson and Tait, the date given being 1879—that is to say, the date of the new edition of part i. of vol. i. As the word has at least ten years of previous history, it may be desirable to put on record a few additional facts in regard to it. My own first use of it was in class-teaching in the College Hall at St. Andrews in 1869, and I possess a note-book, belonging to one of my students of that year, in which the word is used. The introduction of it was almost simultaneous with my proposal of the word "therm" in connection with the measurement of heat.

The advantages of the latter word I went so far as to point out in a letter to NATURE dated almost exactly forty years ago (see vol. i., p. 606). At that time I was inclined to suggest the form "rad" in preference to "radial" or "radian," it being advantageous to have a monosyllable for the fundamental unit of a series if auxiliary units like "kilotherm," "millirad," &c., were likely to be called for (see NATURE, vol. iii., p. 426).

It was in 1874, after several conversations on this and similar subjects with the late Prof. James Thomson, of Glasgow, and especially after an exchange of letters with the late Alexander J. Ellis, that the form "radian" was definitely adopted by me. In that year I came across the following passage in an interesting historico-biographical note written by Ellis as an appendix to his "Algebra Identified with Geometry" (London, 1874):—"Let u be a unit-line, then, if r and ζ be both real numbers, $re^{\zeta i}u$ represents a line of the length ru and inclined to u at ζ radial angles" (p. 82), there being added in brackets the definition "2π radial angles$=4$ right angles." As a consequence I wrote to him, and he declared at once for the form "radian," on the ground that it could be viewed as a contraction for "*radi*-al *an*-gle" in accordance with precedents in chemistry which he had himself followed in his nomenclature of the so-called "stigmatic" geometry. He also incidentally mentioned that he had used the expression "radial angle" from his Cambridge undergraduate days. THOS. MUIR.

Cape Town, South Africa, March 6.

The Fertilising Influence of Sunlight.

THE letters on the above subject in NATURE of February 17 and March 3 and 10 are of much interest. In many parts of the world artificial heating of the soil is a regular practice. For example, in the rice districts of heavy rainfall in the Bombay Presidency the seed-bed for transplanted rice and some small millets is almost invariably subjected to a process known in the vernacular as "rab." This consists of spreading a layer of branches, grass, cow-dung, &c., over the surface of the plot (often only a few metres square) selected as the site of the seed-bed. This material is then slowly burnt before the breaking of the monsoon.

There is a general agreement as to which kind of "rab" is best, that consisting largely of cow-dung (in the form of a plaster with chopped straw) being considered by far the best. Then comes that composed of the branches of certain species of Terminalia, after which come those of any available trees, and finally that composed of dried grass.

An experiment I conducted on these materials in the year 1906–7 at Lanowli, in the rice district above the Ghats between Bombay and Poona, gave the results stated below. Unfortunately, an untimely shower fell a few days before the material was burnt, so that the temperature of the soil was probably not raised so high as in ordinary seasons; this temperature was taken by scraping off the ashes at various points and inserting a thermometer 3 or 4 centimetres into the soil immediately after burning; it varied between 200° and 230° F.

The material was prepared and burnt in the ordinary method used by the natives; in addition, plots were added, one of which was manured with safflower (*Carthamia tinctoria*) cake, another with cow-dung, another with ashes scraped off a "rabed" plot, while in a fourth the soil was finely pulverised to a depth of about 8 cm., and in a fifth the surface soil was removed to this depth, placed on iron sheets, and heated from beneath until a temperature of 200° to 230° F. was reached, when it was allowed to cool.

At the time of transplanting, twenty average seedlings were taken from each of the plots, dried, and weighed.

The results were as follows:—

Treatment of plot	Average dry weight of seedlings (in grams) in each of the triplicate plots						Mean
	A		B		C		
1. Manured with safflower cake.	0·4097	...	0·4967	...	—	...	0·4532
2. "Rabed" with branches of Terminalia	0·0879	...	—	...	—	...	0·0879
3. "Rabed" with mixed branches	0·2181	...	0·1708	...	0·1430	...	0·1773
4. Manured with ashes of mixed branches	0·0797	...	0·1094	...	0·0954	...	0·0948
5. Manured with cow-dung ...	0·0928	...	0·0772	...	—	...	0·0850
6. "Rabed" with cow-dung ...	0·2561	...	0·3172	...	—	...	0·2866
7. Soil pulverised	0·0909	...	0·0625	...	0·1000	...	0·0845
8. Soil heated	0·3562	...	0·2968	...	0·2276	...	0·2935

It should be noted that owing to scarcity of this material at the time sufficient branches of Terminalia could not be obtained even for the single plot. Hence, probably, the poor result on this plot.

From the above it will be seen that the *raison d'être* of this process is to obtain the effect of heat, and neither to improve the physical condition of the soil (cf. plots 7 and 8) nor to supply plant food (see plots 4 and 5). The ashes have practically no value, and the natives state that it is of no consequence when the ashes, as is often the case, are removed by wind.

The enormous effect of safflower cake is well known, an application to sugar-cane being many times more efficient than that of any other cake when applied to give equal quantities of nitrogen. The reason for this is under investigation.

The fertilising effect of heat on soils has been known for ages, as witness the ancient practice above detailed. That, however, it is due to the causes assigned by Drs. Russell and Hutchinson, viz. a partial sterilisation of the soil, is very much open to doubt. In their extremely interesting work at Rothamsted they find an increase in bacterial activity and rate of increased decomposition of organic matter after partial sterilisation associated with an increased crop yield. There is the possibility, however, that these latter phenomena are accompaniments, and not the causes, of the increased crop-yields, all being the result of a destruction of toxic material in the soil. In any case, the theory put forward is apparently incapable of explaining many causes of sterility in soil, and is, apparently, not a general explanation that has any practical bearing on the general question of soil fertility. For example, it is difficult to see how it can account for the fact that certain plants will not grow in the immediate neighbourhood of others, as the present writer has found to be the case ("Memoirs of the Department of Agriculture in India," Bot. Ser., vol. xi., No. 3, April, 1908).

The excellent work of the U.S. Bureau of Soils has proved that roots of plants excrete a toxic substance. The present writer has noted the same phenomenon, and has further isolated the substance from water in which plants have been cultivated. A further paper on this question is in preparation. It may, however, be stated here that if water rendered toxic by the growth in it of plants is shaken with benzene, toluene, chloroform, or carbon bisulphide (the antiseptics used in experiments for partially sterilising soil), this toxic substance is rendered insoluble, and therefore innocuous.

As an example, when such water is shaken with toluene, an emulsion is formed which floats on the surface of the water. If this emulsion is poured off and the toluene and water allowed to evaporate, a residue is left

which is not soluble in water (or at least not in the quantity of water from which it was extracted).

It therefore appears probable that the effect of toluene on the soil is to render insoluble and innocuous this toxic substance. Similarly with the other antiseptics mentioned; ether apparently does not convert the substance into an insoluble form, and its method of acting is being investigated.

The writer has also found that heating to dryness on a water-bath decomposes this substance, and it is probable when in the soil that a lower temperature will suffice. It seems probable, therefore, that the fertilising effect of sunlight will be found to be due to the decomposition of this toxic substance.

F. FLETCHER.

School of Agriculture, Gizeh, Egypt.

TRANSCASPIAN ARCHÆOLOGY.[1]

IN the two volumes referred to below are incorporated the results of the American expedition which visited Russian Turkestan under the direction of Mr. Raphael Pumpelly, the well-known geologist, in 1904, and, besides conducting excavations at Anau, near Askhabad, collected material bearing on the physiography of the Central Asian deserts and oases. Thus the work of the expedition was two-fold. On one hand, we are presented with geological and physiographical observations, illustrating changes which have taken place in the character of Central Asia; on the other, we have a full and able presentment of the archæological material obtained from the excavations at Anau, including a very complete ceramic record. We should add that the excavations were directed by Dr. Hubert Schmidt, of Berlin, who joined the staff of the expedition for that purpose.

On the physical side, Mr. Pumpelly, assisted by Messrs. Davis, Huntington, and R. W. Pumpelly, who were also members of the expedition, found traces in High Asia of several great glacial expansions during the Glacial period. According to the picture which he gives us, there existed a cap of continental ice, thousands of feet thick, which spread over nearly the whole of European Russia; and Central Asia was covered by a huge inland sea, larger than the Mediterranean, and fed by rivers flowing from the snow and ice. The sub-Glacial period was marked by a general trend towards desolation, accompanied by the disappearance of the ice-cap from Russia and a diminution of the great glaciers on the southern mountains. As evaporation became more rapid than the inflow of water, the inland sea shrunk and broke up into smaller basins, and the dried silts of seas and rivers were carried by the wind in great columns of dust across the earth. The lightest material was carried farthest, and deposited in beds of loess, the extraordinarily fine and fertile soil which covers a great part of the surface of Northern China and Turkestan, and extends in a continuous zone from north of the Caspian to Austria. The heavier silts, in the form of sands, moved more slowly along the surface of the plains, where they formed great seas of sand-dunes, heaped up in places to a height of more than a hundred feet. We may note that to the shifting of such sand-deserts in historic times we owe the burial of cities in the Khotan region, which have been so successfully excavated by Dr. Stein for the Indian Government. With regard to the geological side of his work, we certainly think that Mr. Pumpelly's researches on the spot tend to confirm Richthofen's theory of the wind-borne origin of loess, and he has succeeded in obtaining further evidence of his own modification of the theory as to the important part played by river silts, and the chemical action of vegetation, in furnishing the constituents of loess.

As a deduction from his archæological researches, Mr. Pumpelly would regard the Central Asian oases as the fountain-head of Western Asiatic culture. According to his theory, their inhabitants were isolated from Africa and Europe from the Glacial period onward, and their cultural requirements were consequently evolved in complete independence. Changes in climatic conditions, however, took place, under which the early civilisations in these regions tended to disappear, and these gave rise to extensive migrations, which eventually reacted on the outside world. In support of his theory, Mr. Pumpelly would trace the early appearance of wheat and barley in Babylonia and Egypt, and the presence of certain breeds of domestic animals, to their first establishment in the Transcaspian oases. Moreover, he would place the original home of the Sumerians in Central Asia, where, before their arrival in Babylonia and their subsequent fusion with Semitic nomads, he pictures them as having already acquired the elements of their racial culture and organisation under the stern discipline of a struggle with nature. The absence of any form of writing in the mounds of Anau may be cited as negative evidence against any racial, or even cultural, connection with the Sumerians, though, as we shall see later, a study of the ceramic points to some influence having been exerted from that quarter on the early cultures of Susa in Elam.

In this connection it is indeed a moot point whether the parent civilisation was not that of Elam herself.

FIG. 1.—(1) The North Kurgan at Anau, in Russian Turkestan, with the Camp of the Pumpelly Expedition in the foreground. (2) The South Kurgan at Anau, showing excavations in progress.

[1] Explorations in Turkestan: Expedition of 1904. Prehistoric Civilisations of Anau. Origins, Growth, and Influence of Environment. Edited by Raphael Pumpelly. Vol. i., pp. xxxvi+240+vi; vol. ii., pp. x+(241-494)+x; with 97 plates and 548 illustrations, including maps and plans. (Washington: Carnegie Institution, 1908.)

It would be tempting to seek the origins of the Babylonian and Elamite cultures in the highlands of Asia, for it is not difficult to assign causes for a succession of migrations westward. The nomad population of Central Asia, swollen to the limit of the supporting capacity of its pasture lands, would be forced to seek outlets into more favoured regions. This process may well have been accelerated by periods of drought, due to the climatic changes which have left no uncertain traces behind them in the character of the country itself. The present condition of aridity would appear to have been of continual growth, with certain oscillations, since the Glacial period. Already in prehistoric times the seas of sand-dunes had en-

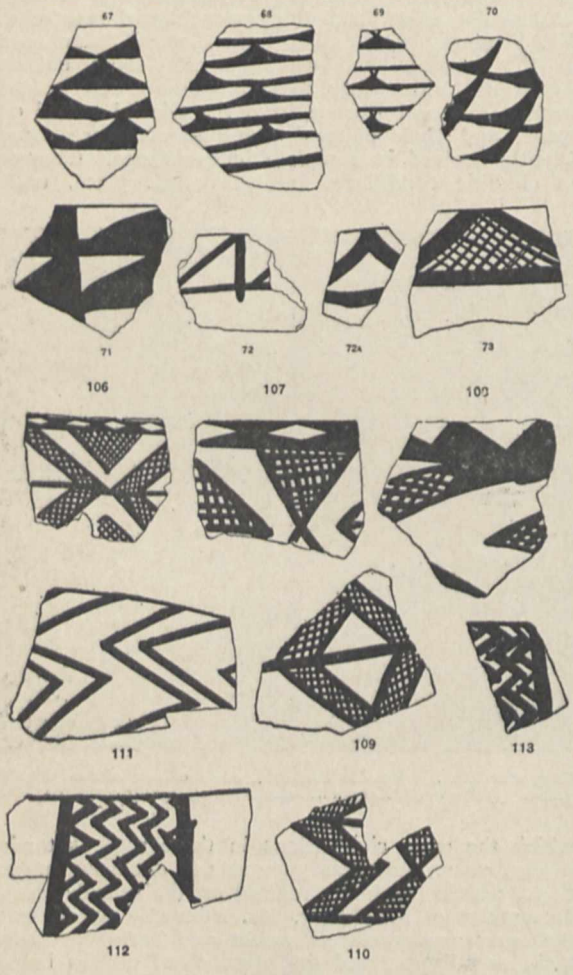

FIG. 2.—Designs on painted potsherds from the Neolithic and Aeneolithic Strata (Cultures I. and II.) at Anau, which bear a certain resemblance to linear and geometric designs on sherds from Elam and Western Asia. From the North Kurgan.

croached upon the fertile plains of loess, and the delta-oases, at the mouths of streams emerging from the mountains, or at points where larger rivers lost themselves on the surface of the plains, have been the favourite home of man. It was at one of these, at Anau, near Askhabad, some three hundred miles east of the Caspian, that the Pumpelly expedition conducted excavations in 1904, and obtained its principal material for archæological study.

Near the middle of the Anau oasis, and about a mile from one another, are the two Kurgans, hills with rounded contours, rising some forty and fifty feet above the plain, and marking the sites of long-forgotten cities. The structure of the North Kurgan had already been exposed by a trench cut in it some twenty-five years ago by General Komorof, which showed a series of stratified remains, including the bones of animals and potsherds of plain and painted ware. It was this trench which first directed Mr. Pumpelly's attention to the mound, and his subsequent excavations, both here and in the South Kurgan, laid bare a stratified structure of precisely similar character. The strata represented successive occupations of the sites, and, as their inhabitants lived in houses built of sun-dried brick, the hills gradually rose in height by the accumulation of *débris* from previous settlements. Of the two hills, the North Kurgan was of earliest formation, its earlier strata representing a Stone-age culture, while its upper layers belong to an æneolithic stage of civilisation. The third culture, that of the South Kurgan, dates from a Copper age. The archæological part of the work was left wholly to Dr. Schmidt, assisted by Miss Brooks, and to his admirable method of noting the precise spot and level of every object recovered we owe the possibility of tracing the gradual development of culture during the successive periods of settlement. Moreover, the Transcaspian Railway passes little more than half a mile to the north of the North Kurgan, so that no difficulty and little risk were involved in the conveyance to Europe of all the archæological material obtained. The collection of animal bones from the North Kurgan alone weighed nearly half a ton, but the neighbourhood of the railway enabled the whole collection to be transported without trouble to Dr. Duerst, of Zürich, who contributes a report on them as part vi. in the second volume.

The cultural progress of the three great periods is most clearly revealed by the pottery, which exhibits a gradual evolution in form, technique, and decoration. Although the vessels of the first two cultures are hand-made, and the wheel was not introduced until the advent of the Copper age, yet the vessels of both earlier epochs are excellent ceramic productions. It would be out of place in the present review to discuss in detail the problems presented by a study of the potsherds, so admirably edited by Dr. Schmidt; but it may be noted that many of the geometric designs occurring on pottery of the earlier periods from North Kurgan bear a striking resemblance to designs on pottery found by MM. Gautier and Lampre at Mussian, and by M. de Morgan at Susa. This may well point to some connection between the stone and early metal-using cultures of Transcaspia and Elam, while the baked clay figurines from the copper culture of South Kurgan may be due to some early cultural contact with Babylonia, as first suggested by Prof. Sayce. Whether we may treat as significant a further resemblance which has recently been pointed out by Mr. H. R. Hall between the Persian and Transcaspian sherds, on the one side, and fragments of similar geometric pottery on sites in Asia Minor and even in Northern Greece, is a subject outside the scope of the present review. That such problems should be even mooted is a sufficient testimony to the importance of the archæological material obtained by the Pumpelly expedition.

In fact, Mr. Pumpelly, though not an archæologist himself, has, with Dr. Schmidt's valuable cooperation, produced a work of the first importance to students of archæology. In the first five chapters of part i. of the first volume he has admirably summarised the results obtained by the expedition, but there is one feature of his treatment to which we feel we

must take exception. Mr. Pumpelly's attitude with regard to prehistoric chronology is indicated by the remark with which he introduces his description of the sub-Glacial period in Central Asia. "Remember," he says, "that while we look, in our time-perspective, millenniums are as seconds." This generous and imaginative method of treating the lapse of time, which is no doubt a very necessary virtue in the geologist, is wholly destructive of an accurate chronology in archæological study. Moreover, the attempt to apply geological methods of dating to the purely artificial growth of a city site is totally unscientific, and we are glad to note from a remark at the end of Mr. Pumpelly's preface that he has already realised the possibility of error in at least one of his assumptions. Such dates as 8000 B.C., which he suggests for the beginning of the Neolithic settlement at North Kurgan, or 5000 B.C., for the beginning of the Copper age in South Kurgan, are wholly fanciful. It is true that very early dates were at one time in

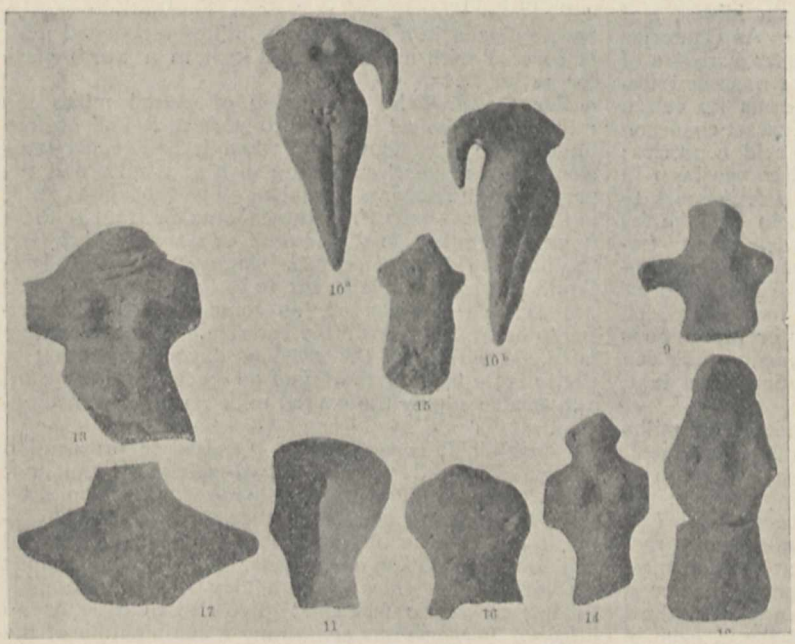

FIG. 3.—Terracotta figurines from the Copper Age Stratum (Culture III.) at Anau, suggesting a cultural connection with Babylonia. From the South Kurgan.

vogue, both in Egyptian and more particularly in Babylonian archæology; but these are now given up, and it is recognised that the earliest Sumerian remains in Babylonia do not date from an earlier period than the end of the fourth millennium B.C., while the Neolithic remains at Susa are probably not of a very much earlier period. While these facts naturally affect the dates suggested by Mr. Pumpelly for the cultures at Anau, they do not in any way upset their relative arrangement. It is perhaps significant that Dr. Schmidt nowhere mentions a date; and throughout the whole work the material is presented in such a way that the student is in no way hampered or misled.

The success of the expedition, and the admirable volumes which set forth its achievements and results, are a striking testimony to Mr. Pumpelly's enthusiasm and powers of organisation, and at the same time show the high scientific aims and standards which inspire American archæological and geological research at the present time. L. W. KING.

SOURED MILK: ITS NATURE, PREPARATION, AND USES.

THERE seems to be little doubt that as age advances the microbial flora of the human intestine, especially of the lower portion or large intestine, often undergoes a change both in the number and in the character of the micro-organisms present. From middle life onwards the number of microbes increases, and species capable of inducing putrefactive decomposition of proteins become more abundant. This change can be roughly gauged by making microscopical preparations of the dejecta and staining by the Gram process, a selective method by which certain organisms only are stained. In the child's dejecta Gram-staining microbes are relatively scanty and are mostly *Bacillus bifidus and B. acidophilus*, and it is noteworthy that these are lactic-acid producing bacilli. In and after middle life Gram-staining forms usually become more and more numerous, the Gram-staining species now being principally *Bacillus putrificus* and *B. Welchii*, bacteria which induce marked putrefactive decomposition of proteins.[1] In unhealthy conditions of the intestinal tract somewhat similar changes or various abnormal fermentations may occur.

Metchnikoff[2] in a study of the nature of senility formulated the hypothesis that it is caused, partially at least, by auto-intoxication, poisoning by the absorption of products derived from the action of micro-organisms in the digestive tract. Such poisons would be the products of the putrefactive decompositions brought about by the micro-organisms named, and also bodies belonging to the phenol series which are formed by the action of *Bacillus coli*, which is always present in the intestines, becomes more and more numerous from youth to old age, and which also multiplies excessively in unhealthy conditions of the digestive tract. In seeking for some agent which would combat the multiplication of micro-organisms in the intestine, particularly these harmful forms, Metchnikoff conceived that lactic acid, which has no deleterious action in the human economy, would probably effect the end desired, since the growth of these bacteria is inhibited by a moderate percentage of this acid. Bienstock, for example, found that the B. *putrificus* is inhibited in growth by *B. coli* thanks to its acid-producing power, the acid formed, though small in amount, being lactic acid. Simply to introduce the acid as such would, however, be of little use, for it would be absorbed and decomposed long before it reached the large intestine. Metchnikoff therefore sought for some means whereby lactic acid might be formed *in situ*, and naturally fell back on the use of lactic-acid-producing bacteria, which, if they could be established in the large intestine, might there produce sufficient lactic acid to inhibit the growth of the putrefactive and other deleterious forms. But the problem was not an easy one, for it entailed the finding of a lactic acid ferment which would grow at body tem-

1 Herter, "Bacterial Infections of the Digestive Tract," 1907.
2 "On the Prolongation of Human Life."

perature (99° F.) and maintain itself in spite of the competition of the other micro-organisms present. The ordinary lactic acid ferments found in milk grow best at 75°–85° F., and are unsuitable.

Metchnikoff says[1] "I had no illusion as to the difficulty sure to be encountered in any effort to introduce lactic microbes into the intestinal flora which has been preoccupied by a multitude of other microbes. To make surer of the result, I chose the lactic microbe which is the strongest as an acid producer. It is found in the *Yoghurt*, which originates in Bulgaria. The same bacillus has also been isolated from the *leben* of Egypt; and it is now proved that it is found in the curdled milk of the whole Balkan peninsula, and even in the Don region of Russia." Metchnikoff also noted that some of those who consumed a diet of little else than the soured milk lived to an advanced age. This then was the origin of the use of Bulgarian sour milk, and of the introduction of artificial substitutes for the natural article. It may be added that the use of sour milk seems to be widespread in the East, for it is found also in Turkey, Siberia, and Asia Minor, and in India under the name of "Dadhi."[2] As Chaterjee says, "The extensive use of one or other varieties of fermented milk, produced by means of a special ferment in Eastern countries, probably owes its origin to the difficulty of preserving milk in a sweet condition for a long time, in comparison to cold countries; milk when undergoing spontaneous decomposition in hot climates becomes changed within a few hours to a foul-smelling fluid in which the casein and the fat have undergone liquefaction, whereas, when fermented by means of the special ferment the decomposing, gas-producing, proteolytic bacilli are killed off by the more vigorous organism of the ferment, which has no destructive action on the fatty or albuminous constitutents of milk, so that by this means milk can be kept in a condition fit for consumption for a long time."

The bacteriology of the various natural sour milks is somewhat complex and not yet fully elucidated, although considerable research has been devoted to it. Micro-organisms of a peculiar type are present in all. One of the first to be isolated was the *Bacillus bulgaricus*, a large Gram-staining, non-sporing, rod-shaped organism, which grows best at temperatures between 110° F. and 120° F. Development, however, is slow even at the optimum temperature, taking three days for the maximum production of lactic acid in milk, and it is therefore unsuited for the preparation of artificial soured milk. Another organism is the "granule bacillus" (Körnchenbacillus) of Kuntze. This is probably the organism so often spoken of as the "bacillus of Massol," and is widely used for the preparation of soured milk, as it grows rapidly and well at a temperature of about 100° F. and produces a relatively high percentage of lactic acid. The name of "granule bacillus" is derived from the fact that granules which stain deeply are present in the bacterial cell. In all the natural soured milks somewhat similar micro-organisms are to be found. It is of interest that Kuntze has suggested that these Bulgarian lactic ferments are allied to the *B. acidophilus* and *B. bifidus*, which, as already stated, are present in the child's intestine, and they are probably primarily of intestinal origin.

In natural sour milks the special lactic acid ferments are always associated with other ordinary lactic acid bacteria, particularly a Streptococcus (*S. lacticus*), and a mixed culture of this last-named organism with the bacillus of Massol, presents advantages over the use of the latter alone.[1] For instance, when the *B. bulgaricus* grows alone in milk it has some effect on the fat, producing small quantities of nauseous tasting substances, but Metchnikoff has shown that this result is entirely obviated by a symbiotic growth with an ordinary lactic acid organism. The ingestion of milk soured by an ordinary lactic acid organism also tends to produce in the intestine an acid environment which favours the growth and persistence of the special lactic ferment, the bacillus of Massol.

Various procedures are adopted for the preparation of the natural sour milks. According to one account, Yoghurt is prepared by boiling milk until it has diminished to half its volume by evaporation, it is then allowed to cool somewhat and a little of a previously prepared sour milk is added and the whole allowed to stand in a warm place until next day. Another method is to wipe round a wooden bowl with a piece of cheese (presumably prepared with the sour milk) and then to introduce into the bowl the boiled milk. Dadhi is prepared by boiling milk for some time, cooling to blood-heat, and then inoculating with a needle dipped in a former brew. The inoculated milk is covered with a blanket and kept in a warm place for 12 hours.

For the artificial production of soured milks the milk is well boiled in order to sterilise it and destroy undesirable organisms, and when it has cooled sufficiently a "starter" consisting of a pure culture of the proper lactic ferments is added. The inoculated milk is then kept at 100° F. or thereabouts for from 10 to 24 hours, according to the amount of starter added, and should then be fit for use. Many "starters," both liquid and solid (tablets), are to be had, but only a few are to be recommended, as some are grossly contaminated with undesirable bacteria. Another method is to add a little of the previous day's preparation to the milk to be soured. Some of the large dairy companies also supply the soured milk ready for consumption.

Considerable care must be exercised in preparation to use sterilised vessels and to safeguard the milk from contamination during incubation. The milk properly prepared should be thoroughly curdled, possess a not unpleasant tart flavour, and have a marked acid reaction. Some of the older "starters" contained sporing bacilli which though they curdled the milk (owing to tryptic ferments) gave rise to little or no acidity. Preparations containing a combination of the bacillus of Massol, with *Streptococcus lacticus* or *lebenis*, are probably the most suitable.

The internal administration of tablets, &c., containing the lactic ferments, in place of the soured milk, is of questionable utility.

Although some are still sceptical as to the value of soured milk, it can hardly be doubted that it is beneficial in many complaints.[2] Among these are (*a*) those depending on abnormal putrefaction of proteins in the intestinal tract, and including certain cases of acute enteritis and acute and chronic colitis; (*b*) auto-intoxication, with products of intestinal putrefaction, as in many cases of general failure of health in elderly persons, forms of anæmia, neurasthenia, with flatulent dyspepsia, &c.; in minor ailments such as lassitude, headache, some forms of constipation and diarrhœa, rheumatic pains, and the like, benefit frequently results. It must also be recognised that even if the soured milk as such does little good, it often enables an addition of valuable and easily assimilable

[1] *Century Magazine*, November, 1909, p. 56.
[2] Chaterjee, *Ind. Med. Gazette*, September, 1909, p. 329.

[1] "On the Bacteriology of Yoghurt," &c., see Luerssen and Kühn, *Centralbl. f. Bakt.*, Abt. ii., xx., 1908, p. 234; Kuntze, *ib.*, xxi., 1908, p. 737; White and Avery, *ib.*, xxv., 1909, p. 161; Hastings and Hammer, *ib.*, xxv., 1909, p. 419. Full references to the literature of the subject are given in these papers.
[2] Herschel, Proc. Roy. Soc. Med., January, 1910.

food-stuff to be made to the diet by its use. On the other hand, soured milk is by no means a universal panacea, and should not be taken indiscriminately without medical advice, as it sometimes disagrees.

Moreover, the home preparation of soured milk cannot be recommended unless it is undertaken by a member of the household having some knowledge of the scientific principles involved in the practice of sterilisation and use of pure cultures.

R. T. HEWLETT.

CLASSICS AND SCIENCE IN EDUCATION.

THE recent correspondence in *The Times* on the question of "compulsory Greek" at Oxford chiefly refers to academic expediency and the establishment of a *modus vivendi* between the Oxford tradition and the claims of scientific students. But the vital and ultimate question is not this detail of practical politics; it is the question of the fundamental principles of education. The recrudescence of the "Greek controversy" is important, as showing how social evolution is gradually forcing education —however unconscious educationists may be of the fact—along the lines of progress.

The issue at Oxford is between the classical or "literary" test, as a guarantee of the classical or "literary" foundation (or "character," it may be said) of the whole system of Oxford studies, and the interests of "the large body of scientific and other workers to whom literary studies are difficult and tiresome, and to whom the examination in Greek is a mere 'obstacle.'" We quote the words of Prof. Turner; he adds that, in his opinion, "Greek is as important to a literary education as mathematics to a scientific. In neither case is the particular study essential, but it is of vast importance." Dr. Jackson points out that "in many of the university studies the highest proficiency cannot be obtained without a knowledge of Greek. For the highest proficiency in mathematics or any branch of science Greek is not, but modern languages are, a necessity."

In connection with this reference to proficiency, a proposal was recently made that Greek should be retained where it is essential for a complete mastery of the subject, but that where it is not essential an alternative which ensured a certain amount of "literary culture" might be allowed.

Such a test is meant to safeguard the Oxford principle of a "literary" or humanistic foundation for all its studies. With this principle is supposed to be bound up "the Oxford spirit."

If this principle is interpreted to mean that the study of science, for example, should be preceded or accompanied by a training in the arts of language which are necessary for complete power of expression and for the development of that side of the mind which is built up by language, the principle is sound. But if it is made to mean the educational necessity of "culture," in the sense of a literary, rhetorical, or æsthetic habit of mind or refinement of "taste," one must protest. The former has no general applicability to education; it is merely a result of specialising upon literary, rhetorical, or æsthetic material. As for the latter, mental refinement is as much a result of scientific as of literary or classical studies. It is a manifestation of the critical, that is, of the scientific habit.

As a test of this, a general training in science would be at least as effective as the study of a special subject such as Greek. And, to take another point of view, a study of physical phenomena and of their relation to human life and history is essential to both complete mental development and a liberal education. To confuse these last with a "literary" or humanistic tone or curriculum is to confuse general development and general education with specialisation.

Greek is essential to a study of literature or to a complete literary training, but to nothing else. But even supposing that it were necessary for a liberal education, and therefore desirable for scientific students, it is obvious that the standard of Greek required for entrance at Oxford is ludicrously inadequate; it is absolutely no test of anything except of a *beginning* in the study of a particular *language*.

It is as well to be clear on the meaning of the term "literary." As used in this controversy and with reference to the "Oxford spirit," the term implies rather that form of liberal education which consists mainly in a rhetorical philosophy of politics, history, law, and literature than a literary education proper. Even for this form of liberal education a knowledge of the Greek language, however high the standard attained, would not be essential. Greek, as we have said, is only essential to a literary training proper.

Again, whether used for this or for any purpose, it is useless unless it reaches a high standard. To reach such a standard is itself specialisation, and would require so much time that a boy would be unable to learn with any efficiency any other subject. That is to say, he would have to devote to the study as much time as those boys who enter for classical scholarships. Greek, be it understood, implies Latin. The abolition of Latin as well as of Greek is hardly dreamt of as yet.

Prof. Murray, who thinks that the vital point is "the maintenance of both Greek and Latin—but a better as well as an easier Greek and Latin," is assisted by the classical reformers. These are applying new systems, the most important of which is known as the Frankfurt scheme, for the production of better classical results in half the time. Thus, whereas in the old English public-school system a boy took about ten years to attain proficiency, but by no means adequate proficiency, in two dead languages which he never learned to speak, under the Frankfurt scheme, the first three years, say from nine to twelve, are chiefly devoted to obtaining a good grounding in French instead of in the acquisition of Greek and Latin grammar. Then, and not until then, is Latin commenced; Greek is commenced two years later.

On these lines a great deal of experiment is being made in English schools. Much ingenuity is also being shown in methods for quickening and improving the assimilation of Greek and Latin—the oral method, the heuristic, the principle of learning translation from the very beginning instead of after a long training in grammar, and so on. But it is noteworthy that towards the end of the course the classical time-table becomes excessive again.

It does not seem to have occurred to educationists that possibly the only way of learning a foreign language is by speaking it, and that the best results are obtained by learning the vernacular first. There is a further possibility awaiting realisation, namely, that the study of any other language than the vernacular is a case of specialisation. It follows that the imposition of Latin or Greek or French on the curriculum of young boys is at least premature. In time, lastly, we may come to realise that "no man fully capable of his own language ever masters another," or, at any rate, that for the purposes of a general preliminary education or propædeutic (as contrasted with specialisation), not only is the vernacular sufficient if properly taught, but that the learning of another language or languages while the vernacular is in process of formation is so far from being

an aid in this or an assistance to mental development that it is actually mischievous.

The traditionists (for, after all, tradition, whether of the old "learning" or, in more subtle form, of a sort of class prejudice, seems to be the main reason for the retention of classics as a propædeutic) reply that the character of the classical tongues, their inflectional structure and their logical habit, are of great value in the development of the intellect. Instead of asking for proofs of this, we may note the possibility that an efficient study of the vernacular can secure the same results. The Germans (as is shown in a recent report [1]) are beginning to see this. The classicists may quote anecdotes of this or that distinguished man who attributed his lucid and logical English style to his early training in Latin prose, but the same or a better result could be secured in far less time. If the time now given in our schools to classical and modern languages were given to English, the benefits would be enormous both for the general culture of the people and for the special work of specialists, whether in science or languages, in "technical" or "literary" studies. The English taught in schools as yet is a mere parody of what it might be. It is remarkable that the English language does not possess a single text-book of its natural history that can claim any philosophic or scientific importance.

If English were properly taught as the main component of a propædeutic (the other components being elementary mathematics and science, the study of which also needs reorganisation), boys who begin specialisation (for specialisation now perforce begins at school), whether in science or mathematics, would find "literary" studies by no means an obstacle. They would have a command of their own language far in advance of the best classical or "literary" scholar as trained to-day. The result would also be a great benefit to science itself.

The world has already absorbed the Greek "spirit," but it should not forget the fact that the essence of that spirit is the scientific temper. It must also realise that as knowledge increases in bulk there must be periodic sacrifices of what can best be spared. "The wisdom of the ancients" is a phrase which, if not merely sentimental, is absurd. *Antiquitas saeculi juventus mundi.*

Reform is needed in the school curriculum no less than in the university system. If the propædeutic there is on sound principles, there will be no fear of scientific students being without a literary training (and this in the best and most useful direction, the mother-tongue), nor, we may add, will there be any risk of "literary" students being without a scientific training. Greek and Latin will then be reserved for special university courses, just as Hebrew, or rigid dynamics, or forestry may be so reserved, according as the specialist is moved by his own spirit or the spirit of evolution.

A. E. CRAWLEY.

THE CENSUS OF 1911.

THE Census (Great Britain) Bill, making provision for the taking of the census of 1911, was read a first time in the House of Commons on March 4. The Act for the last census, that of 1901, provided that the schedule should require the following particulars, and no others:—"(*a*) the name, sex, age, profession or occupation, condition as to marriage, relation to head of family, birthplace, and (where the person was born abroad) nationality of every living person who abode in every house on the night of the census day; and (*b*) whether any person who so abode was blind or deaf and dumb, or imbecile or lunatic; and (*c*) where the occupier is in occupation of less than five rooms, the number of rooms occupied by him; and (*d*) in the case of Wales or the county of Monmouth, whether any person who so abode (being of three years of age or upwards) speaks English only or Welsh only, or both English and Welsh"—a provision suitably modified in the case of Scotland by a reference to the speaking of Gaelic instead of Welsh.

These requirements have been amplified in the Bill now before Parliament by omitting the limitation to "less than five rooms" in (*c*), so that all occupiers will have to make a return as to the number of rooms inhabited, and by the addition of a new section:—"In the case of any person who so abode being married, the duration of marriage, and the number of children born of the marriage." The first change is of importance, as it will enable the census authorities to give tables covering, more completely than was formerly the case, tenements inhabited by the working classes, and it may be hoped that, in the subsequent tabulation, some distinction as to the ages of persons inhabiting tenements of each given size may be found feasible; a distinction between children and adults would render possible some better indication of overcrowding than the present somewhat crude measure of "more than two persons to a room."

The new section requiring a return, in the case of married persons, as to the duration of marriage and the number of children born of the marriage is of the very highest interest, though its full value will not be reached until the results of later censuses are available for comparison. If the returns are tabulated so as to show the number of children for a given age of mother and a given duration of marriage, it will be possible to compare essentially similar marriages in different districts, and some fresh light will be thrown on the present state of legitimate fertility in this country. It is also to be hoped that a subdivision may be found possible according to the occupation of the father; it would be sufficient to choose a few typical groups of occupations, and it would hardly be necessary to do more than give tables for England and Wales as a whole. Such tables would afford information of the most important kind, which we do not at present possess in any form.

No question is included as to religion, except in the case of the Irish census, for which separate provision is made, and the present Census Bill is very disappointing in that it makes no attempt to place the organisation of the census on a permanent basis or to provide for an intermediate quinquennial census. It is absurd that so important a part of the stock-taking of the nation, as the census is, should be dependent on the chances of party politics, and it is false economy to spend time and money on training a staff for the execution of census work and then to scatter that staff to the four winds—only to go through the process again after a few years have elapsed. A smaller but more permanent staff would be much more efficient and could be fully engaged between one census and the next in the carrying out of supplementary investigations after the publication of the main report. The necessity for the intermediate quinquennial census has been shown again and again, but the statement of the President of the Local Government Board that he is "not without hope that a system of quinquennial census may come to be adopted" cannot be said to carry conviction.

[1] "The Teaching of Classics in Secondary Schools in Germany." (Board of Education Special Reports, vol. xx., 1910.)

ALEXANDER AGASSIZ, FOR.MEM.R.S.

ALTHOUGH the great American oceanographer had reached the age of seventy-five, few of his friends were prepared to hear of his death, which appears to have taken place, somewhat suddenly, on board the s.s. *Adriatic* on March 28, while on a voyage back to the United States.

The distinguished son of a famous father, Alexander Agassiz was born in Switzerland but naturalised in America; yet, so cosmopolitan was he in his tastes and habits, that if ever an individual deserved the title of "a citizen of the world" he was the man. Up to the age of thirteen, he was educated in his native land, but, proceeding to the United States in 1848, he went to the Harvard University, where—as a student in chemistry and engineering—he obtained his degree of B.Sc. at the age of twenty-two. After spending a short time as a member of the United States Geological Survey, young Agassiz became a mining expert, and so successful was he in this profession that, acquiring possession of valuable properties in the Lake Superior region, he rapidly made a very large fortune in connection with the copper mines.

The love of natural-history studies, however, which he inherited from his father, soon made itself felt; at first he assisted his father as curator of the Museum of Comparative Zoology at Harvard. As his wealth increased, he was able to benefit that institution, not only by specimens collected during his extensive travels and by defraying the cost of many expensive publications, but also by gifts of money up to 100,000*l*. After the death of his father he acted as curator of the museum for eleven years. Beginning with the study of marine ichthyology, he subsequently came to be acknowledged as a great authority on the Echinodermata, so that, on the return of the *Challenger* expedition, he was asked to undertake the report on the Echini collected during the voyage.

But the work for which Alexander Agassiz will be chiefly remembered was that which, during nearly forty years, he carried on at his own expense in connection with oceanography. The United States Government, with the greatest liberality and consideration for the interests of science, allowed him from time to time the use of their surveying vessels, the captains of which were instructed to place themselves virtually under the orders of Agassiz himself. The naturalist, aided by a staff selected and paid by himself, carried on soundings and dredgings in every part of the globe, special attention being devoted to the study of coral reefs. Beginning, in 1877, with the study of the Gulf of Mexico, the Caribbean Sea, and the Atlantic coast of America, Agassiz continued his work in 1880 by investigating the surface fauna of the Gulf Stream. Besides working out the details derived from the study of collections made during these voyages, the results of which were published in connection with the Harvard Museum of Comparative Zoology, Agassiz wrote a well-illustrated account of his work, "The Three Voyages of the *Blake*," in two volumes.

In 1891 Agassiz transferred his attention to the western shores of the United States and Central America, investigating the seas around the Sandwich Islands, and paying special attention to the coral reefs there, between 1892 and 1894. His explorations were extended during 1895–6 to the Great Barrier Reef of Australia, and in 1897–8 to the Fiji Islands. In 1899 and 1900 he was able to undertake a cruise among the various groups of coral-islands lying between San Francisco and Japan. In 1901–2 Agassiz commenced his study of the Indian Ocean, paying especial attention to the Maldive Islands and their surroundings; and, in order to complete the examination of portions of the Pacific that he had not already visited, he devoted the years 1904–5 to a cruise among the important island-groups of the eastern half of the Pacific Ocean.

The intervals between his several voyages were occupied by Agassiz in the study of his enormous collections and the preparation of memoirs dealing with the results obtained. These were issued, regardless of expense as to their illustration, in the publications of the Boston Society's Museum of Comparative Zoology. No fewer than thirty volumes of memoirs and fifty-three volumes of bulletins are devoted to the results obtained from the study of these collections by Agassiz and the various specialists who assisted him. His own favourite place of work was Paris, where rooms were always allotted to him in the Museum of Natural History, and he had the fullest access to scientific libraries.

Of the value and importance of the results of these voyages it is impossible to speak too highly. Perhaps the most striking of the conclusions arrived at by him are those relating to great movements which have taken place in the bed of the Pacific in comparatively recent geological times. This is evidenced by the numerous upraised coral-reefs which, following Dana, he described; in many of these the limestone rock, now at elevations of 1000 feet and upwards, has been more or less completely converted into dolomite.

It is not necessary, in face of the above statement of facts, to add that Agassiz was a man of indomitable energy. He thought as little of crossing the Atlantic as we do of crossing the Thames, and death met him at last while still "on the move." Of his courage, a remarkable example is told concerning an altercation he had with a military officer in a crowded restaurant in Germany; on that occasion he did not hesitate to resent an insult by a blow, though fortunately any serious result from the rash act was prevented by the interposition of a number of judicious friends of the officer, aided by American and English visitors who were present. In early life, Alexander Agassiz exhibited something of the dogmatic habit of mind that distinguished his illustrious father; but, mellowed by age and constant intercourse with other men, he became in after life strikingly open-minded and ready to listen to arguments, even those that told against his most cherished convictions. Those who were privileged to enjoy his friendship in his later life knew him as a man of ardent enthusiasm, restless energy, and charming bonhomie, but also as one patient in discussion, and always ready to listen to facts and reasonings from whatever quarter they came. His generosity was unbounded, and he was always ready to place his abundant materials at the service of young men who were qualified and willing to engage in their study.

In every scientific circle of Europe, as well as in those of America, Alexander Agassiz was well known, and in all of them his loss will be deeply mourned. In France he received the Légion d'Honneur, and in Germany the Order of Merit. In this country he was for many years a Foreign Member of the Royal Society. Only last year the Royal Geographical Society awarded him the Victoria research medal, and we may fitly conclude this notice with the verdict of the president in announcing the award—a verdict in the justice of which all must agree—"He has done more for oceanographical research than any other single individual."

JOHN W. JUDD.

NOTES.

THE Oceanographical Museum at Monaco was inaugurated last week by the Prince of Monaco in the presence of a gathering of more than two hundred representatives of Governments, of scientific institutions, and of oceanographical research. Among many others present were:—M. Loubet, ex-President of the French Republic; M. Pichon, French Minister of Foreign Affairs; Admirals of the Fleet von Koester from Germany and Grenet from Italy; Vice-Admiral de Jonquières, commanding the French Mediterranean Squadron; and distinguished representatives of the Governments of Spain and Portugal. The Institute of France sent a large body of members representing the Academies of Sciences and of Fine Arts. The Academy of the Lincei at Rome, the Academies of Sciences at Berlin, Vienna, and St. Petersburg, the Royal Societies of London and Edinburgh, the Geographical Societies of Paris, Berlin, Vienna, and St. Petersburg, the Challenger Society, and many other societies and institutions were amongst the societies sending delegates. The British Government was not represented officially, owing to some blunder, but Mr. W. E. Archer, of the Board of Agriculture and Fisheries, Mr. J. Y. Buchanan, F.R.S., Dr. G. H. Fowler, Prof. W. A. Herdman, F.R.S., Dr. J. Scott Keltie, and Dr. H. R. Mill represented British marine studies. Among the leading men connected with oceanography, marine biology, and kindred sciences in other countries there were Mr. Bendall, of Bordeaux; Prof. Drygalski, of Munich; Prof. Forel, of Lausanne; Senator Grassi, of Rome; Prof. Haeckel, of Jena; Dr. P. P. C. Hoek, of Haarlem; Prof. Hensen, of Kiel; Prof. Hergesell, of Strassburg; Dr. Knipovitch, of St. Petersburg; Prof. Krümmel, of Kiel; M. de Margerie, of Paris; Prof. Otto Nordenskjöld, of Gothenburg; Prof. Penck, of Berlin; Prof. Perrier, of Paris; Prof. Pettersson, of Stockholm; Dr. Schmidt, of Copenhagen; Dr. Schott, of Hamburg; Prof. Supan, of Breslau; Prof. Thoulet, of Nancy; Prof. Max Weber, of Amsterdam; and Dr. Richard, director of the new museum, with Profs. Berget, Joubin, and Portier, of the Oceanographical Institute in Paris. The museum was inaugurated by the Prince of Monaco at a grand function on Tuesday, March 29; on the following day there was a banquet to three hundred guests, and the evenings were occupied by a special performance at the famous Opera House in Monte Carlo, a display of fireworks of extraordinary brilliance in the harbour, and finally by a magnificent State reception in the gorgeous apartments of the ancient palace of the Grimaldis. Meetings of four commissions, on the Atlantic, on the Mediterranean, on the perfecting of the Oceanographical Institute, and on the bathymetrical chart of the world, were held under the presidency of the Prince, and a summary of the proceedings will appear in another issue of NATURE. The Prince conferred the Order of St. Charles in four classes on a number of persons, amongst whom may be mentioned as receiving that of the second class, or commander, Mr. J. Y. Buchanan, Senator Grassi, Prof. Penck, and Dr. Richard. The princely hospitality displayed on the occasions extended to the provision of free hotel accommodation for all the visitors invited to the *fêtes*, while the representatives of States were entertained at the Palace as personal guests of the Prince.

SIR WILLIAM RAMSAY, K.C.B., F.R.S., has been nominated president of the British Association for the meeting to be held at Portsmouth next year.

SIR HARRY JOHNSTON, G.C.M.G., has been elected a corresponding member of the Italian Geographical Society, in recognition of his work in Africa.

WE regret to see the announcement of the death, at eighty years of age, of Prof. E. Pflüger, professor of physiology at the University of Bonn, and director of the Physiological Institute there.

THE council of the Institute of Metals has decided to initiate what is hoped will be an annual series of May lectures. The first of these will be given in London on Tuesday, May 24, when Prof. W. Gowland, F.R.S., will deliver a lecture on "The Art of Working Metals in Japan."

A REPORT from Berlin states that Prof. Abegg, of the University of Breslau, was killed as the result of a balloon accident on April 3. Prof. Abegg was president of the Silesian Aëronautic Society, and a prominent figure in the German aëronautic world.

WE learn from the *Chemist and Druggist* that M. Henry Giffard, who died at Paris in 1882, made the State his residuary legatee. By a recent decree the Minister of Public Instruction placed a sum of 4000*l.*, being part of the legacy, at the disposal of the University of Paris for the foundation of an Institute of Radio-activity.

AT to-morrow's meeting of the Royal Astronomical Society, Prof. P. Lowell is expected to be present, and will speak upon his work. Major-General H. P. Babbage will exhibit and describe a calculating machine which he has recently completed, corresponding to the portion of the analytical engine which his father, the late Charles Babbage, named "The Mill."

A REUTER telegram from Berlin states that an expedition will leave Bremerhaven on July 1 on board the North German-Lloyd steamer *Mainz* for Spitsbergen in order to investigate the possibilities of an airship flight to the North Pole, which is planned for the summer of 1912. The party will include Prince Henry of Prussia, Count Zeppelin, and Profs. Hergesell and Drygalski, and will number altogether twenty-four members.

THE valuable collection of shells formed by the late Mr. Thomas Gray, a well-known Glasgow conchologist, who died recently at the advanced age of eighty-nine, has been left by him to Kelvingrove Museum, Glasgow. More than 7000 species of shells are represented in the collection, including both British and foreign, land, fresh-water, and marine forms. It is said to be the finest collection of its kind in Scotland, and its possession places the Kelvingrove Museum well abreast of the leading museums in this country.

AN Industrial and Agricultural Exhibition will be held at Odessa from May 15 to October 1 of this year. During the exhibition there will be lectures on technical and scientific subjects, and arrangements are being made for some congresses. The cooperation of scientific men is invited by the committee of the exhibition (Odessa, Novoselskaja 4, Technische Gesellschaft).

THE Civil Service Commissioners announce that, in addition to the open competitive examination for situations as cartographer in the Hydrographic Department of the Admiralty, which is to be held in July next, another open competitive examination for similar situations will be held in December. Forms of application for admission to the December examination will be ready for issue about the middle of July, and will then be obtainable on request, by letter, addressed to the Secretary of the Civil Service Commission, London, W.

MR. F. G. OGILVIE, C.B., has been appointed by the President of the Board of Education to a new post of Secretary of the Board for the Science Museum, Geological Museum and Geological Survey. Mr. E. K. Chambers has been appointed to succeed him as principal assistant secretary of the technological branch of the Board. Dr. H. F. Heath, director of special inquiries and reports, has been appointed to the post of principal assistant secretary of the universities branch of the Board in combination with his present post.

MR. WALTER RUNCIMAN, President of the Board of Education, has appointed a departmental committee to consider and report upon various questions in regard to the present condition and the future development of the valuable collections comprised in the Board's Science Museum at South Kensington and Geological Museum in Jermyn Street. In particular, the committee is asked to advise him (*a*) as to the precise educational and other purposes which the collections can best serve in the national interests; (*b*) as to the lines on which the collections should be arranged and developed, and possibly modified, so as more effectively to fulfil these purposes; and (*c*) as to the special characteristics which should be possessed by the new buildings which it is hoped will be erected shortly on the South Kensington site to house these collections, so as to enable the latter to be classified and exhibited in the manner most fitted to accomplish the purposes they are intended to fulfil. The committee is as follows:—Sir Hugh Bell, Bart. (chairman), Dr. J. J. Dobbie, F.R.S., Sir Archibald Geikie, K.C.B., P.R.S., Dr. R. T. Glazebrook, F.R.S., Mr. Andrew Laing, Sir Schomberg McDonnell, K.C.B., Sir William Ramsay, K.C.B., F.R.S., Prof. W. Ripper, Sir W. H. White, K.C.B., F.R.S., with Mr. F. G. Ogilvie, C.B., as secretary.

REUTER messages from Catania record that the eruption of Mount Etna increased in violence up to the end of March, when a stream of lava was moving at a speed of nearly forty yards an hour in the direction of Cisterna Regina, near Borrello. On April 4, however, the activity had considerably lessened. The streams of lava had diminished in volume, and changed their direction. They were then flowing towards Monte Rinazzi and Monte Faggi, submerging the lava remaining from previous eruptions. There was a pronounced recrudescence of the eruption early on April 5. The lava stream flowing towards Cisterna Regina in particular increased its rate of progress to 10 metres an hour, and reached a spot only 250 metres distant from the Nicolosi Borello road, destroying the cultivated land on its course.

THE summary of the weather for the first three months of the present year, just issued by the Meteorological Office, shows that the mean temperature was above the average over the entire kingdom. The rainfall was below the average in the north of Scotland, and in agreement with the average in the north-east of England, whilst in all other districts the fall was in excess of the average; the greatest excess was 2·77 inches, in the north of Ireland. The largest total measurement was 14·61 inches, in the north of Scotland, and the least 5·21 inches, in the east of England. The number of rainy days were everywhere in excess of the average. There was an excess of sunshine over the whole of Great Britain, amounting to 84 hours in the Midland counties, 76 hours in the north-west of England, and 70 hours in the south-west of England. The largest aggregate duration of sunshine for the three months was 362 hours, in the Channel Islands, and the least 212 hours, in the north of Ireland. There was an excess of sunshine in twelve out of thirteen weeks in the Midland counties, and in eleven out of thirteen weeks in the south-west of England.

MR. R. M. BARRINGTON, writing from Fassaroe, Bray, Co. Wicklow, says:—"On March 21, at 9 a.m., the reading of the wet-bulb mercurial thermometer 4 feet from the ground in a Stevenson's screen was 1° F. *higher* than the dry-bulb mercurial thermometer 3 inches distant in the same screen, the readings being 46° and 45° respectively. Assuming the instruments are accurate and in working order, can such a thing occur?" He adds that at the moment of observation the temperature was falling rapidly. A distinguished meteorologist informs us that cases of the wet bulb above the dry are by no means rare, but the difference is rarely so much as 1°. They are generally dealt with in practice by attributing the differences to instrumental errors or temporary meteorological circumstances (such as the rapid fall of temperature noted by Mr. Barrington), which bring out an imperfection in the conventional methods of thermometry.

THE tragedy which deprived M. Charlois of his life on Easter Day deprived French astronomy of a brilliant worker and the Nice Observatory of an enthusiastic observer. M. Charlois devoted himself chiefly to the minor planets, and was only second to Dr. Max Wolf in the number of these bodies which he discovered. At the foundation of the Nice Observatory by M. Bischoffsheim in 1881, Charlois was appointed secretary to M. Perrotin, the first director, and in 1887 was given charge of the minor planet work. Observing with the 38-cm. refractor he discovered, up to December, 1902, 104 which previously had escaped detection. Twenty-seven of these were found visually, between 1888 and 1892; but M. Charlois was the first to adopt Dr. Wolf's photographic method, and thereby added seventy-seven more asteroids to the rapidly growing family. These he discussed in vol. viii. of the Annals of Nice Observatory, but he also published a number of orbits, observations, &c., in the *Bulletin astronomique*, the *Astronomische Nachrichten*, &c.; for this work he was awarded the Janssen medal of the Astronomical Society of France in 1899. Minor planets did not, however, absorb all M. Charlois's energies, for he observed many comets, measured double stars, made a great number of latitude observations, and accompanied M. Thollon to Spain for the transit of Venus in 1882. At the transit of Mercury in 1907, he made observations which afforded corrections to the ephemeris, and he also rendered valuable assistance to the International Astrographic Conference in their work on Eros; it is interesting to note that he secured a plate showing the trail of this remarkable asteroid on the same evening that it was discovered by De Witt, but did not recognise it until after the announcement of the discovery by the Berlin observer.

LITTLE has hitherto been known of the language of the Yana tribe of Indians, who occupy part of Shasta County, in the northern region of California. This want has now been supplied by Messrs. E. Sapir and R. B. Dixon, who have contributed to the ninth volume of the Publications of the University of California a series of legends recorded from the lips of the two last survivors of those learned in the tribal traditions. One of these tales is a remarkable variant of the Prometheus type of legend, describing how Fox, Sandpiper, and Coyote stole the fire, how the world was burned, and how the thieves escaped in a basket which Spider hauled up to heaven by his thread. Another and less complete version of the tale has been published by Mr.

J. Curtin in his "Creation Myths of Primitive America." The present collection of tales, recorded in two dialects, will preserve for the use of philologists a language which is fated before long to disappear.

THE group Mesozoa is, as is well known, a kind of zoological waste-paper basket into which various obscure forms of extremely lowly organisation have been cast from time to time. Many of these forms are of great interest as indicating possible transitions from the unicellular to the multicellular condition. The genus Haplozoon has been added to this miscellaneous assemblage by Dr. Dogiel, who describes some new species thereof in the *Zeitschrift für wissenschaftliche Zoologie* (Band xciv., Heft 3). These remarkable parasites, which live in the alimentary canal of various polychæte worms, occur in the form of single or multiple chains of cells, the first cell of the series being provided with one or more stylets. Dr. Dogiel has proposed the group-name Catenata for these organisms, which he considers to be derived from the unicellular Peridinea, and to exhibit protophyte rather than protozoon affinities.

IN a paper on the stability of the physiological properties of coliform organisms (*Centralbl. f. Bakteriologie*, Abt. ii., Bd. 26, 1910, S. 161) Mr. Cecil Revis suggests that the capacity of a micro-organism to ferment various sugars, polyhydric alcohols, and polysaccharides depends on the presence of certain atomic groups in the substances. Thus glucose, mannose, galactose, lævulose, and lactose all contain the group —CHOH—O—CH=, and are fermented by *Bacillus coli*, while sucrose does not, and is not fermented by many strains of *B. coli*. Attempts were made to change the fermentive properties of various strains of *B. coli* and other organisms by prolonged sojourn in soils contaminated with fæces, &c., and in a non-albuminous medium. After some months changes were frequently noticed in the organisms isolated. Thus with one typical *B. coli* which fermented lactose, dulcitol and glucose well in twenty-four hours, after seven months in soil contaminated with human fæces an organism having the original properties was isolated, and, in addition, three other forms, A, B, and C, were isolated, characterised by differences in the appearance of their colonies. Of these, A and C gave the original reactions unchanged, but B fermented none of the test substances. Other instances of similar changes are given. In control cultures kept on gelatin, in general no change at all occurred.

THE Municipality of Hanover, according to a paper by Mr. E. Howarth on some German museums in the February number of the *Museums Journal*, deserves the gratitude of antiquarians for having restored and fitted up as a museum Leibnitz House, the picturesque fifteenth-century residence of a German merchant. It contains four storeys, all stocked with objects of industrial art and industry, arranged from an æsthetic rather than a systematic point of view.

IN the March number of the *Irish Naturalist* Mr. R. J. Ussher gives his experiences of cavern-exploration in Ireland, in which he has taken so large a share. Most important of all is the mammoth-cave near Doneraile, Cork, which was worked from 1904 onwards, and is older than any other except Shandon. This cavern takes its name from the number of mammoth-remains, but is also characterised by the abundance of reindeer and the absence of red deer, wild boar, and badger.

ACCORDING to the report of the Lancashire and Western Sea-fisheries (to which allusion was made in a recent issue), there is reason to believe that black-headed gulls are injurious to cockle-beds. In the Floodborough district these birds have been ascertained to feed almost exclusively on young cockles, which they pick out of the sand. It is accordingly recommended that these birds should be excluded from the Wild Birds Protection Act, and their eggs destroyed in the breeding-season.

IN the course of an interesting account of his recent journey in north-western Arabia, published in the March number of the *Geographical Journal*, Mr. Douglas Carruthers claims to be the first European who has sighted the Arabian ostrich since Palgrave's time. Three were seen in the Wadi Hidrij, about 120 miles south-east of the Dead Sea, which is probably the northern limit of these birds, the range of which includes all the interior of Arabia. It is suggested that the Arabian ostrich is inseparable from the typical *Struthio camelus* of North Africa, but since the Arabian oryx and baboon are distinct from their African relatives, this is by no means certain, and can only be determined by the acquisition of actual specimens. Mr. Carruthers states that the interior of Arabia is undergoing secular desiccation, so that many of the Beduin find it increasingly difficult to maintain themselves.

THE question of the proper pose of the limbs of Diplodocus, which was opened some months ago by Dr. Hay, has been taken up again by Mr. G. Tornier in a paper published in the *Sitzber. Ges. naturfor. Berlin*, 1909, p. 193. In this paper a restoration is given of the skeleton, in which the shoulder-girdle is pushed low down and the humerus and femur are extended almost horizontally, so as to bring the belly within a very short distance of the ground, while the head and neck are raised aloft in swan-like fashion, the feet being mounted in wholly plantigrade style. The general appearance of the skeleton is somewhat grotesque. On p. 507 of the serial cited Mr. Tornier replies to those who have criticised his restoration of Diplodocus. Prof. O. Abel (*Verh. k.k. zool. bot. Ges., Wien*, 1909, p. 117) has likewise entered the lists, and urges that all the sauropod dinosaurs were "elephant-footed," that is to say, in place of being plantigrade, their feet were of the semi-digitigrade type characteristic of the Proboscidea, with posterior foot-pads. This Mr. Tornier refuses to admit in a paper published in the *Sitzber. Ges. naturfor., Berlin*, 1909, p. 537, where the completely plantigrade character of the feet of these reptiles is re-asserted.

MR. B. H. RANSOM, assistant-custodian of the helminthological collections, the National Museum of Washington, has written a valuable work on the tænioid cestodes of North American birds (Bulletin No. 69, U.S. National Museum, Washington, 1909). Ten years ago, when studying under Prof. H. B. Ward, at that time of Nebraska, he began an investigation into the cestodes of North American birds, and the present volume, of 140 pages, is the first outcome of this research. The volume contains detailed descriptions of five new species, and there are numerous adequate figures. It also contains keys to the genera of the superfamily Tænioidea, diagrams of families, subfamilies, and genera, and lists of the species occurring in North American birds are added. The recent monograph of Dr. O. Fuhrmann, the well-known authority on bird tape-worms, has been of great service to the author. Mr. Ransom's paper ends, as is usual with American publications, with a very full bibliography and an accurate and full index, for which we cannot be too grateful to the author.

DR. K. M. LEVANDER has published an important work on the food and parasites of fishes in the Gulf of Finland ("Beobachtungen über die Nahrung und die Parasiten der Fische des Finnischen Meerbusens," *Finnländische Hydro-*

graphisch-Biologische Untersuchungen, No. 5, Helsingfors, 1909), supplementary to the earlier works of Dr. G. Schneider. A work of this kind requires very careful analysis and abstracting, and if we are to learn which of the species forming the food has supplied the parasites in question, we must carry the research rather farther. We have in this work very long lists of species of insects and their larvæ, of Crustacea and their larvæ, of molluscs, occasional worms, and other fish all eaten as food. We have also considerable lists of cestodes, trematodes, nematodes, Acanthocephala, &c., but the paper does not, in our opinion, sufficiently attempt to indicate which food-animal brought into the body of the fish the several parasites enumerated. Nevertheless, the work forms a foundation for further investigation, and one which will afford material for a greatly developing subject.

THE spread of interest in ecological botany is naturally creating a demand for photographs and lantern-slides of typical areas of vegetation. Mr. W. B. Crump, of Halifax, who has taken part in some of the British botanical surveys, has accumulated a series of photographic negatives

(a) (b)

Calluna Heath: a Cheshire Mere. (*a*) *Molinia coerulea*; (*b*) *Juncus supinus*.

depicting many of the recognised plant associations, from which he offers permanent photographic prints (15 by 12 inches or 12 by 10 inches) made by the ozobrome process or lantern-slides. The more detailed studies are only offered as lantern-slides. Descriptive notes are supplied. The photograph reproduced represents a Cheshire mere, near the margin of which clumps of *Molinia coerulea* are growing, while heather is seen in the immediate foreground, and a plot of *Juncus supinus* occurs on the further side.

THE first issue of the *Kew Bulletin* (1910) opens with a descriptive list, communicated by Mr. G. Massee, of new exotic fungi. An agaric, *Marasmius scandens*, so called from the way it extends its cord-like mycelium and produces the resupinate pilei at intervals, is reported to cause considerable damage to cocoa plants on the Gold Coast. Two suspected insect parasites are described, viz. *Sclerodermis gigaspora*, taken on orange leaves with scale insects, and *Septocylindrium suspectum*, found on the bodies of dead "frog-hoppers." A new parasite on the roots and branches of *Hevea brasiliensis*, received almost simultaneously from Singapore and the Gold Coast, receives the name of *Diplodia rapax* (Melanconiaceæ). Mr. A. D. Cotton contributes an article on the growth of the alga *Ulva latissima*, which, in contrast to most algæ, flourishes in stagnant and sewage-polluted water.

MESSRS. J. B. BAILLIÈRE ET FILS are issuing a small monthly booklet, *Le Mois agricole*, containing notes likely to be of value to the agriculturist, the vine-grower, and the gardener. There are also detailed notices of the recent publications of the firm.

THE necessity for continued work on the sugar-cane is thoroughly recognised in the West Indies, and bulletins are regularly issued setting forth the results obtained up to the time of publication. We have recently received Pamphlet No. 63 of the Imperial Department of Agriculture for the West Indies, giving a summary of the results obtained in Antigua and St. Kitts during 1908–9.

THE Agricultural and Horticultural Association issue an annual booklet entitled "One and All Gardening," containing a number of short articles of interest to gardeners and others. Among the most attractive is one by the Hon. H. A. Stanhope, in which the legends attached to certain plants are pleasantly re-told. The outdoor school lessons given at the Frensham Schools in Surrey are described, while Miss Sipe writes on school gardening in the United States. The booklet is well illustrated.

FROM the Edinburgh and East of Scotland College of Agriculture we have received a bulletin, by Dr. Lauder and Mr. Fagan, giving the milk records for the dairy herd at the Rosslynlee Asylum. An attempt was made to trace the relation between ventilation of the cow-sheds and the yield of milk, but the results are not very decisive. So far as they go, they indicate that the animals in the well-ventilated, and therefore colder shed, gave at least as much milk as those in the warmer, ill-ventilated sheds, and remained in a healthier condition.

A REPORT has recently been issued by Mr. E. Brown on the poultry industry of 1909, from which it appears that the decline in the import of foreign eggs, which has been going on since 1903, still continues, not so much as a result of increased home production as of increased requirements by Germany, now the largest importer of poultry produce in the world; but although the amount of our imports has declined, the values have risen, and the factors at present controlling prices seem to be permanent. It is urged that farmers and small holders have now an opportunity in connection with poultry raising such as they never have had before.

IN vol. lii., part iv., of Smithsonian Miscellaneous Collections, Mr. G. P. Merrill describes and figures a stony meteorite which has recently come into the possession of the U.S. National Museum at Washington. The interest

of this specimen, which is of rudely quadrangular form, with a maximum diameter of about 2½ inches, consists in the fact that it was actually seen to fall by the late Mr. B. F. Wilson on October 15, 1888, in McDuffie County, Georgia. It fell within a distance of about thirty yards of the observer, who was engaged at the time in picking cotton, and was at first under the impression that someone had thrown a stone at him. The meteorite buried itself to a depth of some 6 or 8 inches in the soil.

AN application of the hydrodynamical theory of seiches to the Lake of Garda (Benaco) forms the subject of an essay by Dr. Francesco Vercelli (*Memorie del R. Istituto Lombardo*, vols. xxi.–xxii. [3], 1). The form of the lake is very irregular, the lower end being divided into two branches by a rock forming the peninsula of Sirmione, and projecting for a considerable distance further under water. The author has calculated the positions of the various nodes, and has applied Chrystal's so-called "quartic approximation" to determine the periods of the various oscillations. On comparing these with limnographical observations made at Desenzano, a good agreement has been obtained, while the formulæ of Merian and of Du Boys are stated not to have led to the same satisfactory conclusions.

THE ordinary form of liquid bath for the determination of melting points has been modified by the introduction of an air-bubble system, causing a rapid circulation of the liquid, and hence a uniform temperature. The same idea has been very ingeniously applied by Mr. H. Stoltzenberg (*Zeitschrift für physikalische Chemie*, March 11) in designing a low-temperature cooling bath. The liquid (pentane) is caused to circulate by means of hydrogen bubbles through a spiral dipped in liquid air, ether, and solid carbon dioxide, or a mixture of ice and salt, according to the temperature required, and then passes into the vacuum-jacketted vessel in which the measurements are carried out. The temperature can be easily regulated by altering the amount of the spiral immersed, and can be kept very constant.

IN the *Annalen der Physik*, iv., 30 (1909), Dr. M. Laue discusses the question of thermodynamic reversibility as applied to diffraction of light through a grating. The question has assumed a new aspect since the investigation of the properties of coherent pencils has shown that regular reflection and refraction at the surface of two media is not essentially irreversible. The conclusions at which Dr. Laue arrives are fairly simple and straightforward. If an indefinitely extended train of plane light waves falls on an equally indefinitely extended grating no irreversible change takes place. On the other hand, if the grating is limited in extent the measure of the irreversible changes, in terms of entropy, is equivalent to that produced by diffraction through an aperture equal in size to the grating itself. Thus the larger the area of the grating the less entropy change is associated with the diffraction, and every intermediate condition exists between the practically reversible diffraction of a very large pencil of light and the irreversible diffraction of a small one. In the *Physikalische Zeitschrift*, x., pp. 807–10 (1909), Dr. Laue enunciates analogous conclusions. He finds that the scattering of light by small transparent particles is irreversible, and that if diffraction at a grating is accompanied by absorption the change of entropy is the same as if the absorption were associated with an equivalent geometrico-optical process. We have here a simple illustration of the futility of formulating a thermodynamical scheme on the dQ/T definition of entropy. At the same time, the principle of coherence does not render it possible to produce an increase of available energy, but only to rescue what would otherwise be lost, and this is not inconsistent with a broader enunciation of the laws of thermodynamics.

MESSRS. G. PHILIP AND SON, LTD., have issued a planisphere of the earth (price 7*s*. 6*d*. net), devised by Mr. G. F. Morell, by which it is possible to determine, with a single adjustment, the local time corresponding to any given Greenwich time, or *vice versa*. The whole surface of our globe is projected upon a disc about 23 inches in diameter, capable of rotation about a point fixed at the North Pole. Parts of this disc show through a circular window about 13 inches in diameter on the face of the planisphere, and around this window the hour lines are marked, so that the relation between the meridians on the map of the earth and the time can be seen at once. About three years ago the same publishers produced a "Standard Time-dial," in which the north and south hemispheres of the earth were mounted back to back and rotated together on a single pivot (see NATURE, October 31, 1907). The planisphere now issued serves the same purpose, and while it has the advantage of enabling the relation between the times at any parts of the world to be seen at a single glance, it suffers from the disadvantage of great distortion in the case of regions south of the equator. For the consideration of relative times this distortion does not matter, though it would be misleading if used for purposes of geographical instruction, and it enables believers in a flat earth to show that all the phenomena of local time can be explained on their theory. The diagrams of constellations inserted around the circular opening convey a completely wrong impression as to the relation of the stars to the earth; but while the planisphere will be of little value educationally, it provides a very convenient means of determining easily the corresponding standard times at any instant in different parts of the earth.

THE first edition of Prof. J. Percival's "Agricultural Botany" was published by Messrs. Duckworth and Co. ten years ago, and was favourably reviewed in these columns (vol. lxii., p. 570). The work has been accepted as the standard text-book for agricultural students and others concerned with practical aspects of botany, and we are glad to welcome the appearance of the fourth edition. A new chapter has been added on the Linacæ, with particular reference to flax or linseed; and among the additions is an account of Mendelian laws of inheritance, to which much experimental work has been devoted since the original volume appeared in 1900. The book now contains about twenty more pages than the first edition, and the revision and additions will enable it to maintain the high position it holds among text-books for the study, laboratory, and the reference book-shelf.

A COMPREHENSIVE catalogue of important works on mathematics, astronomy, physics, chemistry, and kindred subjects is comprised in the first part, just issued, of the supplement to Messrs. H. Sotheran and Co.'s "Bibliotheca Chemico-Mathematica." The notes to many of the works are both interesting and curious, and they make this catalogue a readable publication instead of merely a list of titles of books.

MESSRS. WATTS AND CO. have issued for the Rationalist Press Association, Ltd., a cheap reprint of Prof. Haeckel's "Last Words on Evolution." The price of the new edition is sixpence in paper covers and one shilling bound in cloth.

OUR ASTRONOMICAL COLUMN.

OCCULTATION OF MARS, APRIL 13.—An occultation of Mars by the moon will take place at 10.28 p.m. on April 13, the planet disappearing behind the dark limb of the moon in position-angle 0°. Emersion will take place at 11h. 4m. p.m. in position-angle 278°, the angle in each case being reckoned from the zenith point of the moon towards the east.

COMET 1910*a* AND HALLEY'S COMET.—From an article by Mr. Knox Shaw, published in No. 40 of the *Cairo Scientific Journal*, we learn that photographs of comet 1910*a* were secured at the Helwan Observatory. The comet was first seen ten minutes after sunset on January 20, clouds having prevented earlier observations. The Reynolds reflector was not ready for photographing objects at such low altitudes, but some good photographs were secured with a 4-inch Cooke lens on January 24, 25, 27, and 28; more cloudy weather then intervened. The photographs show the twin tails and also the southern secondary tail, which is much fainter, and can only be traced to a distance of 40′ from the head.

Mr. Shaw also publishes a useful diagram of the path of Halley's comet, with regard to the sun and the earth, during the period February 1 to May 29. A photograph of this object, obtained at Helwan on January 28, showed faint traces of a tail about 18′ in length.

Three excellent photographs of 1910*a*, and one of Halley's comet, appear in No. 1, vol. iv., of the Journal of the Royal Astronomical Society (Canada). They were taken at the Dominion Observatory, Ottawa, on January 25, 28, 31, and February 10, respectively. On the last-named date the negative of Halley's comet showed a tail ½° long.

A brief message from M. Jean Mascart informs us that he is at Teneriffe, where, at an altitude of 2700 metres, he intends making observations of Halley's comet. M. Mascart's station is very near that occupied by Piazzi Smith during his sojourn, for astronomical observations, in the island.

SUN-SPOTS AND FACULÆ IN 1909.—Prof. Ricco's usual annual summary of the sun-spots and faculæ observed at Catania during 1909 appears in the February number of the *Memorie di Astrofisica ed Astronomia* of the Società degli Spettroscopisti Italiani (vol. xxxix., p. 17). On the whole, the activity displayed during 1909 was markedly less than that of 1908. In April, 1909, there was a sudden decrease of spots, the mean frequency becoming 2·5 instead of 4·1 as it was in March. This low value continued for six months, but in October there was a renewal of activity, the mean frequency again rising to 4·3, a value which it maintained until the end of the year. Thus, although the quarterly values of the frequencies were 4·1, 2·4, 2·3, and 4·3 respectively, the half-yearly values were more nearly equal, at 3·1 and 3·2, the latter also being given as the mean frequency for the whole year. The frequency values for faculæ vary in the inverse to those of spots, the quarterly values being 1·2, 1·4, 2·1, and 1·2; the mean for the year is 1·6.

THE NATURE OF COMETS' TAILS.—In the course of an article on the present position of the problem of the formation and constitution of comets' tails, which appears in the *Physikalische Zeitschrift* for March 15, Dr. L. Zehnder revives and extends a theory he first put foward twenty-six years ago in the pages of *Kosmos*. According to this theory, as the swarm of meteorites which constitutes a comet approaches the sun, the meteorites nearer the sun begin to give out gases and vapours which arrange themselves as atmospheres about single or about groups of several meteorites. These atmospheres refract the light from the sun, and, according to their densities, concentrate the sun's rays to foci at different distances behind themselves. If a meteorite is present at a focus it may be rendered visible, or even be heated sufficiently to produce combustion of any hydrocarbons present in it. The meteorites thus heated surround themselves in turn with atmospheres which concentrate the sun's rays on still more remote meteorites, and the visible tail of a comet is, according to the theory, the locus of the successive foci. Dr. Zehnder considers the forms of the refracting atmospheres which would produce the various types of tails now known.

PERIODIC ERRORS IN RIGHT ASCENSION OF STANDARD STAR CATALOGUES.—A comparison of the periodic errors of the right ascensions of the Newcomb, Auwers, and Boss standard catalogues is published by Dr. Downing in No. 420 of the *Observatory*. The comparisons were made with the "Standard Mean Right Ascensions of Clock Stars for 1900·0, based on Twelve-hour Groups," published in the Greenwich "Second Nine-year Catalogue," the places there given being, presumably, free from periodic errors depending upon right ascension.

The differences found are very small in amount, but most interesting in their distribution. There is a distinct drop at R.A. 4h. and a rise at R.A. 20h. which are too persistent, throughout the catalogues, to be entirely due to accidental errors. It is suggested that the peculiar distribution of magnitude through R.A. may account for some of, but not all, the discordances in question.

OBSERVATIONS OF SOUTHERN DOUBLE STARS.—The first number of the Circular of the Transvaal Observatory is devoted to the measures of a number of double stars discovered by Mr. Innes, with the 9-inch Grubb refractor, south of declination −19°. Experience shows that this instrument, used at the altitude (5900 feet) of the Transvaal Observatory, is capable of resolving very close doubles (0·3″) discovered by Prof. Hussey with the 36-inch refractor at Lick, and 11 per cent. of the 268 stars (Innes, 433–700) now given are separated by not more than 0·5″; 43 per cent. have distances of 1·0″ or less. Mr. Innes also gives a list of stars which have been wrongly identified by other observers.

THE "GAZETTE ASTRONOMIQUE."—We regret to learn from the current number of the *Gazette Astronomique*, published by the Antwerp Astronomical Society, that, until further financial support is forthcoming, this very useful journal for amateur astronomers will only be published alternate months, instead of monthly, as heretofore. The *Gazette* always contains ephemerides, notices of phenomena, &c., in addition to interesting accounts of observations; the subscription is 3 francs per annum, post free.

AURORAL DISPLAYS.

BRILLIANT displays of aurora were reported from many different parts of Scotland on the nights of March 27, 28, and 29, and aurora was also observed in Ireland and the northern portion of England. At Aberdeen aurora was seen each night between 8 and 9 o'clock. The *Westminster Gazette* gives an account of a brilliant display seen at Edinburgh early on the morning of March 28, stating that two separate displays were seen before 2 a.m., and there was a third shortly before 2.30 a.m. One of the first indications of the coming of this third display was a long, luminous shaft stretching upwards and intersecting the constellation Cassiopeia at a point near the star δ Cassiopeiæ. For some seconds it remained motionless and alone, like the tail of a great comet. Then the sudden flashing forth of a myriad quivering shafts and sheaves of light, exquisitely and delicately tinted, outlined a wide arch of striking beauty.

Mr. Wilfred C. Parkinson, writing from Eskdalemuir Observatory, Scotland, gives the following interesting details of the display on March 28:—

8.10 p.m.—Luminous band first observed in N. rising slowly like a bank of light cloud.

8.14–8.38.—Gradually assuming a curved form 10°–12° above horizon at middle point, which was rather to the W. of N., and about 8° in width. Length about 140°.

8.40.—Band very bright and well defined, very intense at top edge, gradually thinning out towards the lower edge.

8.53.—The lower edge of the main band had formed a distinct band by itself, running parallel to the higher band, but not so wide, long, or intense. Higher band of uniform intensity throughout.

8.54.—Vertical streamer gradually forming, and also smaller ones, fluctuating in length and brilliancy.

8.56.—Vertical streamer very intense, especially where the curved bands cross it.

8.59.—Lower horizontal band gradually disappearing. Upper band growing faint and ill-defined. Vertical streamers growing more numerous.

(A most marked feature after 9h. was the way in which the streamers formed in the north and moved in a procession towards the west.)

9.8.—Lower band entirely gone. Upper band still visible, but faint. Numerous vertical streamers forming and intersecting the horizontal band.

9.16.—Horizontal band had entirely disappeared. Vertical streamers had increased in numbers and intensity. Constant fluctuations in brilliancy until 9.28, when last streamer had disappeared.

Mr. S. L. Elborne, writing from Peterborough, reports that on March 28, about 6 p.m., he saw a magnificent display of parhelia or mock suns, lasting about twenty minutes; on each side of the sun, and at equal distances from it in the same straight line, and parallel with the horizon, appeared a brilliant spot displaying the colours of the spectrum in the centre of each, giving the effect of three suns setting simultaneously; from each arose a luminous band, thus making a splendid arch over the true sun.

THE PUBLIC HEALTH OF THE METROPOLIS.[1]

THIS report abounds in information of great interest to all who have at heart the well-being of the metropolis. The first part relates almost exclusively to vital statistics, the second to public health administration, and the third part contains much instructive matter upon school hygiene.

The year 1908 was a very exceptional one for London so far as vital statistics are concerned, for the marriage-rate (15·9), birth-rate (25·2), and death-rate (13·8) were the lowest ever recorded. The death-rate has shown a decline for the past forty years, while in the case of the birth-rate the fall year by year has been slight, but uninterrupted, for some thirty years. What this decline in the death-rate of a population of 4,795,757 persons implies is very forcibly expressed in terms of "life capital." By this expression is implied the years of life saved to the community by a reduction in the death-rate. The number of lives saved at each age period (as calculated by comparing the number of deaths for the year, in each age period, with the mean death-rates for those age periods for ten years, and crediting each life saved with the years representing the expectation of life at that age) represented a saving of 26,205 lives, and a gain to the community of 1,066,770 years of "life capital." The highest corrected death-rates were furnished by the City of London, Finsbury, and Bermondsey, and the lowest by Hampstead and Lewisham.

The infant mortality rate was lower in London for the last decennium than in all save one of the thirteen other large English towns; and London had a lower figure for 1908 than any of those towns. This fact, as Sir Shirley Murphy, the Medical Officer of Health, states, is matter for congratulation, though, as he adds, it needs to be remembered that the infant mortality rate is liable to considerable fluctuation, owing to climatic conditions and varying degrees of prevalence of epidemic maladies. There are notable differences in the rates of infant mortality in districts well and badly circumstanced socially, a fact which sufficiently indicates the results which might be obtained if the infants of the less favoured districts had extended to them the same care as that bestowed upon infants of the better favoured districts. Among metropolitan boroughs the loss of infant life has for several years been greatest in Shoreditch and Bermondsey, and least in Hampstead.

The infant mortality rate is, of course, affected by the administrative efforts made to reduce it, but the rate is so extremely sensitive to other influences, which vary from year to year, that the value of this work cannot be judged by the mortality of the moment. Among systematic efforts now being made in the metropolis for the preservation of infant life, Sir Shirley Murphy commends the system of visitation by health visitors, and he points out that the Notification of Births Act, 1907, which is such a valuable measure for enabling this work to be undertaken most advantageously, had in 1908 been adopted in all but eight boroughs. In some districts official workers were supplemented by a staff of voluntary workers supplied by local health societies.

During the year 1908 the lowest death-rate from the epidemic diseases was recorded. No death occurred from small-pox, and the deaths from measles, whooping-cough, diphtheria, enteric fever, diarrhœa, and phthisis were below the averages of the last ten years, but those from influenza and scarlet fever were above the averages.

The London vaccination returns give food for thought and apprehension. As legislation has made it more and more easy to obtain exemption from vaccination, the unvaccinated children would be expected to increase. The latest returns recorded are those for the year 1906, when the percentage of unvaccinated children was 21·2, as against 26·4 in 1896, 7·8 in 1886, and 6·5 in 1876. There can be little doubt that the percentage of exemptions for the past three years will, when these are available, demonstrate a considerable increase. A notable feature in the behaviour of enteric fever in London in recent years has been the manifestation of localised prevalence occurring in poor populations and lasting often for a considerable number of weeks. There were two such prevalences in 1908, one in Bethnal Green and the other in Shoreditch, and Dr. Hamer furnishes, in an appendix, a full report on these two outbreaks.

Special reference is made to results obtained by Dr. Sidney Davies from the voluntary notification of zymotic diarrhœa among infants in Woolwich in the months of July, August, and September. Dr. Davies is of opinion that the infection spreads from person to person, and he thinks the distribution of the cases is consistent with the hypothesis that the disease is conveyed by flies. An examination of the statistics contained in his inquiry shows that while infants who are breast-fed suffered much less than those artificially fed, there is not much difference between the incidence of attack on children fed on cow's milk and those fed on condensed milk—except among the children fed on cow's milk at the Infants' Milk Depot, who suffered much less than other infants artificially fed.

The phthisis death-rate for 1908 was the lowest ever recorded. It amounted to 1·32 deaths to every 1000 persons living during the year. In dealing with phthisis the Medical Officer comments upon the work done in connection with the voluntary notification system in operation in twenty-one London boroughs in 1908, and he refers to the Order of the Local Government Board requiring notification of cases of phthisis in London which occur in Poor Law practice. London is, however, as the medical officer points out, but very imperfectly provided with the opportunities which are needed for utilising the knowledge thus gained. Phthisis mortality occurs especially among the poor, and measures for its reduction must not only include sanatoria and hospitals, but also those which afford assistance not only to the sufferer, but often to the families which are dependent upon him. It is here that the extension of philanthropic effort is greatly needed.

For the purpose of enabling the incidence of cancer on the several populations of the London sanitary areas to be more precisely stated, factors have been calculated for correcting the death-rates, so far as possible, for the differences in the age and sex constitution of the several populations compared. When these allowances are made it is found that in the year 1908 St. Pancras (1·17) had the highest rate, and that the lowest obtained in Fulham (0·79).

The question of nuisance from flies in connection with deposits of house refuse and stable manure has again been dealt with on lines similar to those followed in 1907, and the observations form the subject of another appendix to the report. In 1907, as in 1908, the large part played by collections of horse manure in determining fly prevalence was abundantly apparent, and the need for regulating the sanitary condition of stables was thus again emphasised.

On July 1, 1908, the administration of the General Powers Act, 1907, part iv., was brought into operation, and from that time until the end of the year 620 samples of milk were taken, principally from churns at the large railway stations. Of the samples in which it was found practicable to make a complete examination, 11·6 per cent. were found to be tuberculous. The farms supplying the

[1] Report of the Public Health Committee of the London County Council, submitting the Report of the Medical Officer of Health of the County for the Year 1908. (London: P. S. King and Son.) Price 3*s.* 6*d.*

samples giving positive results were inspected by the council's veterinary inspector; 4997 cows in all were examined, and of these 147 were found to present tuberculous udders. Provincial local authorities have shown willingness to cooperate with the council in preventing the sale of milk from cows which the council's veterinary inspector has certified to be suffering from tubercular disease of the udder, and in a few instances veterinary inspectors have been appointed by the local authorities to deal with this danger.

The report by Dr. Kerr upon the medical work of the council, as the education authority, deals with a period for the twenty-one months ending December 31, 1908. This period has been marked by great activity in all matters concerning school hygiene and the physical care of children. There are, in the opinion of the medical officer, further and wide-reaching changes in prospect. He states:—"Any public provision for protecting and aiding growth and development of children during the years of school life—three to sixteen years of age—should be entirely committed to the Education Authority. This would allow such matters as feeding, teaching, cleansing, medical treatment, or social protection of school children, when these duties become a public care, to be administered by the one authority, and by bringing all the various problems into a correct relation and perspective would also effect considerable financial economy. On the other hand, transient conditions in which the child bears the same social relations as any other individual, as for instance when affected with typhoid or scarlet fever, or when guilty of a crime, would still come under the same provision by the Sanitary Authority or Police respectively as at present. Fortunately this is the line taken by all the recent legislation in matters concerning children."

The educational work of the county council which falls under the direction of a medical officer is very extensive, embracing the examination of candidates for employment and scholarships; medical inspection of school children, including the inspection and the hygienic condition of school premises, &c.; a large amount of work to promote cleanliness and to prevent communicable disease; and prescribing the special school work amongst the scholars in schools for the mental or physically defective, the blind or deaf, &c. The medical staff at the end of 1908 numbered fifty-two, and it has been decided to increase the staff by the addition of sixteen school doctors in the summer. The school nursing staff consists of a superintendent, two assistants, and fifty-one school nurses; these undertake the oversight of personal hygiene in both elementary and secondary schools. Upon the subject of underfed school children, the medical officer directs attention to the fact that there is no certain criterion of this condition, and it seems often quite impossible to distinguish between bad feeding, improper feeding, and bad home conditions. The treatment of those children in whom medical inspection discovers defects has received a great deal of consideration at the hand of the county council. A solution has not yet been arrived at, but it is certain that visual troubles, discharging ears, ringworm, and conservative dentistry are matters on which neither the private practitioner nor the hospitals can give sufficient or satisfactory relief, and the establishment in London of school clinics to deal with these conditions amongst school children will probably be the eventual solution. The work of the school nurses was almost entirely directed to effecting the cleansing of scholars' heads, bodies, and clothing. Nearly twenty thousand children are known to the nurses as uncleanly in these respects. That such conditions are tolerated gives an idea of the conditions of the homes, which are often so dirty and dark, and wanting in the means of cleansing, that it would be an injustice to exclude such children and prosecute the parents. It appears that the municipal cleansing stations provided for cleansing verminous persons are inadequate to deal with all these cases. The Children's Act, 1908, gives power to the education authority to examine and cleanse these children in default of the parents, and it looks as if that authority will have to make some provision for dealing with these cases, at least in some parts of the metropolis.

The open-air schools provided by the council (four in number) are doubtless doing a great service, physically and educationally, to children with ailments which unfit them to take their place in the school class-room with the ordinary scholars. Children with scrofulous and tuberculous conditions, anæmia, adenoids and enlarged tonsils, heart disease, and certain bone, nervous, and eye diseases, profit considerably by a few months in these open-air schools.

PROBLEMS OF THE SOUTH-WESTERN HIGHLANDS.[1]

THE southern Highlands of Scotland consist of a complex series of gneisses, schists, crystalline limestones, and quartzites, trending across Scotland approximately from south-west to north-east. These metamorphic rocks are bounded abruptly to the south by the Highland boundary fault, which brings them against Upper Palæozoic rocks. Their northern boundary is less regular, and is generally the junction with the Moine gneiss, the rock which occupies so much of the Northern and Central Highlands. The schists and the associated rocks between the Moine gneiss and the boundary fault may be conveniently grouped together, under the name proposed by Sir Archibald Geikie, as the Dalradian system.

The most important difficulty in the interpretation of these rocks is the uncertainty as to which is the upper and which the lower end of the succession. According to Nicol, the southern members are the youngest, and there is a descending series to the north. This view is contradicted by many obvious facts in the field geology, and the view is therefore widely held that Nicol's order must be reversed, and that the beds of the southern margin are the oldest. One serious difficulty in the second view is that the southern rocks are much less altered than the northern, and this theory therefore involves some measure of selective metamorphism. Several ingenious interpretations have been advanced to overcome this difficulty. The author of the address, however, held that both views as to the order of succession are correct in parts. For convenience of reference, the Dalradian system may be divided into five series, which, with their relations to the other pre-Cambrian rocks, are shown in descending order, as follows:—

Algonkian	Torridon Sandstone	
Dalradian	Main sequence (5) Schichallion Quartzite (4) Blair Atholl Limestones and Black Schists and interbedded Quartzites (3) Ben Lawers series (2) Loch Tay Limestones and associated garnetiferous mica schists (1) Loch Lomond Gneiss	On Southern Margin Age ? Upper Dalradian or later: Aberfoil Slates and Grits Ben Ledi Schistose Grits
Caledonian	Moine Gneiss and associated schists	
Lewisian	Lewisian Gneiss	

This classification adopts Nicol's succession in part, as it accepts the Aberfoil and Ben Ledi series as younger than the Loch Lomond gneiss, against which they rest, and it is consistent with the less altered condition of the southern rocks and the steady diminution in the metamorphism of the rest of the rocks going northward, as, for example, from the Loch Lomond Gneiss to the Loch Awe Grits, and from the garnetiferous mica schists of the Loch Tay series to the black schists and unfoliated quartzites near Blair Atholl.

The evidence in some points of this succession is still incomplete, especially as regards some of the rocks within easy access of Glasgow. The special points on which

[1] Abstract of the Presidential Address delivered to the Glasgow Geological Society, by Prof. J. W. Gregory, F.R.S.

further research would be most useful were therefore mentioned in the hope that the members of the Glasgow Geological Society would investigate them.

The problem is of interest from its bearing upon the early geological history and geography of north-western Europe. The structure of western Europe has been dominated by the formation of three great mountain systems, each due to pressure usually from the south, and each having its younger rocks exposed mainly on the northern flanks of the chain. The youngest is the Alpine system, formed mainly in Upper Cainozoic times, and including the Pyrenees, Alps, Carpathians, &c. A somewhat similar mountain system, of which fragments remain in southern Ireland, Devonshire, Brittany, and Germany, had been formed in Upper Palæozoic times; from its analogy with the Altai Mountains of Asia, Suess has called its mountains the European Altaids. Still earlier, in later Archæan times, there was formed the first of these European mountain systems, of which fragments occur in northern Ireland, the Grampians, and Scandinavia. There are many interesting analogies between these old Grampians and the later Altaids and Alps. The old mountain system to which the Grampians belonged probably extended far westward into the North Atlantic, and to its influence may be attributed the desert climate of Scotland during the deposition of the Torridon Sandstone.

THE ETIOLOGY OF LEPROSY.

THE eighteenth report of the Board of Health on leprosy in New South Wales contains the usual careful clinical records of the features of the disease in the patients admitted during the year, as well as a record of all the cases occurring in the Commonwealth during 1908. No case of leprosy has ever been heard of in Tasmania. In the other States the disease occurs apparently most frequently in Chinese and in aboriginals, and is more frequent in northern than in southern territories.

An account is given of a systematic test of Prof. Deycke's "nastin" treatment. Nastin is a vaccine made from a leptothrix found in some recent Lepromata, and not from the bacillus lepræ. It is pronounced valueless, any beneficial result being assigned to the natural fluctuations in the progress of the disease; one or more cases of spontaneous cure are noted. For the rest, the report is remarkable for the scepticism the author, Dr. J. Ashburton Thompson, expresses on the etiology of leprosy and on the value of isolation as a preventive of transference of the disease.

It will be remembered that the International Congress at Bergen last year endorsed the view that the bacillus lepræ of Hansen was the etiological agent. Dr. Thompson's views are seemingly published as a protest, and, holding the views he does, it is gratifying to learn that Dr. Thompson recognises that, as the presiding and executive member of the central health authority to which the Leprosy Act is entrusted, he has a clearly defined duty to perform, and that he performs it, notwithstanding his thinking "the *mère idée* on which that law is based to be of doubtful utility," and his statement, "I can at all events safely assert that its validity has not been demonstrated." One would have thought that the success which has attended the practice of isolation in Norway during the past forty years afforded sufficient evidence of its value even to the most sceptical, for Hansen's prophecy some forty years ago that in 1920 there would be no leprosy in Norway is in more than a fair way of being fulfilled.

HELIUM IN AIR AND MINERALS.

AN interesting paper on the occurrence of helium in the air of Naples and in minerals from Vesuvius is published by Prof. A. Piutti in the *Rendiconto* of the Royal Society of Naples (third series, vol. xv., p. 203). It is well known that in 1881 Prof. Palmieri read a paper before the same academy in which he claimed to have recognised the characteristic line D_3 of helium in the flame spectrum obtained by heating in a Bunsen flame "an amorphous, buttery substance of a yellow colour which was found as a sublimate on the edge of a fumarole near the mouth of Vesuvius." This is generally accepted as the first discovery of terrestrial helium, although Nasini and Anderlini in 1906, on examining the flame spectrum of a large number of volcanic incrustations, failed to recognise the presence of helium in any of the specimens they examined under the conditions described by Palmieri.

Prof. Piutti has now investigated with especial care, and by an ingenious method, the gas evolved on heating several Vesuvian minerals. The gas was expelled by heating the mineral in a quartz tube connected, through a three-way cock, with a Plücker tube, a Gaede air-pump, and a glass bulb containing cherry-stone carbon, which could be cooled to $-192°$ C. The latter served to absorb nitrogen and inert gases other than helium. All air was first entirely removed from the apparatus by the Gaede pump, special care being taken to ensure its complete absence prior to heating the mineral and during the course of the experiments. When the carbon is cooled by liquid air and the vacuum applied, any nitrogen present is first absorbed by the carbon, and the lines of argon and neon appear until the kathode space is formed. At this point, if even the smallest trace of helium is present, the D_3 line is seen distinctly by the side of the sodium lines. Control experiments showed that 0·073 cubic mm. could be detected in the apparatus employed. Helium can also be detected in the same way in 3·5 c.c. of ordinary air.

The examination of several radio-active forms of sanidinite from Vesuvius showed that the radio-activity was due to particles of zircon contained therein. This zircon was found to evolve helium, and other samples of zircon from different localities, Italian and otherwise, were also found to contain helium in varying proportions. No relation could, however, be traced between the proportion of helium and the radio-activity or density of the samples. The Vesuvian zircon had the highest radio-activity, but the proportion of helium was relatively low.

THE SUGAR INDUSTRY IN HAWAII.[1]

HAWAII and its associated islands, Maui, Oahu, Kauai and others, form a volcanic group in the Pacific 20° north of the equator, largely devoted to sugar production. In 1895 the Sugar-planters' Association established an experiment station at Honolulu, and some five years later the islands were annexed by the United States. The enormous importance of these two events is reflected in the statistics for sugar production:—

	Hawaii	Maui	Oahu	Kauai	Total
1895	61,643	27,735	17,433	42,816	149,627 tons
1896	109,259	29,097	35,782	51,650	225,828 ,,
1900	115,224	57,347	53 625	63,348	289,544 ,,
1901	134,618	58,349	99,534	67,537	360,038 ,,
1905	126,405	100,434	123,095	76,314	426,248 ,,
1908	180,159	122,629	137,013	81,322	521,123 ,,

The increase during the fourteen years has been from less than 150,000 tons to more than 520,000 tons, and detailed statistics show that the produce per acre, as well as the total acreage, has increased.

Practically all phases of the sugar industry are dealt with at the experiment station. Varieties of canes are tested, seedlings are raised and examined, and the effect of change of variety is investigated, the object being always to obtain plants more prolific, better adapted to the local surroundings, and more resistant to the local diseases or insect pests than those at present grown. Considerable attention is paid to insect pests, which naturally do an increasing amount of damage as cultivation becomes more and more intense. Methods of working up the sugar are also studied, the chemical and milling problems involved are gone into, nothing within the power of the staff and likely to benefit the planters being omitted.

In consequence there is a constant tendency to economy in production; thus in the early years fertilisers were often applied without any reference to the specific requirements of the crop or the general deficiencies of the soil; now, however, these, and also climatic considerations, are taken into account, and the staff are able to give useful definite information as to the mixture of fertilisers required.

1 Tropical Life, No. 2, vol. vi., 1910. Bulletins of the Sugar-planters Associations, Hawaii.

Relatively large quantities of nitrogenous and of potassic manures are found necessary, phosphates being less needed; to meet this demand, potash salts and nitrate of soda are now imported in quantity. Ten years ago there was practically no importation of these manures.

A certain amount of the land has to be irrigated, especially that occurring on the leeward side of the high land forming the interior of the island. On the windward side, however, the rainfall is higher and irrigation is not necessary. On the island of Hawaii itself most of the plantations are unirrigated, but on the other islands irrigation is very general. Here, also, useful help has been given by expert engineers in ascertaining the cheapest effective way of obtaining the necessary water.

NATURAL SCIENCE IN BENGAL.

THE annual report of the Asiatic Society of Bengal for the year 1909 has now been published. We notice that the society celebrated its 125th anniversary on January 15, 1909. The celebration took the form of an evening reception held in the Indian Museum. Many scientific, archæological, philological, and historical exhibits were shown, illustrating the progress and activities of the society. The council awarded the Barclay memorial medal for 1909 to Lieut.-Colonel David Prain, F.R.S., I.M.S. (retired), in recognition of his biological researches.

The total number of contributions to the society under the heading mathematics and the natural sciences was seventeen. Commenting on these, the report points out that Mr. Hooper's paper on *Tamarisk manna* shows that the chief sugar in it is not mannite, but a saccharose. Babu Bidhu Bhusan Dutta, in a contribution on the constituents of the roots of *Arisaema concinnum*, Schott, and *A. speciosum*, Mart., shows that these two famine foods contain much nutriment, chiefly starch. Mr. B. L. Chaudhuri directed the attention of the society to the mosquito-larvæ eating propensity of fish of the genus Haplochilus, and asked for cooperation in making further observations. Several species of this genus of small fishes are voracious feeders on the larvæ.

Babu Nibaran Chandra Bhattacharjee directed attention to the way in which *Marsilia quadrifolia* fruits only when the water in which it has been growing recedes from it and leaves it dry. Mr. H. Martin Leake's paper on Indian cottons is of importance. His object is to breed early cotton suitable for cultivation at Cawnpur, with the good lint of the slow-maturing cottons; he has observed the characters in bud development which lead to early or late maturity in order to recognise such as combine with the desirable quantities in the lint. Mr. E. P. Stebbing, in a paper on the Loranthus parasite of the Moru and Ban oaks (*Quercus dilatata*, Lindl., and *Quercus incana*, Roxb.), shows how destructive the parasite is to these oaks in the neighbourhood of Naini Tal and in Kumaon. Sir George King's "Materials for a Flora of the Malayan Peninsula" has been continued. Accounts of the orders Gesneraceæ, by Mr. H. N. Ridley, and Verbenaceæ, by Mr. J. Sykes Gamble, have been received. Mr. Burkill has diagnosed two varieties of the lemon oil grass, *Cymbopogon Martini*. Prof. P. Brühl has contributed a paper on recent plant immigrants into Bengal; 234 species are named by him; their origin is discussed and the causes of their introduction. America supplied 54·7 per cent. of these immigrants.

THE DEVELOPMENT OF ELECTRICAL POWER AT NIAGARA FALLS.[1]

THE development of electrical power at Niagara Falls has long attracted widespread attention and interest. Since the first installation upon the American side, descriptions and discussions of its works and methods have been granted a conspicuous place in technical records and the scientific Press, but the fact is apparently less known that there now exist at Niagara four more installations, each larger than the pioneer plant, and one at least differing from it to a very marked degree in the method in which the turbines are employed and coupled to the electrical generators.

The author, having paid a visit to Niagara in December, 1907, when exceptional opportunities were afforded him of inspecting the whole plant of the Ontario Power Company, takes the present opportunity of recording the following notes, which may supplement the knowledge of the subject hitherto available, especially so as, after the completion of these notes, correspondence took place with the Ontario Power Company with the object of eliciting further information, and photographs were received illustrating the operations of the company.

Scheme.—Briefly outlined, this company's development comprises the taking of water from the Upper Niagara River above the Horseshoe Fall, leading it through pipes and penstocks to turbines in a station below the Fall, and there utilising its energy for the generation of electricity, which is transmitted to a second station on the hill above, and thence distributed. There is a fall in level of 55 feet in the rapids above the Horseshoe Fall, and to take advantage of this the headgates are placed just above the rapids. From the headgates three great steel and concrete tunnels or conduits, laid below the surface of the Victoria Park, will convey nearly 12,000 cubic feet of water per second to the top of the cliff above the power-house, and just beyond the Fall. Thence it will pass through twenty-two steel penstocks in shafts and tunnels down and out through the cliff to an equal number of horizontal shaft turbines in the power-house below, which is situate on the water edge immediately at the foot of the Horseshoe Fall. From the generators, the electrical cables will pass through tunnels to the twenty-two banks of switches, transformers, and instruments in the distribution station on the hill above, and thence to the transmission lines beyond, the whole installation, when complete, being capable of an output of more than 200,000 horse-power.

The intake works for the entire 200,000 horse-power are now finished. One of the three main conduits is completed and in use, while the portals and headworks for the second and third tunnels are completed, and a portion of the excavations made. Six of the twenty-two penstocks are completed, and with their turbine-sets are at work, and at the time of the author's visit the seventh was practically completed. The distribution-station building is complete for the switchboard of the entire twenty-two units, for the transformers of eight, and the other apparatus of fourteen units, and is well ahead of the developments in the power-house.

The most important engineering features wherein this latest company differs from its predecessors are the arrangement of intake works, the design of main conduit and spillway, the horizontal shaft turbine units, the symmetry of arrangement of the whole, the centralisation of control, and the protective isolation of the various apparatus.

Particulars of Niagara River and the Falls.—The total drop in the Niagara River in its course of thirty-six miles between Lake Erie and Lake Ontario is 326 feet, of which 216 feet is in the Falls and the rapids immediately above them.

The American Fall is 167 feet high and 1000 feet in width, while the Horseshoe Fall is 159 feet high and 2600 feet in width. The greatest depth of the river immediately below the Falls is about 192 feet. It is estimated that an average of 222,400 cubic feet of water pass over the Falls each second. This is 25,000,000 tons per hour, or about one cubic mile a week, and represents a kinetic energy of nearly 5,000,000 horse-power. At the headworks of the Power Co. the river is 3400 feet wide, and flowing at an average velocity of about 8 feet per second.

Intake.—These works have been placed and designed, not only to take advantage of the additional height of the rapids as mentioned above, but also with special reference to the ice difficulties, which have been the limiting factor in the success of Niagara power. Cake-ice in enormous quantities floats down for weeks at a time from the Great Lakes, and mush-ice is also formed in the rapids, primarily by the freezing of spray and foam, and secondarily by the disintegration of cake-ice. The latter trouble is avoided, since the intake is in the smooth water just above the

[1] From a paper entitled "An Account of a Visit to the Power Plant of the Ontario Power Co. at Niagara Falls," read before the Institution of Mechanical Engineers on January 7, by Mr. C. W. Jordan.

rapids at a place where the current is very swift. To exclude the former trouble, the following precautions have been taken:—a long and tapering forebay, protected at the entrance by the main intake, terminates at its narrow down-stream end in a deep spillway. Upon the river side it is enclosed by a submerged wall, while the other side, near the spillway, is occupied by the main screen building leading to the inner bay and to the portals and headgates of the three conduits.

The intake, which is nearly 600 feet long, stretches across the inlet at Dufferin Island almost parallel with the current in the river. Throughout its whole length, a concrete curtain wall extends down 9 feet into the water, which is 15 feet deep at this spot, so that the gate openings beneath admit only deep water, and this at right angles to the swift exterior surface flow, which, sweeping the full length of the curtain wall, carries the floating ice past to the rapids beyond.

The intake is divided into twenty-five bays, through which the water is admitted at a velocity of 5 feet per second. Provision is made for inserting stop-logs into each of the twenty-five openings in order to regulate the flow of water.

The outer forebay has an area of 8 acres, and a depth ranging from 15 to 20 feet, and is bounded on its down-stream side by a submerged wall or dam 725 feet long, terminating at the down-stream end of the screen-house, which is 320 feet long, built of reinforced concrete faced with Roman stone.

The inner forebay is 2 acres in area with a depth of 20 to 30 feet, whilst the gate-house, similar in construction to the screen-house, is 120 feet long and divided into six bays, two for each of the main conduits. The 18-foot "Stoney" gates which guard the entrances to the conduits weigh 18 tons each, or 36 tons including the counter-balance. They were built by Ransomes and Rapier, and are operated by electric motors of 5 horse-power capacity.

At the main screen the same precautions for the exclusion of ice are repeated. This structure, which is 320 feet in length, in 20 feet depth of water, lies across the entrance to the inner bay, and parallel with the direction of flow in the outer bay. Here again a curtain wall formed by the front wall of the superstructure admits only deep water to the screens at right angles to the main current, while it also excludes ice with the surface currents maintained through the forebay by a huge spill of surplus water. At the gate structure, where the water is 30 feet deep, the tapering portals leading to the electrically operated Stoney headgates are protected with wide-meshed screens, which are also enclosed and safeguarded by a curtain carried by the front wall of the gate-house. There is an ample ice-run from the bay in front of the curtain to the river, and both at the headgates and screens an open canal spills into a gravity ice-run emptying into the river. Both buildings are supplied with steam for heating and thawing from an underground boiler plant, and the author can testify to the entire success of the heating. It was a bitterly cold day, snowing and freezing hard, with a nasty wind, but inside these houses it was almost unpleasantly hot, in spite of the large masses of ice-cold water coming in continuously from the river. The water before entering the conduits must pass through three automatically selective steps, each excluding ice, and, in addition, through two screens, each behind ice-runs, in heated buildings containing live steam for emergencies, and the experience of three winters has proved the above plan of excluding and preventing the formation of ice to be an entire success—a record which is unprecedented for power plants in a climate like that of Niagara.

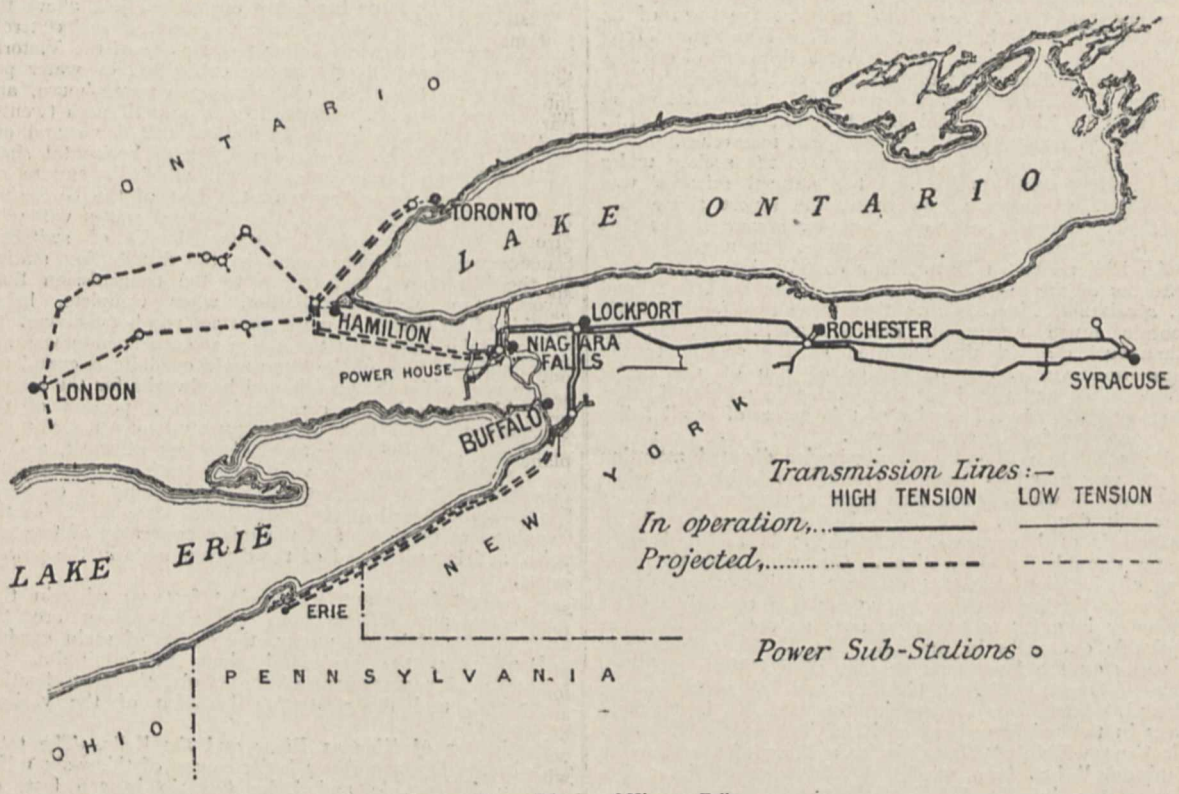

FIG. 1.—Power District of Niagara Falls.

An electric overhead travelling-crane runs along the screen-house for removing the screen-frames for cleaning and changing when necessary, and as this building is situate in the park the roof is flat and finished off as a promenade, access being obtained from the outside by broad steps at either end of the building, and from this point a magnificent view of the upper rapids is obtained.

Main Conduits.—These are of 0·5-inch rivetted and reinforced steel embedded in concrete 18 feet and 20 feet in diameter and 6500 feet long, sunk beneath the surface of the park. The water flows through them at an approxi-

mate velocity of 15 feet per second. The only conduit at present in service has a sectional area of 254 square feet, and is capable of supplying sufficient water for the operation of six generators at full load. The second and third conduits have not as yet been installed. Just beneath the top of the cliff, behind the power-house, is a long underground chamber 274 feet long, 10 feet high, and 16 feet wide, with an arched concrete roof to support the conduit above. Rivetted to the bottom of the main conduit are seven large tapered steel castings leading to the 9-foot valves and penstocks below, each supplying water at 10 feet per second to a single horizontal shaft turbine in the power-house below.

Spillway and Weir.—The spillway at the end of the conduit, which is intended to prevent water-hammer in the case of sudden loss of load, is little more than the enlarged end of the main conduit, raised and fitted with an enclosed weir and underground discharge. The weir is adjustable as to height, and the discharge tunnel, after a steep initial pitch in the taper from the weir, follows a uniform grade and symmetrical curve while circling about to reach the river in a helix, thus preserving a water column which is smooth and unbroken, of highest velocity and least expenditure of energy. This has the effect of preventing erosion, restricted flow; and excessive air-suction, the latter on account of the danger of ice forming from the spray under forced circulation of air.

Location of Power-house.—The power-house is situated on the river bank nearly at water-level and close under the Horseshoe Fall, and it is an interesting and important point that the full head of water between the upper and lower rivers has been acquired so far as was possible from an economic standpoint, while the huge and costly excavations rendered necessary in the previous schemes have also been dispensed with, resulting in a greatly reduced capital expenditure.

Owing to limited space, the generating station is only 76 feet wide, but when completed it will be nearly 1000 feet long; the generating units stand side by side in a single row right down the centre of the building, the turbines being on the land side and nearest their source of supply. The space between them and the rear wall is occupied by a gallery, upon which are mounted the oil-pressure governors, each almost over the end bearing of the turbine it controls.

The mean water-level at the generating station is 343 feet above tide, though it varies from 338 to 365 feet. The walls of the generating station are of concrete, the rear wall being 12 feet thick at the bottom and the river wall 9 feet.

Generating Units.—Each generating unit consists of a horizontal double turbine direct coupled to a generator. The completion of the station and its equipment will be but an extension of the present form until, according to present plans, there will be an installation under the one roof, capable of continuously delivering 200,000 horse-power of electrical energy. Three of the generators, which are all of the conventional horizontal shaft pattern and exactly alike in appearance, have a capacity of 10,000 horse-power each, while the others have each a capacity of 12,000 horse-power. These machines are wound for three-phase current at 12,000 volts and 25 cycles, and have revolving fields, the revolutions being 187·5 per minute. The total weight of each generator is 231 tons, and each was entirely assembled on the spot, including the building up of the laminated iron rotor and the winding and insulating of the armature.

Turbines.—The turbines were made by J. M. Voith, Heidenheim, a. d. Brenz, Germany, and are of the Francis or inward-flow type, double, central discharge or balanced twin turbines, and are designed to deliver 12,000 horse-power at 175 feet head. Their shafts are 24 inches maximum diameter, and each carries two 78-inch cast-steel runners of "normal" reaction. The housings are of reinforced steel plates 16 feet in diameter, spiral in elevation, and rectangular in plan. Gates are of the wicket or paddle type, and the rotating guides forming them are carried by shafts which project through stuffing-boxes to an external controlling mechanism worked by the governors, thus freeing the casings from the objectionable internal-gate rigging, and leaving the approaches to the guides uniform and open. Whilst the velocities in housings and draft-tubes are high, corresponding losses are avoided by easy changes of velocity and direction, and large curves free from acute angles or obstructing projections.

Leads.—The leads from the generators are single conductors, insulated with treated cambric. These leads, each in a separate compartment, are mounted on porcelain insulators, ample clearance to earth being allowed everywhere; the compartments are built up of thin shelves of reinforced concrete fastened to the concrete substructure of the power-house, and are closed by asbestos doors readily removable for inspection. At no place are the leads of more than three generators brought near one another, and the leads of each set of three generators, where they approach their respective oil-switches on the gallery, are so protected and isolated from each other that earths or short circuits are impossible. Field circuits, exciter leads, and control wires are carried in iron conduits, and are either in separate passages or at a proper distance from the main wires.

Distributing Stations.—The generating and distributing stations are parallel, and nearly 600 feet apart, with a difference of 260 feet in elevation. The distributing station is wider and shorter than the power station, and is divided into three longitudinal bays or five main sections. The narrow front bay contains the switches, bus-bars, &c., at generator pressure; the wider rear bay contains those at transmission pressure. Between these bays is the main middle bay, divided transversely by a three-floor switchboard section into two long transformer-rooms. The projecting central bay is utilised as offices. The transformers stand along the centre of the two rooms in groups of three, corresponding in position and capacity to their respective generators. Similar apparatus is arranged in rows parallel with each other and with the generating units. Unit values corresponding to the generators in capacity and position are maintained throughout. Thus each generating unit has its individual cables, switches, and switchboard, section of bus-bars, transformers, interrupters, and high-pressure switches complete to the transmission lines, enabling independent operation as an independent power plant, or, through the selector switches, and duplicate sectional bus-bars, the operation of all units in any combination of groups, as readily and perfectly as their operation in parallel.

Transformers.—The low-pressure bay contains on the main floor the 12,000-volt automatic oil circuit breakers in double column, and in the chamber beneath only the sectional duplicate bus-bars and their immediate connections. In the transformer-rooms the transformers stand in pits 6 feet below floor-level, and parallel with them, adjacent to the high-pressure bay, are corresponding pits for choke-coils or other protective apparatus. Beneath, and between the foundations, are laid the various systems of piping for water, oil, and drainage, and the main cableways to the transformer above. Each transformer is fitted with a recording thermometer, and is of the oil-insulated, water-cooled type, three to a unit, connected in delta on the low voltage, and in star with centre grounded on the high-voltage side. The secondary potential of each transformer is 36,000 volts, and, as connected, the resultant line voltage is approximately 62,000 volts. Each transformer has a normal capacity of 3000 k.v.a., and weighs, complete with oil and case, approximately 50 tons. They are cylindrical in form, and the three constituting a unit are arranged in a triangular group in the pit.

Recording Instruments.—The graphic recording instruments are of a new type, and comprise voltmeters, ammeters, wattmeters, and frequency and power-factor indicators. They are so connected in the low-voltage circuits that there is a continuous record of each generator as well as of the demands of any set of feeders. In the control-room, the chief operator's position is in the centre, where at his desk he may observe, by means of his instruments, every electrical occurrence, and direct his assistants as required. He has his own private telephone system running to all the rooms in the building, and also has direct connection with telephones along the transmission wires. The telautograph is invariably used for communicating with the generating station, because of its un-

mistakable records. The chief operator is thus able, without moving from his chair, to control every electrical circuit and situation of the system, and to stop, start, regulate, or synchronise each unit. He can throw the output of each unit through its transformer to the transmission as if from a single isolated plant, or he can throw the current upon either bus-bar while supplying its transformers from the same or another bus-bar. The experience obtained up to the present in the practical working of the plant has been so successful that it is to be anticipated that other large plants in the future will adopt the same system.

Distribution of Power by the Ontario Power Co.

Two 60,000-volt lines run from the distributing station for six miles to a point on the Niagara River near the town of Queenstown, where they cross the gorge, and connect with the lines of the Niagara, Lockport, and Ontario Power Company delivering power for use in the United States. These lines consist of aluminium conductors $1\frac{1}{8}$ inches in diameter, carried on steel towers 55 feet high to the top wire, with an average span of 500 feet. The insulators for this line are of porcelain, and weigh 35 lb. each.

The first of the transmission lines was put into operation on July 7, 1906, and the plans realised at present, and contemplated for the immediate future, in the plant of the Niagara, Lockport, and Ontario Power Co., involve a maximum transmission distance of 160 miles. This distance puts the plant amongst the longest transmissions of the world.

Size of Cables.—There are only three sizes of cables used on the main transmission lines, designated by the company as 3/3, 2/3, and 1/3 respectively. The 3/3 cable is aluminium cable, consisting of nineteen strands, and having a total area of 642,800 cir mils, being equivalent to 400,000 cir mils copper. The areas of cross-section of the other cables are respectively two-thirds and one-third that of the large one.

It is impossible to enumerate the manifold purposes for which the power is used, but some of the more important are the following:—

Light.—The power generated at this station and sent out over the above-described transmission lines furnishes part or all of the public and private lighting in Niagara Falls, Welland, Stamford, and St. Catherines, Ontario; and Lockport, Depew, West Seneca, Hamburg, Batavia, Rochester, Canandaigua, Auburn, Baldwinsville, Phœnix, Fulton, and Syracuse, New York.

Heat.—The same power operates electric furnaces for the reduction of iron, copper, and other ores, and the manufacture of cement, calcium carbide, and lime nitrates in Port Colborne, Welland, Niagara Falls, and Thorold, Ontario, and Lewiston, Lockport, and Caledonia, New York.

Power.—The same power operates wholly or in part the trolley systems in Syracuse, Rochester, Canandaigua, Geneva, West Seneca, and Hamburg; and the interurban lines Syracuse, Lake Shore and Northern Syracuse and South Bay, Rochester and Geneva, Rochester and Mount Morris (Erie Railroad), Buffalo, Lockport and Rochester, Buffalo and Hamburg, and Buffalo and Dunkirk (partly constructed). It operates the steel works of the Ontario Iron and Steel Company at Welland, Lackawanna Steel Company (7000 employees), Shenandoah Steel Wire Company, plate-rolling mills of Seneca Iron and Steel Company, and pumping works of Depew and Lake Erie Water Company at West Seneca; repair shops of the New York Central and Hudson River Railway Company, and Delaware, Lackawanna and Western Railroad Company, and the works of the Gold Coupler Company at Depew, stone-crushing establishment of the Kelley Island Lime and Transport Company at Akron; works of the United States Gypsum Company at Oakfield, and various smaller industries located on main transmission lines.

The utilisation of a portion of the vast energy of Niagara without in any way detracting from the splendour or beauty of the Falls is destined to create in the Ontario peninsula and in western New York a vast manufacturing district.

SCIENTIFIC WORK OF THE SMITHSONIAN INSTITUTION.

THE report of Dr. Charles D. Walcott, secretary of the Smithsonian Institution, for the year ending June 30, 1909, has just been issued. All the numerous departments of the institution's activity receive attention, but it is possible here to deal only with the more direct scientific work accomplished during the year under review. Subjoined is a summary of the parts of the report dealing with matters of scientific interest.

Smithsonian African Expedition.

Through the generosity of friends of the institution, there was provided during the year a special fund to pay for the outfitting and to meet the expenses of the naturalists on a hunting and collecting expedition to Africa under the direction of Colonel Theodore Roosevelt. No part of the fund was derived from any Government appropriation or from the income of the institution. The special interest of the institution in the expedition is the collection of biological material for the United States National Museum.

The party sailed on March 23, 1909, from New York, whence steamer was taken to Mombasa, British East Africa. The expedition arrived in Africa on April 21. A letter, dated at Nairobi, May 31, announced the shipment of twenty barrels of large mammal skins in brine, comprising Colonel Roosevelt's first month's collection. While no new species, so far as is known, is included in this first shipment, the collection will supplement materially the specimens already in the National Museum. Together with this shipment are expected a large number of specimens of small mammals, and also of birds. Through the Smithsonian African expedition the National Zoological Park has been presented with an exceptional collection of live African animals.

Cambrian Geology and Palaeontology.

Dr. Walcott's studies of the older sedimentary rocks of the North American continent, which he has been carrying on as opportunity offered for more than twenty years, were continued in Montana and the Canadian Rockies during the field season of 1908. The scientific results of the 950-mile trip through the forests and on mountain trails will aid materially in the solution of several problems connected with the stratigraphy and structure of the main ranges of the eastern Rocky Mountains and of the geological position and age of many thousands of feet of the sandstones, shales, and limestones forming the mountains in northern Montana, British Columbia, and Alberta. On the return an examination was made of the geological formations in the vicinity of Helena, Mont., and of the Wasatch Range, south-east of Salt Lake City, Utah. Three additional papers giving a summary of the results of these studies in Cambrian geology and palæontology were published during the year.

Researches on Atmospheric Air.

A Hodgkins grant was approved in October, 1908, for the erection of a small stone shelter on the summit of Mount Whitney, California, for the use of investigators during the prosecution of researches on atmospheric air, or on subjects closely related thereto. The pioneer trip to the summit of Mount Whitney in the summer of 1881 by the late secretary, Dr. Langley, at that time director of the Allegheny Observatory, will be recalled in this connection, as well as his conviction that in no country is there a finer site for meteorological and atmospheric observations than Mount Whitney and its neighbouring peaks.

Mr. C. G. Abbot, who succeeded Secretary Langley as director of the astrophysical observatory of the Smithsonian Institution, and to whose immediate suggestion and earnest personal efforts the preparation for and the establishment of this important post on Mount Whitney are largely due, began his observations there in the summer of 1909, and obtained important data in the determination of the solar constant. The cooperation of Prof. W. W. Campbell, the

director of Lick Observatory, University of California, at Mount Hamilton, has been most helpful during the erection of the shelter. The class of researches to be prosecuted at this exceptionally favourable station are not only of great scientific interest, but are expected also to prove of value in determining questions having a direct, practical influence on the preservation and progress of human life on our globe.

International Standard Pyrheliometers.

A limited grant from the Hodgkins fund was approved in February, 1909, for the construction of several silver disc pyrheliometers. These instruments are to be placed in charge of scientific investigators in widely separated localities for the purpose of establishing an international scale for the comparison of observations on solar radiation. The varying results published by observers have made the need of international cooperation in this connection apparent, and the matter has received considerable attention at conferences of the Solar Union. These simple and comparatively inexpensive instruments are to be constructed after a design by Mr. Abbot. Similar pyrheliometers have been employed in the researches of the Astrophysical Observatory for several years, and have proved entirely satisfactory.

Langley Medal and Memorial Tablet.

As a tribute to the memory of the late secretary, Dr. S. P. Langley, and his contributions to the science of aërodromics, the regents of the institution adopted the following resolution on December 15, 1908:—"That the board of regents of the Smithsonian Institution establish a medal to be known as the Langley medal, to be awarded for specially meritorious investigations in connection with the science of aërodromics and its application to aviation." Following the establishment of this medal, a committee of award, composed of gentlemen of recognised attainments in the science of aërodromics, was appointed. The committee recommended that the first medal be bestowed on Messrs. Wilbur and Orville Wright, and the medal was awarded on February 10, 1909. Designs for the Langley memorial tablet are now being prepared by a well-known architect of Washington.

National Museum.

More than 250,000 specimens were added to the museum collections during the year, about 200,000 of them pertaining to biology and the remainder to geology and anthropology. One of the most important additions to the division of ethnology was a contribution from Dr. W. L. Abbott, consisting of about 500 objects from south-western Borneo. To the technological collections were added more than 200 objects transferred from the United States Patent Office. The department of biology received a noteworthy gift of about 1200 European mammals and sixty-one reptiles from Mr. Oldfield Thomas, of the British Museum, and Mr. Gerrit S. Miller, of the National Museum. This has so greatly increased the importance of the National Museum collection of the mammals of Europe that it now ranks as one of the largest and most valuable in the world. Mention must also be made of a contribution of about a thousand mammals and birds of Borneo, received from Dr. W. L. Abbott.

In connection with the work of excavation and repair of the Casa Grande ruins in Arizona, under the direction of the Smithsonian Institution, there were collected and placed in the National Museum about 650 stone axes and hammers, rubbing and grinding stones, earthenware bowls and vases, pieces of basketry and textile fabrics, shell ornaments, and wooden implements. From similar excavations in the Mesa Verde National Park, Colorado, there were received about 500 objects of like character. The department of geology received a large series of Cambrian fossils from the Rocky Mountains, collected during Dr. Walcott's field studies in that region. There were also added to the collections many objects pertaining to mineralogy and palæobotany. Eighty-two regular sets of geological specimens to the number of 7739 were distributed during the year for educational purposes, besides 1300 specimens of geology, marine invertebrates, and fishes arranged in special sets.

Two field parties in which the institution and museum are greatly interested left America during the year for important collecting regions, from both of which valuable results may be expected. The first will explore Java and some of the adjacent islands; the second expedition is that under the direction of Colonel Theodore Roosevelt into British East Africa and more inland districts.

Bureau of American Ethnology.

The bureau has collected data relating to sixty families or linguistic stocks and upward of 300 tribes. It does not expect to study all the tribes in detail, but rather to investigate a sufficient number as types which may stand for all. It has seemed wise at this stage of the researches to prepare a summary of our knowledge of the tribes, and this has taken the form of a "Handbook of the Indians," of which one large volume is published and the second nearly through the press.

The people of the United States have two great obligations which the bureau is trying to fulfil:—(1) that of acquiring a thorough knowledge of the Indian tribes in the interests of humanity; (2) that of preserving to the world an adequate record of the American race which is so rapidly disappearing.

Recently much interest has been manifested in the antiquities of the country, more especially in the great pueblo ruins and cliff dwellings of the arid region, and the fifty-ninth Congress enacted a law for the preservation of these antiquities. A first step in making this law effective is their exploration. A second is the excavation and repair of the more important ruins to ensure their preservation and to make them available to the public and for study. Dr. J. Walter Fewkes, of the bureau, has continued the work of excavation and repair of the ancient ruins in the Mesa Verde National Park. During the year the repair of Spruce Tree House was completed, and at the end of June excellent progress had been made in uncovering and repairing the crumbling walls of Cliff Palace, the greatest of the ancient ruins of its kind in the United States.

There is need also for ethnological work in the Hawaiian Islands and Samoa, for the following reasons. It is regarded as most important that the Government should have definite and detailed information regarding the native inhabitants of these islands, which are under its control and for whose welfare it is responsible. It is not less a duty of the nation to preserve some record of this peculiar race for the purposes of history and science, as neglect will become a source of deep regret. An experienced ethnologist should make investigations regarding the history, social institutions, religion, and general culture of the people, and a physical anthropologist should study their physical and mental characteristics.

National Zoological Park.

The National Zoological Park during the year added 576 new animals to its collections, which offsets a loss of 562 by exchange, death, and return of animals, and brings the number of individuals on hand, June 30, 1909, up to 1416. The entire support of the park was derived from an appropriation of 19,000*l.* for general purposes, including the purchase, transportation, care, and maintenance of animals; the care and improvement of grounds; the construction and repair of all buildings, enclosures, roads, walks, and bridges. Of this amount, the increased price of necessary provisions and labour brought the cost of maintenance alone to about 17,000*l.* It was therefore possible to do little toward permanent construction or improvement.

Astrophysical Observatory.

The work of the Astrophysical Observatory during the year consisted:—(1) Of bolometric observations carried on at Washington on the brightness of different parts of the sun's image; also some experimental work on the transparency of the air for long-wave rays, such as the earth radiates. A computation of the results of these experiments is now far enough advanced to show their satisfactory quality. Precise knowledge of the selective absorption of our atmosphere for earth rays is still lacking, and contradictory views are still being expressed about this

important subject; hence it is hoped that these experiments will be useful in the study of the dependence of the earth's temperature on radiation.

(2) Spectrobolometric measurements of the solar constant of radiation have been continued at the Mount Wilson Observatory in California. As in former years, evidences of a fluctuation of solar radiation were found in the results of the measurements thus far obtained. A new and improved standard pyrheliometer was found to be more satisfactory than the one used in 1906, and great confidence is felt in the results obtained with it. Efforts have also been made to carry the bolometric measurements much farther in the ultra-violet through the use of a large quartz prism, a large ultra-violet glass prism, and two magnalium mirrors.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The special board for biology and geology has appointed Mr. Leonard Doncaster, of King's College, to be superintendent of the Museum of Zoology, and the Vice-Chancellor has approved of the appointment.

GLASGOW.—Principal Sir Donald MacAlister, K.C.B., has been appointed to represent the Senatus of the University at the centenary festival of the University of Berlin in October next.

A scheme for the formation of a clinical branch of the medical school of the University, to be situate at the Royal Infirmary, was approved by a Parliamentary Commission, after a two days' hearing, on April 1. The provisional orders for the purpose contemplate the establishment of four professorial chairs at this infirmary, in addition to those held at the Western Infirmary, namely, those of medicine, surgery, obstetrics, and pathology. The necessary funds, amounting to about 2000*l.* a year, are provided for from existing endowments and by grants from St. Mungo's College, the Muirhead trustees, and other benefactors. All the instruction thus provided will be open to women students of the University as well as to men.

THE late Colonel G. E. Church, who died on January 4, bequeathed 1000*l.* to the Royal Geographical Society towards a fund for the enlargement of its premises or towards a new building for its use. He left to Harvard University his collection relating to North and South America, consisting of books of travels, voyages, explorations, boundary-line questions, geography, ethnology, and history, as well as all writings by Latin and American authors, to be known as the "George Earl Church Collection." Should the authorities of the University not accept this gift within four months of his death, then the collection is to be offered to the Brown University, Rhode Island, or the Stanford University, in California.

IN Class iv. (Education, Science, and Art) of the Civil Service Estimates for the year ending March 31, 1911, the estimate amounts to 18,651,483*l.*, a net increase of 697,718*l.* on the amount voted in 1909. The estimate for the Board of Education shows a net increase of 417,663*l.*, of which 348,775*l.* arises under the subhead of grants in respect of public elementary schools, &c. A sum of 200,000*l.* is again provided for special grants to certain necessitous local education authorities. The estimate for scientific investigation, &c., includes a grant of 7500*l.* in aid of the expenses of the aëronautical section of the National Physical Laboratory, and a grant of 20,000*l.* in aid of the expenses of the British Antarctic Expedition of 1910.

THE following courses of free advanced lectures have been arranged by the University of London:—a course of five lectures on "Fertilisation and Related Phenomena," to be given by Prof. J. B. Farmer, F.R.S., at the Royal College of Science, on Wednesdays at 5 p.m., beginning on April 27; a course of five lectures on "The Anatomy of Plants in Relation to External Conditions," to be given by Mr. L. A. Boodle at University College on May 26, May 30, June 2, June 6, and June 9, at 5 p.m. A course of three lectures on "The Geology and Geography of Charnwood Forest" will be given by Prof. W. W. Watts, F.R.S., at the Imperial College of Science and Technology, on Mondays at 5 p.m., beginning on April 25. The lectures are addressed to advanced students of the University and to others interested in the subjects. Admission is free, without ticket.

THE difficulty of reaching the cultivator of the soil for any educational purpose has not as yet been overcome in any country, and certainly not here. Some interest, therefore, attaches to a scheme that has been at work in the West Indies for about eighteen months, and has proved so effective that it is to be adopted permanently. Courses for home reading are drawn up, divided into three parts, at the end of each of which are held examinations known respectively as the preliminary, the intermediate, and the final. The preliminary examination requires a general all-round education, and is dispensed with in the case of students who possess certain qualifying certificates. The intermediate examination requires such knowledge of the general principles of agriculture, and of planting work in particular, as might be expected from an intelligent overseer of a few years' experience, while the final examination reaches the standard necessary for a man capable of managing an estate. A leaflet is issued by the West Indian Agricultural Department containing a syllabus of the subjects necessary for each part, with hints as to what books should be read. In addition, the *Agricultural News*, the fortnightly paper issued by the Department, devotes nearly a page in each issue to notes bearing on the current work of the estate, thus giving the necessary practical illustrations of the general principles set out in the text-books. A few questions are also set which students are advised to attempt. The Department, however, does not set up to act as a correspondence college and correct the answers to the questions. It is left to the student to find someone who will discuss his work with him and help him over those hard places where a man, reading on his own account without any assistance, inevitably gets stranded sooner or later. At first the officers of the Department gave a good deal of help by organising students' meetings where difficulties could be discussed; voluntary workers also came forward. The examinations are conducted by the staff of the Department, acting in conjunction with some of the planters. The intermediate and the final are essentially technical in their nature; the candidate is expected to be a better man at field or plantation work as a result of his reading, and he must demonstrate his superiority to the satisfaction of the planters on the examining board. In this way the interest and sympathy both of masters and of men can be enlisted, and both are brought to realise that the certificates awarded indicate increased efficiency on the part of the holder. Interest in the scheme is said to be spreading among the cultivators, while the organisers have found certain modifications that will still further increase its utility. It will be carefully watched by those in this country who are engaged in elementary agricultural education.

THE National Union of Teachers held its conference this year at Plymouth during Easter week. Naturally, most of their discussion was confined to various aspects of elementary education, but other subjects of national importance were also considered. Mr. Marshall Jackman, the president, was chiefly concerned with a demand for more money from the Treasury for elementary education, to relieve the financial straits in which many local education authorities find themselves. Mr. Jackman contended that we build Dreadnoughts regardless of cost, not because we want them, but because we feel the necessity of keeping pace with our neighbours. If we could have a similar cry in education to the Two Power standard cry for the Navy we should be able to do much for educational progress. He set out a national educational standard which he thought was worthy of this great Empire. Is it too much to demand that the educational opportunities for British boys and girls shall be no less than those for the children of any other nation? His new standard was that all forms of education should be as free to the British child as to the American child, the elementary schools of Britain should be manned by teachers no less efficient than those in the schools of Sweden, the classes of the schools in Britain should be no larger than those of Den-

mark, and the health of the children in this country should not be less cared for than that of the children in German schools. The care of adolescents came in for careful debate. Sir Henry Hibbert, chairman of the Lancashire County Education Committee, said the duty of providing further discipline and training for all children during the years which follow the day-school period is receiving attention in many countries, all of which seem to be moving towards three conclusions:—(1) that increased effort should be made by the State to compel local authorities to organise, according to the needs of different localities and of different trades, courses of instruction useful to any child, and so planned as to train them for healthy living and for the duties of citizenship; (2) that there should be a further delimitation of the hours of juvenile labour; and (3) that all employers, Government as well as private, should be compelled by law to enable any persons of less than seventeen or eighteen years of age employed by them to attend courses of instruction, general or technical, for a specified number of hours per week at times during which the pupils would not be too tired to profit by the instruction. Dealing with the same subject, Miss Adler, of the London County Council, explained that the aim of the trade schools of the London County Council is not entirely to supersede apprenticeship, but to reduce the period of indenture, and to enable the lad to enter the workshop already equipped to take an intelligent interest in workshop processes, to handle tools effectively, and to be in a better position to learn by observation than the lad who enters the workshop direct from school. The development of handicraft side by side with the general intelligence is the primary aim of the trade school, and when this is possible on practical lines postponement of entry into the workshop is a distinct advantage, more especially when the trade side of the work is to some extent supervised by members engaged in the industry taught in the school. It was pointed out during the conference that the cost of compulsory attendance between fourteen and seventeen would be some 2,625,000*l*., and if the age were increased to eighteen 3,500,000*l*.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, March 16.—Prof. J. A Thomson, president, in the chair.—Miss L. S. M. **Summers**: Antipatharians from the Indian Ocean. Fourteen species were dealt with, including three which are new, viz. *Cirripathes indica, Antipathes salicoides, Pteropathes simpsoni*. In several cases the presence of well-preserved polyps made it possible to remove some of the doubts which Brook expressed in regard to various species. The paper referred also to certain peculiarities in the polyps and spines. The collections were made at Ibo, in Portuguese East Africa, and in the Mergui Archipelago.—E. M. **Nelson**: The visibility of the tertiaries of *Coscinodiscus asteromphalus* in a balsam mount. The author directed attention to the continued improvement in microscope objectives, and particularly to a new $\frac{1}{8}$-inch objective by Zeiss. Twelve years ago he received a slide of Nottingham deposit mounted in sulphide of arsenic, and he then saw, for the first time, the tertiaries in *Coscinodiscus asteromphalus*. He had had a balsam mounted selected slide of this diatom since 1876, and had tested hundreds of objectives upon it, but these tertiaries had never been visible. Recently he received from Messrs. Zeiss a long tube $\frac{1}{8}$-inch apochromatic object-glass of N.A. 1·4, and it was tested on this balsam-mounted slide. The tertiaries which had for so many years eluded the grip of all kinds of lenses were conspicuous. This apochromatic $\frac{1}{8}$-inch was more sensitive to tube length, stood a larger axial cone, bore a deeper eye-piece, and had sharper definition than any microscope lens he had previously seen.—A. A. C. Eliot **Merlin**: The measurement of the diameter of the flagella of the cholera bacillus prepared by Löffler's method. Slides of bacteria are prepared by Löffler's method to render the flagella more easily demonstrable, as the organism and its appendages are greatly distended by the process, thus rendering them comparatively coarse objects. Little has been attempted as regards the measurement of these appendages since Dr. Dallinger read his paper on the measurement of the diameter of the flagella of *Bacterium termo* in 1878. The author of the paper obtained his results by what are termed extinction measurements, the resulting measurements being for the finest flagella 1/64725-inch and for the coarser 1/62226-inch. He checked these results by measuring, by means of a filar micrometer, the flagellum of a selected specimen, the measurement by this method giving a diameter of 1/66756-inch as against 1/64725-inch of a flagellum of approximately similar fineness measured by the extinction method.

Geological Society, March 23.—Prof. W. W. Watts, F.R.S., president, in the chair.—L. **Moysey**: Palæoxyris and other allied fossils from the Derbyshire and Nottinghamshire Coalfield. After reviewing the bibliography of Palæoxyris, the author records the finding of twenty-two specimens from Shipley Clay-pit (Derbyshire) and above 130 from Digby Clay-pit (Nottinghamshire), also several isolated examples from other localities in the district. He describes *Palaeoxyris helicteroides* (Morris), noting especially the presence of a "beak," which had not hitherto been adequately described. He then describes *Palaeoxyris prendeli* (Lesquereux) from Shipley Clay-pit, again noticing the formation of the "beak." The discovery of *Palaeoxyris johnsoni* (Kidston) from Digby is noted, and it is proposed that this fossil be removed into the genus Vetacapsula. The author also describes a specimen of *Vetacapsula cooperi* (Mackie and Crocker) from Newthorpe Clay-pit (Nottinghamshire).

CAMBRIDGE.

Philosophical Society, March 14.—Prof. Bateson, president, in the chair.—Sir J. J. **Thomson**: The cause of the phosphorescence of the glass in vacuum tubes when the pressure is not very low.—J. A. **Crowther**: Transmission of β rays.—J. L. **Glasson**: Secondary X-rays from metallic salts. These experiments show that the absorption coefficient of the secondary homogeneous X-rays from the metals of the chromium-silver group is unaffected by the combination of the metal with certain acid radicles. The only effect of the combination is the superposition of a small quantity of hard scattered radiation on the homogeneous radiation of the metal. Moreover, the valency of the element has no influence on the secondary homogeneous radiation from it. The absorption coefficient of the characteristic radiation from manganese is deduced from the absorption curve of manganese sulphate.—S. G. **Lusby**: Some experiments on ionisation in dried air. All the known properties of ions have been found to vary with the amount of moisture present in the gas experimented on, but in all cases the negative ion is the more susceptible. Hence it was thought that if the gas were dried, it should acquire a positive charge. The experiment was therefore tried, liquid air being used as the drying agent. On testing a stream of air which had been ionised and then dried, no indication of electric charge was detected. By using another method, it was found that both the positive and the negative ionisation are increased greatly by this drying action, but in an equal ratio, which in some cases amounted to ten. This was found to be due to decreased re-combination. The effect could be eliminated by previously filtering the air.

DUBLIN.

Royal Dublin Society, March 22.—Mr. R. Ll. Praeger in the chair.—Prof. T. **Johnson** and Miss R. **Hensman**: Agricultural seeds and their weed impurities; a source of Ireland's alien flora. The first-named author stated that as under the Weeds and Seeds Act for Ireland he had ceased to be responsible for the seed-testing station of which he had been director during the ten years of its existence (1900–9), the paper he communicated gave a summary of the purity and germination percentage of the 11,000 samples of seeds already tested, and of the weed-seeds found in these samples. Utilising the results of Dr. Stebler's investigations, he showed how many of the weed-seeds serve as source-indicators of the agricultural seeds sold. The paper contains also a list of casuals already recorded in the Irish flora, so far as these are traceable to introduction in seed. A list of 120 weed-seeds is given, 75 per cent. of which are the seeds of non-indigenous weeds.

PARIS.

Academy of Sciences, March 29.—M. H. Poincaré in the chair.—Paul **Sabatier** and A. **Mailhe**: The mechanism of the dehydration of alcohols by the catalytic action of various metallic oxides. The action of sulphuric acid and of metallic oxides upon alcohols at various temperatures is compared, and the possibility of the formation of a compound of the oxide and alcohol analogous to ethylsulphuric acid considered.—M. **Carpentier**: A description of a new electrical measuring instrument, the logometer.—Charles **Nordmann**: Remarks on a preceding communication.—G. **Denigès**: The detection of methyl alcohol in general, and especially in the presence of ethyl alcohol. The method, full details of which are given, is based on oxidation by potassium permanganate in dilute sulphuric acid solution. Formaldehyde is produced, and is detected by fuchsine decolorised by sulphurous acid.—P. **Yvon**: Aniline arsenyl tartrate. Details of the preparation and physical properties.—A. **Guilliermond**: New observations on the cytology of yeasts. The results of the experiments given are entirely opposed to the views put forward by Wager and Peniston.—M. **Dugast**: The presence of boron in Algerian wines. All the Algerian wines examined, of known origin and purity, were found to contain boron.—E. **Chuard**: A new method of treating for mildew by oxychloride of copper. The substitution of the oxychloride of copper for the mixtures of copper sulphate and lime reduces the amount of copper used to one-half.—Maurice **Gignoux**: The classification of the Pliocene and the Quaternary in southern Italy.—Jules **Welsch**: The formation of the Poitevin Marais and the separation of the "islands" of Ré and Oleron.

DIARY OF SOCIETIES.

THURSDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

LINNEAN SOCIETY, at 8.—Elm-seedlings showing Mendelian Results: A. Henry.—On the Foraminifera and Ostracoda from Soundings, chiefly deep-water, collected round Funafuti by H.M.S. *Penguin*: F. Chapman.

RÖNTGEN SOCIETY, at 8.15.—Some methods of using the Alternating Current Mains for Röntgen Ray Work: Dr. G. B. Batten.—Treatment of X-Ray Dermatitis by Radium: Mackenzie Davidson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Progress of Electric Braking on the Glasgow Corporation Tramways: A. Gerrard.

FRIDAY, APRIL 8.

ROYAL INSTITUTION, at 9.—Lowell Observatory: Photographs of the Planets: Prof. Percival Lowell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction and Extension of Egremont Ferry Pier: G. H. Hodgson and H. M. Gell.

PHYSICAL SOCIETY, at 8.—An Experimental Demonstration of the Loading of Artificial Telephone Cables: B. S. Cohen.—Further Tests of Brittle Materials: W. A. Scoble.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Note to Paper on Star Colours and Spectral Types: W. S. Franks.—*Probable Papers*: Investigations relating to the Spectra of Comets: A. Fowler.—Places of Halley's Comet, 1909–1910, deduced from Photographs taken at the Radcliffe Observatory, Oxford: A. A. Rambaut.—Proper Motions: Astronomer Royal for Scotland.

SATURDAY, APRIL 9.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

MONDAY, APRIL 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Across Africa from the Niger to the Nile: Dr. Karl Kumm.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Brick-making: Dr. A. B. Searle.

TUESDAY, APRIL 12.

ROYAL INSTITUTION, at 3.—The Modern Development of the Problem of Alcoholic Fermentation: Dr. A. Harden, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Charcoal Burning in Epping Forest: S. Hazzledine Warren.—Additional Notes on the British Camp at Wallington: H. C. Collyer and N. F. Roberts.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The New Clyde Bridge of the Caledonian Railway at Glasgow: D. A. Matheson.—The Queen Alexandra Bridge over the River Wear, Sunderland: F. C. Buscarlet and A. Hunter.

WEDNESDAY, APRIL 13.

ROYAL SOCIETY OF ARTS, at 8.—The Port of Dover: A. T. Walmisley.

GEOLOGICAL SOCIETY, at 8.—The Volcano of Matavanu in Savaii: Dr. Tempest Anderson.—Notes on the Geology of the District around Llansawel (Carmarthenshire): Miss Helen Drew and Miss Ida L. Slater.

THURSDAY, APRIL 14.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Viscous Flow in Metals and Allied Phenomena: E. N. da C. Andrade.—The Refraction and Dispersion of Argon and Redeterminations of the Dispersion of Helium, Neon, Krypton and Xenon: C. and M. Cuthbertson.—The Action of the Radiation from Radium Bromide upon the Skin of the Ear of the Rabbit: J. O. W. Barratt.—And others.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

FRIDAY, APRIL 15.

ROYAL INSTITUTION, at 9.—The Chemical Significance of Crystal Structure: Prof. W. J. Pope, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

SATURDAY, APRIL 16.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer

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