THURSDAY, APRIL 7, 1904.

COLOURING MATTERS, ARTIFICIAL AND NATURAL.

A Systematic Survey of the Organic Colouring Matters. Founded on the German of Drs. G. Schultz and P. Julius. By Arthur G. Green, F.I.C., &c., Professor of Tinctorial Chemistry at the Yorkshire College, Leeds. Second edition. Pp. x+280. (London: Macmillan and Co., Ltd., 1904.) Price 21*s.* net.

APART from its special value to experts as a standard work of reference, the present compilation is of general interest as enabling chemists to gauge the progress in a department of industry which is perhaps more intimately associated with scientific research than any branch of manufacture that has been called into existence as the result of laboratory work. The first English edition bears the date 1894, and it was noticed in these columns at the time of its appearance (vol. l. p. 267). The present edition, therefore, enables us to measure the development which has taken place during the last decade. First, with respect to the actual number of coal-tar colouring matters on the market. The edition of 1894 enumerated 454 distinct compounds; the present edition comprises 695; an apparent addition of 241 definite organic products of tinctorial value in ten years is an instructive illustration of the resources of chemical science when these are requisitioned in the service of industry. The actual number of new products is, however, even greater than this, since 59 dyestuffs which were included in the last edition have been removed from the list as being obsolete. The total number of new colouring matters is thus 300, so that the increment has been taking place at the rate of 30 per annum.

A more detailed analysis of the tables will also serve to bring out the new departures which have been made, and which are, in part at least, responsible for the large number of new products added to the list. Thus in 1894 artificial indigo was entered as "not in commerce," although the fundamental process which has since been developed with such marked success in Germany was known at that time, and the references to Heumann's paper and the first patents of the Badische Company are included in the literature. In the present edition five processes for preparing synthetic indigo are tabulated, and five new products derived from or related to indigo are added to the tables as the outcome of the industrial development of the chemistry of this group of colouring matters.

In the great domain of the azo-colours, the development is quite astonishing. From 234 recorded in the last edition, the number has now reached 383, grouped into 125 monazo, 203 disazo, 45 trisazo, and 10 tetrakisazo compounds. The first representative of the group of colouring matters now known as the oxazines was discovered by the writer of this notice in 1879. In 1894 thirteen compounds belonging to this group were recorded as technical products; in the present edition 31 oxazines are in the tables. The first member of the sulphur-containing compounds, known as the thiazol or thiobenzenyl colouring matters, was discovered and introduced into commerce in 1887 by Prof. Green under the name of "primuline." The monopoly conferred by the right of discovery of this important compound was lost to the firm in the laboratory of which the discovery was made by the adoption of the short-sighted policy that a new product could be protected as a "trade secret." Within a year of its introduction the Germans had found out its chemical constitution and were manufacturing it, and a German firm actually obtained patents for producing it in this country as well as in Germany. Those who are now bidding for notoriety by directing public attention to the ways in which British industries have been lost may draw some very instructive conclusions from the consideration of this little chapter in the history of industrial chemistry.

Another very striking development, familiar, of course, to tinctorial chemists, and brought out conspicuously by a comparison of the two editions of the present work, is to be found in the group of sulphide colouring matters. In 1873 the French manufacturers introduced under the name of "Cachou de Laval" a brown dyestuff prepared by fusing sawdust, bran, &c., with sodium sulphide. This figures in the 1894 edition as the only compound of its class. The action of fused sulphides upon definite organic compounds of known constitution has led since 1894 to the introduction of no less than 20 new colouring matters, into the composition of which sulphur enters as an integral constituent of the molecule. Some of these compounds are black dyestuffs of great value on account of their fastness. They are, moreover, of particular scientific interest as offering a new field of research in connection with the question of the constitution of what may perhaps prove to be thiocyclic compounds. With the exception of the "immedial sky blue" of Messrs. Cassella and Co., for which a probable formula is given, not one of these new compounds has even an empirical formula assigned to it. We have here, in fact, another illustration of the well-known principle that technology is often in advance of pure science.

In many other directions can the industrial and scientific development of this great branch of chemical technology be traced in the pages of the present work. The raw and intermediate products of which the translator and editor gave an account in the English edition numbered about 243 and occupied fifty-seven pages of the first edition. In the present edition some 60 new intermediate products have been introduced, and their description extends to more than seventy pages. Neither must the theoretical developments be overlooked in connection with an industry which is so intimately associated with the advancement of our knowledge of the chemical constitution of organic compounds. Evidence of this advancement is to be found throughout the tables before us, one of the results being a more detailed and perfect classification of the groups of colouring matters and the transference of many compounds of which the constitution was formerly unknown to definite places under their group type. It is of interest to note also in passing that the

quadrivalent character of the oxygen atom, which received such remarkable confirmation a few years ago through the researches of Prof. Norman Collie and his colleagues, now finds definite expression in the formulæ of the oxazines and certain other colouring matters.

In two respects the present edition differs from its predecessor. The tables for the qualitative examination of colouring matters have been omitted, and in their place a section on the natural dyestuffs has been added at the end of the tables of artificial colouring matters. This new section is of interest from many points of view. It serves, in the first place, to remind us that natural dyestuffs have not yet been entirely superseded by synthetical coal-tar products. It also brings out the fact that with respect to the chemistry of these vegetable colouring matters pure science is in advance of technology, inasmuch as the constitutional formula of the majority of these compounds has been determined with more or less probability. With the exception, however, of luteolin, the colouring matter of weld, which has been synthesised by Kostanecki and his colleagues, none of the products entered in this last table have been produced by laboratory processes. Such important colouring matters and dyestuffs as hæmatoxylin from logwood, brazilin from Brazil wood, quercetin from quercitron, and rhamnetin from Persian berries have for many years been undergoing investigation here and abroad, and some or all of these may have to be transferred to the tables of artificial products by the time this work reaches a new edition. Supposing such syntheses to be accomplished, the struggle between the synthetical and the natural products will no doubt furnish the industrial world with further material for serious reflection. Whether the result of the artificial production of these outstanding members of a group which supplied the world with dyestuffs before the discovery of the coal-tar products will be the same as that which followed the synthesis of alizarin, and threatens to follow the synthesis of indigo, it would be extremely rash to predict.

The usual considerations respecting the loss of the coal-tar colour industry to this country cannot but arise in looking through the present series of tables. The enormous development to which attention has been directed in this notice is almost entirely due to German discoveries. The hundreds of patents referred to in the bibliographical columns are German by an overwhelming majority. The causes of this decadence of what was originally a British industry have been so frequently discussed that it would appear that nothing further is to be gained by their reiteration. Of late years, however, two subordinate causes of this decline have been thrust upon public notice with such vehemence that the uninitiated may be led to believe that the "imperfection of our patent laws" and the want of "duty free spirit" have together wrecked manufacturing enterprise in this direction. The present writer is glad of this opportunity of expressing dissent from these statements. An amendment of our patent laws is certainly desirable, and duty free spirit would unquestionably be a boon for certain branches of manufacture. But to exalt these, which may be called minor deterrents, into the rank of a complete explanation of British failure and German success is simply dragging the proverbial red herring across the trail.

No further commendation of the well-known work which has led to these reflections is necessary than the statement that it is as indispensable as its predecessor to all who are in any way concerned in this branch of chemistry and of chemical technology.

R. MELDOLA.

THE MALAY FAUNA.

Fasciculi Malayenses. Results of an Expedition undertaken by N. Annandale and H. C. Robinson. Zoology. Parts i., ii. and Supplement. By various authors. (London: Longmans, Green and Co., 1903.)

OF late years, mainly owing to the labours of Captain Stanley Flower and to the collections made by the *Skeat* Expedition (of which, by the way, Mr. Annandale was a member), very considerable advances have been made in our knowledge of the vertebrate fauna of the Malay countries. So large, indeed, was the amount of new information thus acquired that it might have been supposed little more remained to be accomplished. If such an idea were ever seriously entertained, it is, however, at once disposed of by the work before us, which, as stated on the title-page, is intended, when complete, to give a full account of the anthropological and zoological results of an expedition to Perak and the Siamese Malay States undertaken during the years 1901 and 1902 by Messrs. Annandale and Robinson, under the auspices of the Universities of Edinburgh and Liverpool. That the wise liberality of these two bodies has been amply justified is fully demonstrated by the present parts, which form only a foretaste of what is to come.

In the introductory note to the mammals, Mr. Robinson states that he was not so successful in the capture of these creatures as he had hoped to be, and that, in his opinion, there are many new small forms yet to be discovered. Nevertheless, Mr. J. L. Bonhote, to whom this section of the work has been entrusted, announces the discovery of eight new species. Among these, the most interesting are, perhaps, a cat and a squirrel respectively allied to *Felis badia* and *Sciurus lowei* of Borneo, and thus indicating a close relation between the faunas of that island and the Malay Peninsula. Not less important is the identification of the Malay porcupine with the *Histrix grotei* of Gray, hitherto known solely by one young example.

Of even greater interest is the series of reptiles and amphibians, which is described by Mr. G. A. Boulenger. In collecting reptiles for the *Skeat* Expedition, Mr. Annandale paid special attention to snakes; on the second occasion his attentions were mainly devoted to lizards; consequently the two collections are complementary. Mr. Boulenger describes as new two frogs, as many tortoises, a lizard and a snake, while he adds one snake and three lizards to the fauna of the Malay Peninsula. The new tortoise (*Testudo pseudemys*) is a near relative of the Burmese brown tortoise (*T. emys*), an isolated species, with the limbs enveloped in a complete bony panoply, which also ranges into the peninsula. In regard to frogs, the most interesting observations are by Mr. Annan-

dale, who states that there is no support whatever to the story told by a Chinaman to Dr. Wallace as to the flying powers of *Rhacophorus nigropalmatus*, or a closely allied form. Consequently, it may be hoped that the fable of the flying frog will disappear from zoological literature—but errors of this sort die hard. Mr. Annandale notices that certain kinds of Malay reptiles are much more brilliantly coloured in the immature than in the adult condition, and likewise records that the giant cobra (*Naia bungarus*) is the object of mimicry by a harmless snake of the genus Zamenis, typified by the Indian rat-snake.

Of the invertebrates included in the first section Colonel Swinhoe treats of the moths, and shows in the course of his descriptions that these insects do not display that division into a lowland and a mountain type so noticeable in the case of the birds. Land-planarians, of which one out of the three specimens procured indicates a new species, are described by Mr. F. F. Laidlaw. The six species of parasitic Diptera collected—the first recorded from Malacca—are discussed by Dr. Speiser. Tiger-beetles are treated of by Mr. H. C. Robinson. Finally, dragon-flies fall to the lot of Mr. Laidlaw, who tells us that in respect of these insects the fauna of the Malay Peninsula, as contrasted with its Burmese representative, is much more closely related to that of Sumatra.

Part ii. includes seven articles (together with an appendix), of which the first four are devoted to invertebrates. Mr. W. E. Collinge describes the land molluscs, among which the discovery of one remarkable Bornean genus in the Malay Peninsula is of considerable interest. Rhynchota, of which only a portion of the collection is described, fall to the lot of Mr. W. L. Distant, who records several new forms, illustrated in a coloured plate. Dr. D. Sharp contributes an interesting account of the remarkable and gigantic insects of the genus Helicopris. In the vertebrate section, Mr. G. A. Boulenger contributes a list of the freshwater fishes; while Mr. J. Johnston reports on the marine representatives of that group. Especially interesting is a species of mud-skipper of the genus Periophthalmus described by the latter gentleman as new, owing to a marked difference in its habits from other species. Finally, Dr. C. W. Andrews contributes a note on a tooth of *Elephas namadicus*, in the course of which he makes the apparently incorrect statement that the species in question occurs in the Upper Siwaliks, whereas it is confined, in India, to the gravels of the Narbada Valley.

While fully appreciating the manner in which this section of the work has been carried out, we may suggest that it would much facilitate reference if in future, instead of the serial title appearing in the headlines of both pages of the text, the titles of the different articles were given on the right-hand pages.

In the supplement Messrs. Annandale and Robinson furnish, in the form of an itinerary, a brief general account of the districts visited, which cannot fail to be of great value to future travellers. In addition to several photographs of scenery, it contains an excellent coloured map of the middle portion of the Malay Peninsula. R. L.

FIRM FOUNDATIONS.

Vorlesungen über projektive Geometrie. By Prof. F. Enriques. Deutsche Ausgabe von Dr. H. Fleischer. Pp. xiv+374. (Leipzig: Teubner, 1903.)

Encyklopädie der Elementar-Mathematik. Von H. Weber und J. Wellstein. Erster Band. Elementare Algebra und Analysis. Von H. Weber. Pp. 447. (Leipzig: Teubner, 1903.) Price 8 marks.

THE fact that Prof. Enriques's book has been translated from the original Italian into German at the instigation of Prof. Klein argues much for both its intrinsic merit and its widespread reception; for it is designed to fall within the scope of readers to whom the foreign language presents a greater difficulty than the subject-matter. The warm praise bestowed by Prof. Klein in his introductory notice renders criticism superfluous. He says, "ich kenne keines (Werk), welches den systematischen Aufbau dieser Disziplin in einer dem heutigen Stande der Wissenschaft entsprechenden Form in so durchsichtiger und gleichzeitig so vollständiger Weise darböte, wie das vorliegende. Dabei ist die Darstellung überall anschaulich und doch völlig streng. . ."

Probably the best known book on the subject is Reye's "Geometrie der Lage," and in the region where the two overlap the present volume is, speaking personally, much more readable. Reye, however, includes a large amount of solid geometry, reaching even Kummer's surface by synthetic methods, whereas Enriques devotes all but one chapter to plane geometry. He makes continual appeal to intuition, but at the same time skilfully bases his system on rigorous logical deductions from six axioms, without becoming tedious. Of the axioms, three deal with incidence, two with order, and the last is Dedekind's axiom of continuity.

Since cross ratio occupies so large a portion of the book, it is unfortunate that the notation is rather confusing; the elements should be named in the order in which they would actually occur if the range were harmonic. There is great practical convenience in doing this, and it is customary at least in this country.

An interesting feature of the book is the chapter on constructions with certain instruments. It is shown that all metrical problems of the first degree are soluble with the aid of a ruler when a square is given, and all problems soluble with ruler and compasses are soluble with a two-edged ruler alone. Certain problems of the third degree appear here for the first time in a text-book.

The volume concludes with a short historical account, which has been increased in the German edition.

The title of the series of three volumes by Herren Weber and Wellstein is possibly appropriate, but certainly misleading, as it suggests a comparison with the great "Encyklopädie der mathematischen Wissenschaften" which is in course of publication by the same firm; whereas there is no similarity, and the present work is written more from a pedagogic point of view than with the intention of supplying an exhaustive work of reference. One can imagine the

book to be the outcome of a course of lectures to graduates intending to enter the teaching profession, in which Prof. Weber brings his long years' experience and profound knowledge to bear upon some of the subjects usually regarded as "elementary."

The first volume contains three parts, Grundlagen der Arithmetik, Algebra, Analysis. The remaining two volumes are to deal with geometry, and applications. The contents are what every teacher of elementary mathematics should know and not teach. The authors have found some difficulty in defining the range of subjects of discussion, but no limitation has been imposed upon the methods employed. The first few pages deal with aggregates, and later we come to the logical reasoning upon which the introduction of irrationals and of imaginaries is based. The part on algebra is chiefly concerned with theory of equations and theory of numbers, and the third part with infinite series and products, including the most important examples. Speaking generally, subjects of technical or practical interest are excluded, and only those presenting serious logical difficulties are discussed in detail.

The book is admirably printed and clearly arranged, and should prove a very useful and trustworthy companion to all who care for exact knowledge for its own sake. R. W. H. T. H.

OUR BOOK SHELF.

Stars and Sextants. By Sprigge, Doak, Hudson and Cox. With an introduction by Lord Ellenborough. Pp. xxv+55. (London: J. D. Potter, 1903.) Price 2*s.* 6*d.*

THIS book places in the hands of explorers, navigators, surveyors and others who use the sextant a simple means of finding its centring error. The centring error of a sextant at sea has hitherto been severely left alone on account of the somewhat tedious calculations necessary to find it.

The method of obtaining the total error (and hence the centring error by applying the index error) by observing the distance between two stars when on the same vertical circle is mentioned in "Hydrographical Surveying," by Sir William J. L. Wharton, in the second edition, 1898. The error thus obtained is owing to refraction not strictly accurate, unless the two stars are of equal altitudes at the time of observing. The best time for observing the distance between two stars, so that refraction may have the least possible effect and alter slowest with the time, is when the altitudes of the stars are equal. However, the error due to refraction in observing stars at different altitudes is not great when they are on the same vertical circle, and in finding the error of a sextant at sea it may be neglected, especially if the altitude of the lower star be above 30 degrees.

The centring error can only be found for different points on the arc of a sextant by taking a large number of observations for each point and meaning the results. It is to be hoped this book will induce many to take these observations, so that while learning the principal stars they may also become expert observers.

The book contains (1) ephemeris, 1904, with star pairs of nearly equal magnitude; (2) distances of star pairs; (3) ex-meridian star pairs, with distances for every ten days; (4) semi-diurnal arcs for finding the time a fictitious star rises and sets; (5) astronomical refraction corrected for barometer and thermometer; (6) notes on the stars. The descriptions and rules for using the tables are clear and simple, the figures are well arranged, and the type is very distinct. The temperature required for correcting the refraction should be taken by a Fahrenheit thermometer in a screen exposed to the open air.

This book might lead a tyro to suppose that correct time for obtaining errors and rating chronometers can only be obtained by equal altitudes of the sun, and only by a sextant of which the centring error is known; such is not the case. Time can be accurately obtained with a faulty sextant by observing sets of single altitudes both A.M. and P.M. of the sun, of stars both east and west of the meridian and meaning the results. By another less known but very valuable method the time is obtained in less than half an hour, if the stars are properly selected, by taking the equal altitudes of two different stars on opposite sides of the meridian.

Nothing must prevent the navigator from finding his position by stars. Take them at other times when possible, but *always* at twilight.

VANSITTART HOWARD.

Engine Tests and Boiler Efficiencies. By J. Buchetti. Pp. xv+255. (Westminster: Constable and Co., Ltd., 1903.) Price 10*s.* 6*d.* net.

THE volume before us is a translation, by Mr. Alexander Russell, of M. Buchetti's well-known work "Guide pour l'Essai des Moteurs." The object of the volume is to place before British and American engineers a record of Continental practice so as to render a comparison possible with home practice, and in order to further this comparison the measures and tables have been converted to English units.

The subject-matter is divided into nine chapters, and commences with well illustrated descriptions of the many indicators in use for testing steam and other engines. The important subject of mounting the indicator is then thoroughly dealt with, and this is as it should be, since the accuracy of the results depends entirely on the fitting and the scientific arrangement of the gear; M. Buchetti appears to have taken infinite pains to treat these details very thoroughly—there are many evidences of this right through the book.

The same can be said of the treatment of the several types of brakes now in use. When dealing with properties of steam, we note on p. 180 one or two clerical errors under the paragraph on saturated steam. The author talks about "If we compress the piston," &c., and further on in the next paragraph he says, "When the piston is allowed to expand"; surely the word piston should read "saturated steam" or "steam"?

The brief chapter on the testing of steam turbines by the Hon. C. A. Parsons, F.R.S., is all too short; we should have welcomed more interesting details from the pen of this able experimenter and engineer.

Taken as a whole, however, this book is full of interest. Students of steam and engineering should lose no time in obtaining a copy, since its contents are of the highest value to them. N. J. L.

An English Grammar. By the Rev. S. Claude Tickell, A.K.C. Pp. 60. (London: O. Newmann and Co.) Price 2*s.*

THIS pamphlet of sixty pages is very unlike what is ordinarily understood by an English grammar. It opens with a paragraph of three lines headed "Analysis and Parsing Differentiated." Then comes

a fearfully intricate-looking table with the heading "(I.) Analysis by Triple Formula and Genealogy. (A) Analysis into Words." To the meaning of "triple formula" we find no clue but such as may be contained in the statement of the preface that "Analysis resolves itself into Limitation, Limiting Capacity, and Modification to denote Limiting Capacity." The table, which fills three pages, should, the author says, be learnt by heart. Further on there are two other similar tables, headed "(B) Analysis into Sentences and Clauses," and "(II.) Parsing." The "analysis into words" is exemplified by a number of specimens, in which the words forming the sentence are arranged in a diagram resembling a genealogical tree. The "analysis into sentences and clauses" is also performed by means of diagrams, but of a different kind. We must confess that the first impression we received on turning over the pages was one of utter bewilderment. After a while, however, we began to see that the author had a meaning, and for the most part a reasonable meaning, though his mode of presenting his ideas is not felicitous. Mr. Tickell seems to be one of those persons who have a talent and a passion for methodical classification, and an exaggerated estimate of its importance. We have no doubt that he has found the preparation of this little book a valuable help to the attaining of clear ideas on the structure of English sentences, but we should greatly pity any schoolboy who was condemned to learn his grammar from such a manual. On the other hand, we think it is possible that teachers may find in the book a good deal of useful suggestion.

The Chemistry of Plant and Animal Life. By Prof. H. Snyder, Professor of Agricultural Chemistry, University of Minnesota. Pp. xvii+406. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 6*s.* net.

This is a text-book of a type which is not very satisfactory from an educational point of view, as being written to supply the needs of a special class of students. It aims at supplying the chemistry, both pure and applied, which will be required by a class of mature students taking a college course in agricultural science. No preliminary knowledge of chemistry is assumed, and the preface indicates that the work is to be completed in a session of six months with one class-room or laboratory exercise each day. In consequence, the contents range from instructions for bending glass tubes to an account of such debatable matters as the relation of gliadin and glutenin to the quality of wheat flour. It would be hardly fair to call the treatment superficial, but clearly the object of the book is not so much to educate the student as to supply him with a certain amount of information about the scientific side of practical matters, and particularly to put him into a position to follow the current investigations of the experiment stations. Of course, the task is an impossible one; no ordinary student can acquire a real knowledge of pure and agricultural chemistry in six months, but given the special conditions, the book represents Prof. Snyder's abundant experience of trying to make the most use of the limited opportunity. The first 150 pages are devoted to ordinary inorganic chemistry, then about 100 pages deal with the proximate constituents of plants, followed by a section on the general course of development in the plant. Then come discussions of the composition of individual crops, and about eighty pages on digestion and the nutrition of animals. In the earlier part of the book a number of experiments are suggested, with a useful series of questions designed to make the student think out the object of each experiment.

LETTERS TO THE EDITOR.

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

A New Mineral from Ceylon.

In the beginning of February I bought from Mr. Holland 5 cwt. of the mineral described by Prof. Dunstan in last week's Nature (p. 510). It crystallises in cubes, and the density is substantially that found by him. Mr. Tyrer, of the Stirling Chemical Works, Stratford, was so kind as to promise to work it up for me, and the process is still being carried on.

I had hoped to have positive and definite results to communicate before describing its constituents, but the publication by Prof. Dunstan of an analysis, and his statement that he is still engaged in its investigation, makes it necessary to write this letter.

The mineral, when heated alone, gives off 3·5 cubic centimetres of helium per gram; fused with hydrogen potassium sulphate, the amount is increased to 9·5 cubic centimetres. From this source I have already stored about 12 cubic feet of pure helium extracted in Mr. Tyrer's works.

It was at first believed that the mineral was rich in uranium, but different specimens contain only from 8 to 12 per cent. of that element, agreeing in this respect with the analyses published by Prof. Dunstan. Next, the other main constituent was believed to be zirconium, but the high density of the mineral rendered this improbable. An analyst of high standing, whose daily business it is to analyse minerals of this kind, returned 82 per cent. of zirconia as a constituent; the percentage of thorium was trifling—under 1 per cent. The mineral contains practically no thorium; this has been repeatedly confirmed in my laboratory. Nor does it contain any appreciable amount of cerium, lanthanum and didymium. The oxalate is almost completely soluble in excess of ammonium oxalate—a reaction which excludes thorium and the cerium group, but which points to zirconium. The equivalent of the elements of the oxalate group, which I at first took for zirconium, excludes the presence of any large quantity of zirconium, although that element is undoubtedly present. Fractionation shows that the oxalate precipitate (the portion soluble in ammonium oxalate) gives equivalents between 25·0 (the most insoluble portion of the double sulphate) and 44·7 (the most soluble portion); by far the major part of the element has the last mentioned equivalent. The separation of this portion is now being carried out with large quantities of material; several hundredweights are being worked up.

Assuming that the element is a tetrad, which is probable from its behaviour, it undoubtedly possesses an equivalent approaching the highest number (44·7), and for this there is a gap in the periodic table between cerium and thorium; one at least of the elements present (supposing that there is more than one present) will probably have an atomic weight of about 177, preceding tantalum (182·5) in the horizontal row of the periodic table.

I am at present engaged in mapping the spectrum of this new body or bodies.

As for the radio-activity, the mineral was bought in the hope that it would have a high content of radium. There is a trace of radium present, due, no doubt, to the spontaneous change of the uranium which the mineral contains. But the radio-activity due to this source is certainly not 5 per cent. of the total.

The period of decay of the emanation appears to point to the presence of a radio-active element closely resembling thorium X. The half value is 50 or 51 seconds, and while this is not quite the time for the decay of thorium emanation, it very nearly approaches it; at present the balance of evidence appears to point to the presence of an element closely resembling thorium, but not identical with it. The total radio-activity, moreover, is much greater than can be accounted for by the supposition that the one consists of pure thoria. Within the limits of a letter I am obliged to omit many more characteristics of this curious ore which have been ascertained, but I hope soon to be able to publish

more definite results; as it is, I regret to have been obliged to tell an imperfect story.

I should like to conclude by acknowledging the great assistance given me in this work by Mr. Tyrer and by my students, Messrs. Gimingham and Le Rossignol.

University College, April 4. WILLIAM RAMSAY.

The Blondlot or *n*-Rays.

IN this laboratory we have obtained uniformly negative results in experiments on the Blondlot rays. Our experiments were made with the help of seven observers, including five doctors, one student, and one laboratory attendant. Calcium sulphide screens rendered fluorescent in a separate room by burning magnesium were employed. They were brought into an absolutely dark room in which the observers had been kept for some time. Two forms of screens were used:—

(1) Flat screens on which a circular area on a slip of glass is covered by calcium sulphide.

(2) The later form in which a circular area at the back of a hemispherical lens is covered by calcium sulphide. The screens were made by Mr. Leslie Miller.

The screens were either held by the hands of the observers or were clipped on stands.

The observers were told first to look steadily at the screens and report any variation in brightness, calling out "bright," "dimmer," "dim," "brighter," &c., as the appearances seemed to change. Even with the screens on the slips of glass the observers after a few moments were able to call out the changes, *although there was no attempt at muscular contraction*. With the lens form of screen the changes in brightness were very marked.

We next attempted to find whether muscular contraction behind the screen caused an increase of brightness. Of course, where the observer sees a change in brightness without muscular contraction it is easy to be misled on this point. We made the observer continue to call out the degree of brightness, and we contracted the muscles of the arm behind the screens sometimes after he had called out "bright" and sometimes after he had called out "dim." In the great majority of cases the effect we looked for did not follow. In the few cases in which it occurred we naturally attributed the results to the changes in brightness which can be observed without any muscular contraction.

We next told our observers to look, as it were, into the distance beyond the bright spot, and to report on the brightness of the screens. When the accommodation of the eyes for near vision was relaxed they reported without exception that the brightness of the screens was constant, and that muscular contraction made no difference.

When observers were then asked to touch the backs of the screens, thus warming them, they reported an increase of brightness.

It is not easy to explain the phenomena we have described. We believe that there is difficulty in accommodating for the fluorescent circle, and that there is a wavering movement of the ciliary muscles, and probably also a wavering in the size of the pupils. Yet it is asserted that we can focus a point of light in a dark room, and it is difficult to see why the fluorescent screen cannot also be kept steadily in focus when it consists of a flat glass slip with fluorescent circle. In the case of the later, and presumably more successful form of apparatus, the difficulty is easily understood. In that form the fluorescent rays proceed from the back of a hemispherical lens, that is, from a point within the posterior principal focus, and they are widely divergent and thus strain the accommodation of all but near-sighted people. The fact that in every instance we found that the light becomes steady after relaxation of the accommodation is very striking.

But the phenomena observed by us do not go any distance towards explaining the results described in M. Blondlot's papers. How is it that he and many of his compatriots see increase of brightness under conditions in which we see none? Is the explanation to be found in the paper by Heinrich, "Die Aufmerksamkeit und die Funktion der Sinnesorgane" (*Zeitschr. für Psychologie u. Physiol. d. Sinnesorg.*, vols. ix and xi.), in conjunction with our observations? Heinrich found after many careful experiments that the pupil dilates when attention is directed to an object situated in the field of indirect vision, and that it dilates still more during a short mental effort, such as a calculation. He found also that on directing attention to an object in the field of indirect vision the ciliary muscle relaxes, thus diminishing the curvature of the crystalline lens, and that during mental calculation this change is very marked, causing a curvature even less than that required for vision of a remote object. He found also that under the same conditions the axes of vision tend to become parallel or even divergent.

Can it be that the mental condition of some observers in a state of expectancy reacts on the intrinsic muscles of their eyes, and thus they see what they think they should see?

We have also experimented with the rays from a Nernst lamp, but without result. JOHN G. MCKENDRICK.
WALTER COLQUHOUN.

Physiological Laboratory, The University, Glasgow, March 29.

Learned Societies.

IN NATURE of March 10, Mr. Basset directs attention to the fact that referees frequently know less about the subject-matter of the papers than the author, and that their reports frequently contain errors from their not understanding the papers.

Had Mr. Basset held a brief for the opposite camp to that which he claims to represent, he could hardly have adduced more powerful arguments in favour of the referee system.

If a paper is of any value, the author must *ipso facto* know more about the subject-matter than anyone else. If he does not he is not the proper man to write the paper. But it is just because authors so frequently send up papers in a form in which other people cannot understand them that referees are necessary.

At present few people have time to wade through pages and pages of discursive and ill explained writings on the off chance that they may ultimately light on an interesting result. On the other hand, it is desirable that workers in one branch of science should have some insight into the general character of the investigations which are being pursued by specialists in other directions. Now I have before me a number of mathematical papers which contain no indication whatever of what the authors are driving at. They begin by putting down certain formulæ which the reader is assumed to know, and when they have twisted these formulæ about a bit they stop short abruptly without any obvious rhyme or reason. There are, of course, specialists who understand and appreciate these papers, but to the man who has specialised in applied mathematics or in a different branch of pure mathematics, the whole thing as presented appears meaningless. On the other hand, I have read with interest many well expounded papers dealing with such subjects as physiology, palæobotany, or psychology of the general character of which it is easy for anyone to form an estimate, even without previous university training. The functions of a referee should be to see that the arguments in a paper are clearly put forward, and that the main conclusions are prominently stated at the beginning or end in such a way that a general survey of the ground covered can be formed by the reader before the methods are examined in detail.

I believe that a useful purpose would be served if one of the referees of a paper were in each case selected on account of his *ignorance* of the subject-matter with which the paper dealt. Transactions would then be more readable and more widely read than they are at present.

It frequently happens, moreover, that results are buried in out-of-the-way corners of lengthy papers where they get overlooked, and that when someone has published similar results in a more accessible journal an undignified priority controversy is the result, whereas the original discoverer has only himself to blame for failing to present his subject in a readable form.

Learned societies are frequently penny wise and pound foolish in issuing their transactions *uncut*, consequently those who wish to study the contents have to waste much of their time in jagging and often tearing the pages with a

paper knife. This inevitably means *so many more papers left unread.*

While on the subject of referees, I should like to protest against the impatience of many secretaries, who seem to expect the poor referee to neglect his university duties at a minute's notice and to give up his whole time to preparing a report for return post.

If Mr. Basset were to start a "British Journal of Mathematics and Physics" without adopting the referee system or some equivalent, what would he do when X. Y. Z. sent him a paper disproving the existence of gravitation, when L. M. N. wrote proving that the ether consisted of jerk-backs of energy, or when P. Q. R. called men of science fools for not agreeing with his view that the sun's photosphere was composed of diatoms of electricity?

All the same, a journal of the kind suggested, if published of a convenient size, and with the pages cut, would fill a distinct want which certainly exists. G. H. BRYAN.

Euclid's Definition of a Straight Line.

I HAVE long thought that by the words ἐξ ἴσου, commonly translated *evenly*, Euclid means *symmetrically*. The symmetry can be tested by turning the line over; for instance, the edge of a flat ruler is straight if, when turned over, it coincides with its original position.

If a long rigid body is rotated, while two points, one in each end, retain their places, every line of particles joining the two fixed points describes a surface of revolution, which is symmetrical (in the sense intended) with respect to the two fixed points. The innermost of all such surfaces is of vanishing breadth, and is Euclid's straight line.

J. D. EVERETT.

11 Leopold Road, Ealing, March 29.

Spawning of the Plaice.

WITH reference to the letters of Prof. Herdman and Mr. W. Wallace as to the commencement of the spawning of the plaice this season, it may be stated that in the Moray Firth plaice were found spawning in the last week of December, and that spawning is not yet completed. The time mentioned is rather earlier than usual for this district, and it is not unlikely that spawning has been accelerated by the mild winter. T. WEMYSS FULTON.

Aberdeen, March 29.

Fossil "Rain-drops."

THE preservation of impressions of rain-drops in slabs of Triassic marl has always presented some difficulty, since mud that was soft enough to receive such impressions would seem too soft to retain them.

I have to-day, at the borders of a flood plain, in a back-water of the Dorn Valley, near the Cherwell, seen exactly similar impressions in some stiff marly clay from which the flood water has lately subsided, where the surface of the tongues of clay is covered with the foot-prints of herons, rooks and smaller birds, with sun-cracks gradually widening until the clay curls into separate flakes, and the characteristic "rain-drop" pittings dispersed over the surface upon which no rain has fallen since the water subsided. This led me to seek another cause for these peculiar marks, and I soon found their origin. The film of mud over sand was in some cases still covered with about an inch of quiet water, and the decaying vegetation in the mud had given rise to innumerable bubbles that rested unbroken upon the mud bottom, like the bubbles adhering to the sides of a tumbler of soda-water. As the water very slowly leaves these bubbles some of them break, and some become coated (by surface tension, I suppose) with a thin film of mud which strengthens the dome, so that they can become larger, as they also become flatter, and sink slightly into the tenacious mud, which then contracts slightly away, so that the diameter of the circle is enlarged. When at length they disappear, they leave circular pits behind them in the half dried mud with a slightly raised ring edge, and finally, when the mud has completely dried, these shallow rounded pittings present exactly the appearance of Triassic "rain-drops" amongst the sun-cracks and foot-marks already alluded to.

I have not seen any such explanation of these "rain-drops," but it seems to remove a difficulty.

Oxford, March 19. E. C. SPICER.

THE USE OF LIGHT AND OTHER RADIATIONS IN THE TREATMENT OF DISEASE.

ONE of the most interesting fields of medical research at present is the investigation of the therapeutic properties of various rays, and although much has been accomplished in a few years, there is promise of a still greater future for this development of the healing art. Any advance in medical science is of the greatest moment to the general public, and cannot be too widely known, and in this respect this branch of therapeutics has had a measure of publicity which is probably unique, but which is not altogether free from harm. The discussion of purely medical details, and the description of "cures" of apparently hopeless cases in the columns of the lay Press, have unfortunately led to misconception and to terrible disappointment to many sufferers.

The fact that certain rays of light possess special physiological properties has been long known, and valuable papers on the subject were presented to the Royal Society as far back as 1872 by Downes and Blunt. But the credit of rendering the knowledge obtained by these and other observers of practical value in the treatment of disease belongs to Finsen, of Copenhagen. His first work was to show that the chemical rays of light, the violet and ultra-violet rays of the solar spectrum, have a deleterious influence upon the eruption of small-pox, and this led him to introduce the red light treatment for this disease. The patient is confined to an apartment from which the chemical rays are excluded by means of red curtains. For the treatment to be successful the curtains must be thick enough to exclude the chemical rays as completely as they are excluded by the photographer from his plates and films. In a patient under these conditions the ordinary course of the small-pox eruption is modified, the fever of the second stage is lessened, and the scarring is infinitesimal. It is not claimed that the mortality from this terrible disease is materially diminished by the light treatment, for in a certain proportion of cases there is no hope from the first, but in a large majority suffering is diminished, convalescence is easier, and disfigurement is slight.

Finsen's next work was the development of the light treatment for lupus. Lupus vulgaris is a very chronic destructive disease of the skin and mucous membranes caused by the bacillus of tubercle, the microbe which attacks and destroys the lungs in consumption. The chemical or actinic rays are here the therapeutic agents used. These rays have a definite germicidal power, and they are also capable of setting up a peculiar form of inflammation. They are the cause of sun-burns and of pigmentation of the skin from exposure to the sun's rays. In the treatment of lupus the rays of the sun, or, more conveniently in northern climates, those of a powerful electric arc light, are concentrated by means of lenses upon the diseased area. For the lenses rock-crystal must be used, because ordinary glass obstructs the passage of a considerable proportion of the rays in the ultra-violet part of the spectrum. When the sun's rays are used a light filter is employed to cut out as far as possible the heat rays at the red and yellow end of the spectrum. The light filter is a hollow lens filled with a solution of methylene blue or an ammoniated solution of the sulphate of copper. If the electric light is used the light filter is now dispensed with, as the proportion of heat rays is much less than in the rays of the sun. Even with the light filter a certain proportion of heat rays pass, and in using either the sun or the arc light it is found necessary to cool the surface under treatment. This is effected by placing in contact with the area treated an apparatus through which a current of cold water is constantly passing,

and when the electric light is used by also passing the rays through a cylinder containing distilled water, which is kept cool by a water jacket, similar to that used in the Maxim gun. Another point of importance is that the area under treatment should be rendered bloodless, for the red colouring matter of the blood prevents the passage of the chemical rays to the deeper parts of the skin. This was shown by a simple little experiment of Finsen. If a piece of sensitised paper be placed behind the lobule of the ear and a powerful light be concentrated upon it, so that the rays have to pass through the ear, the paper will not be blackened at the end of some minutes; but if the ear be compressed by two glass slides, so as to render it bloodless, and the light be concentrated as before, the sensitised paper is blackened at the end of twenty seconds. In practice the apparatus which is used to cool the surface is used to compress the area under treatment, and it is held in position by an attendant. Various means have been tried to do away with this constant personal attention, but no mechanical means yet devised can replace it, for the parts treated must be kept in accurate focus.

The light is applied for an hour at a time, and six to twelve hours after treatment the part becomes red and inflamed, and a blister commonly forms. The inflamed, blistered area heals under simple dressings. It will be noticed that the effect of light is very different from that of heat. The application of intense heat to the skin causes an immediate inflammation, a burn, while the inflammatory reaction to light does not appear for some hours. As a result of the inflammation set up, and also of the specific germicidal action of the actinic rays, the bacilli in the tissue are killed, and after successive treatments the diseased area is replaced by a pale, soft, supple scar. The cosmetic results of this treatment are unequalled. The process is essentially a conservative one. All other methods of treatment, such as removal by the knife, scraping or cauterising, are destructive and tend to produce grave disfigurement, an important point, as the disease commonly attacks the face. The disadvantages are, however, serious. In the first place, the length of time required for the satisfactory treatment of even small areas is considerable. Secondly, the apparatus is expensive, and each patient requires constant skilled attention, and this is an important item in the cost. Lastly, it is often impossible to reach the disease when it involves the interior of cavities such as the nose and mouth. In some cases also of long standing, the area involved is so extensive that the method is too slow to keep pace with the spread of the disease. With early cases a cure can be completed in a few weeks, but in some instances a cure cannot be effected in less than a year or two. A large number of cases are now on record in which patients have been free from the disease for five years and upwards, and many unfortunates who were debarred from obtaining work by their disfigurement are now in regular employment.

Certain other affections of the skin of parasitic origin can also be treated successfully by Finsen's method, notably a form of baldness; and some superficial nævi have been removed.

The use of light baths has many advocates. As commonly applied, the whole body or an affected limb is subjected to the radiations from a number of incandescent electric lamps in a closed chamber. This produces local or general perspiration, and the effect is that of a Turkish or Russian vapour bath. By another method the patient is exposed to the light from powerful arc lamps, and these appear to influence nutrition by their powerful stimulation of the skin.

To Prof. Röntgen's brilliant discovery medical science owes an incalculable debt of gratitude, for not only are the Röntgen rays of the greatest value in the diagnosis of injuries and diseases of the bones, in the localisation of foreign bodies, such as needles, bullets, &c., in the tissues, and in the demonstration of calculi, and even of diseases of the lungs and great blood vessels, but they have been found to possess therapeutic properties of immense value. In the early days of X-ray work operators and patients occasionally suffered from a peculiar form of inflammation, a so-called burn, occurring days and sometimes weeks after exposure to their action. This power has been turned to practical account in treatment. Schiff and Freund, of Vienna, showed that certain cases of lupus could be cured, at any rate temporarily, by their means, and other superficial diseases of the skin have also been found to be benefited. The results are not so certain or so permanent as those achieved by Finsen's method, but in some cases, as already indicated, the latter are inapplicable.

Not long after Schiff and Freund's discovery the rays were applied to cases of rodent ulcer, a locally malignant disease, starting in the skin and often destroying deeper structures, and even bone. Rodent ulcer usually attacks the face, and its treatment by older methods was so frequently unsatisfactory that it had received the name of *noli me tangere*. It was demonstrated that the peculiar cells of the rodent growth are destroyed by the Röntgen rays, and that they are replaced by healthy scar tissue. Recurrences do happen after apparent cure by the rays, but such recurrences are as a rule easily removed by a further application. The rays are applied to the diseased tissue for ten to twenty minutes at a time. There is little or no discomfort to the patient, and in most cases improvement is at once manifest.

The success which attended the X-ray treatment of rodent ulcer led to the hope that in it would be found the cure for cancer. But there are essential differences between rodent ulcer and cancer. Rodent ulcer is peculiarly a local disease, while the characteristic of cancer is the spread of the disease to and the involvement first of the glands and then of internal organs. The Röntgen rays have an undoubted influence upon many cancerous growths. Superficial tumours have disappeared when exposed to their action, ulceration heals, and pain is relieved, but not by any means in all cases; in some, even when the growth appears to be localised, the glands and internal organs are already involved, and there is no hope of a cure by such a purely local measure. One thing is certain, and that is that where it is possible to remove a cancer by operation that procedure should be adopted in preference to ray treatment; but where operation is out of the question suffering may be relieved by the application of the rays, and possibly the cancerous development may be checked, but cure is not to be expected. Some surgeons are now applying the rays after operation, so that any outlying cancer cells which have not been removed may be destroyed. It is as yet too early to say how far such measures are likely to prove successful.

Another therapeutic application of the X-rays demands a few words. The rays have the power of removing hair, and for this purpose are used in certain diseases where the hairs are attacked by parasites. One such disease is ringworm. The difficulty in treating this and similar diseases lies in the difficulty in thorough epilation. The rays do not kill the parasites, but they remove the infected hairs, and in that way hasten a cure. If applied for a short period only, the roots of the hairs are not destroyed, and after a time the area treated is covered with new healthy hair. The removal of superfluous hair which is so often a disfigurement by the X-rays is not to be recommended,

for the effect is not permanent unless the application is made for so long a time and so often as to run a risk of exciting a severe inflammation, with the possibility of causing greater disfigurement than the original hirsuties. Moreover, there are other more satisfactory means which are quite safe.

Radium is the latest addition to the therapeutic armamentarium. The romance of its discovery, the mystery of its radiations and emanation, its relation to some important scientific theories, and, above all, the possibility of its being the long desired cure of cancer, have fixed upon M. and Madame Curie's discovery the attention of the world. The element in the form of a bromide, and other compounds more or less pure, is now under trial in various diseases. Rodent ulcers and some superficial cancers react to it with very similar results to those obtained by the X-rays. There is no doubt that it is an agent of great value, but further observations are necessary to estimate its position. It can certainly be applied to disease in regions which it is now impossible to reach by the X-rays, but that its field in the treatment of cancer is limited is obvious. Its effect is local, so far as present observation has shown, and the remarks made above upon the influence of the X-rays in cancer apply equally here. Radium has to be used with great care, for it is powerful for evil as well as for good. If too long applied it causes destruction of tissue, and such destruction may take months to heal.

It will be gathered that rapid strides have been made in this field, and it would appear that we are but on the threshold of further developments. The latest discovery, the mysterious *n*-rays which are said to be produced by nervous and muscular action, does not appear to possess therapeutic importance, and whether it is likely to be of value in diagnosis is at present purely problematical.

IMPERIAL METEOROLOGY.

SLOWLY, but still step by step, the science of meteorology progresses, and new visions are opened up which suggest bright prospects for future possibilities, but which also lay exposed the lost opportunities of the past. Like every other science, the modern methods of observation, for at any rate the chief meteorological elements, are nearly all that can be desired, but when it is required to revert to observations made more than thirty or forty years ago, how lamentably few are the records and how uncertain in many cases is their accuracy. Further, anyone who has had occasion to hunt up early series of observations of pressure, temperature, rainfall, &c., records will have been struck with the common occurrence of breaks extending here and there for one, two, three or more years. Nevertheless, it is little use crying over the past, but strenuous efforts should be made in the future to see that the needed observations should be secured.

The more the variations of weather are studied the more is the idea strongly impressed on the investigator that these variations from year to year are not mere matters of chance, but are produced by a cause originating outside the earth's atmosphere, and with little doubt from the sun, naturally the prime factor and father of all the important weather changes.

His daily apparent journey round the earth, caused by the latter's rotation, is the origin of all the diurnal changes familiar to meteorologists.

The earth's journey round the centre of our solar system is again the origin of all the other meteorological variations which pass through their phases in a year.

From year to year, however, these daily and yearly variations, although they preserve more or less their original variations as regards their lengths of period, change in amount sometimes to a very great degree, and cause one to speculate on the probable kind of weather for the following year.

The view that these changes from year to year are due to the direct or indirect action of the sun has a very great degree of probability in its favour, since we know that this highly heated body is in an active state as deduced by the numerous and varied solar phenomena that have been observed. Further, the periodicities deduced from long series of solar observations have added another link in the chain of evidence showing that the sun's heat must be constantly varying, a fact which it is necessary to prove before solar influence can be put forth as a possible source of the terrestrial changes.

It is the work of the now numerous magnificent meteorological institutions spread over the globe for each to gather into its own particular net the meteorological changes that are occurring in its own area, and by means of these facts to forecast what kind of weather may be expected either on the following day, week or month, or as far ahead as possible. Many of these institutions for several years found that their own areas were too limited in extent to give them the necessary data for the work in hand, and so entered into a mutual compact with neighbouring countries for the exchange of certain pieces of meteorological information.

The present stage of meteorological investigation has in the last few years indicated that even this mutual help of the neighbouring countries, each working for its own immediate ends, is not sufficient for a satisfactory solution of world meteorology.

Sir John Eliot, who recently retired from the Indian Meteorological Department, one of the, if not the, finest meteorological service that exists, gives his views on this subject, which should be read by all those interested in the welfare of meteorological science (*Broad Views*, March).

Dealing with the Indian area during the period 1892 to 1902, he points out how these eleven years were unique in the history of Indian meteorology, but this condition was unfortunately disastrous to India. Not only did that extensive country suffer more severely from droughts and famines than during any other similar period for a hundred years at least, but it was paralleled, "so far as we are aware, only by the seven years of famine in Egypt in Biblical history." More interesting still is it to find that the drought of 1895 to 1902 "was a more or less general meteorological feature of the whole area, including Abyssinia, East and South Africa, Persia, Baluchistan, Afghanistan, India, probably Tibet, and the greater part or whole of Australia." Such a statement will probably recall the attention of our readers to an article published in this Journal (vol. lxvii. p. 225), in which it was stated:—"Commencing with Indian pressures (as represented by Bombay), the area was gradually extended to Ceylon (Colombo), Java (Batavia), Mauritius, and finally to Australia (Perth, Adelaide and Sydney). The striking similarity between these curves shows that over the whole of this area, which includes both north and south latitudes, the same kind of variation is in action, and therefore the whole region is intimately connected meteorologically." Sir John Eliot's remarks thus indicate the truth of this result.

In the article from which the above quotation was taken it was shown that while one hemisphere of the earth, which included Europe, southern Asia, Africa, India, and Australia, was experiencing high atmospheric pressure on the average, the other hemisphere, which included North and South America and Siberia,

was experiencing a deficiency of pressure, and *vice versâ*.

This apparent see-saw of pressure between the two hemispheres, which has a period of about four years or a little less on the average, indicates the importance of being acquainted simultaneously with the pressure conditions on *both* sides of the earth.

There seems every reason, then, for the purpose of long-period forecasting, for meteorological institutions to extend their spheres of inquiry still further afield.

Such being the case, it is important, therefore, that in this connection the views of Sir John Eliot, included in the following quotation from *Broad Views*, should be widely known, for who is there better capable of judging what is required than one who has so ably and successfully directed the Indian Meteorological Department for so many years?

"The next development of weather study will almost certainly be in the direction of international or world meteorology, and its relation to the phenomena of sun-spots and terrestrial magnetism.

"Sir Norman Lockyer has, we believe, made a most valuable and fertile suggestion which might lead up to this development. It is that the English Meteorological Office should collect meteorological data from the whole Empire, and should have a special branch to deal with and discuss the larger problems which would arise from such an extension of its field of work.

"It may perhaps be objected that Great Britain is outside the tropics, and that its weather has no connection with that of either India or Australia. This, however, is a matter which has not been taken up by any meteorologist for investigation and definite conclusions. The facts of the past ten or twelve years are, to say the least, suggestive. Whilst the Colonies and Empire in the East were suffering from drought parts of England were experiencing year after year shortage of rain. When the drought in Australia and in East India was giving way in 1903, England had a plethora of rain, almost tropical in character, disastrous to the crops.

"World Empire entails world duties, and one of these appears at the present time to be the study of meteorology from the imperial, and not solely from the national or parochial standpoint."

LABORATORIES FOR BOTANICAL RESEARCH.

THE publicity given to the opening ceremonials of the new science laboratories at Cambridge by the King and Queen on March 1 will, it may be hoped, do something to rouse those who are responsible for the welfare of the nation to a wider sense of their duties. The time has surely passed when the remarks of a well-known prelate and of a Prime Minister to the effect that they were born in a pre-scientific era could be received, if not with overt applause, at least with sneaking sympathy.

Sluggish as we are, some progress has been made. Up to the middle of the last century, and for some time after, there was scarcely a botanical laboratory properly so-called in the whole country. Now we have the Jodrell laboratory at Kew, a very modest institution when compared to the necessities of the case or to the excellent equipment of other departments of this great national establishment. The Jodrell laboratory is not intended for instructional purposes, but chiefly for study and research, and much good work has been done there.

At Cambridge, Edinburgh, Glasgow, Dublin, at University College, London, the Royal College of Science, and in many other universities, agricultural colleges and technical institutes, there are now more or less well equipped laboratories under competent direction. But these are mainly for the instruction of students. Research laboratories are still rare, and those willing and competent to utilise them are also few in number. This condition of affairs is largely due to the indifference and lack of encouragement on the part of those who ought to know better. The *cui bono* question is ever in their minds, and much too frequently on their lips. Abstract science does not appeal to their sympathies, or to their intelligence, unless some immediate practical result at once comes into view. When that happens, the commercial instinct may perchance be aroused, and they begin to ask, will it pay? Of course, no reader of this Journal is likely to undervalue abstract science, and most of them are well aware of the enormous value of the practical results that may and do result from it. But even such persons must have been startled to find how the observations of Bower and others on the minute anatomy of the prothallus and spore-producing tissues of ferns, observations which might have been thought to be too abstruse and recondite to be of any practical value whatever, have directly led up to the extremely important researches of Farmer and his associates into the essential nature of cancer!

Satisfactory as this undoubtedly is, we have only to look across the Channel to see how puny—numerically and financially speaking—are our efforts to promote original research. Our cousins across the Atlantic, a practical people if ever there was one, are even more energetic. Does a "freeze" destroy or seriously injure the oranges of Florida, what matter? In a very short time a man of science and a man of resource is on the spot. He looks for and finds a hardy stock whereon to graft the tender scion, he puts the resources of hybridisation to the test in the endeavour to procure hardy seedlings. All this is done at once by State or Government agency. Here, if anything were tried in a parallel case, it would be with great deliberation and with little or no encouragement or support.

Those familiar with what is done to promote research in the universities and colleges of the United States, as at New York, Chicago, Philadelphia, and in California, not to mention the older foundations of Harvard and Yale, must feel almost aghast at the progress that is being made, and at our own backwardness. In the *Gardeners' Chronicle* for January 30 is an article contributed by a well-known professor familiar with what is being done here as well as there. In that article he gives details as to the astonishing activity manifested in the American universities, mainly by the aid of funds provided by private individuals. We too have reason to know and appreciate what is done by the Government Agricultural Department, and by the very numerous experimental stations scattered all over the wide territories of the United States.

As we write, there comes to us a report of the establishment, under the auspices of the Carnegie Institution, of a "Desert Botanical Laboratory, the purpose of such establishment being to study thoroughly the relation of plants to an arid climate and to substrata of unusual composition." A laboratory has accordingly been erected near Tucson, in Arizona, under the management of Dr. W. A. Cannon, of the New York Botanical Garden, who has been appointed resident investigator in charge of the laboratory. What may be described as a sort of preliminary report has been drawn up by Mr. Coville and Dr.

MacDougal, and a very interesting and copiously illustrated report it is.

As some of our readers may care to see this publication, we may add that it is issued by the Carnegie Institution of Washington, U.S.A. (publication No. 6).

Vast as is their territory, and numerous as are their experimental stations and like institutions, our cousins are not yet satisfied. They have invaded British territory, in a most genial and friendly manner it is true, but still they have annexed, with our consent, a portion of the island of Jamaica, and there they have established, at "Cinchona," a botanical laboratory and research station open to the students of all countries. The direction is in the hands of Dr. Britton, of the New York Botanical Garden, in cooperation with Mr. Fawcett, the Director of Public Gardens and Plantations in the island. The policy of the "open door" pursued by the Americans in these matters prevents us from doing anything but acquiesce in their proceedings. But why what should have been a plain duty for us should have been allowed to be undertaken by others is a mystery.

We do not question the utility of ironclads and cruisers as protectors of our commerce, but it is obvious to those who are watching the proceedings of our neighbours and of our rivals that if we do not largely extend our scientific training and induce our wealthy citizens to follow the example of their American brethren in endowing science, the necessity for protection will vanish, and that not slowly.

NOTES.

RECOGNISING the great and immediate importance of investigation of the nature and properties of radium and radio-active bodies, the court of the Goldsmiths' Company recently signified its willingness to hand over a sum of 1000*l.* to the Royal Society to constitute a radium research fund. The council of the Royal Society at once accepted the duty of administering this grant, and ordered the cordial thanks of the society to be transmitted to the Goldsmiths' Company for its generous and timely subvention to scientific research. Proposals relating to the method of utilising the fund for the assistance of scientific investigation have at the same time been communicated to the company for its approval.

THE fiftieth anniversary of Sir H. E. Roscoe's graduation at Heidelberg is to be celebrated on April 22 by a reception at the Whitworth Hall, Manchester, at which a congratulatory address will be presented from his old pupils, as well as addresses from a number of universities, colleges and learned societies. In connection with this occasion efforts have been made to communicate with as many as possible of the chemical students of the Owens College from 1856–1886. If any of these have been inadvertently overlooked they are requested to send their addresses as soon as possible to Dr. G. H. Bailey, the Owens College, Manchester.

THE second annual meeting of the South African Association for the Advancement of Science was opened at Johannesburg on Monday, when Sir Charles Metcalfe delivered the inaugural address. Lord Milner occupied the chair.

WE learn from the *Times* that the Canadian Government has purchased the steamer *Gauss*, which was built three years ago for the German Antarctic Expedition, and the vessel is now in Bremen Harbour. The *Gauss* is to be commanded by Captain Bernier and a picked Canadian crew, and is to be employed at once in conveying relief stores and coal to the Government steamer *Neptune*, at present wintering in Hudson Bay. Subsequently she will be engaged in survey work on the coast of Labrador. Captain Bernier hopes to be able to utilise the *Gauss* in 1905 in an attempt to reach the North Pole from Canada.

THE annual meeting of the Iron and Steel Institute of Great Britain will be held on Thursday and Friday, May 5 and 6. Upon that occasion the Bessemer gold medal for 1904 will be presented to Mr. R. A. Hadfield, vice-president, and the awards of the Andrew Carnegie gold medal and research scholarships for 1904 will be announced.

ON Tuesday next, April 12, Prof. L. C. Miall will deliver the first of three lectures at the Royal Institution on the transformations of animals, and on Thursday, April 14, Prof. Dewar will commence a course of three lectures on dissociation. The Friday evening discourse on April 15 will be delivered by Count Vay de Vaya on Korea and the Koreans, and on April 22 by Colonel David Bruce on sleeping sickness in Uganda.

THE foundation stone of a library which will be erected in connection with the British School at Athens as a memorial to the late Mr. F. C. Penrose, F.R.S., says the Athens correspondent of the *Daily Chronicle*, was laid last week by Lady Evans, in the presence of a distinguished gathering of diplomats and savants. The Greek Archæological Society has offered to present the Penrose Library with a bust of Mr. Penrose, in recognition of his great services to architecture and archæology.

THE death is announced of Prof. Arthur Greeley, professor of biology at Washington University, St. Louis.

M. JEAN DEBROUSSE has bequeathed an annual revenue of thirty thousand francs to the Institute of France "in the interests of letters, sciences and arts." At a recent special meeting the institute decided, says *La Nature*, to devote five thousand francs to the publication of lunar tables.

THE *British Medical Journal* states that Sir Michael Foster, F.R.S., has given notice that on April 12, the day on which Parliament reassembles after the Easter recess, he will ask the First Lord of the Treasury whether opportunity will be given to discuss in the House of Commons, before action is taken, the portion of the report of the War Office (Reconstitution) Committee which bears on the health of the army.

REUTER reports that repeated slight shocks of earthquakes were felt at Belgrade during the morning of April 4. A message from Philippopolis states that three earthquake shocks, the severest experienced during the last fifty years, were felt there between midday and 1 p.m. on April 4. The disturbance, which was from west to east, was accompanied by a loud rumbling noise; little damage was done to buildings in the city. Earthquake shocks are also reported to have occurred at several places in Greece on April 5.

MR. JOHN PATERSON writes to the *Times* that on a voyage from New York to Plymouth on August 29, 1903, in latitude N. 49° 43′, longitude W. 25° 35′, he threw into the Atlantic a mineral water bottle in which a note was enclosed. In a letter dated March 23 Mr. Paterson was informed that the bottle was found on the shore of the bay of Trevignon, near Concarneau, in Brittany, at high-water mark of the ordinary tides. Concarneau is in latitude 47° 50′ N. and longitude 4° W., so that the bottle travelled in an easterly direction 21° 35′ of longitude and went south 1° 53′ of latitude from the place where thrown into the sea.

THE New York correspondent of the *Daily Chronicle* states that Mr. Andrew Carnegie's gift of 300,000*l.* to provide a building for the various engineering societies in the city really involves an outlay of 500,000*l.*, for in addition to the amount given by Mr. Carnegie there is an investment of about 200,000*l.* for two lots which will be occupied by the proposed Union Home. The offer was made originally to the five great engineering societies of the United States:—American Society of Civil Engineers, Institute of Mining Engineers, Institute of Mechanical Engineers, Institute of Electrical Engineers, and the Engineers' Club. The first named society has, however, not accepted the offer.

IN a report on the German estimates for this year, Mr. Robertson, one of the secretaries to the British Embassy in Berlin, states that, in the new estimates, a sum of 800*l.* is inserted under the head "Furtherance of scientific, especially ethnological, studies in China." In explanation it is mentioned that, as the opening of China advances, a more exact study of the individuality of east Asiatic nations is becoming a necessity. It is therefore advisable to station permanently in China a German scholar well acquainted with ethnology and the Chinese language, whose object is to develop intellectual relations with a little known form of civilisation.

AN article upon the route of the Tibet Mission, by the special correspondent of the *Times*, contains an interesting record of temperatures and conditions of life at high altitudes. The mission has necessitated the continued exposure of a very large number of untried men to life at altitudes ranging between 10,000 feet and 15,700 feet, and the general results are of considerable value. The lowest temperature yet reached on the route has been −26° F. at Chuggia, on the Tang-la, which was, however, only an encampment. Of actual nightly exposure to cold of men and animals Tuna probably holds the record with −17° F. But Phari has repeatedly reached −15° F., and Kamparab, nine miles distance from Phari, might—if continual registration had been possible there—show a lower figure than either. The normal night *minimum* during January and February is probably −10° F. for 15,000 feet, warming to 7° F. for 10,000 feet. Mountain sickness has been closely observed by the medical men accompanying the mission. Indigestion has been common on account of the eating of imperfectly cooked food. At 15,000 feet water boils at a temperature about 30° F. lower than at sea-level, and the normal amount of cooking is therefore quite inadequate. At 15,000 feet it is almost impossible to boil rice properly. Dal—the common red lentil of India—affords a curious example of the difficulty of cooking at high elevations. Of the five different kinds of dal supplied to the troops—Mussoor, Urad, Arhar, Moong, and Chenna—only the first is capable of being cooked at all at heights above 10,000 feet. It is difficult to make the native understand these aberrations of gastrology, and a great deal of insufficient cooking has been the natural result.

THE subdirector of the Norwegian Meteorological Institute, Mr. A. S. Steen, has contributed to the *Proceedings* of the Christiania Society of Sciences an interesting paper on the diurnal variation of terrestrial magnetism, and on the possible connection of this phenomenon with meteorology. The author points out that, so far as the accuracy of weather forecasts is concerned, we stand now nearly in the same position as we stood some twenty-five years ago; the distribution of atmospheric pressure and temperature is often quite different from what might have been expected from the telegraphic reports of the previous day, and leaves the impression that there are unknown factors in cooperation. He considers that too little attention has been paid to the electrical conditions of the atmosphere, and that such investigations as have been carried on in this sense are vitiated by the observations being generally made in the lowest strata of the atmosphere. Prof. Schuster's investigations point to the probable connection of electrical currents in the atmosphere and the diurnal variation of the terrestrial magnetic elements, and Dr. von Bezold goes so far as to imagine a connection between the latter and certain meteorological phenomena. In the paper in question Mr. Steen has searched the hourly magnetic observations of eighteen stations during the polar year (1883), and has found a continuous calm period of forty-eight hours between March 18 and 20, and this period he has submitted to special examination. The author considers that, when viewed in conjunction with the researches of Schuster and von Bezold, the results arrived at are so promising as to call for wider investigations with more ample materials than were at his disposal.

IN the *Physikalische Zeitschrift*, Dr. A. Korn describes a new receiver for telautography and the telegraphic transmission of half-tone process blocks. In the transmitting apparatus the writing or the points and lines of the half-tone block are formed by a non-conducting ink on a sheet of metal foil. This is wrapped round the surface of a cylinder which is rotated with uniform angular velocity. The electric current is transmitted by means of a metal pen which moves forward 0·01 inch in each revolution. In the receiving apparatus the cylinder is rotated with an angular velocity greater by 1 per cent. than in the transmitting apparatus, and at the end of each revolution it is made to await a synchronising signal by which it is restarted. The impression at the receiving station is produced on sensitised paper by a small electric lamp or vacuum tube, which by means of a suitable relay for Tesla currents is made to glow whenever the pen at the transmitting station passes over a non-conducting portion of the picture. The paper is illustrated by specimens of handwriting transmitted by this method.

IN the *Popular Science Review* for March, Mr. O. Chanute gives a survey of progress in aërial navigation in a paper read by him before the American Association in December last.

M. JULES BAILLAUD, in a recent number of the *Journal de Physique*, sums up the opinion of the Graz conference on the firing of cannon for the prevention of hail by the following statistics:—out of fifty experts eight considered the method efficacious, nine found the efficacy doubtful but probable, thirteen found it simply doubtful, fifteen found it doubtful and improbable, and five found it *nil*.

AN experiment showing the production of high frequency currents by means of the telephone has been exhibited by M. Ducretet before the French Physical Society. The apparatus employed was the loud speaking telephone of MM. R. Gaillard and E. Ducretet. The microphone and the receiver were placed in circuit with a battery of about 10 volts, so as to give a current of about half an ampere. By suitably regulating the distance between the receiver and microphone free oscillations were set up which could be maintained indefinitely, and these were increased in intensity by connecting the microphone and receiver with a metal tube.

THE second part of vol. lxxvi. of the *Zeitschrift für wissenschaftliche Zoologie* contains two articles of a highly technical nature, the one, by Mr. F. Schwangart, on the

question of the origin and structure of the epithelial lining of the alimentary tube in the Lepidoptera, and the other (which is to be continued), by Mr. E. Bresslau, on the developmental history of the turbellarian worms.

IT is satisfactory to learn from the scientific investigation report of the Northumberland Sea-Fisheries Committee for 1903 that, in spite of some local diminution, the improvement in the results from trawling, to which attention had been previously directed, is maintained, if the results of the whole period are taken into consideration. It is added that while the season has not been so good for the salmon and herring fishing, "white fish" have yielded better than in the previous year. Small fish have been measured, marked and returned to the sea. A few of these have been recaptured near the same places, and one in another bay. Other experiments tend to show that the migration of crabs is not so simple as has been hitherto supposed.

THE *Boletim* of the Goeldi Museum at Para contains an annotated catalogue, by Messrs. Goeldi and Haymann, of the species of local mammals represented in the collection. It is somewhat remarkable to find among these a species of stoat (*Mustela*, or *Putorius, paräensis*), but there can be little doubt that this, although now domiciled in the country, was originally introduced by human agency. Two very spirited plates illustrate the paper, one showing the extraordinary width and straightness of the opening of the mouth in one of the howling-monkeys (quite unlike what we are accustomed to see in museum specimens in this country), and the other the head of one of the indigenous species of cat. Mr. O. Thomas contributes an appendix to the catalogue, in which two subspecies are described as new.

THREE out of the four articles in the current number of the *Zoologist* are devoted to bird subjects. In the fourth Mr. A. H. Cocks reverts to the subject of the gestation of the badger, and arrives at what he confesses to be the very remarkable conclusion "that the pairing may take place at any time during a range of some ten months, and yet that the young are always born within a season limited to about six weeks. In other words, it appears that the gestation may amount to anything between under five and over fifteen months, and yet that the young are all born within some six weeks of each other; and, moreover, that the females which paired earliest by no means necessarily whelp earlier during the six weeks' season than others which paired several months after them."

THE necessity of carefully studying the anatomy of the smaller mammals, instead of restricting our attention to the description of new subspecies founded mainly on colour, is exemplified by certain notes on the insectivorous genus Tupaia contributed by Dr. H. C. Chapman to the *Proceedings* of the Philadelphia Academy for March. These serve to show that the presence of a cæcum is by no means, as has hitherto been supposed, a constant feature of that genus. The paper concludes with a discussion on the phylogeny of the Primates, in which a provisional table of descent is sketched. In view of the researches of other biologists it is somewhat remarkable to find Chiromys figuring as the ancestor of the rodents, and Tarsius as the parent form of the insectivores, while it is scarcely less surprising to see American monkeys placed between the lorises and the monkeys of the Old World in a direct phylogenetic line. It is, however, only just to the author to mention that in the text he states that some of these suggested relationships may have to be reconsidered.

THE report of the medical officer of health of the City of London for the four weeks ending March 12 details the inspection of kitchens of restaurants, &c., commenced early in the year 1902, and now just completed. There appear to be no less than 909 kitchens in the district, employing 9888 men and women. In the course of the inspection 1996 various sanitary defects were found. It would appear that the Factory and Workshop Act 1901 is adequate to deal with this class of work-place.

IN the *Empire Review* for March Dr. Cooke Adams contributes an article on cancer research in Australia. His statistics show that the death rate from cancer in Australia among the British born is nearly double that among the Australian born portion of the population, being, for the age period of thirty-five years and upwards, 12·5 for the former and 6·9 for the latter per 100 deaths. Among the aborigines cancer appears to be practically unknown, although a large number live to the age period at which the disease chiefly manifests itself.

"PROTOZOA and Disease" is the title of an article in the *Century Magazine* by Dr. Gary Calkins. After some introductory remarks on the classes of protozoa and their life-history, the protozoan parasites causing certain diseases in the lower animals and in man are described, viz. diseases of the mole and of brook trout, malaria, scarlatina and small-pox. In scarlatina Dr. Mallory has met with structures which he considers to be protozoan organisms, and in small-pox Dr. Councilman believes that a protozoon is the cause, and that it attacks the nuclei of the cells of the skin. In vaccinia Dr. Councilman describes an organism similar to that of small-pox, but differing from the latter in that it attacks the cell bodies and not the nuclei. The article is illustrated with several excellent figures.

THE last number of the *Izvestia* of the Russian Geographical Society (xxxix., 5) contains the results of an inquiry, by G. E. Grum Grzimailo, into the origin of the populations of eastern Tibet and the Kuku-nor region, the conclusion of the paper being that the presence of a white race element in the population of eastern Tibet is very probable. Another paper of scientific interest is the report by Captain Serghievsky on the pendulum observations made in Russia during the last five years. Relative determinations only, by means of the Sterneck apparatus, were carried on, those regions which offered interesting anomalies being made the subject of detailed studies, namely, the region of the well known pendulum anomaly in Kursk, the Caucasus, Turkestan (in order to ascertain the disturbing influence of the Pamir), the region covered by the geodetic triangulation for the measurement of an arc of the meridian in connection with the Spitsbergen measurements, and the stretch between Pulkova and Dorpat.

IN an essay entitled "Prehistoric Pile-structures in Pits," Mr. L. M. Mann records the results of excavations made at Stoneykirk, in Wigtownshire (*Proc.* Soc. Antiq., Scotland). The discovery of these early inhabited sites was due to Mr. A. Beckett, who directed attention to a row of depressions in the land, situated on the edge of a plateau. The depressions proved to be silted-up pits. In one of them, at a depth of 7 feet, there were found decayed "logs of round timber more or less vertically placed." In the silted material chips, cores, implements of flint and of other stones, as well as charcoal and fragments of pottery were found. Twigs and branches belonging to supposed wattle-work were likewise obtained. There was evidence which tended to show that the timber had been shaped by stone axes. It appears probable that the pits were used as shelters or sleeping places and workshops. The fact that the lowest stratum met with was a bluish clay suggests that a struc-

ture of wooden piling was erected in order to provide a dry floor. The ornamentation on the pottery and other evidence point to the Neolithic age as the period during which the sites were in use.

AN article on the structure of the Upper Cretaceous turtles of New Jersey is contributed by Mr. G. R. Wieland (*Amer. Journ. Sci.*, February). The genera Adocus, Osteopygis and Propleura are described and figured.

THE Hurricane Fault in the Toquerville district of Utah furnishes a theme for an essay on the effects of faulting on the scenery in the region of the Grand Canyon; it is written by Messrs. E. Huntington and J. W. Goldthwait (*Bull. Museum Comp. Zool., Harvard Coll. Geol. Series*, vi., No. 5, February).

WE have received the report of progress for 1903 of the University of Texas Mineral Survey, which is under the direction of Mr. W. B. Phillips. The work is carried on with especial reference to economic geology. Attention is directed to the study of the clays of Texas, by Dr. H. Ries. Under a plan of cooperation with the Texas World's Fair Commission, Dr. Ries examined the chief clay producing districts in the State, and as a result there will be exhibited at St. Louis samples of the clays, to each of which will be attached a card giving the locality, chemical composition and physical characters, such as fusibility, plasticity, strength, colour on burning, proper temperature for burning, suitability for various purposes, &c.

AN interesting essay on periodic migrations between the Asiatic and the American coasts of the Pacific Ocean is contributed by Mr. J. P. Smith (*Amer. Journ. Sci.*, March). It is shown that the living faunas of the Japanese province and of the western coast of North America are rather closely allied with a large number of species in common, and they live under approximately the same conditions. Between them there lie the southern shores of Alaska and the Aleutian Islands, interrupted by the deep channel east of Kamchatka and in this region the warm Japan current is met by the cold current from the Bering Sea, whereby the Alaskan waters and those along the shores of California are tempered. At present the migration of shallow water species is stopped by the depth of the channel at the end of the Aleutian chain, and also by the cold water which extends south-westward from Bering Sea. A rise of 200 metres would close Bering Sea, cutting off the Arctic waters, and providing a broad land bridge between Alaska and Siberia. An uprise of this, or of greater extent, in recent geologic times would allow of the intermigration of marine Mollusca between the Japanese area and that of western America, and this is the only explanation of the present distribution of most of the species that are common to the two regions. By such changes we can understand the history of the past faunas, which do not form a genetic series, but rather one showing periodically diverse origin and characters. Thus the faunal relations between western America and eastern Asia from the Trias to the present were the same, Asiatic facies alternating with periodically recurring invasions of the Boreal type. It is concluded, therefore, that there is no presumption against the contemporaneity of similar species in widely separated regions in the past.

ALL the volumes of the first annual issue of the "International Catalogue of Scientific Literature" have now been published, and the volumes of the second annual issue are appearing. The first catalogue of zoological literature is in two parts—one an authors' and the other a subject catalogue—and they are concerned with the publications of 1901. Of the second issue, we have received the volumes dealing with mechanics, physics, astronomy and bacteriology. The volumes can be obtained from Messrs. Harrison and Sons, St. Martin's Lane, W.C.

THE second number of *The Central*—the magazine of the old students' association of the Central Technical College—contains several articles of practical value. Profs. W. C. Unwin and A. G. Ashcroft describe the engineering course and laboratories at the college, Mr. R. S. Dahl gives an account of the design of small motors, Mr. J. M. Donaldson contributes an article on electric power in the City of Montreal, and the work of Dr. T. M. Lowry and Dr. E. F. Armstrong on the mutarotation of glucose is briefly described. A photogravure of Prof. Henrici forms the frontispiece of the number.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, two Bare-eyed Cockatoos (*Cacatua gymnopis*) from South Australia, presented by Miss Hester Forshaw; a Hairy-footed Jerboa (*Dipus hirtipes*) from Egypt, presented by Mr. A. Lethbridge; a Shining Weaver-bird (*Hypochera nitens*), a Common Waxbill (*Estrelda cinerea*) from West Africa, an Orange Weaver-bird (*Euplectes franciscana*), three African Silver-bills (*Munia cantans*) from North-east Africa, three Banded Grass Finches (*Poëphila cincta*) from Queensland, four Amaduvade Finches (*Estrelda amandava*) from India, a Fire-tailed Finch (*Erythrura prasina*) from Java, a Red-headed Weaver-bird (*Foudia madagascariensis*) from Madagascar, presented by Mrs. M. Summers; a Potto (*Perodicticus potto*), an African Civet Cat (*Viverra civetta*), two Crowned Cranes (*Balearica pavonina*), a White-throated Monitor (*Varanus albigularis*) from Lagos, presented by Dr. McFarlane; a Loggerhead Turtle (*Thalassochelys caretta*) from tropical seas, deposited; an American Flying Squirrel (*Sciuropterus volucella*) from North America, a Boatbill (*Cancroma cochlearia*) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF EROS.—In one of the papers included in the *Decennial Publications* of the University of Chicago Prof. E. E. Barnard publishes the results of the micrometrical observations of Eros made at the Yerkes Observatory with the 40-inch refractor during the opposition of 1900–1901. After describing the methods of observation and discussing the errors, he gives, in tabular form, the details of each of the 7500 individual "settings" made during the series of observations. He also gives the results of a set of observations which were made during 1898 and 1900, but have not previously been published.

At the time these measures were made the oscillations of the magnitude of Eros had not been recognised, but on looking through the records Prof. Barnard discovered that the planet had often been compared, in regard to its brightness, with the reference stars, and he therefore appends the actual notes regarding the relative magnitude which were made during the period September, 1898, to January, 1901, inclusive.

ORBIT OF THE MINOR PLANET CHICAGO (334).—Another paper of the *Decennial Publications* (Chicago) contains a discussion of the orbit of the minor planet (334) by Prof. Kurt Laves. In the introduction the author discusses the minor planets of the Hilda type in regard to their "libration," and gives, in algebraical form, the inequality which is the criterion of the existence of libration in the orbits of these bodies. He then discusses the development of the

"perturbative function," and gives the elements, step by step, for the determination of the orbit of (334).

ABSORPTION IN THE SOLAR ATMOSPHERE.—In an article published in No. 2, vol. xix., of the *Astrophysical Journal*, Mr. Frank W. Very discusses the cause which produces the apparent selective absorption of the more refrangible radiations emitted by the photosphere which takes place in the solar atmosphere. He points out that beyond certain limits the increased depth of an "emission" layer does not increase the radiating power owing to the fact that beyond these limits the increased emission is counterbalanced by the increased absorption in the outer layers; similarly the line absorption produced by a gas does not increase indefinitely with the depth. For this reason he believes that the absorbing atmosphere is everywhere deeper than is actually essential to produce the absorption observed, and consequently it makes little or no difference whether the emission and absorption take place at the centre or the edge of the solar disc. Mr. Very contends that the apparent selective absorption is due to "selective scattering" rather than to "absorption," the more refrangible radiations being scattered and reflected by the small particles which float about in the solar atmosphere; further, he thinks that the scattering does not take place solely in a thin layer immediately above the photosphere, but is active even in the limits of the outer corona. Whereas "absorption" would require that the absorbing medium should become heated "selective scattering" does not, for the radiations are simply reflected.

This theory explains the nearly constant radiations of sun-spots when nearing the limb by supposing that spots, being cooler than the photosphere, only emit, at any time, the less refrangible radiations which are not affected by the extremely fine particles that cause the scattering.

WAVE-LENGTH OF THE GREEN CADMIUM LINE.—It has been noticed by many spectroscopists who are interested in the determination of absolute wave-lengths that the wave-length of the green cadmium line at λ 5086 as determined by M. Hamy (*Comptes rendus*, No. 130, p. 490, 1900) differs considerably from the value obtained for the same line by MM. Michelson and Benoit. This discrepancy is now accounted for by M. Ch. Fabry, who shows that under the conditions obtained by Michelson in a tube of cadmium vapour *with electrodes* the line is a close doublet, whereas in the tube used by Hamy *without electrodes* it is a triplet, and the latter observer measured the less refrangible component which does not appear under the former conditions. M. Fabry has determined the interval between the component measured by Michelson and the extra line measured by Hamy, and has found that on taking the value of this interval into account the apparent discrepancy is reduced from 15 in 1,000,000 to 3 in 10,000,000 (*Astrophysical Journal*, No. 2, vol. xix.).

A BRIGHT METEOR.—Mr. Roland Mott writes to say that on March 22 he observed a bright meteor from a position four miles west of Gloucester. "The meteor was in the north-eastern sky, and first appeared at an altitude of about 45 degrees from the horizon, falling directly towards the earth. It had the appearance of a brilliant arc lamp, and far outshone the stars of the Great Bear, although they and the moon were very bright. The time was 9.58 p.m."

SPECTRA OF MIXED GASES.—From a number of experiments made in order to ascertain the reason of the predominance of one spectrum over another in a mixture of gases, Mr. P. G. Nutting, of the National Bureau of Standards, Washington, has arrived at the definite conclusion that at such low pressures (0·1 to 10 mm.) as obtain in a Plücker tube, and under a homogeneous excitation of not more than 10 milliamperes, "the spectrum of a gas of greater atomic weight will be the brighter."

During his experiments he has found that neither the relative quantities nor the metallic or non-metallic character of the vapours present affect this result. The introduction of one molecule of mercury into three thousand molecules of hydrogen will reduce the brightness of the hydrogen spectrum at least one half, and sulphur and iodine (non-metals) are nearly as effective in causing this reduction as is mercury.

About eighty combinations of the fifteen readily vapourisable elements have been studied, and it is hoped to extend the results by using quartz tubes in which even copper and silver may be vapourised.

In concluding his communication Mr. Nutting discusses the effects of chemical combination on these results, and the explanation of the latter afforded by the modern electron theory (*Astrophysical Journal*, No. 2, vol. xix.).

RETURN OF THE NATIONAL ANTARCTIC EXPEDITION.

THE *Discovery*, with the members of the National Antarctic Expedition on board, arrived at Lyttelton, New Zealand, on April 1, accompanied by the relief ships *Morning* and *Terra Nova*. The news of the safe return of the expedition has been received with satisfaction; and there is every reason to believe that the scientific results obtained will make the expedition a noteworthy one in the records of polar exploration.

The *Discovery* left England in the summer of 1901 and reached Lyttelton on November 23 of that year. A few weeks later the vessel sailed for the Antarctic, and the first news of the work accomplished was brought back by the relief vessel *Morning* in March of last year (NATURE, vol. lxvii. p. 516). It was evident from the information then received that the expedition had already achieved great success both as regards exploration and scientific observation, but some anxiety was felt as to the chances of the *Discovery* being released from the ice during the southern summer just passed. When the winter quarters of the *Discovery* were found, the ice prevented the *Morning* from approaching the vessel to a less distance than eight miles; and the transfer of coal and provisions had to be done by means of sledges. As the *Discovery* only had provisions to last until January of this year, it was considered necessary to send out two vessels to relieve the expedition and bring back the members if the ship could not get free. The *Morning* and *Terra Nova* were therefore equipped for this purpose, and sailed from Hobart on December 5, 1903, and reached the edge of the ice on January 5 of this year. There were then seventeen miles of ice between the *Discovery* and the sea, but heavy weather and explosives assisted this to break up, and in the middle of February the vessel was in open water.

Commander Scott's report upon the results of the first year's work in the Antarctic was summarised in NATURE of July 30, 1903 (vol. lxviii. p. 307); but some additional details of interest are given in Press messages from New Zealand. A Reuter message states that the interior of Victoria Land is found to rise to a height of 9000 feet, and is evidently a vast continental plateau.

Wilkes Land was found to be non-existent, the *Discovery* sailing over the region where it has been charted. Since Ross's time, the ice is alleged to have broken back 30 miles from the barrier, which is moving northward at the rate of a quarter of a mile a year.

The main practical interest of the expedition lies in the results of the magnetic investigations. Continuous observations were taken in the neighbourhood of the magnetic Pole.

One primitive form of insect life was secured, and much information obtained as to the higher forms of animal life. The latter consisted mostly of birds, including the emperor penguin, specimens of which have not previously been found in these regions. The only species of living plants secured were mosses and lichens, but sandstone fossil remains of dicotyledonous plants from an altitude of 8000 feet were obtained on a sledging trip westward.

The following particulars of the expedition are from an interview which the correspondent of the *Daily Mail* at Christchurch, New Zealand, had with Commander Scott, published in that journal on Saturday last.

All went well after the departure of the *Morning* in 1903. The ice remained fast and firm within four miles of the *Discovery*. The weather was colder but less windy than in 1902. One hundred degrees of frost were recorded in May. The routine of scientific work and observations continued as in the previous year.

Sledging opened in September under the most severe conditions. One party made a depôt to the south; another

party visited Emperor and Penguin Islands and surveyed Cape Crozier with complete success. The temperatures encountered by the parties were constantly below 50 degrees and frequently below 60 degrees. The lowest recorded was 68 degrees. A third party found a new route to the west and established a depôt 2000 feet up the glacier, sixty miles from the ship.

On October 6 a party started for the strait in latitude 80 degrees south. The strait was found to contain a large glacier formed from the inland ice. Detailed information was obtained as to the exact point of junction between the barrier ice and the land, and a depôt established last year was found to have moved a quarter of a mile to the north. The party returned on December 13.

A party started on November 10, with five weeks' provisions, and reached a point 160 geographical miles south-east of the ship, travelling continuously over a level plain. No trace of land and no obstacles in the ice were encountered, and evidence was obtained showing this vast plain to be afloat. A most uniform series of magnetic observations was secured.

A party set out to the west on October 12, and reached a height of 5000 feet on the glacier, 80 miles from the ship, on October 18. The ship was reached again on October 21, and on October 26 another start was made. The party gained the summit on November 11, and crossed 180 degrees, the magnetic meridian, on November 20 in about longitude 155½ degrees east.

Commander Scott proceeded west with two men for eight and a half days, and reached a point 270 miles from the ship in latitude 78 degrees south and longitude 146½ degrees east. He regained the glacier on December 14, and reached the ship on Christmas Eve.

The interior of Victoria Land stretches continuously at a height of 9000 feet. It is evidently a vast continental plateau. No land was visible after losing sight of the ranges which front the coast. The temperatures were low and the wind increasingly strong. The glacier valley affords magnificent scenery and gives a natural geological section of the mountains. Mr. Ferrar and two men accompanied Commander Scott to the summit, and on the return journey they explored the valley in detail and discovered sandstone with plant remains.

In the middle of December a camp was formed eight miles north of the ship, and all hands were set to work on ice-saws in the neighbourhood to cut a passage out. Commander Scott arrived at the camp on December 30, and found that 180 yards of channel had been sawn in twelve days, through ice 7 feet to 8 feet thick. The open water was then 17 miles from the ship. As the canal cut had frozen over again in places, showing that the efforts were obviously futile, the men were sent back to the ship.

The relief ships arrived simultaneously at the edge of the ice on January 5. As they had closed but little on the *Discovery* by January 15, all hands were employed in sledging and collecting the instruments. The ice began to weaken between the ships on January 20, and broke rapidly towards the end of the month. The opening came within 8 miles of the ship in the early days of February. Its advance was slow, but it was increased by systematic blasting with dynamite. The crews of the relief ships were employed in making holes in the ice for this purpose. On February 12 a general break-up of the ice began, and the relief ships reached Hut Point amid much excitement. On the night of February 14 two heavy charges were exploded, and these placed the *Discovery* in open water.

On the morning of February 16 a heavy gale began. In the night the *Terra Nova* succeeded in finding shelter to the south, but in the morning was driven north. The *Discovery* dragged her anchor and was forced ashore, remaining eight hours in a critical position. The ship eventually freed herself. On February 19, 75 tons of coal were obtained from the relief ships before a fresh gale drove the *Discovery* north. The ship was kept close in along the coast line, and in the morning parted company from the other ships at Cape Washington, with a clear sea to the north.

The *Discovery* skirted the pack to the east and north, losing sight of the *Terra Nova* during a gale on February 28. It proceeded west along parallel 69½ degrees of latitude, and on March 2 the Balleny and Russell Islands were found to be identical. It continued west to the 156th meridian of longitude. The coast-line reported in this direction was found to be a mistake. No such land exists.

Auckland Island was reached on March 15. The *Terra Nova* and *Morning* rejoined the *Discovery* on March 19 and 20, after experiencing terrific weather and being compelled several times to heave to. The results of the expedition are eminently satisfactory.

UNIVERSITY EDUCATION IN SOUTH AFRICA.

THERE was an especial appropriateness about the visit of Prof. Hele-Shaw, F.R.S., to the Cape of Good Hope University on the occasion of the degree day, on February 27, when he gave an address on the true function of a university and the directions in which university work in South Africa should be strengthened and developed. Prof. Hele-Shaw, it will be remembered, is in South Africa to organise technical education in the new colonies, and he is for the present acting as senior professor in charge of the department of mechanical and electrical engineering at the Transvaal Technical Institute. This institute will, it is hoped by the local authorities of the Transvaal, develop into a university, but the university authorities at the Cape of Good Hope naturally desire that the future shall see no undesirable competition and no overlapping between the university work of Cape Town and that of the Transvaal when the latter becomes fully organised. There is in other quarters the fear that in the work of instituting new universities an undue prominence may be given to the subjects of study of a more technical kind, and that the branches of knowledge usually associated with the inculcation of cultured ideas may be neglected. All these questions were discussed at length by Prof. Hele-Shaw.

The University of the Cape of Good Hope was incorporated by an Act of the Legislature in 1873, and thereupon took the place of the Board of Public Examiners which had been similarly established in 1858 under the administration of the late Sir George Grey. In 1879 the late Queen Victoria granted a Royal Charter to the university declaring that the degrees conferred by the university are entitled to the same rank, precedence, and consideration as the degrees of any university in the United Kingdom. But, as was pointed out by the *Cape Times* of February 29, reporting the proceedings on degree day, as it is at present constituted the Cape University is almost exclusively an examining body. It is not, in the commonly accepted sense of the term, a teaching university, and however valuable it is for South Africa to number among its educational institutions a body which has the power to confer degrees, and thereby to set the seal of its authority upon the intellectual attainments of its graduates, this is not the highest of all advantages which a university can offer. This was the ideal at which the University of London formerly aimed, but which it has been able to replace by a great teaching university which it is hoped will be soon worthy of the capital of the Empire. The need for a teaching university at Cape Town is beginning to be felt in South Africa—for a university at which the students will be brought into direct touch with the professors and lecturers, and not, as at present, an institution in which knowledge is tested wholly by examination papers. It is the influence and the teaching of the university as a whole which largely contribute to stimulate that affection for their college that is so distinguishing a feature of the great English and Scottish universities.

Prof. Hele-Shaw directed the attention of the authorities of the Cape of Good Hope University to the aspirations of those who are founding the Transvaal Technical Institute, and pointed out that their ultimate ideal is the foundation of a university for the Transvaal. Under existing conditions in South Africa, says the *Cape Times*, it may well be doubted if two university establishments could be effectively maintained without injury to the interests of one or the other. But if the country makes that progress in wealth and population and prosperity which it is hoped to see realised, the day when there will be ample room for a Transvaal university may not be very far removed. There need be no friction between those at work at Cape Town and Johannesburg respectively.

It is true that with the establishment of a mining course in Johannesburg the engineering establishment at the South African College is faced to a certain extent by competition, but there is no reason why the earlier stages of instruction should not be taken at the South African College and the final stages at Johannesburg, where special facilities will exist. As to the future contingency of overlapping, Prof. Hele-Shaw suggests, in the probable event of an engineering faculty being established, that while the Transvaal could devote itself solely to mining engineering, the Cape University could develop the study of naval, architectural and marine engineering, for which there would be special facilities in the peninsula.

In his remarks on the future relations of the University of the Cape of Good Hope and the Transvaal Institute, Prof. Hele-Shaw said the present year will see the work of a professorship of engineering commence at both places, and continued, "There need be no fear of overlapping, since such a course, though suitable, and, indeed, necessary, for any branch of the constructive professions, can in the later stages be specialised to suit the local requirements. Thus in the north mining would naturally be a strong feature of a special course, whilst your city (Cape Town) has possibilities in the way of naval architecture and marine engineering which even the wildest dreams of the projector of the ship canal to Johannesburg would never contemplate for the latter city. Such a faculty of engineering, if true to its proper aims, would, by right, take its place, as representing a learned profession amongst the other great faculties, and would doubtless have its distinctive university degrees."

Speaking more particularly of the new institution at Johannesburg, Prof. Hele-Shaw said:—"The university idea will, I trust, even at its initial stages, be fully maintained in the Transvaal Institute, not by any mere artificial standards of entrance, but by the due appreciation of the spirit in which learning should be sought and teaching given. There will be due provision made that all entering students shall by their previous training be able to take full advantage of the lectures and classes, just as provision is made for this at the South African College. But the doors of the institute will be closed to no one, however humble, who seeks such knowledge and is able to take advantage of it. This freedom for the acquisition of learning is a very different thing from the granting of diplomas to those who are unworthy. In its diplomas and certificates the institute will try to follow the highest standards, and in this we can hope for your friendly cooperation and support. For the present our mining students will derive incalculable benefit from the seal and stamp which you will set upon their university career, a seal which will derive its value from the high standard which you have ever striven to maintain amongst your graduates. You may be sure that whatever developments there may be in the future when our own university becomes an accomplished fact, the same safeguards for a university degree will be enforced for our university as there are for yours. No university degree can have any value which does not insist upon evidence of some amount of literary knowledge and include an acquaintance with more than one language on the part of its graduates—in a word, upon evidence of liberal education."

Referring to the fears expressed in some quarters in connection with a possible over-multiplication of universities, Prof. Hele-Shaw remarked:—"There is abundant evidence that the proportion of the population who are imbued with a love for higher learning and a determination to secure a university standard is far greater here than in the cities of the older countries. There may, possibly, exist some fear of what I have called a multiplication of universities—a fear that one university may arise and grow at the expense of another. I have heard this fear expressed in the instances with which I myself am personally acquainted; but I have also seen this fear prove groundless. In the first place, it is known that the university which lowers its standard in the hope of attracting students thereby inevitably compasses its own downfall, and in the second place the remarkable effect of the institution of a new university seems to be that, whilst educational enthusiasm has been aroused in a new centre, a patriotic and zealous spirit has been rekindled in the old, and both universities have flourished where before one was only languishing."

THEORY OF AMPHOTERIC ELECTROLYTES.[1]

AMPHOTERIC electrolytes are those which are capable of acting as acids towards bases and as bases towards acids. One of the simplest types is that of the amino-acids, for example, glycine, $NH_2.CH_2.COOH$, which in virtue of the NH_2 group is an anhydrous base, whilst in virtue of the COOH group it is an ordinary organic acid. When such a substance is dissolved in water, it is ionised as acid, as base, and as the salt formed by their reciprocal neutralisation. From molecular weight determinations in aqueous solution it is found that in general the molecule is simple and not double, so that the unionised salt must be

$$\overline{NH_3.CH_2.COO}$$

The theory of the ionisation and electrical conductivity of the aqueous solutions of amphoteric substances may be deduced by a consistent application of the law of mass action and Arrhenius's theory of electrolytic dissociation. If the anhydrous electrolyte is represented by the formula X, and the hydrated form by the formula HXOH, the ions found in the solution will be

H+	OH−	XOH−	HX+
a	b	c	d

The letters beneath the formulæ represent the active masses for equilibrium of the corresponding ions. With regard to the active masses of the various forms of unionised electrolyte, it can easily be shown that these are in fixed ratios, whatever the concentration may be. We may therefore represent the sum of the active masses of the unionised forms by the letter u, and by considering the equilibrium of the different pairs of positive and negative ions, arrive at the following expressions:—

$$a=\sqrt{\frac{K+k_a u}{1+\frac{k_b}{K}.u}}$$

$$b=K/a$$

$$c=k_a u a$$

$$d=k_b u a/K,$$

in which K represents the ionic product for water, k_a the dissociation constant of the amphoteric electrolyte acting as acid, and k_b the dissociation constant of the amphoteric electrolyte acting as base. The value of K is well known, and k_a and k_b may be obtained from measurements of the degree of hydrolytic dissociation of salts of the amphoteric electrolyte. For feebly ionised electrolytes u is very nearly equal to the total active mass, and may be assumed to be so in the first approximation. It is therefore possible to calculate the concentrations of the various ions from a knowledge of the constants given above and of the total concentration. From these ionic concentrations and the corresponding ionic velocities the electrical conductivity of the solution may then be calculated.

This calculation has been made from Winkelblech's data for the amino-benzoic acids, and satisfactory agreement obtained with the observed numbers. For such substances the dissociation constants calculated from the conductivity by Ostwald's formula have been always found to be abnormal. The theory given above explains the abnormality, and accounts numerically for the variation in the "constant."

In general it may be said that in the case of amphoteric acids which have a ratio k_b/K of the order 100 to 1000, the Ostwald constant k_0 is greater than the true acid constant k_a at high concentrations, falls to a minimum considerably lower than k_a, finally to rise asymptotically to the true value k_a as dilution progresses. The conductivity at the high concentrations is chiefly due to the ionisation of the electrolyte as salt, whereas at the high dilutions it is mostly due to the ionisation of the electrolyte as acid. In consequence of this, the measurement of the conductivity of solutions of amphoteric electrolytes affords no criterion of their strength as acids. An amphoteric electrolyte in which the acidic and basic constants are equal would give solutions absolutely neutral at all concentrations, and possessing a molecular conductivity invariable with the dilution, thus differing from all simple acids, bases or salts.

[1] Substance of a paper by Prof. James Walker, F.R.S. Read before the Royal Society on February 18.

SURVEY OF SCOTTISH LAKES.[1]

THE three papers mentioned below complete the account of the survey of the lochs which lie within the drainage basin of the Tay, and show that the excellent work carried on by Sir John Murray and the late Mr. F. P. Pullar is being continued in a manner worthy of the importance of the subject. It may be recalled that part i. of these publications appeared in the *Geographical Journal* for April, 1900, and dealt with the lochs of the Trossachs and Callander district; part ii. appeared in the *Journal* for March, 1901, and dealt with the remaining lochs of the Forth basin; part iii., No. 1, appeared in the same *Journal*, and dealt with Lochs Ericht and Garry in the basin of the Tay. Part i. was noticed in these columns on May 17, 1900 (see NATURE, vol. lxii. pp. 65–67).

In the introductory remarks to the first paper under notice, reference is made to the attempt to induce the Government to undertake a bathymetrical survey of the principal Scottish lakes; to the commencement of such a survey by Sir John Murray and the late Mr. F. P. Pullar, which was brought to a standstill by the sad death of Mr. Fred. Pullar; to the desire of his father, Mr. Laurence Pullar, to continue and complete the work in which his late son took such an active part; to the resolutions passed by the councils of the Royal Societies of London and Edinburgh, and by the British Association, affirming the importance and scientific value of the contemplated survey; to the interest taken in the work by the directors of the Ordnance Survey and Geological Survey, the hydrographer of the Admiralty, and the controller of H.M. Stationery Office; to the steps taken to carry out the work under the direct supervision of Sir John Murray and the staff appointed to assist him; and to the progress made up to the time of publication.

The drainage basin of the River Tay is the largest in Scotland, covering an area exceeding 2500 square miles, and it includes several large fresh-water lochs as well as many small ones, nearly all of which have now been sounded by Sir John Murray and his colleagues. The relative positions of the lochs will be seen at a glance in the index map shown in Fig. 1. In the first paper now under notice, thirteen of the lochs are dealt with, the most important being Lochs Rannoch and Earn; in the second paper fourteen lochs are dealt with, including Lochs Tay and Tummel; and in the third paper thirty-one of the smaller lochs are discussed, making a total of fifty-eight lochs fully described and elaborately mapped. Adding Lochs Ericht and Garry, previously published, the total is increased to sixty, so that only a few little lochans within the Tay basin remain unsurveyed. These sixty lochs cover an area of about forty square miles, and they drain an area twenty times greater—an area of more than eight hundred square miles. The number of soundings necessary to indicate with sufficient accuracy the relief of the bottom varies greatly, according to the dimensions, depth, and form of the basin, but usually a relatively much larger number of soundings is taken in a small loch than in a large one. Nearly seven thousand soundings were recorded in these sixty Tay lochs, or an average of 114 per loch, or 172 per square mile of water-surface. In the thirty-one little lochs included in the third paper the average number of soundings per square mile of surface is 383, while in the largest loch (Loch Tay) the average is only 91.

The sixty lochs lie at elevations varying between 140 and 2575 feet above the sea, the last mentioned, the only one above the 2000 feet level, being the little Loch nan Eun at the head of Glen Taitneach, a tributary of the well-known Glenshee, and the highest loch visited by the Lake Survey. Of the four largest lochs, Loch Ericht is the highest, 1153 feet above sea-level, then Loch Rannoch, 668 feet, then Loch Tay, 349 feet, and Loch Earn, 317 feet.

In this short notice it is impossible to refer to all the lochs dealt with, and therefore attention will be directed only to the larger and more interesting lochs. In order to show their relative dimensions and depths, the principal Tay lochs are arranged in the following tables according to (1) superficial area, (2) length, (3) volume of water, (4) maximum depth, and (5) mean depth, the particulars being given in round numbers:—

(1) *Superficial Area.*

	Square miles		Square mile
Loch Tay	10¼	Loch Tummel	1
,, Rannoch	7½	,, Bà	1
,, Ericht	7¼	,, of Lintrathen	⅝
,, Earn	4	,, Garry	⅜
,, Laidon	2	,, Freuchie	½

(2) *Length.*

	Miles		Miles
Loch Tay	14½	Loch Lintrathen	1⅛
,, Ericht	14½	,, Iubhair	1⅛
,, Rannoch	9¾	,, Loch	1¼
,, Earn	6½	,, of the Lowes	1¼
,, Laidon	5½	,, Turret	1
,, Tummel	2⅝	,, Benachally	1
,, Garry	2½	,, of Forfar	1
,, Bà	2¼	,, Daimh	1
,, Lyon	1¾	,, Con	1
,, Freuchie	1¾		

(3) *Volume of Water.*

	Millions of cubic feet		Millions of cubic feet
Loch Tay	56,550	Loch Drumellie	222
,, Ericht	38,027	,, Bà	206
,, Rannoch	34,387	,, Lowes	194
,, Earn	14,421	,, Daimh	190
,, Laidon	1,762	,, Benachally	178
,, Tummel	1,317	,, Clunie	170
,, Garry	846	,, Iubhair	147
,, Lyon	461	,, Ordie	133
,, Lintrathen	405	,, Kennard	108
,, Freuchie	347	,, Derculich	108
,, Turret	228	,, Loch	103

(4) *Maximum Depth.*

	Feet		Feet
Loch Ericht	512	Loch Kennard	72
,, Tay	508	,, Lintrathen	70
,, Rannoch	440	,, Derculich	70
,, Earn	287	,, Ordie	69
,, Laidon	128	,, Clunie	69
,, Tummel	128	,, Iubhair	65
,, Garry	113	,, Benachally	64
,, Lyon	100	,, Freuchie	62
,, Daimh	95	,, Drumellie	58
,, Loch	81	,, Skiach	55
,, Turret	79	,, Lowes	53
,, Fender	78	,, nan Eun	50

(5) *Mean Depth.*

	Feet		Feet
Loch Tay	199	Loch Clunie	29
,, Ericht	189	,, Drumellie	29
,, Rannoch	167	,, Ordie	26
,, Earn	138	,, Benachally	25
,, Garry	50	,, Iubhair	25
,, Tummel	48	,, Derculich	25
,, Lyon	45	,, Lintrathen	23
,, Daimh	39	,, Freuchie	23
,, Laidon	35	,, Fingask	23
,, Turret	32	,, Giorra	22
,, Fender	32	,, nan Eun	22
,, Kennard	32	,, Lowes	20
,, Loch	29		

The general conformation of the principal lochs may now be indicated briefly; for further details the reader is referred to the papers cited.

Loch Tay is slightly sinuous in outline and comparatively simple in conformation. A depth of 100 feet is met with about a quarter of a mile from the upper (south-western) end, and about one-third of a mile from the lower end. The basin exceeding 200 feet in depth is eleven miles in length,

[1] Bathymetrical Survey of the Freshwater Lochs of Scotland. Under the direction of Sir John Murray, K.C.B., F.R.S., D.Sc., and Laurence Pullar, F.R.S.E. Part iii. Nos. 2–6, *Geographical Journal*, vol. xxii., pp. 237–269, with seven plates of maps; Nos. 7–9, pp. 521–541, with five plates of maps; No. 10, vol. xxiii., pp. 32–61, with six plates of maps, and geological map.

distant more than a mile from the lower end, and more than two miles from the upper end. The bottom falls below the 300 feet level in two basins, the larger extending from about two miles from the lower end for a distance of 7½ miles up the loch, and separated by a slight shoaling of the water over an interval of a mile from the smaller basin, which is half a mile in length. The 400-feet basin lies in the northern half of the loch, approaching to within less than four miles from the lower end, and is 3½ miles in length, while the deepest part of the loch (exceeding 500 feet) is situated about 5½ miles from the lower end, between Skiag on the south and Cragganruar on the north, the maximum depth occurring (roughly) about one-third of the length of the loch from the lower end. A view of Loch Tay, as seen from Kenmore Bridge, is shown in Fig. 2. The areas between the consecutive contour lines, and the percentages to the total area of the loch, are :—

Feet	Acres	Per cent.
0 to 100	1972	30½
100 ,, 200	1532	23½
200 ,, 300	1390	21
300 ,, 400	1017	15½
400 ,, 500	600	9
more than 500	9	less than ½
	6520	100

Loch Ericht is widest near the lower (south-western) end, narrowing towards the upper end. A constriction in the outline of the loch near Loch Ericht Lodge, about 4½ miles from the upper end, cuts it into two deep basins, but, though the width here is less than a quarter of a mile, the depth exceeds 100 feet, so that the 100-feet basin is a continuous area 13¼ miles in length, extending from less than half a mile from the lower to less than a mile from the upper end. The 200-feet and 300-feet basins are each divided into two parts by the constriction referred to, the larger part in each case being found in the southern portion of the loch. The greatest depth observed in the portion of the loch to the north of the constriction is 314 feet, the deepest water in the loch occupying the wider southern portion, where, about 3½ miles from the lower end, there is a small area exceeding 500 feet in depth. The areas between the contour-lines, and the percentages, are :—

Feet	Acres	Per cent.
0 to 100	1575	34
100 ,, 200	1160	25
200 ,, 300	875	19
300 ,, 400	476	10½
400 ,, 500	474	10½
more than 500	58	more than 1
	4618	100

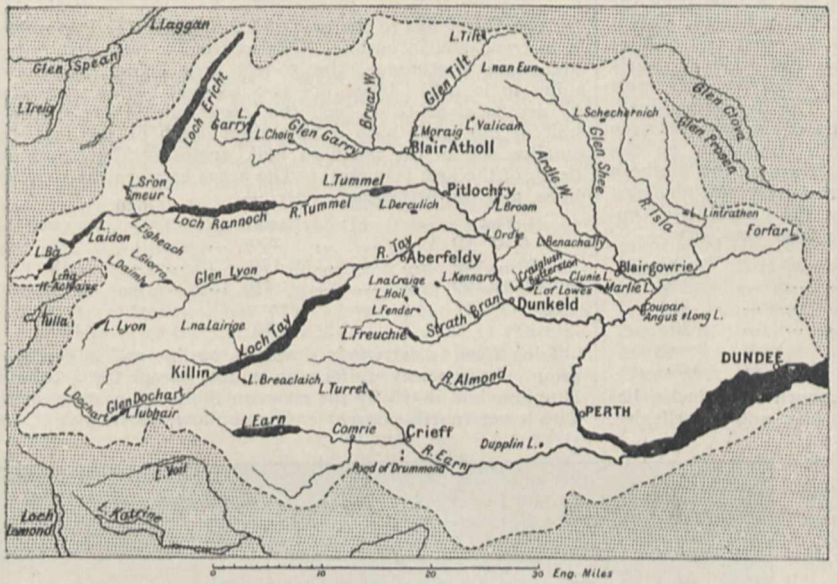

FIG. 1.—Index Map of the Tay Basin.

Loch Rannoch is widest and deepest in the eastern half, narrowing and shallowing towards the west. It consists of one large deep basin, with two subsidiary small basins exceeding 50 feet in depth near the west (upper) end, the maximum depths in which are 84 and 54 feet respectively. The 100-feet basin approaches close to the lower (east) end, extending for nearly seven miles up the loch, while the 200-feet basin is six miles, and the 300-feet basin four miles in length, distant respectively about a quarter of a mile and half a mile from the lower end. The bottom sinks in three places along the central axis of the loch below the 400-feet level, the easternmost basin being the largest and deepest, the maximum depth of the loch (440 feet) having been observed less than two miles from the lower end; the deepest soundings recorded in the other two small basins are 404 and 421 feet respectively. The areas between the contour-lines, and the percentages, are :—

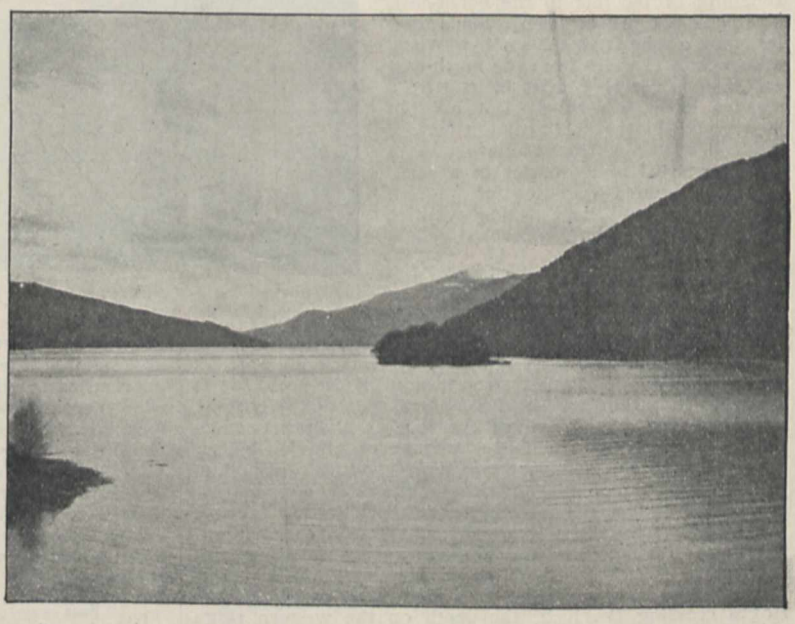

FIG. 2.—Loch Tay.

Feet	Acres	Per cent.
0 to 100	1950	41
100 ,, 200	877	19
200 ,, 300	950	20
300 ,, 400	875	19
more than 400	65	more than 1
	4717	100

Loch Earn is extremely simple in conformation and flat-bottomed in character, the depth of water increasing gradually from the shores down to the deepest part, which is centrally placed, but rather nearer the upper (west) end. A depth of 100 feet is met with less than a quarter of a mile from the west end and less than half a mile from the east end. The 200-feet basin is 4½ miles in length, distant about three-quarters of a mile from the west end and 1¼ miles from the east end, while the 250-feet basin is nearly two miles in length, being distant 1½ miles from the west end and 3 miles from the east end. The maximum depth of 287 feet was observed near the centre of the loch, between the mouth of the stream called Allt Bhacaidh on the northern shore and that of the Allt Dhùnain on the southern shore, about 2¾ and 3¾ miles from the west end and east end respectively. The areas between the consecutive contour-lines, and the percentages of the total area, are :—

Feet	Acres	Per cent.
0 to 100	926	38½
100 ,, 200	755	31½
more than 200	700	30
	2381	100

Loch Laidon, the largest of the Rannoch Moor lochs, lies on the boundary line between Perthshire and Argyllshire. It trends in a north-east and south-west direction, sending out a long shallow arm towards the west, and with a small shallow distinct basin, called Dubh Lochan, at its north-eastern end. The floor of the loch is rather irregular. The deepest part is in the centre of the loch, where there is a basin three-quarters of a mile in length and more than 100 feet in depth, the maximum depth of 128 feet having been observed about 2¾ miles from the south-west end and 2½ miles from the north-east end. Outside of this main 100-feet basin, isolated soundings of 104 and 100 feet were obtained to the south-west, and a sounding of 100 feet to the north-east. The principal 50-feet basin extends from less than a mile from the south-west end to less than 1½ miles from the north-east end, and is nearly 3 miles in length; a smaller basin, one-third of a mile in length, lies in the north-eastern part of the loch, separated from the larger basin by an interval of a quarter of a mile, with an isolated sounding of 50 feet midway between them. Of the entire lake-floor, 74 per cent. is covered by less than 50 feet of water.

Loch Tummel is the final one on the Tummel branch of the Tay, and it receives the outflow from all the other lochs on this branch, including Lochs Ericht, Rannoch, and Laidon; its drainage area is thus very considerable—about 306 square miles, or 312 times the area of the loch. It is irregular in outline and in the conformation of the bottom. The west (or inflow) end of the loch is shallow, and is being silted up by the large amount of alluvial matter brought down by the river; two large tongues of alluvium project into the loch on both sides of the river, and, indeed, the loch must formerly have extended much farther towards the west, but has been gradually silted up and shortened. Cones of alluvium have also been formed at the mouths of the inflowing streams, both on the northern and southern shores. The loch is divided into three deep basins by two ridges crossing the loch, the depth on the western ridge being 53 feet and on the eastern 56 feet, so that the 50-feet area is continuous, and nearly 2½ miles in length, approaching to within 100 yards from the east end and a quarter of a mile from the west end. Of the three deep basins, the western one is the deepest, with a maximum depth of 128 feet; the central one has a maximum depth of 119 feet, and the eastern one a maximum depth of 99 feet. A view of Loch Tummel is shown in Fig. 3. The areas between the contour-lines, and the percentages, are :—

Feet	Acres	Per cent.
0 to 50	352	56
50 ,, 100	217	34½
more than 100	60	9½
	629	100

Loch Garry lies to the east of Loch Ericht, and resembles it in trend and in outline. The 25-feet, 50-feet, and 75-feet areas are continuous, the 50-feet area being nearly two miles in length. There are two 100-feet basins, separated by depths of 82 to 93 feet, the larger one in the southern half of the loch, with a maximum depth of 105 feet, the smaller one in the northern half, enclosing the maximum depth of the loch (113 feet). The areas between the contour-lines, and the percentages, are :—

Feet	Acres	Per cent.
0 to 50	200	52
50 ,, 100	170	43
more than 100	19	5
	389	100

Loch Lyon is extremely simple in outline and in conformation. It is nearly uniform in width, except for a cone of alluvium laid down by the river on the south-eastern shore. The lower (north-eastern) end is shallow, as though it had been silted up, the 25-feet contour being distant about a quarter of a mile, while at the upper end the 75-feet contour approaches to within 300 yards of the shore. The alluvial cone mentioned causes a constriction in the outline of the loch accompanied by a slight shoaling of the water, the depth here being 77 feet, deepening to 84 feet to the south-west, and to 100 feet to the north-east; the last-mentioned sounding—the maximum depth observed—occurs approximately in the middle of the loch. The areas between the contour-lines, and the percentages to the total area of the loch (which show the flat-bottomed character of the deep basin), are :—

FIG. 3.—Loch Tummel.

Feet	Acres	Per cent.
0 to 25	92	39
25 ,, 50	36	15
50 ,, 75	55	23
more than 75	53	23
	236	100

The Loch of Lintrathen is the source of the Dundee water-supply, and has been raised 22 feet in connection therewith; Loch Turret similarly supplies the town of Crieff,

and Loch Benachally the town of Blairgowrie. The results obtained by the Lake Survey must be of particular interest to these municipalities, as indicating the capacities and the depths of the lochs from which they draw their water-supplies. Lochs Daimh, Kennard, Turret, and Fender, though small lochs, are interesting on account of their relatively great depth. The little Loch Fender, which has an area of only some 22 acres, is especially striking in this respect.

Temperature observations were made at the time of sounding most of the lochs, and the results are given under each loch. In the case of Loch Rannoch, the observations extended over a period of four months, and gave some interesting results as to the march of temperature throughout the waters of the loch from March to July, 1902, but usually the observations are too few to afford material for discussion, though they are available for comparison with any future observations.

The bathymetrical maps illustrating the papers are a distinctive feature, and are excellent examples of chromolithographic work. They are reduced from the Ordnance Survey charts to the uniform scale of 3 inches to the mile. The water-surfaces are tinted in deepening shades of blue, the darkest shades indicating the greatest depths. The land-surfaces are tinted in deepening shades of brown, the darkest shades indicating the highest elevations. Longitudinal and cross sections of the principal lochs are given, the true vertical relief drawn to scale being shown in solid black, while coloured extensions in outline represent the vertical scale exaggerated five times in order to show the relative depth with greater effect. Besides the maps there are numerous woodcuts in the text, some of which are reproduced in this notice.

Appended to the concluding paper are some valuable notes on the geology of the Tay basin, by Drs. Peach and Horne, illustrated by an admirable geological map, and on the biology of the lochs of the Tay basin, by Mr. James Murray, assistant zoologist on the staff of the Lake Survey.

In their concise sketch of the geology and glaciation of the district, Drs. Peach and Horne show that the Tay basin is geologically divided into two parts by the great fault along the Highland border—to the north-west metamorphic rocks pierced by igneous intrusions, to the south-east rocks of Old Red Sandstone age with a small patch of Carboniferous strata. Most of the lochs lie to the north-west of the Highland fault, and the groups of strata are enumerated in the order in which they are met with on proceeding northwards from the fault, their distribution being indicated, and the system of north-east and south-west dislocations which traverse the metamorphic area discussed. After dealing with the lower and upper divisions of the Old Red Sandstone, which occur to the south-east of the border fault, the authors proceed to consider the evidence relating to the glaciation of the Tay basin, which leads to the conclusion that, during the climax of the Ice age, the region must have been covered with one continuous sheet of ice; striæ have been found up to elevations of 3000 feet, showing that the highest mountains were over-ridden by the ice, the movement of which must to some extent have been independent of the existing valley-system. This stage was followed by a period of confluent glaciers, when the ice streamed over passes connecting adjoining valleys, leaving in its track lines of moraines. Finally, there was the phase of corrie-glaciers, when the glacial detritus was borne for no great distance from the local centres of dispersion.

The majority of the lochs within the Tay basin, most of them small and comparatively shallow, lie in the midst of drift deposits; several other lochs, some of considerable size, lie along lines of displacement, for example, Lochs Ericht, Garry, Laidon, and Lyon, the long axes of which coincide with the courses of more or less powerful dislocations. As typical examples of rock-basins eroded by ice-action, Lochs Rannoch, Tummel, Earn, Iubhair and Dochart are cited. The two last-mentioned originally formed one sheet of water, and have been separated by alluvial material brought down by the river; Loch Dochart is being rapidly silted up, and must formerly have extended three miles up the valley. Further up Glen Dochart a strip of alluvium five miles in length may probably represent a silted-up rock-basin. Loch Tay presents certain features differentiating it from the rock-basins cited, there being no rocky barrier close to the lake, and the Loch Tay fault runs along the course of the lake for a distance of 5½ miles, the deepest part of the basin coinciding with this fault, to which the deflection of the original valley of the Tay must be due. Thus Loch Tay cannot be regarded as a typical example of a rock-basin, but the other rock-basins referred to seem to furnish strong evidence in support of the theory of ice-erosion.

Tow-net collections were taken in most of the lochs in the Tay basin, and have furnished Mr. Murray with material for some interesting notes on the plankton of the open water of the different lochs. The number of species is not very great, and does not vary much; each loch has a distinct character, which, notwithstanding a considerable amount of seasonal variation, is pretty constant. The genera and species usually met with in the open water of the lakes are enumerated, and although all the forms may be present in most of the lakes, the varying proportions in which they occur give rise to great differences in the character of the plankton. This lacustrine type of plankton was found even in the smallest lochs surveyed. Some of the forms are subject to considerable variation, and sometimes a single organism, usually vegetable, will so increase in a loch as to form a "Wasserblut." A brief account of the plankton-organisms observed in some fifty of the lochs visited is given.

THE HOPE REPORTS.[1]

THE fourth volume of the "Hope Reports" contains twenty papers bearing upon the study of insects in particular and the theory of natural selection in general. The most important of these is Mr. Shelford's paper on mimetic insects and spiders from Borneo and Singapore.

So long as we had only a few isolated cases of mimetic resemblance between animals belonging to different families or orders, it was possible for the opponents of the theory of natural selection to make light of them or to urge with some force the argument of the influence of similar external conditions, but as the number increases the difficulty of accounting for these wonderful mimetic resemblances by any other theory than that of natural selection becomes insurmountable. Mr. Shelford's list of mimics and their models is a long one, and as his description is accompanied by valuable field notes and is illustrated by five excellent coloured plates, it forms one of the most important contributions to the literature of the subject which has yet been published. The figures were drawn from the dried specimens as they arrived in this country, and in some cases the mimicry does not seem to be a very close one as it may be judged by the illustrations only, but it is in these cases that the value of the field notes lies.

In the description of a fly belonging to the genus Sepedon that mimics a hymenopteran (*Collyris emarginata*, Macl.), Mr. Shelford says:—

"Both of the species now under discussion were caught together on the wing on Mt. Serambu, Sarawak, and when seen alive and actively moving about were not readily distinguishable. As cabinet specimens they furnish an instance of the importance of field-work in the study of mimicry, and of the unreliability of dead impaled insects or mere figures unless, indeed, both are prepared with reference to careful observations of the living forms. The fly when alive was of a very brilliant blue like that of the Collyris, but the colour has now faded to a dusky indigo, while the abdomen being much shrunk detracts considerably from the previous resemblance. The legs are brilliant red, and constituted one of the most conspicuous features of both fly and beetle."

The tables that Mr. Shelford gives of the arrangement of these insects which mimic and are mimicked into convergent groups should be carefully studied by naturalists who may have the opportunity to study insects in the tropics.

An important series of experiments on the colour relation between lepidopterous larvæ and their surroundings is described by Prof. Poulton. In *Gastropacha quercifolia* the susceptibility to the colour surroundings appears to be restricted to the younger stages of the larva, but in further experiments Prof. Poulton found that in *Amphidasis betularia* every stage except the first and the fifth or sixth is

1 "The Hope Reports." Vol. iv., 1900–1903. (Printed for Private Circulation.)

sensitive. These striking differences in the sensitiveness of two caterpillars to the colour of their environment are highly suggestive, and we may hope that these interesting results will be followed by further investigation on the same lines. The paper is illustrated by some beautiful coloured plates of the effects of lichen and variously coloured bark upon the colour patterns of the caterpillars.

Of the other papers in the volume, attention may be directed to Mr. Guy Marshall's interesting essay on conscious protective resemblance, and to Dr. Dixey's account of the Lepidoptera of the White Nile with some excellent cases of seasonal dimorphism in which the cryptic colour is pronounced in the dry season form.

Mr. Annandale gives a remarkable account of the mantis of the Malay Peninsula that resembles the blossom of a Melastoma, and Prof. Poulton records the capture of a swarm of *Hypolimnas misippus* on a ship 500 miles from the nearest land.

It is quite impossible to do justice in a short notice to the many interesting features of this volume, but enough has been said to show that the activity of the workers in connection with the Hope Department of the Oxford Museum continues, and that the results obtained are of striking value, not only to the specialist in entomology, but to the great body of naturalists in general who have at heart the important problems of the theory of evolution.

S. J. H.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student, commencing residence at the college in October, 1904. Applications should be sent to the Master of Emmanuel not later than October 1.

MR. CARNEGIE has given 10,000*l.* to Kenyon College to endow a professorship of economics.

PROF. T. G. BONNEY, F.R.S., will deliver during May, at University College, two lectures in advanced geology on the subject, lessons from geological mistakes:—(1) about rocks; (2) about ice action.

CARDIFF University College has received an additional donation of 550*l.* from the Drapers' Company towards its building fund. The company has already contributed 10,000*l.* for this purpose.

DR. F. H. NEWMAN has been appointed educational adviser to the Durham County Council, and Mr. Hugh Ramage, of St. John's College, Cambridge, has succeeded him in the office of director of higher education for the City of Norwich.

AN interesting feature of the appeal issued on behalf of the fund for providing new and adequate buildings for the University College of North Wales is the liberal response which has been made by old students of the college, the amount already subscribed or promised from this source being no less than 1313*l.*

THE second volume of the report, for the year 1902, of the U.S. Commissioner of Education has reached us from Washington. This part of the report is devoted largely to statistics, from which it is easy to arrive at the exact state of each grade of education in the United States. We notice under the information given respecting universities, colleges and technological schools that the total amount of benefactions reported during 1902 by the several institutions for higher education amounted to 3,408,000*l.*, of which upwards of 2,500,000*l.* was received by thirty-one universities and colleges of university standing benefiting to the extent of 20,000*l.* or more.

AT a special meeting of the general council of the University of Glasgow held yesterday Lord Kelvin was unanimously elected to the Chancellorship. Tuesday, April 19 will be observed as commemoration day at the university. In the morning an oration will be delivered by Sir William Ramsay, K.C.B., on "Professor Joseph Black, M.D., of the University of Glasgow (1756 to 1766)," the enunciator of the doctrine of latent heat; and honorary degrees will be conferred. In the afternoon the medallion of the late Prof. John Young, M.D., will be unveiled in the Hunterian Museum. At a university banquet to be held in the evening Sir William Ramsay will be entertained as the guest of the evening.

A CORRESPONDENT of the *Times* states that the Secretary of State for India has sanctioned the decision of the Government of India to establish an agricultural research station, with an experimental farm and an agricultural college, at Pusa, in the Darbhangah district of Bengal, and to devote to the purpose the donation of 30,000*l.* entrusted to the Viceroy by Mr. Henry Phipps for some object of public utility, preferably for scientific research. The farm is to serve as a model for similar institutions under provincial Governments, some of the existing institutions being in need of improvement. Lines of experiment are to be initiated and tested before being recommended for trial under local conditions on the provincial farms; seed of improved varieties will be grown for distribution in the different provinces; results reported from other farms will be tested; scientific research work will be carried on; and practical training will be given to students at the college, which is to be known as the Imperial Agricultural College. The students' course will be one of five years, and it will be open to young men from all parts of India. Mr. Bernard Coventry, manager of the Dalsingh Serai estate, has been appointed principal, and enters upon his new duties forthwith, but the college will not be ready to receive students until August or September of next year.

THE third annual general report of the Department of Agriculture and Technical Instruction for Ireland serves admirably to show the great improvement in scientific education in Ireland since the transfer of the administration of the Science and Art Vote from South Kensington to Dublin in 1901. Many instances of this improvement could be given from this report for 1902–3, but one will suffice to show the extent of the activity of the new Irish department. With the aid of direct grants from the department out of the Science and Art Vote, and of indirect grants out of the department's endowment through technical instruction committees, 184 secondary school laboratories, involving an expenditure of, approximately, 35,000*l.*, have been fitted and equipped within two years. When it is remembered that in April, 1901, there were but six science laboratories in secondary schools in Ireland, and that there are now 190 laboratories, with provision for 3500 students working simultaneously, the rapidity with which the department's programme has been adopted will be understood. Laboratories are now recognised in Ireland as an essential part of secondary school provision just as much as desks, blackboards and maps.

AN important Minute on Indian education has been issued and a summary of it was published in the *Times* of Monday. The Minute deals with education of all grades, and with the educational needs of girls and women as well as of boys and men. Referring to university work, the State document points out that it has been realised in India that universities which are merely examining boards tend to accentuate the defects of the Indian intellect—the disproportionate development of the memory, the incapacity to observe and appreciate facts, and the taste for metaphysical distinctions. It is proposed, as a result of the recent commission, to reconstitute the unwieldy senates of the universities, to define and regulate the position and powers of the syndicates, and to extend by law to graduates the privilege of electing members of the senate. The universities will be empowered to provide teaching, while collegiate teaching will be tested not merely by examination, but by systematic inspection, and a higher educational standard will be enforced from affiliated colleges. Such colleges must have a properly constituted managing body, an adequate teaching staff, suitable buildings and equipment, students' residences, sufficient funds, and a proper scale of fees. Government is prepared to afford liberal financial aid to enable the universities and affiliated colleges to adapt themselves to these new conditions, trusting also that such aid may stimulate private beneficence. As regards Indian technical education, the Minute states it has hitherto been

mainly directed to the higher instruction needed to train men for engineering and other employments in Government service or in mines, mills, &c. Valuable work has been done in colleges of engineering and science, and their development is of great importance. But, with a view to the development of Indian industries by native capital for the supply of Indian markets, special technical training must be afforded, resting on the basis of a simple and practical general education acquired in the ordinary schools. In order to provide qualified men for improving Indian industries Government intends to offer scholarships to enable selected students to obtain technical instruction in Europe and America, and it invites the advice and aid of the commercial community in selecting the industries to be studied, in choosing the students, and in turning the knowledge acquired to practical account.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, March 15.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Mr. R. **Lydekker** read a paper on the skull and markings of the quagga, in which he directed attention to vestiges of the face-gland of Hipparion in the skull, and expressed his belief that certain alleged differences in the colour and markings of various specimens of the quagga were due to feeding or to the manner in which such markings came out in photographs. Mr. Lydekker also read a paper on the wild ass of Mongolia, of which an example was in possession of the president at Woburn Abbey, and expressed his opinion that it was the true *Equus hemionus* of Pallas, and distinct from the ass of Tibet and Ladak. The latter he proposed should bear the name *Equus hemionus kiang*.—Mr. R. I. **Pocock** described a new species of spot-nosed monkey, of the genus Cercopithecus, from Benin, West Africa.—Mr. F. E. **Beddard**, F.R.S., read the first of a series of papers entitled "Contributions to the Anatomy of the Lacertilia." It dealt with the venous system of *Iguana tuberculata, Tiliqua scincoides*, and *Varanus griseus*.—Mr. Percy I. **Lathy** contributed a paper dealing with a collection of butterflies from Dominica, West Indies, of which three were described as new and thirteen had hitherto not been recorded from the island.

Faraday Society, March 21.—Dr. O. J. Steinhart in the chair.—On the electrolytic analysis of gold: F. M. **Perkin** and W. C. **Prebble**. The object of the researches described was to arrive at an electrolytic method of estimating gold which should be perfectly accurate and yet far more rapid than the ordinary double cyanide method. Solutions of sodium thiosulphate, of cyanide, of sodium sulphide, of potassium thiocyanate and of ammonium thiocyanate were all tried and the results compared. The first named was useless; of the others—which are all accurate—the thiocyanates gave the best results, and the ammonium salt was better than the potassium. With currents of 0·2 amp. per sq. dcm. the deposition of 0·05–0·08 gm. of gold was complete in 5 or 6 hours. With a current of 0·4–0·5 amp. 1½ to 2 hours sufficed.—Thin-film electrolysis, and a proposed application to printing: C. R. **Darling**. While investigating a process for letterpress printing by electrolysis without the use of ink—an extension of Bain's well known telegraphic printing—the author found that the final results of electrolysis, when the electrolyte forms only a thin film, often differ materially from those observed in an ordinary cell. In these experiments a carbon or metal plate (it was immaterial which) formed the anode; on this was placed an impression pad, consisting of some sheets of moist blotting-paper, upon this was the trial sheet, carrying the electrolyte film, and on this the kathode type or coin. The first experiments were made with saline solutions; silver nitrate gave a clear, permanent black image of the type, but the paper, of course, darkens on exposure; copper sulphate and nitrate yielded images that faded after a time; the same unexpected result occurred with lead, mercury salts and bismuth. The best images were obtained with manganese salts.

Physical Society, March 25.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Note on the measurement of small inductances and capacities and on a standard of small inductance: Prof. **Fleming**. The author referred to a paper read before the society last year by Mr. W. C. Clinton and himself, in which a motor-driven commutator was employed to measure small inductances. It had since been found that very good results could be obtained in the measurement of small inductances by Prof. Anderson's method by using a telephone in place of a galvanometer and a buzzer in the battery circuit. The author had found that for long solenoids, at least 50 diameters long, the inductance could be calculated with an accuracy of about 1 per cent. by the rule:—Inductance in cm. = (length of wire in one unit length of solenoid) × (total length of wire in the whole solenoid in cm.).—A hot-wire ammeter for measuring very small alternating currents: Prof. **Fleming**. The author said that in alternating current work, particularly in taking the power factor of small transformers and of short lengths of cables, the need had been felt for an ammeter not involving the use of iron capable of measuring currents as small as 0·01 or less of an ampere. He exhibited an ammeter capable of being made to read currents as small as 0·002 with fair accuracy. The arrangement was as follows:—Two very fine platinoid or constantin wires, about 1 metre long and 0·05 or even 0·02 mm. diameter, are supported on a wooden rod with arrangements for adjusting their tensions. These wires are 5 mm. apart, and are held down at the centre by delicate spiral springs. The two wires are embraced at the middle by a small loop of paper carrying a very small plane mirror. These wires are enclosed in a box, the lid of which carries a lens. By this means the light of a straight carbon filament of a glow-lamp, or of a slit illuminated by an arc lamp reflected by this small mirror can be focused on a screen of ground glass. If a current is passed through one of these wires it sags down slightly, and the square root of the displacement of the image on the screen is almost exactly proportional to the current passing.—Dr. W. **Watson** exhibited and described a form of ammeter for small alternating currents. The current to be measured flows through a piece of iron wire bent into the form of a right angle. This is linked with a similarly shaped piece of nickel wire forming part of a galvanometer circuit. The thermo-E.M.F. at the junction, produced by the heating effect of the current, sends a current through the galvanometer which can be measured in the usual way. The current to be measured is practically proportional to the deflection of the galvanometer.—Energy of secondary Röntgen radiation: C. G. **Barkla**. To measure the intensity of radiation electroscopes were placed in a primary beam of Röntgen rays and in a secondary beam proceeding from air in a direction perpendicular to that of propagation of the primary rays. By comparison of the two rates of leak when no absorbing plates were used and when similar aluminium plates were placed before each electroscope, it was found that the absorbability of the secondary rays differed from that of the primary by less than 5 per cent. of its value. It was, however, found that a secondary beam of the same intensity as the primary would produce a slightly different number of ions in a given volume of air, consequently the radiations differ slightly in character. The difference in what may be called the "ionising powers" was evidently greater when the primary beam consisted of more penetrating rays. The fraction of energy lost in secondary radiation was very nearly, if not entirely, independent of the character of the primary radiation. The law which the author had previously found to govern the intensity of radiation from gases was found to be equally applicable to those light solids which are the source of a radiation differing little in character from the primary, *i.e.* the energy of secondary radiation from these substances situated in a beam of definite intensity is proportional to the quantity of matter through which the primary beam passes.

PARIS.

Academy of Sciences, March 28.—M. Mascart in the chair.—On the physical constants of some fluorides of phosphorus: Henri **Moissan**. Phosphorus trifluoride, pentafluoride, and oxyfluoride were liquefied after careful purification, and their melting points and boiling points determined by means of an iron-constant in thermo-couple.—On the production of quartziferous rocks in the course of the eruption of Mont Pelée: A. **Lacroix**. From an extended series of observations on Mont Pelée, the conclusion is drawn

that the crystallisation of quartz in a volcanic magma does not necessarily require a great depth, and that the conditions regarding pressure, apparently indispensable for the mineralising action of steam, may be realised near the surface, as in the dome of Mont Pelée.—M. Guichard was elected a correspondant for the section of geometry in the place of M. Lipschitz.—On the possibility of showing, by a contrast phenomenon, the objective action of the *n*-rays on luminous calcium sulphide: J. Macé **de Lépinay.** M. Blondlot has shown that whilst the luminosity of the phosphorescent surface when the rays strike it at nearly normal incidence is increased, it is diminished when the angle of incidence is very oblique. Advantage is taken of this, two screens being arranged, the one vertical and the other nearly horizontal, the intensity and angle being adjusted so that in the absence of the *n*-rays the two appear exactly alike. Under the influence of the rays, the one increases and the other decreases in luminous intensity, the contrast of the two rendering the effect more striking.—On the applications of the diastoloscope to the study of the displacements of luminous objects: C. **Chabrié.**—On osmosis, a reply to M. A. Ponsot: A. **Guillemin.**—The factors of equilibrium, capillary pressure and gravity: A. **Ponsot.** Some applications of the phase rule.—On the properties of curves representing indifferent states: A. **Ariès.**—On the coagulation of colloidal solutions: Jacques **Duclaux.**—The separation of chromium and vanadium: Paul **Nicolardot.** The separation is effected by the formation of chlorochromic acid by the action of fuming sulphuric acid in the presence of a chloride.—The preparation of ether oxides by means of magnesium compounds and halogen methyl ethers, XCH_2OR: l'Abbé J. **Hamonet.** Bromo-methyl ethers are readily acted upon by alkyl-magnesium compounds, giving higher homologues of the ethers. Methyl benzyl, amyl propyl, and phenyl-ethyl methyl ethers have been prepared in this way, the yields being very good.—On nitrogen phosphorus bases of the type $(RNH)_3P.NC_6H_5$: P. **Lemoult.**—The application of acetylene gas to the heating of an incubator by means of an automatic temperature regulator: H. **Joffrin.**—New observations on the diastatic formation of amylocellulose: A. **Fernbach** and J. **Wolff.**—Cephalisation in the annelids and the question of metamerism: A. **Malaquin.**—On the morphology of the trypanoplasma of *Phoxinus Laevis*: Louis **Léger.**—The subterranean fauna of the caves of Padirac: Armand **Viré.**—The endophytic fungus of orchids: Noel **Bernard.** In a previous paper the author has shown that a fungus is necessary in the fertilisation of a particular species of orchid, and an endophytic fungus, morphologically identical, has now been isolated from other species of orchids of diverse origin.—On the earthquakes of Roumania and Bessarabia: F. de Montessus **de Ballore.**—The emission of the *n*-rays in phenomena of inhibition: Augustin **Charpentier** and Édouard **Meyer.**—On the origin of lactose. Experimental researches on the ablation of the mammary glands: Ch. **Porcher.**—The resistance of rats to arsenical poisoning: F. **Bordan.** Rats can support doses of arsenic three times greater than those recognised as being fatal to man. They are more susceptible to small daily doses.—The action of formic acid on the organism: L. **Garrigue.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 7.

LINNEAN SOCIETY, at 8.—The Morphology and Anatomy of the Stem of the Genus Lycopodium: C. E. Jones.

RÖNTGEN SOCIETY, at 8.30.—Exhibition Evening.

FRIDAY, APRIL 8.

GEOLOGISTS' ASSOCIATION, at 8.—On the Metamorphism of Sediments: G. Barrow.

MALACOLOGICAL SOCIETY, at 8.—Description of apparently New Species of Corbicula, Melania, Vivipara and Lagochilus from Java: Rev. R. Ashington Bullen.—The Hawaiian species of Opeas: E. R. Sykes.—On some Non-marine Hawaiian Mollusca: C. F. Ancey.—Description of a New Species of Ancilla from New Zealand: Rev. W. H. Webster.—Report on a Small Collection of Helicoids from British New Guinea, with Description of a New Species: G. K. Gude.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Milky Way Charts of the Heavens on Argelander's Scale 1°=20mm.; with Description of the Lenses and Mounting by H. Dennis Taylor and Alfred Taylor: J. Franklin Adams.—Observations of the Minor Planet (324) Bamberga at Windsor, N. S. Wales: John Tebbutt.—Corrected Continuation of Brünnow's "Tafeln der Flora": A. M. W. Downing.—Note on Elliptic Motion: Asaph Hall.—The Rousdon Variable Star Observations: H. H. Turner.—Measures of the Double Stars in Struve's "Mensuræ Micrometricæ," collected and discussed: Thomas Lewis.

MONDAY, APRIL 11.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Volatilisation of Lead Oxide from Lead Glazes into the Atmosphere of a China Glost Saggar and its Effect upon the Leadless Glaze Ware in the same Saggar: W. Thomason.—The Preparation of Lead Glazes of Low Solubility and some Points to be Observed in the Process: W. A. Thomason.—The Action of certain Solutions upon Aluminium and Zinc: Watson Smith.

ARISTOTELIAN SOCIETY, at 8.—The Em tional Origin and the Assumed Objectivity of Moral Judgments: Dr. Edward Westermarck.

VICTORIA INSTITUTE, at 4.30.—The Conception of the Great Reality: T. Klein.

TUESDAY, APRIL 12.

ROYAL INSTITUTION, at 5.—The Transformation of Animals: Prof. L. C. Miall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Recent Developments in Cargo and Intermediate Steamers: Edwin W. de Rusett.

WEDNESDAY, APRIL 13.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Microscopic Examination of Metals (Illustrated by Lantern Slides): J. H. B. Jenkins and D. G. Riddick.—Cod Liver Oil and other Fish Oils: J. F. Liverseege.—Note on Mushroom Ketchup: J. F. Liverseege.

GEOLOGICAL SOCIETY, at 8.—On the Discovery of Human Remains beneath the Stalagmite Floor of Gough's Cavern, near Cheddar: H. N. Davies.—The History of Volcanic Action in the Phlegræan Fields: Prof. Giuseppe de Lorenzo.

THURSDAY, APRIL 14.

ROYAL INSTITUTION, at 5.—Dissociation: Prof. Dewar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Direct Reading Measuring Instruments for Switchboard Use: K. Edgcumbe and F. Punga. (Continuation of discussion.)—Eddy Currents and Eddy Current Losses in Cable Sheaths: M. B. Field.

MATHEMATICAL SOCIETY, at 5.30.—On a Plane Quintic Curve: Dr. F. Morley.—Mathematical Analysis of Wave-propagation in Isotropic Space of p Dimensions: H. T. Havelock.—On Functions Generated by Linear Difference Equations of the First Order: Rev. E. W. Barnes.—Note in Addition to a Former Paper on Conditionally Convergent Multiple Series: G. H. Hardy.—Spherical Curves. Part II: H. Hilton.—Perpetuant Syzygies of Degree Four: P. W. Wood.—Transformations of the function $F([\alpha][\beta][\gamma].x)$: Rev. F. H. Jackson.

FRIDAY, APRIL 15.

ROYAL INSTITUTION, at 9.—Korea and the Koreans: Rt. Rev. Msgr. the Count Vay de Vaya and Luskod.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Discussion*: Compound Locomotives in France: M. Edouard Sauvage.

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