THURSDAY, JUNE 1, 1911.

AFRICAN VEGETATION.

Die Vegetation der Erde. Sammlung pflanzengeographischer Monographien. By Prof. A. Engler and Prof. O. Drude. ix., Die Pflanzenwelt Afrikas, insbesondere seiner tropischen Gebiete. Grundzüge der Pflanzenverbreitung in Afrika und die Charakterpflanzen Afrikas. By A. Engler. Band i., Allgemeiner Überblick über die Pflanzenwelt Afrikas und ihre Existenzbedingungen. 1 Hälfte (Heft i.), pp. xxviii+478. 2 Hälfte (Heft ii., und iii.), pp. xii+479–1029. (Leipzig: W. Engelmann, 1910.)

THE botany of Africa, especially of tropical Africa, has for the last twenty years attracted much attention among systematists, both in this country and on the Continent of Europe. The important and exhaustive "Floras" of South and Tropical Africa organised at Kew have, after a period of abeyance, progressed steadily towards completion. Many books and papers dealing with more restricted areas have been published, such as the enumeration of Dr. Welwitsch's Angolan collections, the important work on the vegetation of German East Africa, edited by Dr. Engler, of Berlin, and Dr. Wildemann's finely illustrated volumes on the botany of the Congo region. The results of various expeditions, many of which have been largely due to individual effort, have also added much to the botanical literature of this great continent. Towards the achieving of these results no one has worked harder or displayed greater zest than Dr. Engler. Not only has he made good use of the members of his staff at the Berlin Botanical Museum in working up the great mass of material which has been collected chiefly from the German colonies, but has also himself made botanical expeditions in various parts of the continent. Dr. Engler was therefore eminently fitted to prepare a general account of the vegetation of Africa, and the two substantial volumes in which this account is embodied form a valuable addition to the important series of monographs on plant geography issued under his own and Prof. Oscar Drude's editorship.

The greater part of the book, to be precise 870 out of a total of 1019 pages, is occupied with the introduction, a general review of the vegetation of the continent. This takes the form of a series of chapters descriptive of the vegetation of as many areas differing largely in size and importance. Chapter i. (pp. 1–50) deals with Mediterranean Africa, from Morocco to Egypt, and the Sahara. Chapter ii. (pp. 51–478), "Tropical East Africa to Eastern Capeland," deals with the vast area extending from Nubia and Somaliland to the Karroo district of Cape Colony, and includes among its principal subdivisions the Abyssinian flora, the floras of the Somali peninsula, of the Masai highlands, of German East Africa, Nyasaland, Portuguese East Africa, Rhodesia, the east Kalahari district, and the Karroo. The rich and characteristic flora of south-west Cape Colony forms the subject of the third chapter, while the fourth—"the extra-tropical and tropical summer-rain district of West Africa"—is concerned with the enormous area stretching from Namaqualand and Hereroland to Senegambia, and including the Huilla highlands, Angola, the Congo basin, the area of central tropical Africa from the Upper Congo to Uganda and the Great Lakes, the Ruwenzori district, the Cameroons (treated in some detail), Central Guinea or Togoland, Upper Guinea, and Senegambia. The fifth and last chapter deals with the vegetation of the Cape Verdes, the Canary Islands, and Madeira.

A perfect uniformity of treatment of these numerous and widely different areas, some only of which have been indicated above, could not be expected, and Dr. Engler is naturally most exhaustive in dealing with provinces the botany of which he has had most opportunity of knowing, namely, those under German government in East and West Africa. But his review as a whole forms a valuable *résumé* of the work which has been done on the botany of the various parts of the African continent, and gives, so far as is possible from the data to hand, a useful account of the chief characteristics of their vegetation. It shows not only what has been done, but, a matter of equal importance, what still remains to be done. Perhaps the most striking feature of this portion of the work is the wealth of illustration; the pictures occupy almost if not quite as much space as the text. There are more than fifty whole-page plates, beautiful photographic reproductions of vegetation, plant associations, or landscape. In addition there are more than 700 text figures, many of which occupy a full page; these illustrate habit or form of individual plants, or are botanical analyses of one or more species. The illustrations alone give a good idea of the characters of the vegetation of the district under discussion. Mention should also be made of the carefully elaborated list of botanical collectors classified according to districts, which precedes the text proper. Associated with this is a map indicating the routes and collecting stations of the more important collectors. Three other maps illustrate the vegetation of German South-West Africa, the Cameroons, and Togoland respectively.

The comparatively small portion of the book which remains after the introduction, is divided into four parts. Part i. deals mainly with climate—temperature and rainfall—of the tropical and north and south extra-tropical areas; it also includes a chapter on the nature of the soil. Part ii. gives a brief general account of the vegetation of a series of altitudinal regions—tropical rain forest, tropical steppe region, subtropical bush and grass region, subtropical high forest region, and subalpine and alpine regions. Part iii. deals similarly with the various formations—halophilous, including littoral and interior (such as occur in the Sahara in the north, and the Kalahari in the south); hydrophilous, including alluvial forest, marshland, lake, and river vegetation; hygrophilous megatherm, the evergreen rain-forest vegetation; hygrophilous mesotherm—the bamboo forest, high mountain bush, and damp meadow vegetation of the higher regions of the tropical mountains or the slopes

of the subtropical; subxerophilous, such as occur in districts with a short rain season of three to four months or a limited mist formation—a very extensive and diverse series, including the grass steppes at different altitudes, the dry wood- and bush-formations, and subalpine and alpine areas; and, finally, the true xerophilous formations. The fourth and last part contains an elaborate series of lists of orders and genera displaying the various component elements of the African flora, such as a general tropical element, palæotropic, African - Asiatic, African - Malagasy, American-African, Mediterranean-African, endemic tropical, and others. There is also a short sketch of the development of the African flora.

The difficult problem of indexing so extensive and elaborate a sytematic work has been solved by supplying an exhaustive table of contents and by confining the index to names of plants which are figured in the text. A. B. R.

THE ALTERNATE-CURRENT TRANSFORMER.

Transformers: a Treatise on the Theory, Construction, Design, and Uses of Transformers, Auto-transformers, and Choking Coils. By Prof. H. Bohle and Prof. D. Robertson. Pp. xiv+356+Tables A and B+18 plates. (London: C. Griffin and Co., Ltd., 1911.) Price 21*s.* net.

THIS very complete treatise on the alternate current or static transformer will no doubt be found of considerable value in the drawing office of practical transformer builders, and also by teachers and advanced students. Whoever uses it, however, will have to possess time and patience as well as very good eyesight to master the symbolical notation the authors have seen fit to employ, which to most ordinary readers will prove in certain respects exasperating. In dealing with simple periodic or variable quantities, such as alternating currents, electromotive forces, and fluxes, a widely used custom has been adopted of employing small letters for instantaneous values and corresponding large ones for the maximum values, and either brackets or bars over a letter to denote R.M.S. values. The authors of this book have adopted the plan of printing a little $^{\text{I}}$ inside the capital letter to denote the instantaneous value, and a little $^{\text{M}}$ to denote the maximum value. These special symbols are for most eyes quite illegible without the aid of a magnifying glass, and can only be described as producing the maximum amount of eye and mind strain to read them.

Again, most mathematical writers now employ block letters or clarendon type to signify vectors, but the authors of this book have turned their backs on this useful practice, and used block letters such as **T** and **N** to signify scalar quantities such as time, or mere numerics such as number of turns. This may seem to the non-mathematician to be a small matter, but at a time when an International Committee is endeavouring to obtain something like order and uniformity in technical symbolisation, it is a great pity for any authors to display an exuberance of ingenuity in devising symbols which have never been used before, and are not likely to be used again.

Apart, however, from the difficulties of perusal introduced by this deviation from beaten paths, the authors have produced a book which has many valuable qualities. It is characterised by admirable illustrations prepared from photographs of actual transformers, parts, and appliances, and also by excellent plates giving working drawings of transformers in use, which are rendered all the more useful by appended millimetre and inch scales.

There are also a large number of curves delineating the co-variation of pairs of important quantities.

The book is divided into twelve chapters covering general principles, magnetising and no-load currents, losses in transformers, temperature rise, magnetic leakage, transformer vector diagrams, systematic testing, insulating materials, examples of construction, design of transformers, applications of transformers, and polycyclic systems. Having regard to the fact that so much has been written on the subject of transformers, there is a remarkable absence of all references, either in footnote or text, to the work and writings of previous authors.

The subject of the alternate-current transformer has been treated from the point of view of theory and of the student with such completeness in the works of Blakesley, Fleming, Kapp, Bedell, Bedell and Pierce, Rhodes, and many others that the chief room for addition seemed to be in a practical treatise on the design of transformers, giving rules for the systematic predetermination of all dimensions and quantities to a prescribed specification.

This the authors have done in their chapter x., and have added also complete worked out specifications for transformers and choking coils of various sizes and types. These, however, would have been rendered more valuable if the actual results of tests of these transformers had been given to show how far the predetermined values agree with measured ones.

The chapter on testing of transformers seems deficient in not laying sufficient stress upon the measurement of secondary drop or giving good methods for determining it at all loads. When transformers have to be banked to work in parallel, the identity in their drop curves is most important, as otherwise one or more transformers may be overloaded or may overheat. Bragstad's and Kapp's diagrams for transformer regulation are, however, given and explained in the chapter on transformer diagrams.

It would require much time and, in addition, considerable expense to check or test the formulæ given by the authors for dimensions of transformers to comply with certain specified requirements, but the results are for the most part embodied or condensed into tables, which the practical transformer manufacturer can speedily bring into comparison with practice. The book, however, in many respects fills a distinct gap in transformer literature, and will no doubt be of great use to draughtsmen who are responsible for overhauling or improving a line of stock transformers to reduce cost or improve their working. It only remains to add that the book is excellently printed, and in this respect a model of what technical publications should be.

THE FEEDING OF CROPS AND STOCK.

The Feeding of Crops and Stock. An Introduction to the Science of the Nutrition of Plants and Animals. By A. D. Hall, F.R.S. Pp. xvi+298. (London: John Murray, 1911.) Price 5*s.* net.

THIS volume is the third of a series by Mr. Hall dealing with some of the scientific aspects of farming, and, like the preceding treatises, on "The Soil" and "Manures and Fertilisers," gives an exceedingly clear and able exposition of the principles of crop and stock feeding, valuable alike to student, teacher, and practical farmer. It might be well if Mr. Hall would at a convenient time consider the rearrangement of the series, as at present there is some overlapping of subjects which is particularly noticeable in the present volume.

The first four chapters are devoted to the study of the growth of and the chemical changes occurring during the growth of plants. The important points in this process are illustrated by simple experiments which can be performed without the aid of complicated apparatus, and which we particularly commend to teachers of "nature-study" in our elementary and secondary schools. Chapters v. to viii. deal with matter which is more fully elaborated in Mr. Hall's work on "The Soil." Chapters ix. to xi. break fresh ground in dealing with the animal and its food requirements, whilst chapters xii. and xiii. are digests of Mr. Hall's treatise on "Fertilisers and Manures," the last chapter, xiv., containing a short account of the composition of milk and other dairy products.

The subject of the feeding of animals is one to which we could wish the author had devoted more space. Rothamsted has a wealth of results of its researches on the feeding of plants, but the subject of animal feeding has not received the same attention, though by this it must not be understood that extremely valuable work in that direction has not been accomplished, but it is a sad fact, appreciated by all workers in agricultural science, that in England we have no well-equipped station for the carrying on of necessary research in animal nutrition. The United States and Continental nations have seen the importance of such work, and the experimental work of these countries is rich in results, of which Mr. Hall has made excellent use, and we feel confident that had Rothamsted the equipment for such work which its reputation and the *personnel* of its present staff deserve, our knowledge of the feeding of animals would be greatly increased, to the benefit of the stock feeders of the country. Will not some friend of agriculture come forward and establish at Rothamsted a digestion calorimeter and endow its efficient service?

Mr. Hall has, in the work under review, disposed of many fallacies with regard to plant and animal nutrition, and we would commend to all practical men the pages dealing with the valuation of foods and the use of the various constituents of foods in the stages of fattening. (An omission in proof correction of the first few lines of p. 181 in speaking of the cottoncakes may give rise to some misunderstanding.) To the stock farmer it will be obvious that there is much in the book to interest, and if not to instruct him, at least to explain the principles on which his good practice depends, and to the arable farmer there is also much which, from the purely practical point of view, may show the way to economics in manuring by a well-reasoned explanation of the influence of manurial constituents on plants having differing range of root action, differing periods and durations of growth, and differing final products to build up. Such an important point as the quality of wheat is elaborated, with a due consideration of all the factors, and one-time accepted theory that the order of the evaluation of the protein and starch is the cause of the wide variations in quality between strong Canadian and weak English wheats is regarded as untenable.

As has been already stated, many formerly accepted theories are rejected, and sound reasons brought forward for their rejection, the reasons for crop rotations, the acid excretion by roots, the changes induced by ensiling, the use of preservatives for farmyard manure, effect of food on milk, are among many changes of opinion which have been brought about by accurate researches into cause and effect, and although the practical man is apt to be bewildered by these changes of opinion and to be somewhat sceptical as to the accuracy of present theories, the fault lies with those who have in the past hastily enunciated reasons without due consideration of all the factors, not to those who, like the author of this book, demand that a theory shall be not merely a plausible explanation of phenomena, but something which will rigorously satisfy all requirements, and the truth of which can be demonstrated by an appeal to accurate experiment. M. J. R. D.

PATHOGENIC INSECTS.

Insects and Disease: a Popular Account of the Way in which Insects may Spread or Cause some of our Common Diseases. By Prof. R. W. Doane. Pp. xiv+227. (New York: H. Holt and Co.; London: Constable and Co., Ltd., 1910.) Price 1.50 dollars net.

IN this volume, which gives evidence of considerable research, Prof. Doane has presented the first collective narrative, in popular form, of the principal results which have been achieved in relation to insect-borne diseases, both in man and his domesticated animals. And in order that the layman may the more readily understand the biological relations of the various pathogenic organisms and their intermediary hosts, the author has briefly reviewed some of the more salient points in relation to their structure and life-history; in this way it is believed that the most complex inter-relations may be followed clearly.

Prof. Doane has met a great want in producing this unpretentious volume, in which he has successfully collated the overwhelming evidence of the maleficent agency of certain insects and other allied animals in the dissemination of disease. We feel, however, that he has been a little too credulous in some few instances in accepting evidence which is

not of a thoroughly convincing nature, all the more so, seeing that the work is primarily intended for the layman, who has not the means of sifting out such matter and putting the correct interpretation upon it. Thus in dealing with Malta fever, in a few short sentences he would lead the reader to infer that mosquitoes often serve as the "inoculating" agents, and unfortunately leaves one entirely in the dark as to the true cause of the spread of this disease.

Many of the photographic illustrations which accompany this work are very good; indeed, more especially so are those representative of the various developmental stages of the mosquitoes; we do not agree with the author's statement, however, that all his pictures show "the insects, not as we think they should be, but as they actually are," because both colour values and general morphological characters are in many instances entirely wanting, and the resulting print is nothing more than a silhouette. Moreover, the photographs of both museum and microscopical preparations show a marked absence of care and neatness in the display of the various organs, and such figures as these stand out in marked contrast to those of Manson, Kellog, Nuttall, and others. We would point out also that Figs. 76 and 77 represent a female and male mosquito respectively, and not the reverse order, as stated by the author. *Ochromyia anthropophaga* (p. 49) should read *Auchmeromyia luteola*. The latter, not the former, is the parent of the congo-floor maggot.

This work is furnished with an extensive and useful bibliography occupying forty-seven pages, to which annotations are appended.

SYSTEMATICS.

Die taxonomischen Grenzen der Art und ihrer Unterabteilungen. Versuche einer genauen Definition der untersten systematischen Kategorien. By Andreas Semenov-Tian-Shansky. Pp. 24. (Berlin: R. Friedlaender and Son, 1910.) Price 2*s*.

THIS is the German translation of a pamphlet which appeared first in Russian. It deals on a wide basis with the definition of the term species and the lower categories in classification. The author —whose title, "Tian-Shansky," reminds us of his exploration of the Tian-shan or Celestial Mountains in Central Asia—pleads for uniformity of terminology in the various branches of botany and zoology, and then proceeds to examine critically the opinions of various botanists and zoologists on the criteria of species and its several component varieties. The large experience gained by Semenov from his many years' study of insects, especially Coleoptera, and his acquaintance with at least an essential portion of the literature bearing on the subject, enable him to substantiate his criticisms by illustrations drawn from his own knowledge and to adduce corroborative evidence from the writings of other authors. The co-existent species are defined by the author as units which are morphologically and psycho-physiologically separated from each other. The units thus isolated do not fuse, although very occasional intercrossing may occur. The individuals belonging to a species may all be practically alike, or they may form various kinds of varieties. Semenov defines four principal categories of modifications within a species:—

1. Subspecies or geographical race (*subspecies*) is the most important subdivision of a species, inasmuch as it represents a phylogenetic stage one degree below the complete separation from the parent stock.

2. Nation (*natio*) is a term proposed by Semenov for local varieties which are subdivisions of a subspecies, each *natio* occupying only a comparatively small definite portion of the whole area of the subspecies.

3. Morph (*morpha*) is adopted for the non-geographical varieties which are produced by the action of the seasons, the soil or the food.

4. Aberration (*aberratio*) is employed for purely individual deviations from the normal type.

It appears to us so very difficult and often impossible to draw in nature a distinction between subspecies and nation (=sub-subspecies) that in many cases the employment of one or the other term will entirely depend on the personal opinion of an author. The Greek term *morpha* does not appeal to us as a happy choice, and will hardly recommend itself to systematists generally, who are used to the Latin term *forma*, often employed with a convenient qualifying addition, such as *f. temp.*, for the seasonal form.

The pamphlet is a lucid interpretation of the distinguished author's view, and will be read with great profit by all who are interested in the philosophical aspect of systematics. K. J.

COORDINATE GEOMETRY.

An Elementary Treatise on Coordinate Geometry of Three Dimensions. By R. J. T. Bell. Pp. xvi+355. (London: Macmillan and Co., Ltd., 1910.) Price 10*s*. net.

THE substance of this volume has formed the material of a course of lectures delivered for some years past to undergraduates in Glasgow. Its object is to provide the student, whose bent is towards applied mathematics, with as complete an exposition of the subject as he will require, and at the same time to act as an introduction to those who intend to proceed to a more exhaustive study of differential geometry and the theory of surfaces. Its scope is best indicated by a brief enumeration of the headings of the chapters:—coordinates, direction ratios, the plane and straight line, change of axes, the sphere, the cone, the conicoids, axes of sections, generating lines, confocals, the general equation of the second degree, systems of conicoids, conoids and general surfaces, curves in space, ruled surfaces, curvature, geodesics. It will be noted that there is no mention of homogeneous and tangential coordinates. The author has excluded these on the ground that the student has already acquired a knowledge of the general principles involved from his work in plane geometry. The same consideration has led him to exclude any section on duality or reciprocation. Some teachers will regret this omission, as the student is

always interested in the extension of general processes from two to three dimensions.

For those who are studying the subject with little or no external assistance, this is certainly an admirable text-book. The writer is evidently fully conscious of the kinds of difficulties that beset the inexperienced student. The expository work is excellent throughout, but in particular we may direct attention to the section on the discriminating cubic, the chapter on the intersection of conicoids, and the treatment of tortuous curves, which is always a serious stumbling-block at a first reading. Easy numerical examples are freely provided throughout the text to illustrate the working of each new idea. We are particularly glad to see that a fairly complete set of answers has also been supplied. At the end of each chapter there are sets of harder examples, which include some of considerable difficulty, and the book closes with a useful index.

Within the limits which the author has chosen the volume will be found comprehensive, thoroughly trustworthy, and eminently lucid. Those who have had much to do with higher school work or the junior students at the universities have felt for some time the need of a new text-book on solid geometry. We have no doubt that lecturers and tutors will find this volume most useful for their pupils, and we shall not be surprised if a welcome is extended to it from abroad.

PHYSICAL CHEMISTRY.

Traité de Chimie générale. By Prof. W. Nernst. Ouvrage traduit sur la 6e édition allemande. By Prof. A. Corvisy. Première Partie. Propriétés générales des Corps. Atome et Molécule. Pp. iv+510. (Paris: A. Hermann et Fils, 1911.) Price 12 francs.

IN the movement associated with the rapid development of general chemistry during the last twenty-five years, the apathy displayed by a considerable section of French chemists affords a striking contrast to the activity and enthusiasm which has marked the progress of physical chemistry in other countries. For this state of affairs there can be little doubt that the chief factor responsible is to be found in the influence of the older generation of chemists, whose attitude towards the problem involved in the operation of chemical forces has been determined largely by a patriotic adherence to the doctrines of Berthelot. Signs are not wanting, however, that the resistance, which has been offered to the spread of more rational and modern views, is rapidly decreasing.

The translation of the sixth edition of Nernst's well-known work cannot fail to accelerate the acceptance of these views, and the service rendered by the translator in bringing this classical treatise within reach of the average French student of chemistry is no mean one. Since the appearance of the first edition of the work, published in 1893, the book has undergone many alterations, and by appropriate additions the author has contrived to maintain its character as a thoroughly modern treatise of general chemistry.

Amongst such changes may be noted a more detailed treatment of the molecular theory in its application to the liquid and gaseous states of aggregation on the basis of the van der Waals's and the reduced equations of condition. Considerable modifications have also been made in dealing with the subject of electric conduction, and more particularly with the phenomenon of conduction in gases. The recent rapid progress of knowledge in the domain of colloidal chemistry has also necessitated an extension of the chapter dealing with the colloidal state, and a short section is devoted to the consideration of radio-activity. In this, the author's aim is not so much that of recording the epoch-making discoveries which have been made in recent years, as to show the general bearing of the ideas, which have resulted from these investigations, on the atomic and molecular theories.

As an exposition of the general properties of matter the book occupies a unique position, and the rapid sequence of new editions in the original language is a fitting testimony to the widespread recognition of its intrinsic merits in the country of its origin.

As in the case of many other German publications, exception must be taken, however, to the comparative neglect of the work of physical chemists in other countries. This is doubtless more or less accidental, but it is a matter to which attention might be given by the author in the event of the issue of further editions or translations. The present translation claims to be a faithful reproduction of the German, and, as such, the translator's task appears to have been carried out in a highly commendable manner.

OUR BOOK SHELF.

Elements of Analytical Geometry. By Prof. G. A. Gibson and Dr. P. Pinkerton. Pp. xxi+475. (London: Macmillan and Co., Ltd., 1911.) Price 7*s.* 6*d.*

IT is too often the custom to regard analytical geometry and analytical conics as synonymous terms. Most introductory treatises on Cartesian methods limit their scope to the investigation of properties of curves of the second degree, and it is left to writers on the calculus to supplement this course with a brief mention of the nature and functions of a few higher plane curves. A preliminary course in the use of fundamental formulæ is clearly essential, but so soon as facility in expression and interpretation has been acquired, it is both instructive and interesting for the student to realise their application, not merely to the conic, but to curves of a more general character. We therefore welcome the insertion of a chapter, following immediately after a thorough treatment of the straight line and circle, which introduces the student to the conchoid and cissoid simultaneously with the conic. The next sixty pages are devoted to the investigation of the shapes of curves which have simple algebraic equations of the type $y=f(x)$, with special reference to turning values and asymptotic forms. In some respects, simplicity would be secured by a more direct appeal to the methods of the calculus than the authors care to adopt. Such a treatment as is indicated in Mr. Mercer's recent text-book, entitled

"The Calculus for Beginners," will present little difficulty to those who are sufficiently mature to be able to appreciate the comprehensive work of the present volume, and the consequent abbreviation of analysis will render more prominent the principles which are being illustrated.

Owing to the general character of the structure of this book, it is not until page 318 that we first meet the systematic discussion of the equations of the three species of conics, reduced to their standard forms. These are taken together, and the importance of parametric notation is shown here as in the earlier parts of the book. We are glad to see that Joachimsthal's section-equation is employed for tangent and polar properties, not only because the method is intrinsically instructive, but also on account of its application to homogeneous coordinates. The final chapter gives a brief sketch of the theory of the general equation of the second degree, and a few properties of confocal conics and curvature. The authors have excluded line coordinates, homogeneous coordinates and invariants as being beyond the scope of their work. We have no hesitation in describing this text-book as an excellent introduction to Cartesian methods.

Bathy-Orographical Map of the World on Gall's Projection. (Edinburgh and London: W. and A. K. Johnston, Ltd., n.d.) Prices: Varnished, 12*s.*; unvarnished, 10*s.*

IN showing elevation on a map of the world generalisations are essential, but detail and accuracy must not be sacrificed for the sake of graphic effect if such a map is to have any practical value in teaching. On this map three areas are distinguished in colour on the land, above 5000 feet, 1000 to 5000 feet, sea level to 1000 feet, and below sea level. The 5000 feet line has been inserted with considerable care, and gives a fairly true representation of the main regions of high land, but some further distinction is needed between regions of great elevation, such as Tibet, and moderate heights, such as the Drakensbergen. It must be remembered that the principal use of a world map of this kind will be in connection with the study of climate. The absence of any higher elevations is against its use for, to take two examples, the study of the influence of elevation on temperature and that of high marginal ranges, such as the Himalayas, on wind movements and rainfall. That the map is intended to be used in the study of climate may be judged from the fact that inset maps are given of mean annual temperature and of rainfall. An exception must be made to the statement of the general accuracy of the map with regard to the higher elevations in Canada and Alaska. The result of recent observations has not been incorporated in the case of N.E. Canada, N. and S. of Hudson Strait, in which region are situated the highest mountains of the eastern part of N. America, and the accuracy of the Rockies and coast ranges of the N.W. leaves much to be desired when contrasted with that of the W. of the United States.

The next contour is at 1000 feet, which, in the case of countries such as Africa, largely above that elevation, is at too distant an interval to give an adequate representation of the land surface. A curious error has been made in the case of Great Salt Lake, which is shown as below sea-level. The sea depths are indicated at 100, 2000 and 3000 fathoms, but it is doubtful if these lines, which do not correspond to those shown on the land, will be of much use for the general study of land forms. On the whole it must be said that the map is of little use for advanced geographical work, and is too crowded with unnecessary names for elementary teaching.

Plant-Animals: a Study in Symbiosis. By Prof. F. Keeble. Pp. ix+163. (Cambridge: University Press, 1910.) Price 1*s.* net.

ALTHOUGH notices of two of the small volumes in this series have already appeared in NATURE, it has not been precisely indicated that they are early volumes of a new series of short works, dealing with scientific and literary subjects, and intended for the lay as well as for the professional reader, that was initiated last year by the enterprising University Press of Cambridge. The contribution by Mr. Keeble is particularly appropriate to the series as it represents a complete story, replete with instructive problems and a definite piece of research that has entailed persistent observation, ingenious experiment, and cautious interpretation of results.

The research covers the peculiar life-history of two lowly worms, *Convoluta roscoffensis* and *Convoluta paradoxa*, that inhabit the foreshores of Brittany, where they were studied in the sea and in a small laboratory. The first section of the book relates to their structure, rhythmic movements, and periodic seasons of reproduction, and contains an excellent discussion of their sense attributes as influenced by light, gravity, and memory (mneme). The plant element, in the shape of enclosed green or yellow-brown cells, is considered in the second part of the book, with regard to action, origin, nature, and significance, leading to the conclusion that they are reduced algal cells of the family Chlamydomonadineæ. Instructive as are the facts, quite as much so are the observations, experiments, and arguments from which the conclusions are derived. In fact, it is difficult to say whether one admires more the patience and ingenuity displayed, the careful sifting of evidence, or the logical yet popular exposition. The booklet should be quite understandable to and interest non-scientific readers, yet few botanists will fail to glean information and ideas from its pages.

An Elementary Treatise on Conic Sections by the Methods of Coordinate Geometry. By C. Smith. New edition, revised and enlarged. Pp. x+449. (London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.*

THE merits of this book are so well known that comment is almost needless. Nearly thirty years have passed since it was first published, and since then a few additions have been made from time to time, as experience has suggested. The latest edition is considerably enlarged. The number of illustrative examples has been increased; a section on envelopes has been inserted at the end of the chapter on the parabola; and a concise sketch of the theory of invariants of two conics is given in the concluding chapter. There are many other minor additions which will be found useful, such as occasional paragraphs on points of book-work, which have been hitherto regarded as problems, and three sets of miscellaneous examples.

For scholarship purposes, in our opinion, this book is without a rival. The earlier portions are scarcely full enough for the novice, who probably requires a more extensive numerical introduction to the subject. But as soon as this initial stage is completed, it is quite certain that he cannot do better than turn to this text-book and read it from cover to cover.

There are, of course, some features which are open to criticism. The chapter on tangential coordinates is so compressed that a student may fail to appreciate the power of line coordinates and the analytical interpretation they offer of the principle of duality. Again, many teachers would prefer a direct appeal to the methods of the calculus in tangent properties;

and, lastly, we believe that considerations of simplicity render it desirable to replace trilinear by areal coordinates. To avoid overburdening the memory it is advisable to restrict the student at first to one or other of these systems, and in this case we have little doubt that areals should be regarded as the primary system. These are, however, scarcely more than mere matters of detail, and it is not difficult for the teacher to supply the remedy, if he feels it is needed.

LETTERS TO THE EDITOR.

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

The Forest of Auchnacarry.

BOTANISTS and many others will be very sorry to hear that a large part of what remains of the old forest of Scots firs at Auchnacarry has been sold to the timber merchant, and that the whole of it is likely to be felled ere long. The forest lies in the west of Inverness-shire, near Loch Askaig, on the first, or one of the first, of the glens that run westward from the Caledonian Canal, just north of Fort William. It is on the great estate, and near to the mansion house, of Cameron of Lochiel. While not so old as, for instance, the historic trees of the New Forest, or as that strange grove of oaks at Wistman's Wood, the Scots firs at Auchnacarry are of deep interest and value as perhaps the largest and finest fragment that is left to us of "primæval forest," neither planted nor tended by the hand of man. Its area is about 1500 acres, and the trees are of immense size, being mostly from 200 to 300 years old; the largest have a circumference of about 18 feet at 5 feet from the ground, and the dimensions of a very large number are said to be little less. The scenery of the forest is of great beauty, marking the difference that exists between the natural look of self-grown timber and the stiff, unvaried lines of an artificial plantation. In England we think of the Scots fir as an uninteresting, and even unsightly, tree, unpleasing in colour and often cumbering the ground (as in parts of the New Forest) to the exclusion of more picturesque trees. It is usually planted, as Gilpin said in his "Forest Scenery," "in thick array, which suffocates or cramps them, and if they ever get loose from their bondage they are already ruined." Very different from this description are the beautiful glades at Auchnacarry, where (to borrow words from Sir T. Dick Lauder), "We have seen it towering at full majesty in the midst of some appropriate Highland scene, and sending its limbs abroad with all the unconstrained freedom of a hardy mountaineer, as if it claimed dominion over the savage regions around it." And, to quote Gilpin once again:—"When I speak of the Scots fir as a beautiful individual, I conceive it when it has outgrown all the improprieties of its youth; when it has completed its full age, and when, like Ezekiel's cedar, it has formed its head among the thick branches."

The forest of Auchnacarry is, save for a few isolated trees or small surviving clumps, all that we know to remain of the great forest of Scots fir that once spread over all suitable ground in central Scotland from Ben Nevis to the Spey. There was immense and wholesale destruction of these forests in the latter years of the eighteenth and earlier years of the nineteenth century, owing to the needs of the shipbuilder and to the high price of Baltic timber during the Napoleonic Wars. It was then, for instance, that the great forest of Rannoch was cut down, which, from the borders of Argyll, Perth, and Inverness, stretched far and wide across the country to link with the forests of the Spey, the Findhorn, and the Beauly, as well as with those of the "Great Caledonian Glen." The forest of Glenmore on the Spey was purchased of the Duke of Gordon by a Hull timber merchant in 1783, and out of it he built and launched at the mouth of the Spey "forty-seven sail of ships, of upwards of 19,000 tons burden, the largest of them of 1050 tons." A plank from this great felling is, or was, preserved at Gordon Castle, 6 feet long by 5 feet 5 inches broad. In the early part of last century there still remained large portions of the forest of Rothiemurchus, where for many years together a great income was yielded by the timber, sometimes, it is said, more than 20,000*l.* a year. There were also great stretches left of Lord Seafield's forests of Abernethy and Duthel, though a great part of the former had been destroyed by fire just after the rebellion of 1745. But in these and others the axe was already busy, and nowadays, though here and there a few ancient trees remain, the present writer knows of nothing that is left to us so noble and so extensive, so

Scots Firs at Auchnacarry.[1]

worthy of preservation as a relic of an older Scotland, as this doomed forest of Lochiel's at Auchnacarry. There is much ado when a great picture leaves the country; but to the naturalist and to all tree-lovers the destruction of this ancient forest will seem a greater loss, greater because the object is unique and the loss irreparable.

D. W. T.

The End of the *Beagle*.

DR. WATASE, professor of zoology in the College of Science of this University, has directed my attention to a letter on this subject in your issue of December 9, 1909. In view of the Darwin centenary celebrations of the year before last, and wishing to be fully assured of whatever facts were known regarding Darwin's *Beagle*, Dr. Watase got me to write to my old friend Mr. N. E. Smith, C.B., of the Comptroller's Department, Admiralty, Whitehall. The reputed tonnage (B.O.M.) of the vessel bought by Japan was known to be 523; her length and breadth were variously stated as 150 feet by 25 feet 6 inches and 160 feet by 26 feet. Mr. Smith very kindly traced the following notes with regard to Darwin's *Beagle* and to a subsequent vessel of the same name. His conclusion is that the *Beagle* bought by Japan was not Darwin's, but the later vessel. His letter is as follows:—

"The *Beagle* in which Darwin made the voyage round the world was a 10-gun brig-sloop built at Woolwich in

[1] For this photograph we are indebted to the proprietors of the *North British Agriculturist*.

1820. This *Beagle* was sold, by public auction, to Messrs. Murray and Trainer, for 540*l.*, in May, 1870, having for some years previously served as watch vessel at Southend.

"The next vessel of the name was a first-class gun vessel (screw), built at Blackwall in 1854 and carrying 4 guns. This vessel was serving on the East Indies and China Station in 1862, and in the Navy List of that year is shown as 'ordered home'; but in the following year she disappears from the list, and in Parliamentary Paper No. 560 of Session 1867 ('Navy—Ships sold') she is entered as 'sold abroad' in 1863, for 550*l.* Inquiry has been made of the Contract and the Accountant-General's Department as to whether she was bought by the Japanese, but no information on this point is available, all such records of the period having been destroyed. Doubtless, however, this is the *Beagle* to which the inquiry refers.

"The following are the dimensions of the respective ships :—

	Beagle built in 1820.	*Beagle* built in 1854.
Tons	235	477
Length—		
Gun deck	90	160
Keel for tonnage ...	73′7⅝	143′4¾
Breadth, extreme ..	24′8	25′4
Breadth for tonnage ...	24′6	25
Depth in hold	11	13′3
Light draught—		
Afore	7′7	5′10
Abaft	9′5	8′1

"Initialled W. E. S., 15.12.09."

F. P. PURVIS.

Engineering College, Tokyo Imperial University of Japan, May 9.

Distant Orientation in the Amphibia.

ROMANES, in his book on "Animal Intelligence," suggests that frogs have a distinct idea of locality, and he also expresses the opinion that frogs are able to perceive moisture from a great distance. One of his correspondents found that frogs removed from their habitual haunts for 200 or 300 yards returned to them again and again. Romanes quotes Warden, who, in his "Account of the United States," says that when a pond containing a number of frogs dried up, the animals "made straight for" the next water, though it was 8 kilometres away. During the spring of 1910 I made a series of experiments, which have been continued this year, with the view of settling how newts are able to find their way back to water when they have once left it or have been removed from it. Working with the Palmate newt (*Molge palmata*, Schneid.), I got no evidence of a faculty for the perception of moisture at a distance, and in order to explain the spring migrations of the newt it is unnecessary to presuppose its presence, because I certainly think there is a small homing faculty. My results directly point to this. Romanes gives no details, and more information on this question would be welcomed before I draw up a full account of the experiments. The subject has an important bearing on the psychology of the Amphibia, and must form when elucidated an interesting chapter in their natural history; yet the reference in Romanes is the only one I can find. BRUCE F. CUMMINGS.

Cross Street, Barnstaple, N. Devonshire, May 14.

A Zenith Halo.

WITH reference to Mr. Gold's letter in your issue of May 11 concerning the halo observed by Mr. Kreyer, I should like to make the following remarks. I think Mr. Gold is quite right in assuming that the phenomenon observed was the so-called arc of contact of the halo of 46° radius, which for this altitude of the sun is really almost in contact with that halo, whereas, according to Bravais's theory, supported by numerous observations by Ekama and Besson, for lower altitudes these arcs may be separated by as much as 7° (with the sun at the horizon even 12°). But I think Mr. Gold is mistaken in assuming that the centre was at 80°, or 85° altitude.

Mr. Kreyer's observation that the arc formed part of a circle with the zenith as apparent centre is quite in harmony with Bravais's theory and the numerous observations in our country. Even Pernter, who accepts Galle's theory, besides that of Bravais, does not bring conclusive evidence of the existence of arcs in the same altitude with their centre outside the zenith. It is much more probable that Mr. Kreyer's estimate of 10° or 15° has been too low, as is usually the case with the estimates of arcs near the zenith, and that the real radius was about 20°.

These circumzenithal arcs are not of so little frequent occurrence as one might think from Mr. Gold's letter. Messrs. Besson and Dutheil have observed them at Montsouris 111 times in the course of ten years, and the Dutch staff of voluntary observers sixty-seven times in the same period.

In recent years the observations have been even more numerous in our country. The period 1904–8 gives fifty-five days with observations of circumzenithal arcs; 1904, even thirteen observations by one and the same observer. Perhaps the high altitude of the halo is the reason why it is rarely seen by unskilled observers.

E. VAN EVERDINGEN.

Meteorological Institute, De Bilt (Holland).

THE object of my remarks on Mr. Kreyer's observation was to make it clear that the phenomenon belonged to the class due to refraction through ice-crystals. For that purpose the exact position of the centre of curvature of the arc was immaterial, and in the absence of accurate measurements an altitude of 80° to 85° was sufficiently near the observer's estimate of 90°. Dr. van Everdingen suggests that the radius of the arc may have been 20° instead of 10° to 15° as estimated by the observer. I agree with him, and indeed I thought of suggesting this in my notes, but it seemed just as likely that Mr. Kreyer had made a slight error in estimating the altitude of the centre, and I did not regard the matter of sufficient importance to call for a discussion of the alternatives.

The interest of observations such as those of Mr. Kreyer, where the positions and distances are estimated only, does not rest on the support which they may give to the theory of Bravais or to that of Galle, but now that Dr. van Everdingen has reopened this question, I am sure meteorologists would welcome from him a discussion of the two theories in the light of the more extensive observations to which he refers, which no doubt contain the measurements necessary to prove or disprove the horizontality of the arc. E. GOLD.

Meteorological Office, South Kensington, London, S.W., May 20.

The Yale.

THE animal upon which Prof. Hughes has based the sketches published in NATURE of May 25 (p. 415) is evidently the typical, or white-tailed, gnu. But this is a South African species, the northern limit of which is formed approximately by the Vaal River. How, then, can it represent an animal the home of which was supposed to be Ethiopia? The brindled gnu of East and North-east Africa has horns of an entirely different type. I may add that if Prof. Hughes can definitely identify "the antelope" he will perhaps kindly communicate his information to those who are less fortunately situated in this respect than himself. R. L.

Apple Blossoms.

THERE is a theory that the retardation of the flow of sap tends to the production of fruit as against wood buds, and this retardation for apple and pear trees is effected in various ways—by root-pruning, cutting of the bark, for example.

Now last year the want of sunlight, I think, tended to weaken the vitality of trees, and so tended to retard the flow of sap. Should we not, then, expect this year to find an *excess* of fruit buds? The "show" of apple blossom round us, in Gloucestershire, is exceptionally profuse. F. C. CONSTABLE.

THE RECENT CENSUS OF ENGLAND AND WALES.

IN reply to a question put by Dr. Addison, the President of the Local Government Board gave on May 24 a preliminary statement as to the results of the recent census. The figures, which are based on summaries furnished by the local registration officers, are, of course, of a provisional character, but it is not probable that any serious errors are involved.

The total population of England and Wales is returned at 36,075,269, as compared with 32,527,843 in 1901, a gain of 10·91 per cent. This compares with increases of 12·17 and 11·65 per cent. in the two preceding decades, and is the lowest percentage increase recorded in any decade since the commencement of the nineteenth century. It would seem to imply a loss of nearly half a million by excess of emigration over immigration.

The population of the administrative county of London shows an actual decrease, from 4,536,267 to 4,522,961, illustrating the almost universal outward trend of urban populations as the facilities for locomotion increase. The population of the "outer ring"—*i.e.* that portion of London which lies within the Metropolitan Police District, though outside the administrative county—has grown from 2,045,135 to 2,730,002, and the populations of the counties of Essex, Middlesex, and Surrey have increased by 30, 42, and 30 per cent. respectively.

The same tendency is clearly exhibited by many of the returns for the County Boroughs. Few show an actual loss of inhabitants; Canterbury, Halifax, Hastings, and Burton-on-Trent are the only towns coming under this category. Many, however, show only a very slight growth, notably Birmingham, with an increase from 523,000 to 526,000 only during the ten years. Coventry forms the most striking exception to the general rule of slackening growth, with its increase from 70,000 to 106,000, largely due, no doubt, to the motor industry. To realise the general nature of the changes, the figures given in the present return should be compared with the populations estimated by the Registrar-General for last year; these estimates are based on the rate of growth exhibited by each district during the preceding decade, and in the case of the great majority of the boroughs are in excess, often seriously in excess, of the true population even at the present time. The population of Bristol was estimated last year, for example, at 383,000; the census figures show only 357,000. That of Leeds was estimated at 491,000; the census enumerators could only find 446,000. That of Leicester was estimated at 248,000, against a census return of 227,000, and of Sheffield at 479,000, against 455,000.

The present return reinforces, in fact, the lesson that has been so often drawn by statisticians as to the necessity, both for a more frequent census, and for the use of better methods of estimating populations during the intercensal intervals. Many of the County Boroughs, and many of the Metropolitan Boroughs, have been credited during the last ten years with a fall in the death-rate far more rapid than they could lay claim to, owing to the consistent over-estimation of their populations; and this rapid fall has been used not only as the basis for natural self-congratulation by the local medical officers of health, but also as a foundation for party posters in county council elections. Quinquennial censuses would largely reduce the margin of error; the use of methods of estimation based on local information, *e.g.* those recently suggested by Mr. E. C. Snow, (referred to in a Note on p. 459), would narrow it still further. So many improvements in the form of the returns have been introduced during the new *régime* at the Registrar-General's office, that we feel some confidence in expecting a change in this respect. At present the figures given for birth- and death-rates in the annual summaries and reports are often, towards the end of an intercensal decade, very gravely misleading.

INDUSTRIAL BURSARIES.

THE Royal Commission for the Exhibition of 1851 propose to establish industrial bursaries for young men who, after a course of training in a university or approved technical college, desire to enter engineering, chemical, or other manufacturing works. The bursaries are intended to enable suitable applicants to tide over the period between their leaving college and obtaining remunerative employment in industry. The value of the bursary will depend on the circumstances of the candidate, but will as a rule not exceed £100 a year. A bursar will be elected in the first instance for one year, but the tenure of his bursary will ordinarily be prolonged for a second year provided that the Commissioners are satisfied with the work done by the bursar during his first year. In special circumstances a bursary may be renewed for a third year.

The appointments to the bursaries will be made by the Commissioners from among candidates recommended by the authorities of certain selected universities and technical schools, and in dealing with these recommendations great weight will be given to evidence that a candidate has the practical abilities likely to lead to his advancement in manufacturing work, academic success alone being an insufficient recommendation.

The candidate must be a British subject, under the age of twenty-five, and must have been a *bonâ-fide* student of science for a term of three years.

The candidate must further satisfy the Commissioners:—

(*a*) That he has obtained, or can, within one month of election, obtain a post in some engineering or other manufacturing works approved by them.

(*b*) That he is in need of pecuniary assistance to enable him to accept such a post.

A bursar may, if the Commissioners approve, spend part of the tenure of his bursary in studying a special industrial process or processes in works either at home or abroad.

No bursar shall enter a firm as a premium pupil without the special consent of the Commissioners.

A bursar must submit a report of his work to the Commissioners on the expiration of each year of his bursary.

The institutions invited to nominate in 1911 are as under:—University of Edinburgh; Heriot Watt College, Edinburgh; University of Glasgow; Glasgow and West of Scotland Technical College; University of St. Andrews; University of Aberdeen; University of Birmingham; University of Bristol; University of Leeds; University of Liverpool; University of Manchester; Armstrong College, Newcastle-upon-Tyne; University College, Nottingham; University of Sheffield; University of Oxford; University of Cambridge; University of London; Imperial College of Science and Technology; University College of Wales, Aberystwyth; University College of North Wales, Bangor; University College of South Wales and Monmouthshire, Cardiff; Royal College of Science for Ireland; Queen's University of Belfast; University College, Cork; University College, Galway.

THE NATURALIST'S PICTURE GALLERY.[1]

MR. KEARTON'S bird pictures are so well known that it is unnecessary to say much about his latest work, beyond indicating its scope and object, except that the pictures are larger than usual, and, if possible, more beautifully reproduced. This work has been prepared at the request of friends who have expressed a wish for Kearton pictures from nature on a larger scale of reproduction, and in order to give the man or woman, boy or girl, who knows but little of the countryside a bright and stimulating glimpse of the wild creatures dwelling therein. But it will not be to these alone that this sumptuous volume will appeal. Those who know our birds and beasts best will probably appreciate it more than anyone else, for to them these beautiful pictures of their old friends will be an unfailing joy and delight.

FIG. 1.—Nest of the Dotterel in a slight natural hollow. From "Kearton's Nature Pictures."

Upwards of fifty birds and beasts and reptiles are portrayed, and to each is devoted a pleasant descriptive article. First and foremost this is a picture book (wherein birds, beasts, and reptiles jostle together without system, as they jostle in nature's own domain), as its title implies; but the text, although of secondary importance, is as accurate, informatory, and interesting as care and experience can make it. Familiar wild birds and beasts find a place here side by side with the very rarest birds that visit our islands to breed. Mist-wreathed mountains and quiet hedgerows, the restless sea and peaceful meadow, the deep woods and the towering sea cliffs, have all been visited to find these pictures. Altogether the author is fully justified in his belief that the work will form the finest gallery of sun pictures of wild birds and beasts, taken amidst their natural surroundings, ever published in this or any other country.

Amid so much excellence we cannot help directing particular attention to the beauty and interest of the plates showing young thrushes, the peewit, trout, oyster-catcher, tree pipit finding a young cuckoo, and the great black-backed gull. A finer picture of a grand-looking bird in its native haunts than this last we never saw. Mr. Kearton has secured some excellent and characteristic photographs of that little-known reptile, the natterjack toad. This, we imagine, was no easy task. For we remember trying to help a famous photographer to secure some picture of the natterjack on a hot morning among the sand-dunes on the coast of Holland, and how often our efforts were frustrated by the extreme activity of the toads, one of the points in which it differs from the more familiar squat toad of our gardens. By permission of the publishers we reproduce two of the illustrations.

FIG. 2.—Oyster Catcher. From "Kearton's Nature Pictures."

[1] "Kearton's Nature Pictures," beautifully reproduced in Photogravure, Colour, and Black and White from photographs by Richard and Cherry Kearton. With descriptive text by Richard Kearton. Vol. i., pp. viii+96. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1910. Price 15s. net.

WILD PARAGUAY.[1]

EL GRAN CHACO is the name of that great, low-lying alluvial plain, which is situated where the Republics of Paraguay, Argentina, and Bolivia meet. Extending over 200,000 square miles, it is populated, but for a mere fringe of white settlements, entirely by Indians, the total population of whom is estimated at not more than 135,000. Many futile attempts have been made by the Spaniards to explore this vast district, or to "reduce" the fierce native tribes to the white man's ways; they ended mostly in massacres of the exploring parties, and the Chaco was therefore left severely alone until within quite recent times. Even the Jesuit missions in the middle of the eighteenth century had fared badly; futile also was the attempt made by Captain Allen Gardiner, founder of the South American Missionary Society, to settle among the Tobas in the year 1870, and it was not until the year 1889 that the same society succeeded in establishing a mission among the Chaco Indians.

FIG. 1.—Procuring Fire by Friction. From "An Unknown People in an Unknown Land."

W. Barbrooke Grubb, then quite a young man, was sent out and entrusted with the seemingly hopeless task. For twenty years this pioneer and marvel of devotion has lived amongst the savages, at first quite alone, later on joined by helpmates. The present book deals mainly with the events and experiences of the early five lonely years amongst the Lengua tribe, a little to the west of the Paraguayan town of Concepcion. Now there is a flourishing mission, called Waikthlatingmangyalwa, the place where Prof. J. G. Kerr and the late J. Budgett got their material for the mudfish Lepidosiren. It is safe for the white man to traverse some 200 miles west of the river Paraguay, over roads cut by the missionaries; thousands of cattle are now tended by Indians, where but a few years ago men, who had acquired lands, scarcely dared to inspect them for fear of these same Indians. In these parts Grubb's is a name to conjure with, and the Paraguayan Government fully acknowledge what they owe to this man by having made him Commissary-General of the Chaco, with the additional title of "Pacificador de los Indios."

How has he achieved it? By living alone with these savages and almost like one of them, learning their language and customs, without worrying them, but all the time trying to understand what is really at the back of the Indian's mind. Gradually they in turn came to look upon him not as a harmless lunatic, but to respect him. It was uphill work, and not without danger; as for that matter, one of his trusted and most intelligent friends shot an arrow into him, and left him for dead, several days' journey from the nearest native village. This foul deed enraged the native community so much that they ultimately caught the would-be murderer, killed him, and burnt his body to ashes. There is no other record of a Chaco-Indian being slain by his own tribesmen for the murder of a white man.

The greatest difficulty in gaining the confidence of the natives was the opposition of the medicine-men, or witch-doctors, utterly ignorant but shrewd humbugs, who, of course, saw at once that their power would wane as much as the white man's reasoning influence ascended.

The many long years spent with these hitherto almost unknown people have enabled the author to give us a narrative from the point of view of seasoned experience, instead of first impressions, and thus it has come to pass that chapter after chapter, as they deal with the mode of life, rites, and beliefs, are so many essays of ripened authority. It may, however, be regretted that many of the revolting features, and most of their rites are inclined that way, are scarcely hinted at, and that the question of sex is but lightly

[1] "An Unknown People in an Unknown Land": an Account of the Life and Customs of the Lengua Indians of the Paraguayan Chaco, with Adventures and Experiences met with during Twenty Years' Pioneering and Exploration amongst them. By W. Barbrooke Grubb. Edited by H. T. Morrey Jones. Pp. 330. (London: Seeley and Co., Ltd., 1911.) Price 16s. net.

touched. The Lenguas, being strong believers in reincarnation, are convinced that the soul of a deceased person hovers about his old haunts, watching for the opportunity of slipping into some living person. Such a chance is provided when a man dreams, because then his soul is wandering, and these people suffer terribly from dreams, so much, indeed, that it may be questioned whether a more rational diet, or medical relief from indigestion, would not have at least accelerated the painfully slow process of religious conversion. This reincarnation doctrine leads to such ludicrous mental conditions that a man in full vigour may be in doubt whether he is himself or not, asserting gravely that his own real soul is at a distance, being kept away by devils, and that some other, departed, soul has crept into him!

Owing to the custom of infanticide, especially of girls, the men are in the great majority, with the result that every girl has a wide selection of partners.

FIG. 2.—Blanket Weaving. From "An Unknown People in an Unknown Land."

Further, native law requires that the man must leave his own people and join those of his wife. Her main object in life being to feed well and to have as little drudgery as possible, she seeks a mate of a mild disposition, who will be subservient to her rule, besides being a good hunter and gardener. There is a delightful chapter on the baneful result of communalism, socialist principles being carried to such perfection that the lazy bodies will neither hunt nor fish as long as there is something to eat elsewhere, because it is a strict law that all shall share in everybody else's spoil.

The author's profits of this remarkable and well-illustrated book will be devoted to the support of the Church of England South American Missionary Society.

PROF. M. H. N. STORY MASKELYNE, F.R.S.

PROF. MERVYN HERBERT NEVIL STORY MASKELYNE, whose death on May 20 was announced in last week's NATURE, was born on September 3, 1823, and was the son of Anthony Mervyn Story, F.R.S., who married the only daughter of Nevil Maskelyne, the famous Astronomer Royal. The family is thus one of scientific distinction through three generations, and it is not surprising that Maskelyne was early in life attracted to the study of science. He went to Wadham College, Oxford, where he took his degree in 1845, and even in those early days all his spare time, energy, and resources were devoted to the pursuit of chemistry, at a time when there were very limited facilities for the study of science at the university.

In 1856 Maskelyne succeeded Buckland, and became professor of mineralogy, and held that office until the year 1895. He had a laboratory and residence under the Old Ashmolean Buildings, and was one of the chief workers in experimental chemistry in Oxford. He was indeed urged by many persons to be a candidate for the chair of chemistry, which became vacant in 1855, but was not willing to stand in opposition to his friend, Benjamin Brodie. He played a prominent part in the establishment of science teaching in Oxford, and was secretary of the first committee formed to promote the scheme for building a university museum. Some of his reminiscences of that period are related in Dr. Vernon's "History of the Oxford Museum," where it is stated that his classes in analytical chemistry were attended, amongst others, by Thomson, afterwards Archbishop of York, and Henry Smith.

In 1857 he became keeper of the department of minerals in the British Museum, and for twenty-three years combined this office with his Oxford professorship. The keepership of the mineral department he resigned in 1880, when he became Liberal member of Parliament for Cricklade, and afterwards for North Wilts, until the year 1892, when he retired from active political life. Referring to his father's death, he wrote, "it was like a whirlwind that bore me from the museum, where my life would have been impossible, to this country life and into the House of Commons."

Maskelyne's scientific activity was for the greater part of his life in the field of mineralogy, and especially crystallography, and his interests were largely centred in the development of the great collection of minerals at the British Museum. In particular, he brought together the wonderful collection of meteorites which for years has maintained its position as the best, or one of the two best, collections in the world. Much of his time was devoted to the scientific study of these remarkable objects. In 1850 Mr. Sorby had laid the foundation of the modern study of rocks by showing that it was possible to grind sections of them so thin as to be transparent, and Maskelyne was the first to apply the new method to the study of meteorites, and was able by the microscope to identify in them many terrestrial minerals and to discover some which are unknown on earth.

Although in the study of higher physics and mathematics he must have been mainly self-taught, it was towards the physical and crystallographical sides of mineralogy that he was particularly attracted. Mineralogy had become an exact science in the hands of Haüy at the close of the eighteenth century, and Whewell and his eminent successor Miller kept alive in Cambridge the mathematical treatment of crystallography.

It was Maskelyne's work to develop in particular the subject of the symmetry of crystals, upon which he gave a course of lectures before the Chemical Society in the year 1875. Victor von Lang, who subsequently became professor of physics at Vienna, had

been his assistant in the British Museum for a short period (1862–4), and his suggestive book, published in 1866, was one of the first dealing with this subject; much that appeared in the books of both authors was doubtless the result of their discussions during this period.

Maskelyne's own "Treatise on the Morphology of Crystals" did not appear until 1895, the year in which he resigned his professorship in Oxford, but much of it had been written thirty years before, and, if it had been published at that time, the book would have been regarded as a highly original treatise. The proof sheets were familiar to many of his students, and introduced them to a very attractive treatment of what was then a new subject. Owing to the late appearance of this book, his methods were chiefly made known to the world in an indirect way through his pupils, and it is possible that he may not have received the credit that is due to him. For example, it is mentioned in Lewis's "Crystallography" that the mathematical establishment of the angles possible between planes of symmetry in a crystal was first given by Maskelyne in his lectures in 1869, but no publication of such a result was made until that by Prof. Gadolin in 1871.

Among those who worked with him at the British Museum, in addition to his old friend von Lang, were Thomas Davies (1862–80), who was responsible under him for the arrangement of the "Collections"; Dr. Walter Flight, F.R.S. (1867–80); W. J. Lewis (1875–7), now professor at Cambridge; and his successor, Lazarus Fletcher (1878–80), now director of the Natural History Museum. He always spoke with particular admiration of Grailich, of Vienna, who was an early and intimate acquaintance. One of his dearest friends was that remarkable man, Henry Smith, of Oxford, with whom he frequently discussed mathematical problems. It was the good fortune of the present writer, when an undergraduate, to receive instruction from Maskelyne in an informal way in Henry Smith's house; on these occasions the lecture was delivered from an armchair in the drawing-room, Smith himself playing the part of a second student, and illuminating the discourse by questions and comments of profound significance. An example of the stimulus which Maskelyne's active mind gave to those with whom he came in contact is the investigation by Smith of the conditions under which lines in a crystal can be perpendicular to each other.

It is not necessary here to give a detailed account of Maskelyne's scientific papers. They range over a wide field, and are characterised by a charm of literary style which is well known to all who received letters from him. His activities date from so early a period that it is difficult now to ascertain what personal part he played in some of the scientific discoveries of the middle of the nineteenth century, but he worked for a time in Faraday's laboratory at the Royal Institution, was one of the earliest to take a practical interest in the newly invented process of photography, and, indeed, throughout his long life interested himself in almost every branch of scientific inquiry.

Faraday stayed with him during the British Association meeting at Oxford in 1847, when, he writes:—"I showed Faraday for the first time the making and developing of a photo of the College Quad from the window. His joy was that of a boy."

Maskelyne's interests outside science were also very wide, and he was the owner of one of the best and most carefully selected private collections of antique engraved gems; his catalogue of the Marlborough gems, which was privately printed, is well known.

He possessed a remarkable elasticity and alertness of mind, as of body, even in advanced years, and his enthusiasm for all that was new in science, literature, and art was maintained to the end. Only four years before his death he was occupied on a scientific handbook for the use of the dairy farmers of Wiltshire, and was well known throughout the county as a man whose intellectual activities were always available for a good cause. Everything that he did was evidence of his taste, and was marked by a conspicuous refinement and distinction of style and manner.

In a letter written only three years ago he said:—"I think there must be some cement in the smaller sciences like mineralogy and crystallography that links their students by a bond unlike the relations that exist between the advocates of the larger sciences; jealousies and rivalries seem to hold aloof, and certainly from the days of Grailich and Lang to those of my old age some of my dearest and most honoured friends have come to me through the sciences that you and I have professed at Oxford since 1856."

It was in reality his own warm, impulsive, quick-tempered, and sympathetic nature which united him by the closest ties of affection to so many of his pupils and scientific friends. The charm of his manner and the astonishing versatility of his mind were the qualities that most impressed those who met him in the later years of his life.

He received the honorary degree of Doctor of Science at Oxford in 1903, and the Wollaston Gold Medal from the Geological Society in 1893. He was an honorary fellow of Wadham College, and a corresponding member of several foreign societies. In 1858 he married a daughter of Mr. J. D. Llewelyn, F.R.S.; she survives him, together with three daughters, one of whom married the late Mr. H. O. Arnold-Forster, and another Sir Arthur Rücker. H. A. M.

MRS. W. P. FLEMING.

BY the death of Mrs. Williamina Paton Fleming, astronomy has suffered an almost irreparable loss. Concerning the general spectral classification of stars Mrs. Fleming had accumulated a store of knowledge which was second to none.

Born at Dundee, Scotland, in 1857, she became an assistant at the Harvard College Observatory, Cambridge, Mass., in 1879, and in 1898 was officially appointed as the curator of astronomical photographs, a department wherein Harvard holds a unique position. Here Mrs. Fleming was charged with the supervision of a number of ladies whose duty it is to examine minutely, and to classify, the ever-growing library of plates taken at the Cambridge and Arequipa stations. Her special personal labours were chiefly devoted to the study of the enormous number of stellar-spectra plates which form the Draper Memorial. This collection was commenced in 1886 as a memorial to the late Dr. Henry Draper, and consists of an immense number of photographs of stellar spectra taken with the 8-inch and 11-inch Draper telescopes. Each plate covers a comparatively large area, and contains the spectra of a large number of stars, and when we learn, from Prof. Pickering's latest report, that there are now 18,182 plates taken with the 11-inch, and 36,852 taken with the 8-inch telescope, it is easy to understand that Mrs. Fleming's task was no light one.

The chief result of these studies was, perhaps, the production, in 1890, of the "Draper Catalogue of Stellar Spectra," in which Mrs. Fleming classified the spectra of 10,351 stars down to about the eighth magnitude. This Durchmusterung, with its revision,

will probably long remain unexcelled as a comprehensive, comparative study of the broad features of stellar spectra. Its magnitude prevents it, of course, from dealing with the individual spectra in detail, but it stands not only a memorial to Dr. Draper, but also to the patient and specialised studies of Mrs. Fleming.

The minute examination of such a wonderful collection of photographs afforded great opportunities for discovery, and right well did Mrs. Fleming and her staff avail themselves of them. Of the eighteen novæ discovered since 1885, fourteen first stood revealed on the Harvard photographs, by reason of their characteristic spectra; of these, ten were found by Mrs. Fleming.

The first nova thus found was Nova Normæ, on a plate taken at Arequipa on July 10, 1893, and examined by Mrs. Fleming on October 26 of the same year. Some of these discoveries were rather more belated; for example, Nova Persei (No. 1) "appeared" in 1887, but was not "discovered" until the plate was examined at Harvard in 1895.

Then, again, Mrs. Fleming's researches led her to the discovery of a great number of new variable stars, stars having peculiar spectra—such as those of the Wolf-Rayet type—and nebulæ. In a list of 108 nebulæ discovered at Harvard, and published in No. VI., vol. lx., of the "Annals," Mrs. Fleming was credited with fifty-two, discovered during the period 1888 to 1907. It was also her examination of the Harvard plates, in 1891, that revealed the duplicity of β Lyræ, which, up to that time, had remained an enigma, from the changes in its spectrum, to astronomers. Such discoveries as these, by Mrs. Fleming, have been a consistent feature of the Harvard "Circulars" for many years, and from Prof. Pickering's report for the year ending September 30, 1910, we learn that, during that year, Mrs. Fleming's keen examination revealed twenty-one new variable stars, one star of the fourth type, two of the fifth, four of the sixth, four gaseous nebulæ, and one star the spectrum of which appears to be unique. Not a bad haul of discoveries for one year!

Those who had the good fortune to come into personal contact with the deceased astronomer found her most unassuming in her manner, although fitted and ever-ready to give, from her wonderful store of knowledge, every assistance possible to anyone who desired information concerning the remarkable variations of stellar spectra. At Harvard, in America, in fact, throughout the whole astronomical world, her death will be felt as a great loss.

WILLIAM E. ROLSTON.

THE SCIENCE MUSEUM.

IN NATURE for May 4 we announced the publication of the report of the Departmental Committee on the Science Museum and the Geological Museum, and we gave some extracts from it. Since then "Further Correspondence and Memoranda" have been published (Cd. 5673), and besides this there have been many letters in *The Times* on the subject. These have come mainly from biologists, urging that any building erected as a science museum at South Kensington would ultimately interfere with the possibilities of the expansion of the Natural History Museum. As a counterblast to the memorial from representatives of the physical and mechanical sciences published in the report, there has been issued another from representatives of the biological science. As usual, the men of science are working against each other, a sorry spectacle which must greatly gratify those who are asked for money to help its progress.

It would appear also from an "Historical Memorandum," printed in the white paper referred to, and from a letter from Sir Norman Lockyer, which was printed in Tuesday's *Times*, that the authors of the correspondence to which reference has been made have not been too careful about their facts; the main facts are shortly stated in Sir Norman Lockyer's letter, which we reproduce, but even he does not tell us the whole story. When land was to be allocated to the Natural History Museum, 1863, two proposals were before the Government, according to Lord Palmerston, its spokesman (*Hansard*, June 15, 1863), schemes demanding three acres and eight acres respectively. Lord Palmerston compromised with five acres, about the same area on which it is now proposed to build the Science Museum.

To the Editor of THE TIMES.

SIR,

Some four years ago I considered it my duty to call the attention of the Royal Commission of the Exhibition of 1851 to the fact that practically the whole of the land belonging to them had been allocated, and that, so far, no proper provision had been made for a Museum doing for the Physical, Chemical, and Mechanical Sciences what the British Museum Library does for books, the Galleries for Antiquities, the National Gallery does for pictures, and the Natural History Museum does for the Biological Sciences.

As the action of the Royal Commission on my Memorandum has produced a situation which has given rise to some correspondence in *The Times*, I ask your permission to deal with the main question, which is being lost in the various side issues and details now being discussed.

In the original idea of the Prince Consort, by whom the purposes to be served by the Estate were laid down, a Science Museum was contemplated. The Commission sold their first plot of land west of Exhibition Road to the Government in 1863. Lord Palmerston, in introducing the Vote for this purchase, said in the House of Commons (*Hansard*, June 15, 1863):—

"Now, the question is, what do we want? What are the requirements that press on the Government? In the first place we want a Patent Museum." . . . "Then we want an addition to the British Museum." . . . Thereafter he referred to the need for a Portrait Gallery, now provided elsewhere.

The White Paper Cd. 5673 giving, at the instance of Lord Cromer, "Further Correspondence" on this subject, includes an historical memorandum which refers to leading points in the development of the ground. Some of these, however, may well be noted here.

In 1880 the building of the Natural History Museum was completed, and the land on which it was built was fenced off on the north side. The area then fenced in contained very nearly 11¾ acres, more than twice the land assigned to the Natural History Museum by Lord Palmerston. The building itself covered very nearly 3¾ acres, leaving 8 acres unoccupied. From that day to this, *i.e.* a period of thirty-one years, there has been very little reduction of this unused ground, sacred for all this time to nursemaids.

In 1874 the Duke of Devonshire's Royal Commission on Science urged the importance to the nation of the development of the Science Museum and of the organisation of a Solar Physics Observatory—both institutions in direct furtherance of Science and the Arts, the aim of the Commissioners in selling the land to the Government in 1863. The Government acted on both these recommendations. In 1876 a Loan Collection of Scientific Apparatus was organised, and the Office of Works gave permission for an Observatory to be erected on the ground.

In 1876 the success of the Loan Collection was so marked that the Royal Commission offered 100,000*l.* to commence the building of an adequate Science Museum. In 1888 the Government came into possession (with the regrettable exception of the N.W. corner) of the whole area of land between the Cromwell Road and Imperial Institute Road, nearly 21 acres (20·9).

This is now allocated as follows:—

	Acres
Natural History Museum and grounds, including private roadway between E. and W. boundaries, up to the original fence	11·64
Imperial College, Post Office, and Meteorological Office, and necessary open spaces	3·3
	14·94

Say 15 acres.

These 15 acres deducted from the 21 acres leaves 6 acres for the purposes of the Science Museum, roughly only 2 acres more than the area actually occupied by the Natural History Museum building.

Now to use even a part of this area for a Science Museum, which must eventually stretch right across the strip, the Spirit Museum, not necessarily the building, but its inflammable contents, must go. If there is any opprobrium attached to this suggestion, I am content that it should fall on my shoulders, for I was careful to point out this necessity in my Memorandum of 1907 written for the information of the Royal Commission, and I do not know that anyone had considered the question before that year. If there is any difficulty about placing the enlarged Spirit Museum along Queen's Gate, it can be built in two portions east and west of the entrance in Cromwell Road. The future extensions of the Museum might then be erected on the frontages to Queen's Gate and Exhibition Road.

It will be noticed that my figures give a little larger area for the Science Museum than those shown in the "Further Correspondence" (Cd. 5673); this arises from the fact that I not only take the original line of fence, but consider the already existing road to the north of the Natural History Museum is sufficient to serve the purposes of both Museums. If the two organisations work together, not only would space be thus saved, but the amenities of the gardens, until they are built over, would be made common to both Museums.

I now come to the real question at issue in which the Nation is chiefly interested. Now that we have an Imperial College responsible for the highest teaching, both in the Physical and Biological Sciences, represented by the two Museums, it is clear that the highest efficiency of the teaching, if Museums are worth anything, will be secured by all three institutions being as close together as possible.

There would then be a grave objection to one of the courses recommended by one of your biological correspondents, namely, that the whole of the remaining 6 acres should be added to the Natural History domain, making in all nearly 17 acres, of which at present they use about 4, while the Museum dealing with all the other branches of Science should go elsewhere.

It must not be forgotten, too, that the munificent offer of the Royal Commission of 100,000*l.*, now made for the third time, towards the building of the Science Museum has been made on the understanding that the Museum was to be built on land conveyed to the Government by them in accordance with the Prince Consort's views that the National Collections of all kinds should be housed on it.

The Science Museum must then take its place by the side of the Natural History Museum on the South Kensington site. What is it to include? What is likely to be its rate of expansion? It should include all the products of men's ingenuity in science, both pure and applied; it should form the base of the discoveries and the applications of the future in all scientific directions. It should be to the worker in science what the British Museum Library is to the student in literature—a stepping-stone to higher things.

As we have in it to deal with the works of man, and over an enormous field, the new Science Museum should from the start increase rapidly year by year, while the Natural History Museum, dealing with the works of nature, is already an old institution, and has largely completed its general collections. Nature's new species, representing animal advance, are not produced at the rate at which, at this moment, man's new species, representing intellectual and material advance, come into being.

An area, therefore, for the Science Museum about the same as that thought necessary for the Natural History Museum by Lord Palmerston when the land was purchased, an area, indeed, not yet occupied by the buildings for that Museum, should not be considered excessive for the Science Museum. Moreover, it is certain, when space is available, to increase more rapidly than the Natural History Museum, and it will be pinched for space before two generations are out unless the design for the Museum building is prepared on a scheme that will take full advantage of modern methods of construction with the possibility of several superimposed stories of Exhibition Galleries readily accessible by lifts. The frontage Galleries of the adjoining Art Museum show how much can be done in this way.

This being so, is it just and decorous for representatives of the biological societies to claim more space when they already have more than they will require during the next century, judging by the rate of expansion during the last thirty years?

At the same time, it is not to be denied that recent investigations have opened out new inquiries of a most important and far-reaching character. And what has happened in the past may occur again in the future. Ample space must be forthcoming to provide for all such contingencies.

This does not necessarily suppose great expansion of exhibition space; but it may do so, and it will assuredly require the provision of adequate accommodation for investigation of the collections now existing or to be formed.

With regard to extensions of the two Museums in the distant future there is no difficulty. There is a block of houses and mews covering roughly 6 acres to the west of Queen's Gate, and opposite the 21 acres of Government ground. The ultimate purchase of this would allow of the two frontages being continued. It is fair to leave to a future generation the question of such an extension, for we cannot forecast the nature of the demands which may then be made for further Museum accommodation.

Has not the moment at last come when all those interested in science in its various aspects should co-operate to find the solution of a question which has been debated for a generation? There should be no contention between these persons—their aims are the same; they desire to afford the best facilities for the increase and coordination of knowledge in all its branches. In my opinion it can be shown that all this can be accomplished at South Kensington, and a really splendid monument can be provided. Is this the moment for contention as to whether this or that branch has a big enough show? Ought we not rather to come together and see how best to utilise what we have got?

(*Signed*) NORMAN LOCKYER.

NOTES.

THE Faraday lecture of the Chemical Society will be delivered by Prof. T. W. Richards, of Harvard University, on Wednesday, June 14, in the theatre of the Royal Institution.

THERE will be a display of calculating machines on Tuesday, June 13, at the Royal Statistical Society's house, 9 Adelphi Terrace, W.C., from 4 to 5.30, during an at home, for which invitations have been issued.

THE second Biennial Congress of the Far Eastern Association of Tropical Medicine is to be held in Hong Kong from January 20 to 27, 1912. The association is international, and, as the title denotes, was formed to promote the study of tropical medicine in the Far East.

THE death is announced of Prof. Samuel Calvan, professor of geology in the State University of Iowa, and State geologist of Iowa. Prof. Calvan was seventy-one years of age, and had been connected with the University of Iowa for thirty-seven years.

AT the annual general meeting of the Institution of Electrical Engineers, held on Friday last, Mr. S. Z. de Ferranti was elected president, and Mr. W. Duddell, F.R.S., Major W. A. J. O'Meara, C.M.G., Mr. W. H. Patchell, and Mr. J. F. C. Snell vice-presidents, for the session 1911–12.

A FESTIVAL in memory of Richard Jefferies is to be held at Swindon on Saturday, June 10. Jefferies was born at Coate, near Swindon, and spent his early life in the latter place. It is proposed to pay a visit to Coate Farm, the naturalist's birthplace, and an open-air concert, morris dancing, speeches, and a short service in Chiseldon Church have been arranged for.

THE sum of 1000*l.* has been placed at the disposal of the Home Secretary by a colliery proprietor to form a prize for the best and safest electric lamp for use in mines, and Messrs. C. Rhodes and C. H. Merz have consented to act as judges upon the lamps submitted. The competing lamps must be addressed: care of Mr. C. Rhodes at the Home Office Testing Station, Rotherham, and must be delivered by, at latest, December 31 next.

AN appeal is being made to all who are interested in photography, or in the history, archæology, and science of Kent, to become members and correspondents of the Photographic Record and Survey of the county, and to contribute, if possible, half-a-dozen prints each year to the collection in the County Museum of Maidstone. At the recent annual general meeting Sir David Salmons, Bart., was re-elected president, and the secretary reported that 553 prints had been added to the survey collection during the year. Prospectuses of the survey and any information relating to it will be gladly supplied by the secretary, Mr. H. E. Turner, 14 Queen's Road, Tunbridge Wells.

AT the anniversary meeting of the Linnean Society, held on May 24, the following officers and council were elected for the ensuing year:—*President,* Dr. D. H. Scott, F.R.S.; *treasurer,* Mr. H. W. Monckton; *secretaries,* Dr. B. Daydon Jackson, Prof. A. Dendy, F.R.S., and Dr. Otto Stapf, F.R.S.; *council,* Prof. V. H. Blackman, Mr. H. Bury, Sir Frank Crisp, Prof. A. Dendy, F.R.S., Prof. J. Stanley Gardiner, F.R.S., Mr. E. S. Goodrich, F.R.S., Mr. H. Groves, Prof. W. A. Herdman, F.R.S., Mr. A. W. Hill, Dr. B. Daydon Jackson, Mr. H. W. Monckton, Prof. F. W. Oliver, F.R.S., Prof. E. B. Poulton, F.R.S., Dr. A. B. Rendle, F.R.S., Dr. W. G. Ridewood, Miss Edith R. Saunders, Dr. D. H. Scott, F.R.S., Dr. Otto Stapf, F.R.S., Miss E. N. Thomas, and Dr. A. Smith Woodward, F.R.S.

AT the anniversary meeting of the Royal Geographical Society, the Founder's medal was awarded to Colonel P. K. Kozloff for his explorations in Central Asia since 1883, and the Patron's medal to Dr. J. B. Charcot for his expeditions to the Antarctic continent. The Victoria research medal was awarded to Captain H. G. Lyons, F.R.S., for his work on the Nile Basin and the topographical, cadastral, and geological surveys in Egypt, which he directed when Director-General. Other awards were made to Dr. Wilfred Grenfell, of Labrador, Captain G. E. Leachman for work in Arabia, Dr. Arthur Neve for his investigations in the Himalayas, and to Mr. R. L. Reid for his surveys of the Aruwiari River.

THE anniversary dinner of the Royal Geographical Society was held on May 26 at the Hotel Cecil, when Lord Curzon, the president of the society, reviewed the many striking events of geographical importance which had occurred during his predecessor's tenure of office. He alluded to the very inadequate accommodation which the society possessed at the present time, and urged that, in the interest of the scientific development of the subject in this country, better and more commodious premises were urgently needed. Twenty-two past and present medallists of the society were present, and Sir John Forrest, who was honoured by the society as early as 1870, and Dr. Charcot, one of the medallists of this year, responded on their behalf.

THE *Terra Nova,* the vessel which conveyed Captain Scott and his expedition to their base of operations, has now been overhauled and chartered by the New Zealand Government for surveying work. Sailing from Christchurch in July, work will be carried out on the northern coast of North Island, and then between the northern coast and the small islands of Manawa Tawhi. The delimitation of the 100-fathom lines and shoal soundings are to be undertaken which should lead to results of much practical importance. The Central News further reports that Mr. D. G. Lillie, a biologist of the Antarctic expedition, has, in sorting and preserving specimens for transmission to Europe for study by specialists, recognised that the collection contains a number of species of invertebrates hitherto unknown.

PROF. W. L. GRANT, professor of colonial history at Queen's University, Kingston, Canada, lectured before the Royal Geographical Society on Monday last on the geographical conditions affecting Canada. After alluding to the physical character of the country, the lecturer pointed out the immense resources, agricultural, mineral, and climatic, which must inevitably give Canada before many decades a dominant position in the Empire. Much remains to be done, but the large ideas of early pioneers have been fully justified, and bold schemes for the further development of the country are being confidently put forward. Still, there is great need of an adequate inventory of the Dominion's resources, which, though vast and imperfectly known, are of the greatest value, and any squandering of them needs carefully to be guarded against.

THE Research Committee of the National Geographic Society of Washington, it is reported in *Science,* has made a grant of 1000*l.* for continuing the glacier studies of the two previous years in Alaska. The work, beginning in June next, will be done by Prof. R. S. Tarr, of Cornell University, and Prof. Lawrence Martin, of the University of Wisconsin, who have directed the National Geographic Society's Alaskan expeditions of 1909 and 1910 in the Yakutat Bay, Prince William Sound, and lower Copper River regions. This year's expedition will study briefly a number of regions of glaciers not previously investigated by the National Geographic Society, although partially mapped by the Alaska Division of the U.S. Geological Survey. Work will be done on the present ice tongues and the results of glaciation in the mountains and plateaus of parts of the interior and some of the fiords of southeastern Alaska, the former having lighter rainfall and smaller ice tongues than the Yakutat Bay and Prince William Sound regions.

IN a paper read at the Buxton meeting of the Association of Water Engineers on May 20, on the water supplies of the river basins of England and Wales, Mr. W. R. Baldwin-Wiseman, of Southampton, directed attention to the lack of proper coordination and control in the administration of the fresh-water resources of this country. He pointed out the pressing need for river boards, which,

while thoroughly representative of local interests, would subordinate their functions to the general direction of a national hydrographical department, and he considered that this body should be represented in Parliament by a Minister of Water Supply. It is certainly true that, compared with the highly efficient hydrological organisations existing in France, Italy, and the United States, the efforts of similar bodies in Great Britain are local and sporadic, and this lack of interdependence and control is conducive neither to a satisfactory conservation of our resources nor to their effective development. Mr. Baldwin-Wiseman has also dealt with the matter in a paper on the administrative aspect of water conservancy, read before the Society of Engineers in April last. Both papers are timely, for the problem is one which must inevitably be faced and solved at no distant date.

AT the last scientific meeting of the Zoological Society Dr. C. W. Andrews, F.R.S., gave an account of some fossil mammalian remains lately received at the British Museum (Natural History) from British Central Africa. The specimens, which were collected on the eastern side of Lake Victoria Nyanza, were sent to the museum by Mr. C. W. Hobley, C.M.G., Commissioner of Mines for the district. For the most part only fragments of bones are preserved, but in addition to these there is a portion of a mandible of a small species of Dinotherium with several well-preserved teeth, so that there is no doubt as to the genus. The species seems to be very closely similar to *Dinotherium cuvieri* from the Lower and Middle Miocene of France, and it may be that the beds from which the African species is derived are of the same age; but, on the other hand, it is also possible that Dinotherium survived in Central Africa long after it became extinct elsewhere, in which case the deposits may be of a later date. The interest of this discovery is that it is the first record of the existence of Tertiary mammals in Central Africa, and that when the age and relationship of the beds in which they occur are known, much light may be thrown on the geological history of the African lakes. In the same beds occur fragments of a small rhinoceros, a giant land-tortoise, Trionyx, and crocodile. The excellent condition in which the bones are preserved gives great hope that careful collections will lead to the discovery of new forms which will clear up many obscure points on the history of the Mammalia.

THE summer meeting of the Concrete Institute will be held in the Lecture Hall, Denison House, Vauxhall Bridge Road, on June 7 and 8, when the following papers will be read and discussed:—The æsthetic treatment of concrete, by Prof. Beresford Pite, after which an interim report of the Tests Standing Committee on the testing of concrete, reinforced concrete, and materials employed therein will be presented, and the Y.M.C.A. building, Manchester, by Mr. A. E. Corbett, to be followed by the presentation of a report of the Reinforced Concrete Practice Standing Committee on the standardisation of drawings of reinforced concrete work. The first annual dinner of the institute will take place in the evening of June 7, and in the evening of the following day there will be a conversazione in the galleries of the Royal Institute of British Architects.

THE programme of the jubilee meeting of the Institution of Naval Architects (which, as already announced, is to take place on July 5, 6, and 7) has just been issued. We learn from *Engineering* that among the papers to be presented are the following:—Warship building, by Sir P. Watts; naval engineering, by Engineer-Vice-Admiral Sir H. Oram; naval artillery, by Sir A. Noble; mercantile shipbuilding, by Dr. S. J. P. Thearle; steam turbines, by the Hon. C. A. Parsons; armour, by Mr. C. E. Ellis; fifty years' architectural expression of tactical ideas, by Admiral Sir C. Bridge; the history of the institution and the progress of scientific education in naval architecture, by Sir W. White; some further notes on cavitation, by Mr. S. Barnaby; naval construction, by Rear-Admiral Kondo; naval engineering, by Engineer-Rear-Admiral Fujii; mercantile shipbuilding, by Mr. Yukawa and Dr. Terano; and a paper on the service performance of two Japanese turbine-driven ships. A paper on passenger steamboat construction will be read by Mr. F. E. Kirby, and one on the results of tests on models of submarines by Mr. M. F. Chace. Prof. Rateau will deal with the rational application of the turbine to ship propulsion, and Prof. Marbec with the collapsing of beams and elastic curve slips. Dr. O. Schlick will treat of the present knowledge of the vibration phenomena of steamers, and Prof. O. Flamm will deal with the scientific study of naval architecture in Germany. Lieut.-Colonel G. Russo will review progress in shipbuilding in Italy, and Mr. J. Johnson that of recent developments in the transportation of ore.

MR. R. D. BANERJEA, of the Indian Archæological Department, announces the discovery at Dacca, on a temple image of the terrible goddess Chandi, consort of Siva, an inscription of the reign of Lakshmana Sena Deva, King of Bengal, dated 1122 A.D. This is the first inscription of the kind from eastern Bengal proper which gives the date of a king of Bengal. He is said to have reigned over a tract of country extending from Benares to the Garo Hills, and from the Himalayas to the sea. The result of this discovery is that, in the light of the fresh information which it supplies, the greater portion of the ancient history of the Province of Bengal must be rewritten.

IT has repeatedly been stated that the effects of a tropical sun in inducing sunstroke, &c., are due more to the chemical than to the heat rays, and therefore clothing lined with or made of a fabric of material which does not transmit the chemical rays has been recommended for wear in tropical climates. An experiment with orange-red underwear has been tried in the Philippines, and is recorded by Captain Phalen, of the U.S. Army. No beneficial effect whatever was observed from the use of this clothing; on the contrary, it added to the burden of heat upon the system, and it is concluded that white or khaki clothing sufficiently excludes the chemical rays (*Philippine Journal of Science*, v., No. 6, 1910, p. 525).

IN the report of the Zoological Society of Philadelphia for the past year stress is laid on two factors in regard to the well-being of animals in captivity, namely, the importance of *post mortem* parasitical investigations and the success of the outdoor treatment. Even the loss of the tips of their tails through frost-bite by a pair of hamadryad baboons is considered no bar to the continuance of the "simple life" method.

MR. C. FORSTER-COOPER, who recently made an expedition to the Bugti Hills of Baluchistan for the purpose of collecting fossil mammals, has returned to this country. A considerable series of fossils are, we understand, on their way home, and will eventually be added to the collections of the British Museum. The first mammalian fossils from the Bugti Hills were collected by the late Dr. Blanford and described by Mr. Lydekker; they indicate a lower

horizon than the typical Siwalik fauna. A number of new types have recently been described by Mr. Guy Pilgrim.

FROM a report contributed by Dr. F. A. Jentink to Nos. 2 and 3 of vol. xxxiii. of Notes from the Leyden Museum, it appears that the recent Dutch expedition to the Snow Mountains of New Guinea did not obtain anything very striking in the way of mammals. In fact, the only novelties are three species of pouched mice of the genus Phasgologale, one of which is the largest, and a second the smallest, of the Papuan representatives of the group. A lower jaw of a peculiar rat, *Anisomys indicator*, hitherto known only by a couple of specimens and characterised by the extreme narrowness of the lower incisors, was, however, obtained from the natives.

WE have been favoured with a copy of a pamphlet, by Prof. Berthold Hatschek, of Vienna (published by W. Engelmann, of Leipzig), entitled "Das Neue Zoologische System." In this scheme, which is the last of several already prepared by the same author, the animal kingdom is divided into the two sections Protozoa and Metazoa, and the latter again subdivided into three main groups, namely, Cœlenterata (including sponges), Ecterocœlia, and Enterocœlia, the last comprising Chætognatha, Echinodermata, Brachiopoda, Enteropneusta, Tunicata, and Vertebrata, while the second group embraces all other metazoan invertebrates except cœlenterates. The Cœlenterata are regarded as the direct descendants of the Protozoa; but the chief novelty claimed for the scheme is the independent derivation of the two main groups of Cœlosomata, that is to say, the Ecterocœlia and Enterocœlia, from distinct groups of Cœlenterata.

THE May number of *The Zoologist* contains an account of a new earthworm or treeworm recently discovered by the Rev. Hilderic Friend. It is named *Dendrobaena merciensis*, Friend, because it was found near the old capital of Mercia. At first sight it resembles *D. beddardi* and *Bimastus eiseni*, but it differs from these in the fact that the girdle extends from the twenty-second to the thirty-first segment. It is destitute of tubercula pubertatis. In the same journal we have a continuation of the same author's studies in the distribution of British annelids, in which the county records are set forth alphabetically. There are no records known to the author for Bedford, Berkshire, or Cheshire, but we find Bucks credited with eleven species of earthworm, Cambridge sixteen, the Channel Islands and Cornwall twelve, Cumberland seventeen, and Derbyshire sixteen. The total number of known British species has now been raised by Mr. Friend to forty.

IN Heft 4 of the *Zeitschrift der Gesellschaft für Erdkunde* Dr. A. Grund describes the hydrographical results of the first cruise of the steamship *Najade*, which has been detailed by the Austrian Government for the oceanographic investigation of the Adriatic by Austrian and Italian specialists. Four sections were sounded from east to west, while others were at the same time being executed by the Italian surveying ship *Ciclope*. Temperature, density, and salinity of the water were also studied, though the "Bora" blowing down the gulf hindered the work at times.

IN Erganzungsheft No. 4 of the *Mitteilungen aus den Deutschen Schutzgebieten* Dr. F. Jaeger gives the result of a very thorough exploration carried out in 1906 and 1907 in the southern portion of the Eastern Rift Valley, to the south-west of Kilimanjaro, and to the south-east of Lake Victoria. As careful a survey was made of the region as time would allow, and accurate triangulation was utilised to control the topographical work. A large collection of geological specimens was made, and these are described in the present memoir, but no general account of the structure of the district is given. The form of the ground traversed is indicated by form-lines on two maps of large scale (1 : 150,000), but is not described in the text. A vast crater basin with many minor vents occupies the northern portion near Lake Njarasa (Eyassi), and many points rise to more than 3000 metres. The whole area is immature in its topography, the drainage lines being short and steep, leading to the floors of the fault valleys in which the lakes are situated. The southern portion shows more clearly a series of parallel fault-blocks striking N.E., with lakes or marshes occupying the low-lying ground between. The meteorological observations have not been printed, but have been autographed and deposited at various institutions in Germany. As a study of earth forms, the maps are highly instructive.

THE report of the Botanical Club of Canada for 1909, issued by the secretary, Dr. A. H. Mackay, contains the announcement that the club has been dissolved, and that the work of collecting and tabulating phenological observations in the Dominion, formerly undertaken by the club, has been transferred to the officials of the Meteorological Service.

A SHORT paper contributed by Dr. Wm. Trelease to the Transactions of the Academy of Science of St. Louis (vol. xviii., No. 3) deals with the species of Agave cultivated during recent years in Mexico under the name of "zapupe." Of the various forms for which numerous local popular names exist, five different species, all new to science, are delimited according to spine characters, and these fall into three groups. They may be distinguished as "azul," "Tepezintla," "ixtle," "cimarrón," and green zapupe, and are probably all referable to the section Euagave; as cultivated plants they rarely set capsules, and appear to be freely bulbiferous after flowering.

IN the absence of definite criteria, the phylogeny of the algæ provides scope for varying opinions and hypotheses. Thus in the *Biologisches Centralblatt* (April 15) Mr. J. Brunnthaler elaborates the view that the red algæ are the most primitive. A primary reason is supplied by the argument that in early times the earth was surrounded by a dense vapour through which the sun penetrated with difficulty, and therefore the conditions of diffused light which prevailed were similar to those under which most red algæ now live. The origin of the group is referred to primitive ancestors of the Flagellatæ. Next in sequence are placed the brown algæ, derived partly from red forms and partly from the Flagellatæ, while the youngest line of development is assigned to the green algæ.

THE cold days of May were rather late in their occurrence this year, but were experienced towards the close of the period shown by the average results for a series of years. This year, May 19, 20, and 21 were the only really cold days, the maximum temperature for the period at Greenwich being 56·5°, and on May 20 the highest temperature was 52·3°. Last year the cold days in May fell fully ten days earlier, and in 1909 a week earlier. A brisk northerly wind was blowing this year, and an anticyclone was situated in the Atlantic in close proximity to our coasts. A change to warmer weather set in on May 22, when at Greenwich the shade temperature ranged from 35° in the early morning to 70° at midday. The summary of the weather for the week ending May 20, issued by the Meteorological Office, shows that the mean temperature

for the week was above the average over the whole area of the British Islands, the greatest excess being 3·6° in the Midland counties, and the least 1·1° in the north of Scotland. The absolute temperature ranged from 73° in the east of England to 33° in the east of Scotland.

A NEW edition (the seventh) of the handy "Hints to Meteorological Observers," prepared under the direction of the Council of the Royal Meteorological Society by Mr. W. Marriott, has been received. The present edition has been revised and enlarged; the explanations and illustrations of ordinary and self-recording instruments are very satisfactory. We are glad to find a considerable addition to the very useful glossary of meteorological terms, including those most recently introduced. We think this might be still further improved by more additions, and occasionally by a little fuller explanation. We notice here and there a slight departure from the explanations usually given, *e.g.* the order of the colours of the corona. We can only repeat the opinion before expressed, that the work takes a high place among the best of such handbooks published in any country.

AN interesting article on the weather in the seventeenth century, by Mr. W. Sedgwick, is published in *Symons's Meteorological Magazine* for May, containing extracts relating to the spring (March–May) between 1658 and 1705 from the diaries of John Evelyn, F.R.S., and Samuel Pepys, F.R.S. The author proposes in this and subsequent numbers to give an opportunity of considering whether these extracts show that any marked change in the climate of London has occurred since that period. Statements are often made that our climate has undergone considerable changes in comparatively modern times. On the other hand, well-known investigators of the present day have shown that any apparent changes either in temperature or rainfall can be accounted for by the difference in the instruments and their exposure. Although these instruments were known before the close of the seventeenth century, there were but few in existence; they cannot have been used regularly, if at all, by Evelyn or Pepys, and the tendency in the case of non-instrumental observations would be to record abnormal rather than normal conditions. Another important consideration pointed out by the author is the change from the Julian to the Gregorian Calendar, which was made in England in 1752. With reference to the popular belief about the old-fashioned Christmas, in several years during the last decade there have been considerable falls of snow after Christmas which would have occurred before Christmas if the Julian Calendar had been still in force.

THE Journal of the Royal Statistical Society for May contains an important paper, by Mr. E. C. Snow, on a new method of estimating post-censal populations, *i.e.* the populations of different districts of a country in the years following a census. The estimation of such populations often offers considerable difficulties, especially in districts of a rapidly changing character in the neighbourhood of large towns, and the method at present in official use—based on the assumption of the approximate maintenance of the rate of change during the preceding intercensal decade—may lead to very serious errors. For example, the birth- and death-rates in Salford in 1890, based on the estimated population, were calculated at 28·8 and 22·4 respectively, but when the results of the census taken in the following year were made known, these figures were altered to 35·6 and 27·6. Mr. Snow suggests that definite indices of a change of population, such as changes in the number of births, deaths, marriages, or houses, should be used as the basis of the estimate, that regression equations should be formed by the method of correlation between the change in population of a district and the changes in these several indices during a completed intercensal decade, and that these regression equations should be applied to the following decade. Trial of the method on several groups of districts of diverse characters showed that it would lead to greatly increased accuracy.

INVESTIGATIONS of the hitherto almost unknown ultra-violet spectrum—the Schumann region—are of special interest, because the conditions attending the production of these extremely short wave-length radiations are obviously of a different character from those attending the production of the more familiar spectrum. In this research Mr. Theodore Lyman has taken a great part, and in the March number of *The Astrophysical Journal* (vol. xxxiii., No. 2, p. 98) he publishes results obtained from an investigation of the nature of the radiation from oxygen, hydrogen, nitrogen, helium, and argon in the region more refrangible than λ 1900. No lines of helium and oxygen have yet been discovered in this region; if they exist they are too faint to be disclosed by the present methods. By varying the conditions of discharge in the vacuum tube, two spectra of nitrogen were revealed, one of faint bands with heads on the more refrangible edges, the other consisting of two pairs of sharp lines at λλ 1492·8, 1494·8, 1742·7, and 1745·3. No lines were seen in the "red spectrum" of argon, but a considerable number, about forty between λ 1333·7 and λ 1886·1, exist in the "blue spectrum." Repeating the experiments made by Schumann, Mr. Lyman has, as yet, been unable to obtain the primary spectrum of hydrogen which Schumann suspected. An interesting spectrum, apparently intimately associated with hydrogen, appears in the region λ 1650–λ 1450, and consists of five groups, each group containing five lines. Argon containing a trace of hydrogen at a pressure of 2 or 3 mm. shows this spectrum well if aluminium electrodes and no capacity are employed. Nitrogen, oxygen, and helium containing a trace of hydrogen do not show the groups, and if other electrodes are used considerable enfeeblement occurs. With pure hydrogen these groups always appear—with the other lines—and they disappear if the last trace of hydrogen is removed from the argon mixture. If their origin is an impurity in the hydrogen, it must be of a fundamental character, for the groups appear in all the hydrogen used by Lyman and by Schumann for many years; they may be a new spectrum of hydrogen. For a description of the apparatus and methods employed in the research the reader is referred to the original paper.

THE April number of *Le Radium* contains a memoir by M. L. Dunoyer, of the laboratory of Madame Curie, on the production of a material radiation of purely thermal origin. A tube of hard glass about a centimetre in diameter and about 30 centimetres long is joined at its upper end to a wider tube, the length of which varies from 2 to 13 centimetres in different cases. A side tube leads from the enlarged head to a Gaede pump. The lower end of the tube is covered inside with a film of metallic sodium obtained by distillation *in vacuo* from a heated tube originally communicating with the experimental tube, but sealed off when the deposit has been formed. When the lower part of the tube is now heated, so as to vaporise the sodium and drive it into the upper part of the tube, it is found that if diaphragms with small openings of the order 2 or 3 millimetres diameter are placed in the tube above the sodium deposit, the molecules of vapour are driven through the openings with such velocity that they form a

deposit on the end of the enlarged part of the tube which reproduces the shape of the opening of the last diaphragm through which the vapour has passed. If a plate with holes of any form in it is interposed in the path of the molecules, the deposit on the end of the tube reproduces the openings sharply. M. Dunoyer is already engaged in experiments to determine the kinetic energy of the projected molecules or particles and to measure their electric charge, if any.

Red Book No. 155 of the British Fire Prevention Committee deals with the loss of life at the Asch Building fire in New York on March 25. It will be remembered that there were 145 deaths. The committee has procured a trustworthy report from Prof. Ira Woolson, of New York; this report was originally prepared by Mr. F. J. T. Stewart, superintendent of the New York Board of Underwriters. This great loss of life occurred where the structural damage was relatively small, and practically affected only the fitments and equipment of the three top stories of the building. Bad planning and exit facilities, neglect of the ordinary precautions to prevent an outbreak of fire, the absence of any prearranged system of utilising the existing appliances, together with neglect to have all routes of exits clear for easy and immediate use, are the primary causes of the catastrophe. The building comprised a sub-basement, basement, ground floor, and nine floor levels; its height may have some bearing on the total number of lives lost, but scarcely on the general extent and character of the calamity.

We have received a pamphlet from Mr. Wm. Love, of 42 Claremont Square, London, N., giving particulars of his system of maintaining straight the rolls used for rolling flat sheets. The method appears to be novel, and consists in supporting the rolls by means of intermediate bearings. These bearings are in turn supported by means of beams, so arranged that the deflections of all the bearings under a uniform load on the roller are equal; hence the roller remains practically straight. There are no supports at the ends of the roller. Suppose, for example, that four intermediate bearings are fitted. The roller is divided into four imaginary equal segments, and each bearing is at the centre of a segment. The four bearings are supported on a beam, which we may imagine to be divided into two equal segments. This beam is supported at two points, one at the middle of each segment, and the supports are formed symmetrically on a longer beam, which is in turn supported at its ends. On the latter beam deflecting under the load, the two points at which the first beam is supported will suffer equal deflections, and by the arrangement of bearings on the first beam, all these bearings will deflect equally. In this system the roller may be much less in diameter than has been customary, as reliance on its stiffness is unnecessary. For example, a roller 2 inches diameter by 24 inches long, supported in the ordinary way, would deflect, say, 0·1 inch; supported on Love's system, the deflection for the same load is 1/2560 inch. Other applications of the principle are given in the pamphlet.

Messrs. Macmillan and Co., Ltd., announce for early publication the third English edition of Prof. W. Nernst's "Theoretical Chemistry," corresponding to the sixth German edition, and translated by Mr. H. T. Tizard, Magdalen College, Oxford. The portion of the book dealing with thermodynamics has been largely rewritten and includes a detailed account of the author's new theorem of thermodynamics. A chapter on radio-activity has also been added. The text of the earlier English edition has been completely revised and partly rewritten. The translator has also made some additions to the text, at the suggestion of Prof. Nernst, in order to bring the book up to as late a date as possible. These include an account of Nernst's work on specific heats at low temperature, and a short summary of Perrin's recent researches on Brownian movements.

Messrs. E. and F. N. Spon, Ltd., announce for early publication "Bibliographical History of Electricity and Magnetism Chronologically Arranged," by P. F. Mottelay.

OUR ASTRONOMICAL COLUMN.

Metcalf's Comet, 1910*b*.—An observation of Metcalf's comet was made by Dr. Schiller at the Bothkamp Observatory on April 18, and showed that the comet still has a sharply defined stellar nucleus of magnitude 13·5. The total brightness was about equivalent to that of a star of magnitude 12·8, and when thin clouds obscured the comet the nucleus could still be seen. Dr. Ebell continues his ephemeris up to the end of July, when the estimated magnitude will be 14·8. The present position of the comet is two or three degrees north of κ and i Ursæ Majoris (*Astronomische Nachrichten*, No. 4495).

Recent Observations of Halley's Comet.—Prof. Barnard secured good observations of Halley's comet on April 16, 23, and 25, but finds that the object is rapidly growing fainter. On April 23, in a very good sky, the magnitude was estimated to be 14·5 or 15·0, but on April 25, with the sky not quite so good, it was estimated to be 15 or 16. Prof. Barnard states that the brightness has been subject to considerable fluctuations, and at the time of the second observation was probably in one of its fainter phases (*Astronomische Nachrichten*, No. 4500).

Early Visibility of the New Moon.—Mr. Horner's observation of the new moon is discussed by Mr. Whitmell in No. 435 of *The Observatory* (May, p. 203). It appears that the observation was made when the moon was but sixteen, not seventeen, hours' old, which, so far as is known, constitutes a record; the moon was "new" at 1h. 13m. on the morning of February 10, 1910, and was seen by Mr. Horner, whilst looking for comet 1910*a*, at 5h. 13m. the same evening. The difference in azimuth between the sun and moon was roughly 10°, and, according to a paper which Mr. Fotheringham published in the Monthly Notices (R.A.S.) for May, 1910, the moon should be unobservable if its altitude were lower than 11°; but when Mr. Horner saw it the moon had an altitude of only 4° or 5°.

Large Proper Motion of a Small Star.—The examination of plates taken in 1892 and 1906 led Prof. Max Wolf to the conclusion that a 9·7 mag. star in Leo had an extraordinary proper motion. This was confirmed by Prof. Burnham, who has since kept the star under observation, and, from measures made during the period 1907–11, together with the 1892 photograph, finds that the most probable value for the proper motion is 1·228″ in 190·4°. The star's position (1900) is R.A. = 11h. 23m. 20s., dec. = +8° 6′ 1″, and it is 70s. preceding, and 185″ north of, the 7·5 magnitude star B.D. +8°2512 (Monthly Notices (R.A.S.), vol. lxxi., No. 6, April).

Photographic Determinations of Stellar Parallax.—Having described the methods of photographically determining stellar parallaxes with the Yerkes 40-inch refractor, Dr. Schlesinger is now discussing the results in his series of papers appearing in *The Astrophysical Journal*. In papers iii. and iv. of the series (*The Astrophysical Journal*, vol. xxxiii., Nos. 2 and 3) he gives the results for fourteen stars, and in four cases finds positive parallaxes exceeding 0·1″. These are Groombridge 34, $\pi = +0{\cdot}266'' \pm 0{\cdot}010''$; μ Cassiopeiæ, $\pi = 0{\cdot}105'' \pm 0{\cdot}010''$; Weisse I., 5h. 592, $\pi = +0{\cdot}189'' \pm 0{\cdot}010''$; and Fedorenko 1457–8, $\pi = +0{\cdot}148'' \pm 0{\cdot}015''$. The last-named is a well-known double star (Σ 1321), which has a proper motion of 1·7″ per annum, and Dr. Schlesinger gives an interesting discussion concerning the probable source of a systematic error which appears, including therein a discussion of the effect of atmospheric dispersion on the measured images of the stars.

The parallax of π^4 Orionis is found to be $+0.012'' \pm 0.007''$, and in the cases of ψ Orionis and S Monocerotis negative parallaxes result from the measures.

THE PARIS OBSERVATORY.—M. Baillaud's report for the year 1910 contains a record of a great deal of work successfully accomplished, and, besides, gives interesting accounts of several ingenious instrumental devices. The ordinary astronomical work was carried on as usual, but, together with the observations of Halley's comet and other special observations, was greatly interfered with by the unfavourable skies at Paris.

The distribution of time signals by radio-telegraphy took place regularly after May 23, 1910, and on November 23, and subsequently, a signal was sent at 11 a.m., as well as at midnight as previously. A brief account of the installation for this purpose is given.

THE LONGITUDE OF THE RED SPOT ON JUPITER.—In a communication to the *Astronomische Nachrichten* (No. 4498), the Rev. T. E. R. Phillips records his observations of the Red Spot on Jupiter during the present apparition. These show the remarkable fact that the longitude of this feature has diminished by approximately 30° in the unprecedentedly short time of ten months. While in June last year the zero meridian of system ii. practically bisected the hollow, the longitude on April 13 and 16 was but slightly more than 330°.

MEASURES OF DOUBLE STARS.—Lick Observatory Bulletin No. 190 contains the measures of 159 double stars made by Mr. C. P. Olivier. The paper is the fifth of a series on double stars lying south of the equator, and sixty-one of the present objects are south of −30° declination; twenty-four new pairs are included. The bulletin also contains a table displaying Mr. Olivier's personal equation with respect to Messrs. Aitken and Hussey.

THE BRITISH SOLAR ECLIPSE EXPEDITION.[1]

TO continue the hospitality which had been showered on us, Mr. Mills placed a large customs steam launch at our disposal, and the same afternoon took us for an impromptu cruise about the beautiful harbour, Mr. Hedley, the assistant curator of the Sydney Museum, accompanying us. Unfortunately, however, at about 4.30, while steaming up Middle Harbour, we piled up on a sandbank on a falling tide, and it was not until 7.30 that we were able to float off. As we did not arrive back to the hotel until 9 o'clock, our trip to the capital site had to be postponed until next morning. Mr. Hunt had already sent numerous telegrams and secured tickets and sleeping accommodation in the train, but these were generously replaced by others available for the following day. The next morning (March 21) Mr. Hunt showed me the screens on the wall of the Sydney Post Office, in which were exposed the meteorological forecasts. These seemed to be very popular, judging by the number of people I saw closely examining them whenever I passed by. Then he showed me the meteorological department at the observatory. The view from the tower of this observatory is magnificent, and as I had my panoramic camera with me I took views all round. From an astronomical point of view the observatory is very hampered, for on three sides it is surrounded by closely packed buildings, rendering the atmosphere very smoke-laden. The afternoon was spent in motoring in the vicinity of Sydney, and very fine views of the country were obtained. In the evening Mr. Hunt and I left for the capital site. To reach this region we had to make a night railway journey, arriving at Queanbeyan at 4.30 a.m. At the hotel there we turned in until 8 o'clock, and then started away in a two-horsed vehicle for the surveying camp, which is situated on the site of the future capital. This meant a drive of eight miles over a somewhat rough road, but this road is in progress of betterment every day. At this camp we were received by Mr. C. R. Scribner, the chief Commonwealth surveyor, who has the whole Commonwealth territory for surveying purposes in hand. In his offices we were shown contour maps of the whole region, the sites for the water supply, railway, &c. He had in process of making some model relief casts made accurately from the contour maps, and these were being coloured before dispatching them to the various world centres for competition. The competition consists of suggestions for the best arrangement for a "model city," and I believe a valuable prize will be awarded to the winner. Mr. Scribner has a nice little meteorological station in good working order near the camp site.

After lunch we drove a distance of about 6½ miles to the foot of a hill called Stromlow. This hill is 600 feet above the plain below, and its summit is 2600 feet above sea-level. It forms a kind of "Hog's Back" in a north and south direction, the land falling rapidly away on both sides. The eastern horizon is well open, so that solar observations can be made just after sunrise. The observatory site reminds one rather of that chosen for the Solar Physics Observatory at Fosterdown, Caterham, but, of course, on a very much larger scale. As the nearest town to the Stromlow hill will be the capital site, 6½ miles away, and as the latter will be on the leeward side of Stromlow in relation to the prevailing winds, the observatory cannot be rendered ineffective at any reasonably near date. Further, a very large reserve of land all round the hill has been set apart for protective purposes. Both on this and on the hill gum trees are in their thousands, but most of these have been ring-barked, and are therefore dead. The planting of other and quicker growing trees is now going to be undertaken, so that radiation from the ground will be reduced to a minimum. The result of my visit was that I was highly pleased with the site, and Mr. Hunt assured me that the weather conditions all the year round were of the best. The following is the brief report I sent to the Minister for Home Affairs with respect to the Stromlow site:—

AUSTRALIA HOTEL,
SYDNEY,
March 23, 1911.

SIR,

Accompanied by Mr. H. A. Hunt, escorted over the site by Mr. C. R. Scribner, I have now had the opportunity of inspecting the proposed location of the future Solar Physics Observatory. I carefully surveyed the situation with respect to those main requirements which could be judged on inspection, and I feel sure that Stromlow will admirably serve the purpose for the site of a National Observatory such as is proposed.

In selecting a site for a National Observatory for the study of Solar Physics, it is most important that one should look a long time ahead, and that any site selected now should be as good a site in, say, 100 years' time. The Stromlow site seems to be admirably suited in this particular. Again, it is fundamental that the observatory should be situated at a high elevation, because definition for solar observations is best in the very early morning just after sunrise, and an unobstructed eastern horizon is imperative. In fact, solar physics observatories are now situated or are now being removed to high localities to secure these observing conditions, and this result is the outcome of considerable experience.

In the present instance Stromlow is well adapted in this particular, for it is 2600 feet above sea-level and 600 feet above the neighbouring plain, and has an open eastern horizon. The highest points of this site should be utilised for the solar instruments.

Further, the site is good with respect to the western and northern horizons, rendering the location as an observing station one of the highest order.

Another important desideration in the choice of a good site is that the northern, eastern, and western slopes are such that there need be little fear from defects arising from the presence of future buildings on them. On the southern side of the site the plateau is very well adapted for the erection of the main business buildings of the observatory, apart from the observing instruments.

The observatory should be a sufficient distance away from any large town in order to render the sky as little illuminated as possible in the neighbourhood of the observatory from artificial town lights; in addition, it should be situated on that side of the nearest town from which the prevailing winds blow in order to free the

[1] Continued from p. 429.

observatory site from the presence of driving town smoke. These two conditions are, I find, allowed for in the site in question, the Capital site being at a sufficient distance of 6½ miles from the locality and on the eastern side, the prevailing wind being from the north-west.

Another important favourable point in the position of the site is that the area is of sufficient dimensions for the accommodation of the necessary buildings for the observation and study of other allied branches of work, such as meteorology, astronomy, seismology, &c. In the case of magnetism, I would suggest that the *observations* should be made at another site very far removed, while their work of *reduction* should be accomplished in special quarters at Stromlow.

It is very important, further, in the light of modern research, that there should be a rapid means of communication between the head workers in all the above subjects, since the latter are so intimately associated with one another. The bringing together of the various departments into one locality is therefore of considerable value, for instant intercourse and collaboration of the work between the heads of departments can be most efficiently accomplished in this way. For such a large country as Australia this centralisation of work is, I think, the most economical and effective course to take.

Trust that this brief summary of the results of the inspection of the site may serve a useful end,

I have the honour to be, Sir,
Your obedient servant,
WILLIAM J. S. LOCKYER.

The Hon. King O'Malley,
Minister for Home Affairs.

On the evening of March 22 Mr. Hunt and I left by train for Sydney, arriving there at 5 a.m. the next morning. After a short rest I went down to the wharf to see about the ten gallons of spirit which had arrived in the P. and O. steamship *Mongolia*, and had been forwarded by the British Museum authorities for use at Vavau for the preservation of the natural history specimens I proposed to have collected for them. A few days previously I had met Mr. A. W. MacIlwaine, of H.M.S. *Pegasus*, and he told me of the valuable fish collection he had made for the Sydney Museum on a previous cruise. He put me up to all the wrinkles of catching, and escorted me to the museum to introduce me to Mr. Maccullock, who looks after this branch there. Mr. Maccullock kindly supplied me with all the necessary materials for collecting and preserving, and promised to pack our catch properly for dispatch to London as soon as it arrived at Sydney after the eclipse.

Friday, March 24, was spent in packing and saying adieu to many kind friends preparatory to going on board H.M.S. *Encounter* in the evening after seeing Mr. Hunt off by train to Sydney, and I should like to take this opportunity of thanking him for his extreme kindness to me and all of us during the whole time we were in Australia. In Mr. Hunt the meteorology of Australia is in good hands; he and his staff are working at problems of extreme interest, which will be to the benefit of Australia in particular and the world in general.

H.M.S. "Encounter," April 2.

Saturday, March 25, saw us steaming majestically out of the beautiful harbour of Sydney away to far-off Vavau, the scene of our future labours. The ship, with her two tall masts carrying the network of Marconi wires between their tops, and the three funnels sending out the tailings of Newcastle coal, must have looked a pretty sight with the background of abnormal green grass and trees which studded the shores. On board were the two eclipse parties safe and sound, namely, Fathers Cortie and Pigot and Brother McKeon, and my party of Mr. McClean and Mr. Anderson, while safely stowed away below were the eclipse instruments and huts. On board also were some livestock, sheep, cocks and hens, and last, but not least, the ship's goat.

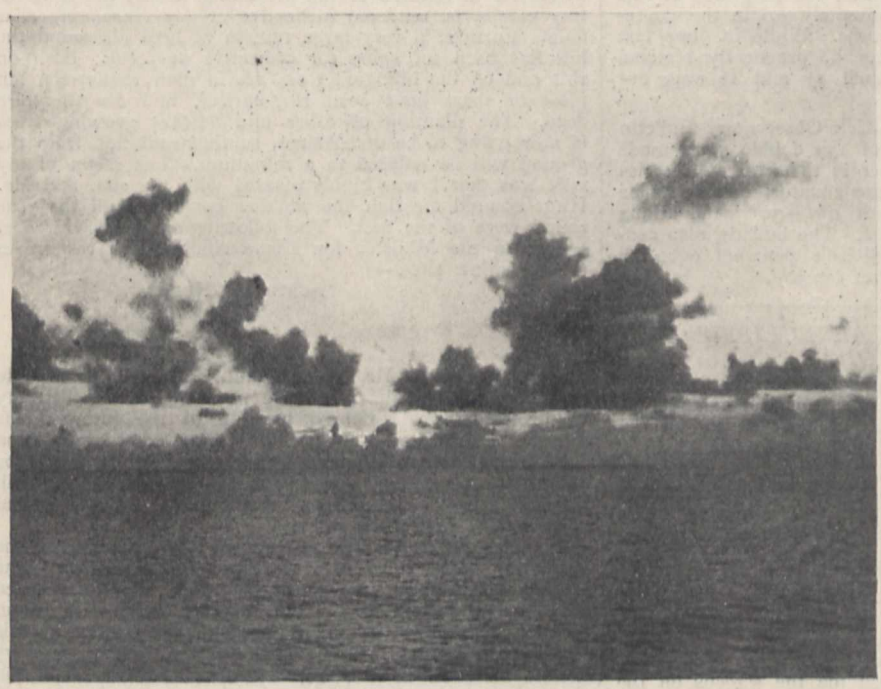

FIG. 1.—Evening Cloudscape in the Doldrums.]

The first day out I erected the screen for the three self-recording instruments, which ought to have been used all the way out from Tilbury. Then I adjusted and started the instruments themselves, the screen being placed on the starboard side of the ship well forward of the funnels and against the conning tower. That evening I gave a lecture, having now lantern and slides, the object of which was to explain to the whole ship's company the kind of assistance they could render us both in the preparations and during the eclipse. The lecture seemed to have attained its end, for the captain asked all those who were willing to assist to give their names in by six o'clock on Sunday, *i.e.* the next day. Not only did all the officers come forward, but 168 men handed in their names.

Sunday was occupied in preparing lists of the requirements of assistance at each instrument and for several parties, such as corona drawing, star observations, &c. When this was completed the captain handed it to the commander to portion off the officers and men for the several lines of work. In addition to the eclipse work, there were numerous volunteers for the "'ologies," as the natural history branches were termed. Thus the captain, assisted by Staff-Surgeon Milln, volunteered to do the catching of the butterflies, moths, beetles, spiders, &c., and he stated that Mrs. Colomb (who is on her way to Vavau with other ladies, wives of the officers) was bringing him the killing bottle. Mr. Anderson has occupied himself with geological study preparatory to rock-specimen collecting. The collection of flowers, seeds, and especially fern seeds, will be undertaken by Lieut. Hunt Gruhl, while Mr. Lane, the purser's clerk, was posted by Mr. MacIlwaine, of the *Pegasus*, in the art of catching fish. Lieut. Clover will look after the birds and bats, &c., and will be assisted by Staff-Surgeon Milln in their prepara-

tion. The Rev. Peshall has also volunteered to make a collection of shells, sponges, &c. Thus even if we are clouded out and do not get our astronomical observations, we hope at least to bring back some new material which may advance science in other directions.

On Tuesday, March 28, Father Cortie delivered a lecture on "Eclipses in General," while the following evening Mr. McClean was persuaded to describe and give his experiences on aëroplanes. In fact, we have all been most busy, and the ship has been rolling and pitching nearly all the time, and a stiff head wind N.E. has been blowing.

On March 31 we were invited to a concert given by the ship's company, which proved very successful.

Early this morning (April 2) we passed on our starboard side the islands of Tofua and Kao; both are volcanoes, the former active, but there were no signs of activity. Tofua lies in the centre of the eclipse track, but has not been looked upon as a suitable place for an eclipse station. On our port side we are now nearly abeam of Late Island, a lonely peak in this landless ocean. In fact, except for a very few birds and a few flying-fish, the ocean and air have been lifeless. The barograph is daily marking out the diurnal double oscillation superimposed on long waves of rise and fall. The temperature has been steadily rising, and has now reached the eighties. The hydrograph persistently records more than 80 per cent. of saturation, but on the moving ship this humidity is not very much felt except when violent exercise is indulged in. We are now in very quiet trade winds, and the good ship *Encounter* is becoming more steady. To-night, or rather this afternoon, we expect to arrive at our destination, and then we shall feel the effects of the temperature and humidity.

At the present moment no decision has been arrived at as to whether we shall live on board or ashore. Most probably it will be the latter. Our present intention is to occupy the spot indicated on the large-scale map of Vavau portioned off as a naval coaling station, for the harbour is sufficiently deep for the ship to lie just off. This harbour has only a very narrow entrance, so that the ship will be well protected from strong winds and landing will be easy.

To-morrow morning (April 3) will be spent in looking for a suitable site, and then on the following day the Union Steamship Company's mail boat arrives from Auckland, bringing the Australian astronomers and the other members of my party, namely, Messrs. Brooks, Raymond, and Winkelmann.

I have arranged with Captain Colomb that, should we be successful on the day of the eclipse, the ship will not leave Vavau until about May 5. The object of this is to give us plenty of time quietly to develop and copy all negatives; as the climate is so hot and humid, particular care must be taken to produce the best results, and it is quite possible that development may only be successfully accomplished during the cool (!) of the night. In the case of our being clouded out, Vavau will be left on May 2. On her return journey to Sydney, H.M.S. *Encounter* will make for Suva, Fiji, to coal, and to land Mr. McClean and myself there.

It is now 11.30 a.m., and two small patches of land ahead give us the first imprint of Vavau, our future home for some time to come. At last we are there after this long journey. W. J. S. LOCKYER.

THE PRIVATE SESSIONS OF THE IMPERIAL EDUCATION CONFERENCE.

IN our review of the public sessions of the conference (see NATURE, May 4), we hoped that the report of the private sessions would reveal a useful interchange of ideas between the delegates from various parts of the Empire, and that organised concerted action would result. The report (Cd. 5666, price 1*s.*) issued by the Board of Education is now before us, and we may state at once that it disposes of the fear—to which the character of the public meetings naturally gave rise—that the Colonial Governments had not been duly consulted with reference to the agenda of conference. Furthermore, we believe that the debates have been of a useful character, and that an important step has been taken to fulfil our aspirations by the organisation of an Imperial Education Bureau. The agenda of the meetings may be summarised as follows:—(1) action arising from the previous conference in 1907; (2) memoranda prepared by the Office of Special Inquiries and Reports on schools in the self-governing dominions; (3) training and qualifications of teachers; (4) cost of instruction and cost of living in connection with advanced technical colleges and universities; (5) the Board's examinations in the overseas dominions; (6) the formation of an Imperial Education Bureau.

Two mornings were devoted to problems of an educational, rather than administrative, character. English spelling and spelling reform formed the subject of papers by Dr. E. H. Edwards (H.M.I., England) and Dr. A. H. Mackay (Nova Scotia); also Dr. W. J. Viljoen (Union of South Africa) contributed interesting information with reference to the simplification of Dutch orthography and grammar. H.E. the Governor of Sierra Leone submitted a paper, written by R. F. Honter, on the psychology of the negro child and on the adaptation of primitive customs, manners, laws, and traditions in a system of education. Sir F. D. Lugard, Governor of Hong Kong, presented a memorandum on the best methods of training character and inculcating a high moral standard in universities founded primarily for non-Christian races, without the compulsory teaching of the Christian religion, and this subject is to be considered further at the next conference. Among the appendices is a report of the Conference on Bilingualism, convened by the President of the Board of Education. The discussion of this question by representatives of South Africa, Canada, the India Office, Scotland, Wales, and Malta, brought clearly into view the desirability of bringing into the common stock the varied knowledge and experience of administrators under diverse conditions.

But the success of the conference rests upon its treatment of the urgent administrative problems indicated in our six items of summarised agenda, especially in regard to the last. Much credit is due to Dr. Frank Heath, as director, and his staff at the Special Inquiries Office. Their activity has been even more productive than appeared from Mr. Runciman's address (*vide* NATURE, *loc. cit.*), as the interchange of officials, as well as of official memoranda, has been facilitated, and the difficulties of mutual recognition of teachers' certificates are approaching solution. The main outcome of the conference is the extension of the work of Dr. Heath's department. If the unanimous and weighty recommendations of the conference are carried into effect, the Office of Special Inquiries and Reports will perform the functions of an Imperial Education Bureau. The machinery by which these functions are to be performed, the provision for the continuity of the conference, modes of cooperation of the several education departments of the Empire, have all been made the subject of definite proposals of a practical character. From these, which will be found on pp. 12 to 18 of the report, we quote the penultimate recommendation:—

"That the several Education Departments of the Empire should publish, each for their own part of the Empire, the following monographs in the order named:—(*a*) the curricula of schools for general education; (*b*) the training of teachers for schools giving general education; (*c*) the laws of compulsory attendance and their working; (*d*) the general education of children in sparsely populated areas; and (*e*) the medical inspection of schools for general education." G. F. DANIELL.

THE ENDOWMENT OF HOME SCIENCE.

IT was announced on Friday last (the Queen's birthday) that a sum of 50,000*l.* had been subscribed for the endowment of "home science" in connection with the Women's Department of King's College, and that her Majesty had graciously allowed her name to be associated with a new hostel to be erected at a cost of 20,000*l.* Another 20,000*l.* is to be used for building and equipping laboratories, and it is hoped to supplement the remaining 10,000*l.* so that the endowment for salaries and current expenses may be 60,000*l.*

A trust fund committee has been formed to receive moneys given for the foregoing purpose, composed of the following:—the Marquis of Anglesey (chairman), Sir William Anson, M.P., Mrs. Asquith, Mr. Balfour, Lord Justice Buckley (hon. treasurer), Viscountess Esher, Lady Meyer, Sir Arthur Rücker, F.R.S., Lady Rücker, and Dr. John Atkins (hon. secretary).

The funds will be administered in accordance with the terms of the trust deed by an executive committee composed of representatives of the donors and of King's College for Women, including the Rev. Dr. Headlam, Prof. Jackson, Dr. Miers (the principal of the University of London), Miss Oakeley, Lady Rücker, and Prof. Smithells.

Among those who have generously contributed to the fund raised for the purposes of the endowment of King's College for Women are:—the Marquis of Anglesey, Mrs. Asquith, the Duke of Devonshire, Sir Richard Garton, Sir Carl Meyer, Lady Mond, Mr. Almeric Paget, M.P., Mrs. Almeric Paget, the Earl of Plymouth, Messrs. Rothschild and Sons, the Marquis of Salisbury, the Earl of Scarbrough, Lady Wantage, and the Duke of Westminster.

The Times in a leading article on Saturday, May 27, warmly eulogises the new departure, which, it says, "will be received throughout the country with universal satisfaction and sympathy."

This sudden and remarkable development will be hailed with satisfaction by those who during the last two years have been engaged in carrying out in connection with King's College, under great difficulties, the first attempt made in a university institution in this country to establish a course of higher education for women, centring round home and institutional life. In spite of the unsuitable accommodation and lack of funds, a beginning has been made, and those who are in charge of the scheme are confident of its value and permanent success. Now that funds and influential support are forthcoming, the chief obstacle to progress will probably consist in the difficulty of winning the goodwill of the educational world.

It is a little unfortunate that there is no good term available for indicating the range of studies that are comprised in the King's College course. The expression "home science" is not very felicitous, and it is to be regretted that its classical equivalent, economy (Οἰκονομία) or economic science, has lost its original significance. The pleonasm, domestic economy, has, not without good reason, fallen into disrepute. But whatever be the term used, it can hardly be doubted that, as in agriculture and other crafts, long left in the empiric state, it should be possible to delimit and develop a tract of higher intellectual studies which will rationalise and inform the vastly important work of household administration.

ANNUAL TABLES OF CONSTANTS AND NUMERICAL DATA.

AT the International Congress of Applied Chemistry held in London in 1909, an International Commission was appointed for the purpose of compiling and publishing annual tables of constants and numerical data, and this commission was subsequently accorded the patronage of the International Association of Academies at the meeting of that body held in Rome in 1910 (NATURE, May 26, 1910, p. 371).

According to the programme drawn up by the commission, the tables published in any one year are intended to contain all the numerical data likely to be of interest in connection with chemistry, physics, and allied sciences, pure and applied, to be found in the literature published during the previous year. The data are to be accompanied by full bibliographic references. This programme has now (May) so far matured that portions of the volume for 1910 are already in the press, while the manuscript of the remaining portions is approaching completion.

Owing to the immense volume of scientific and technical literature which is continually being produced, the difficulties in the way of finding out whether any given measurement has been made or not are increasing year by year. Existing systems of indexing and abstracting offer only limited help, since a large number of measurements are made in the course of researches to which they are purely subsidiary, so that their existence cannot be inferred from the titles and subtitles of the papers in which they are recorded. Also tables which appear only at long intervals, such as those of Landolt and Börnstein, can of necessity cover only a small part of the ground, and, moreover, in most cases they are hampered by the limitations of private enterprise. The annual tables should therefore fill a serious gap which has hitherto existed in the systematic indexing of scientific and technical results.

It is hoped that ultimately the enterprise may become self-supporting; but obviously this cannot be the case for some time to come. The commission has been greatly assisted by grants from various societies; for example, in this country, from the British Association, Chemical Society, Faraday Society, Royal Dublin Society, Royal Irish Academy, Royal Society of Edinburgh, and the Society of Chemical Industry. Donations have also been received from a few private persons, notably from the Earl of Berkeley, F.R.S. The financial position is, however, still far from satisfactory, and further help from societies and private donors is urgently needed. In this connection it may be mentioned that neither the general secretary nor the members of the commission receive payment for their services, except in so far as they may perform actual compiling or abstracting.

The organisation of the commission is sufficiently complete to deal effectively with the periodical literature, but it happens occasionally that data are published only in non-periodical publications, such as books or monographs, and such data may easily be overlooked. Accordingly, in order that the annual tables may be as complete as possible, the authors of such books, monographs, &c., are requested to communicate with one or other of the members of the commission. In cases where the data are numerous, specimen copies or corrected proofs of the tables containing the data would be very acceptable.

The members of the International Commission for the United Kingdom are:—Dr. Alex. Findlay, The University, Edgbaston, Birmingham; Dr. R. T. Glazebrook, C.B., F.R.S., The National Physical Laboratory, Teddington, Middlesex; and Dr. N. T. M. Wilsmore, University College, Gower Street, London, W.C. The general secretary is Dr. Charles Marie, 98 Rue du Cherches-Midi, Paris VI.

STANDARD TIME-KEEPING.

APPARENTLY the efforts of the British Science Guild to show the commercial need that exists for a more widespread observance of standard time than exists at present (see NATURE of February 16) have already attracted some attention, for last week we had an opportunity for inspecting a demonstration of yet another clock synchronisation system, to be made available by the Greenwich Time Co., which, we believe, is either a branch or offspring of the Normalzeitgesellschaft of Berlin, where there are about 30,000 clocks under the control of the company.

The company has offices in Albany Street, N.W., where a Time Bureau is to be established, and by means of the usual arrangements with the Post Office authorities, the Greenwich time signal is transmitted to the bureau over wires provided for the purpose. This signal controls a regulator clock, the function of which is to control electrically, half a dozen times during the day, other clocks in subscribers' premises. These clocks are arranged so as to report back their behaviour at certain times. If the synchronisation is reasonably efficient, the latter appears to us to be a rather unnecessary procedure. We gather that the company is prepared to let out, on hire, clocks suitable for this purpose for an annual rental of something under 2*l.* per clock. This seems rather expensive for subscribers who require a number of clocks, as must be so in the majority of cases, for the whole of the utility of a synchronisation scheme depends upon *every* clock showing the same time.

We observe that some of the reports in the daily Press hailed the inauguration of this company as something entirely novel, but, as readers of NATURE will remember, the scheme is not at all a new one; in fact, the Post Office authorities have for a long time been synchronising their old clocks, and it seems desirable to place on record

again that the Standard Time Co. has offered the public time service in London for many years. Then many of the electric clock firms, notably the Silent Clock Co., the Synchronome Co., and the Aron Time Distribution Co., have for a considerable time offered trustworthy synchronised Greenwich clocks to the public at rates which are, we believe, lower than those quoted by the new company. We wish every success, however, to a laudable endeavour to ensure accuracy in time-keeping,

ARCTIC TIDES.[1]

THE Coast and Geodetic Survey of the United States has just published the summarised account of the tides of the Arctic Ocean, based on the observations made by Peary's expedition and on those by Messrs. Mikkelsen and Leffingwell at Flaxman Island, to the north of Alaska. The recent Russian observations at Taimur Bay and on one of the New Siberian Islands are not yet available for inclusion. Peary's observations were made at Cape Sheridan, Port Aldrich (near Cape Columbia), Cape Bryant, Cape Morris Jesup, and Fort Conger for periods ranging from seven and a half months, November 12, 1908, to June 30, 1909, at Cape Sheridan, to fourteen days at Fort Conger; and hourly heights of the tide are given, as well as for Flaxman Island in 1906. These are followed by a table giving the principal harmonic constants for all stations north of the sixtieth parallel where such constants are at present available, and fifty-four of these have been collected. Besides this, however, the same region furnishes a long range of data from many points which have been obtained by successive explorers, and these have been brought together to show the intervals, ranges, tidal hours, &c., from all published sources, and to deduce from them the mean ranges of the semi-daily tide and the mean tidal hours.

A co-tidal chart from the Pole to latitude 65° shows the results arrived at by means of lines giving the Greenwich lunar time of mean high water, and on this chart a large area of about half a million square miles between Alaska and the Pole is represented as being land but slightly submerged. The following facts are quoted as showing the necessity for such land or shoals: at Point Barrow the flood stream comes from the west; the range of the semi-daily tide at Bennett Island is 2·5 feet, whereas it is but 0·4 foot at Point Barrow and 0·5 foot at Flaxman Island; the observed tidal hours and ranges of tide show that the semi-daily tide is not propagated to the Alaskan coast directly across a deep and uninterrupted polar basin. Not only the position of such a land area is indicated, but its approximate shape is given as roughly trapezoidal, for certain points are suggested by velocity and direction of currents, by Peary's Crocker's Land, and by some of his soundings.

This paper provides a useful and instructive summary of the tidal movements of the Arctic Ocean so far as they are known, and makes a very suggestive addition to our knowledge of the distribution of north polar lands.

AVIATION NOTES.

MR. WINSTON CHURCHILL has wisely amended his "Aërial Navigation Bill," and transformed a measure which, in its original form, promised to kill aërial navigation into one of comparatively small importance. The Bill as it now stands provides that if any person navigates any kind of air vessel over any area prescribed by order of the Home Secretary, unless he can prove that he was compelled to do so by stress of weather or other uncontrollable circumstances, he shall be guilty of an offence, and be liable to six months' imprisonment or a fine of 200*l.*, or both.

The prime object of the Bill is to prevent any daring or reckless aviator from flying over the Coronation processions. It is, however, an open question whether it would succeed in its aim were it not that the Royal Aero Club has requested aviators not to do so, and has provided a penalty for disobedience—the suspension of the certificate of proficiency. It will be perfectly obvious that an aviator could pass high over the processions without incurring any penalty whatsoever. At a height of 1500 feet and upwards the identity of the pilot would be unrecognisable.

M. Jules Védrines has performed an extraordinarily fine feat in flying from Paris to Madrid, a distance of 660 miles, in 12h. 15m., thus winning the prize offered by the *Petit Parisien*. The flight was accomplished on a Morane monoplane fitted with a 50 horse-power Gnome motor and an "Integrale" propeller. M. Védrines started from Issy-les-Moulineaux on May 22, reaching Angoulême, 250 miles away, in 3h. 42m. 18s. The second stage, to San Sebastian (193 miles), took 3h. 43m. 19s., and the final stage, on May 26, to Madrid (220 miles), took 4h. 48m. 42s. The times given are those of actual flight; but it is satisfactory to note that the first two stages were flown without a stop, and only one halt made in the last stage, owing to the breaking of a valve spring in the motor.

The most notable advance recently made in the improvement of aëroplanes has just been successfully tested near Versailles. M. Henry Farman has fitted a silencer to the motor of his military-type biplane, which was already furnished with a wireless telegraphy transmitter. The motor—a Renault—worked without a hitch.

A meeting of the Aërial League of the British Empire was held at the Mansion House on Wednesday of last week to promote a special Coronation appeal for 250,000*l.* for the establishment of a National Institute and School of Aëronautics. The following motion (moved by Sir E. Shackleton) was put to the meeting and carried unanimously:—"That this meeting of the citizens of London and the Empire supports the principles laid down in the circular issued by the Aërial League of the British Empire, and pledges itself to do all in its power to assist the League in its efforts on behalf of the advancement of aëronautics," as was also the following (proposed by Mr. Joynson-Hicks, M.P.):—"That a Coronation fund be raised for the purpose of inaugurating a National Institute and School of Aëronautics."

NEW ORGANIC COMPOUNDS OF NITROGEN.[1]

IN the diversity of behaviour exhibited by its derivatives, nitrogen is unrivalled by any other element. This is illustrated not only by the contrasting properties of ammonia, hydrazine, and azoimide, substances composed solely of nitrogen and hydrogen in different proportions, but also by the chemical, physiological, and æsthetic variations displayed by organic compounds of nitrogen, such as nitrocellulose, indigo, azo-dyes, alkaloids, enzymes, and proteins.

Azoimide or hydrazoic acid, HN_3, discovered by Curtius in 1890, is the parent of a series comprising numerous highly reactive organic compounds, the first of which—phenylazoimide—was brought to light by Peter Griess in 1866, after which date the subject lay dormant for more than twenty years. Two methods are applied commercially to the production of sodium azide; the first, described by W. Wislicenus (1892), consisting in passing nitrous oxide over heated sodamide; the second, due to Stollé and Thiele working independently (1908), depending on the interaction of hydrazine, sodium ethoxide, and an ethereal nitrite. In consequence of these, the salt, originally a chemical curiosity, may now be purchased at 40*s.* per pound, largely owing to the simple and inexpensive preparation of hydrazine devised by Raschig (1908). The principal methods by which organic derivatives of azoimide may be obtained are:—

(1) Action of nitrous acid on a substituted hydrazine, applied by Curtius to the production of numerous acyl azoimides.

(2) Addition of hydrazoic acid to a diazonium sulphate, found by Noelting to yield aromatic azoimides quantitatively.

(3) Interaction of organic halides and sodium azide, as practised at the Royal College of Science in preparing aliphatic azoimides.

[1] Abstract of a discourse delivered at the Royal Institution on Friday May 5, by Prof. Martin O. Forster, F.R.S.

[1] "Arctic Tides." By Rollin A. Harris. (Washington: Coast and Geodetic Survey, 1911.)

It commonly happens that the materials thus obtained are, like the parent compound, explosive, and they are, moreover, very sensitive to light. From a study of their refractive power, it appears that in the aliphatic series the increment of refraction for the triazo-group is 8·91 as compared with 8·93 for bromine; and whilst the atomic dispersion of this halogen is 0·35, that attributable to the triazo-group is 0·36. Moreover, the elevation of boiling point produced by this complex lies between those due to bromine and iodine, whilst the effect on the dissociation constant of an aliphatic acid exceeds that of iodine, but is less than that of bromine. Thus the physical evidence supports those chemical characteristics which classify the triazo-group as a complex radicle having a strong family resemblance to the halogens.

The changes undergone by triazo-compounds may be referred to one of three main types:—

(1) Liberation of two nitrogen atoms in elemental form, leaving the third attached to the carbon which originally carried all three. This is exemplified by triazoantipyrine, which passes spontaneously into a red azo-compound, whilst in triazoacetone, triazocamphor, and triazoacetic acid the change is accelerated by alkali. Sometimes this type of alteration is violently explosive, as in the case of triazoacetic azide.

(2) Unfolding of the three-atom nitrogen ring into a straight chain such as occurs in diazoaminobenzene or in the cycloid tetrazole. Allylazoimide, for instance, a colourless liquid, changes spontaneously into an isomeric solid which no longer contains the triazo-group, whilst hydrazoic acid converts prussic and fulminic acids into tetrazole and hydroxytetrazole respectively.

(3) Complete removal of the triazo-group in the form of hydrazoic acid. The simplest example of this change is found in the behaviour of triazomethylamine derivatives, which liberate hydrozoic acid when treated with cold water; this happens also when triazotised carbon is associated with a halogen, as in the case of triazoethylene dibromide, but more generally this type of decomposition requires the action of alkali.

Although the preparation of chloroazoimide by Raschig (1908) indicates the possibility of producing hexatomic nitrogen by the union of two triazo-groups, this new form of the element has not yet been realised.

A NEW METHOD OF CHEMICAL ANALYSIS.[1]

I HAVE had on several occasions the privilege of bringing before the members of the Royal Institution some of the results of the experiments on the positive rays on which I have been engaged for the last few years. I wish this evening to direct your attention to some applications of these to various chemical problems.

The first application I shall consider is the use of these rays to determine the nature of the gases present in a vacuum tube, to show how they can be used to make a chemical analysis of these gases—an analysis which, as we shall see, will enable us to determine, not merely whether an element, say, for example, oxygen, is present in the tube, but will tell us in what form it occurs, whether, for example, it is present in the atomic as well as the molecular condition, and whether there are allotropic modifications present, such as ozone, O_3, and other still more complex aggregations.

The method is as follows: the positive rays, after passing through a fine tube in the kathode, are exposed simultaneously to magnetic and electric forces, the magnetic field being arranged so as to produce a vertical deflection of the rays, while the electric field produces a horizontal deflection. Thus, if when neither electric nor magnetic fields are present, the rays strike a screen placed at right angles to their direction at a point O, they will, when both electric and magnetic forces are at work, strike it at a point P, where the length of the vertical line PN is equal to the deflection produced by the magnetic field, and the horizontal line ON to that produced by the electric field.

We know from the theory of the action of electric and magnetic fields on moving electrified particles that

$$PN = A\frac{e}{v} \qquad ON = B\frac{e}{mv^2}$$

where A and B are constants depending on the strength of the magnetic and electric fields and the geometrical data of the tube, e is the charge on the particle, m its mass, and v its velocity.

From these relations we see that

$$\frac{m}{e} = \frac{A^2}{B}\frac{ON}{PN^2}.$$

When these rays strike against a photographic plate, they affect the plate at the point against which they strike, and thus when the plate is developed we have a permanent record of the deflections of the rays. The methods of taking these photographs and the details of the experiment are described in my paper in *The Philosophical Magazine*, February. The values of A and B can be determined accurately by the methods I have given in previous papers, and hence if we measure on the photographs the values of ON and PN, we can determine the value of m/e. If we wish to compare the values of m/e for two different rays, it is not necessary to determine A and B; all we have to do is to measure the values of ON and PN, and thus the photograph alone gives us the means of comparing the value of m/e.

Since for the same type of carrier m/e is constant, so that whatever may be the velocity $\frac{PN^2}{NO}$ is constant, and therefore the locus of P, *i.e.* the curve traced on the photographic plate by this carrier, is a parabola. The reason we get a curve instead of a point is that the rays are not all moving with the same velocity, and the slower ones suffer greater deflection than the quicker ones. Each type of carrier produces its own line on the plate, and there are as many curves on the plates as there are kinds of carriers; from an inspection of the plates we can find, not merely the number of kinds of carriers, but from the dimensions of the curves we can at once determine the atomic weight of the carrier, and thus determine its nature. This is one of the great advantages of this method. To illustrate this advantage, let us compare the method with that of spectrum analysis. If the spectroscopist observes a line unknown to him in the spectrum of a discharge tube, the most he can deduce without further investigation is that there is some unknown substance present in the tube; and even this would be doubtful, as the new line might be due to some alteration in the conditions of the discharge. But if we observe a new curve in the positive-ray spectrum, all we have to do is to measure the curve, and then we know the atomic weight of the substance which produced it. To take an example, I have photographed the positive-ray spectrum for nitrogen prepared from the atmosphere and that for nitrogen prepared from some nitrogenous compounds, and have found that the former contains a line[1] which is not in the latter, and that the value of m/e for this line is 40 times that for the atom of hydrogen. We thus know that atmospheric nitrogen contains an element of atomic weight 40, which is not present in chemical nitrogen—this element is, of course, argon. We might by ordinary spectrum analysis have found lines in the spectrum of atmospheric nitrogen which are not in the spectrum of chemical nitrogen, and might thus have suspected the presence of another element; but spectrum analysis could not tell us anything about the nature of this element, whereas the positive-ray spectrum at once gives us its atomic weight.

The positive-ray method is even more delicate than that of spectrum analysis, for by it we can detect the presence of quantities of a foreign gas too minute to produce any indication in the spectroscope. I have, for example, often been able to detect the presence of helium by this method when no indication of its presence could be detected by a spectroscope.

Again, when a line in the positive-ray spectrum can be seen, the atomic weight of the carrier which produces it can be determined with great accuracy. Though the method is only a few months old, it is even now sufficiently developed to determine with an accuracy of 1 per

[1] Discourse delivered at the Royal Institution on Friday, April 7, by Sir J. J. Thomson, F.R.S.

[1] As a matter of fact, there is a second, very faint line for which m/e is about twenty times that for the atom of hydrogen. This is probably due to an atom of argon with two electric charges.

cent. the atomic weight of a gaseous substance, without requiring more than 1/100 milligram of the substance. Another very important advantage of this method is that it is not dependent upon the purity of the material; if the material is impure, the impurities merely appear as additional lines in the spectrum, and do not affect the parabola due to the substance under examination, and therefore produce no error in the determination of the atomic weight. The method would seem to be peculiarly suitable for the determination of the atomic weights, not

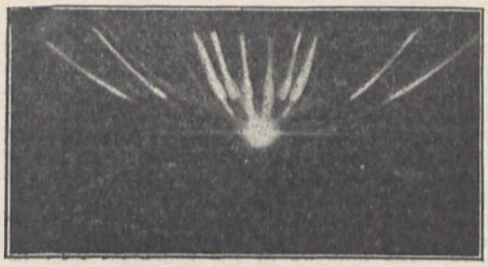

FIG. 1.

merely of the emanation from radio-active substances, but also those of the products into which they disintegrate.

The rays, too, are registered within less than a millionth of a second after their formation, so that when chemical combination or decomposition is occurring in the tube, the method may disclose the existence of intermediate forms which have only a transient existence, as well as of the final product, and may thus enable us to gain a clearer insight into the process of chemical combination.

I will now show a few slides prepared from the photographs we have taken of the positive-ray spectra. The first (Fig. 1) is that of nitrogen prepared from air; the measurements of the photograph showed that the atomic weights of the carrier producing these curves were as follows :—

Positive		Negative
1	H_+	1 H_-
1·99	H_{2+}	11·20 C_-
6·80	N_{++}	15·2 O_-
11·40	C_+	...
13·95	N_+	...
28·1	N_{2+}	...
39	$A_{+}g_+$	...
100	Hg_{++}	...
198	Hg_+	...

The symbol H_+ denotes that the carrier is an atom of hydrogen with one charge; H_{2+} that it is a molecule of hydrogen with one charge; N_{++} that it is an atom of nitrogen with two charges; and so on.

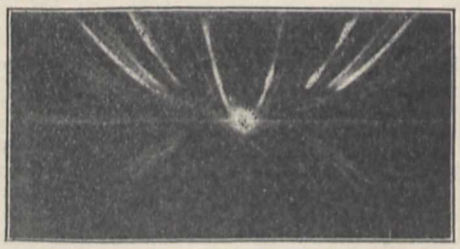

FIG. 2.

With nitrogen from NH_4NO_2 the lines were as follows (the magnetic force was so large that some of the lines corresponding to the lighter particles were thrown off the plate) :—

6·1 C_{++}	44·2 CO_{2+}
7·02 N_{++}	65·5 Hg_{+++}?
12·08 C_+	100 Hg_{++}
14·01 N_+	204 Hg_+
27·9 N_{2+}	

The next slide (Fig. 2) is the positive-ray spectrum for CO, and again the magnetic field is so great that the lighter carriers do not appear.

From the measurement of the lines we find that the atomic weight of the carrier is

Positive		Negative
6·00	C_{++}	12 C_-
6·95	N_{++}	16 O_+
7·95	O_{++}	...
12·02	C_+	...
13·9	N_+	...
15·95	O_+	...
28·05	CO_+	...
43	CO_{2+}	...
69·5	Hg_{+++}(?) very faint	...
100	Hg_{++}	...
202	Hg_+	...

The spectrum for CO_2 is represented in Fig. 3; the atomic weights are :—

5·98 C_{++}	43·9 CO_{2+}
8·00 O_{++}	62·5 Hg_{+++}(?) very faint
12·00 C_+	99·6 Hg_{++}
16·00 O_+	200·0 Hg_+
28·02 CO_+	

The spectrum of CH_4, of which a small region with five lines close together is shown in Fig. 4. This is interesting, because the measurement of these lines shows that their atomic weights are 12, 13, 14, and 15, 16, and thus that we have here C, CH, CH_2, CH_3, CH_4. If I am not mistaken, this is the first occasion when the atoms CH, CH_2, CH_3 have been observed in a free state.

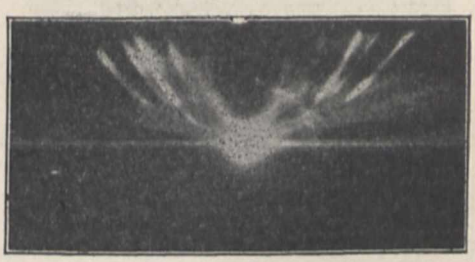

FIG. 3.

The spectrum of the analogous compound chloroform, $CHCl_3$, is represented in Fig. 5. The atomic weights represented in this are :—

1 H_+	18·5 Cl_{++}
1·5 (?)	27·7 CO_+
2 H_{2+}	36 Cl_+
3 (?)	46·5 CCl_+
6 C_{++}	63 (?) faint
8 O_{++}	81 CCl_2
11·9 C_+	102 Hg_{++}
13·7 N_+	201 Hg_+
16 O_+	

The carriers with atomic weights 1·5 and 3 have not been identified. They are of frequent occurrence. I have here two slides, one of SiH_4 (Fig. 6) and the other of the residual gas in the tube, in which they are well marked, though at their best they are only faint lines. In Fig. 7 we have the positive ray spectrum of air, taken under conditions which produce very narrow lines, which can be accurately measured.

Let us now consider some of the results brought to light by these photographs. In the first place, they show that a gas through which an electric discharge is passing is a much more complex thing than a collection of molecules all equal to each other. Even an elementary gas becomes in these circumstances a mixture of a great many different substances. Thus, to take oxygen as an example, the photographs show that when a current of electricity passes through it, we may have present simultaneously oxygen in the following states :—

(1) Ordinary molecular oxygen, O_2.
(2) Neutral atoms of oxygen, O.
(3) Atoms of oxygen with 1 positive charge, O_+.
(4) Atoms of oxygen with 2 positive charges, O_{++}.
(5) Atoms of oxygen with 1 negative charge, O_-.
(6) Molecules of oxygen with 1 positive charge, O_{2+}.
(7) Ozone with a positive charge, O_{3+}.
(8) O_6 with a positive charge, O_6.

And, in addition, there are free negative corpuscles. Thus in the elementary gas there are at least nine (the list has no claim to be exhaustive) separate substances present when the discharge passes through it. Each of these substances has almost certainly different properties, possibly a characteristic spectrum. If we took any other gas we should find that the same thing would be true: thus in hydrogen we have H, H_2, H_+, H_-, H_{2+}, even if we do not ascribe to hydrogen the lines giving $m/e = 1{\cdot}5$ or 3. In nitrogen we have N, N_2, N_+, N_{++}, N_{2+}, carbon occurs as C_+, C_{++}, C_-, chlorine as Cl, Cl_2, Cl_+, Cl_{++}, and Cl_-, mercury as Hg, Hg_+, Hg_{++}, and probably as Hg_{+++}, as there is a very persistent line for which m/e is about 66.

Thus, whenever the electric current passes through a gas, and probably whenever a gas is ionised, the gas becomes a mixture of many different substances. We can thus readily understand why in the spectra of many elements many of the lines may be grouped together so as to form different series—the principal series, the first coordinate series, and so on—and the spectrum of the discharge tube regarded as the superposition of a number of different spectra the relative intensities of which may be subject to very great variations. This, indeed, is just

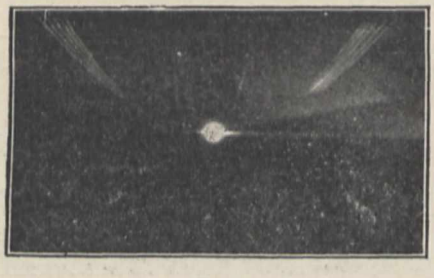

FIG. 4.

what would happen if some or all of the substances which are present when the gas is in the ionised state gave rise to different spectra.

Another feature which I think is of great interest from the point of view of the theory of chemical combination is the occurrence of particles with negative charges. Let us consider for a moment how these are formed. They are formed after the particles have passed through the kathode; the path between the kathode and the photographic plate contains abundance of corpuscles produced by the ionisation of the gas; a neutral particle, after passing through the kathode, picks up a negative corpuscle, and so becomes negatively charged. For this to occur, the attraction between the corpuscle and the neutral particle must be exceedingly strong, for it is not a question of a particle at rest attracting to itself a negatively electrified corpuscle sauntering about in its neighbourhood. In our case the neutral particle is rushing past the corpuscle with a velocity of the order of 10^8 cm. per sec. In order that the particle may in these circumstances be able to drag the corpuscle along with it, the attraction between the two must be so great that to move a corpuscle against this attraction from the surface of the particle away to an infinite distance must require an amount of work of the same order as that required to communicate to the corpuscle a velocity of 10^8 cm. per sec.; this is equal to the work required to move the atomic charge against a potential difference of about 3 volts, and is therefore comparable with the work required to dissociate some of the most stable chemical compounds.

The fact, then, that some particles get negatively charged shows that in the neutral state these particles have an exceedingly strong affinity for a negatively electrified particle, while the absence of a particular particle from the negative side shows that its affinity is much less, but does not imply that it vanishes altogether. From what we have said, it should follow that the more slowly the neutral particles are moving relatively to the corpuscles, the more easily will the negatively electrified systems be formed. This is confirmed in a very striking way by our experiments, for when the discharge is passing very easily through the tube, and the velocity of the neutral particles is relatively small, the number of negatively electrified particles is very much increased; indeed, in some cases the brightness of the part of the photograph corresponding to the negative particles is as great as that corresponding to the positive, whereas when the discharge is passing with great difficulty, and the velocity of the neutral particles is very high, the negative part is very faint compared with the positive.

The particles which have been observed on the negative side are the hydrogen atom, the carbon atom, the oxygen atom, and the chlorine atom. The presence of oxygen and chlorine atoms might, perhaps, have been expected, as these are universally regarded as strong electro-negative elements, *i.e.* as elements which have a strong affinity for negative electricity. The presence of the hydrogen atom is more remarkable, for hydrogen is generally considered to be a strongly electro-positive element, yet on these photographs we find it more persistently on the negative side than any other particle; often when no other line on the negative side is strong enough to be detected, the line corresponding to the hydrogen atom is distinctly visible. This is all the more remarkable, because the hydrogen atom, being the lightest of all the particles, is moving with the greatest

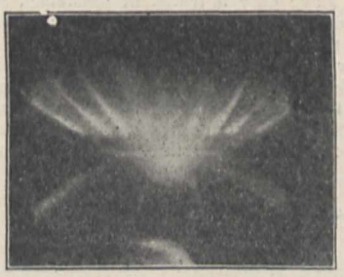

FIG. 5.

velocity relatively to the corpuscles, and therefore would, other circumstances being the same, be the least likely to capture them. The heavier the particle, the slower is its velocity, and the greater chance it has of capturing the corpuscles; the fact that heavy complicated particles are conspicuous by their absence on the negative side shows that the attraction of these for the corpuscles must be exceedingly small compared with that exerted by a neutral atom of hydrogen. It will be seen that the atom of carbon, also regarded as an electro-positive element, is also conspicuous on the negative side.

On looking at the list of the particles which occur on the negative side, we are struck by the fact that they are all atoms: there is not a molecule among them. Thus, although the curve corresponding to the negatively electrified hydrogen atom occurs on every plate, there is not a single plate which shows a trace of a curve corresponding to a negatively electrified hydrogen molecule, although that corresponding to the positively electrified molecule is always present, and on some of the plates is stronger than that due to the positive hydrogen atom. Again, on some plates the positive oxygen molecule shows stronger than the oxygen atom, but on the negative side only the atom is visible.

Thus neutral atoms, but not neutral molecules, can exert on the negative corpuscles those enormous attractions which, under the conditions of these experiments, are required to bind the corpuscles to these rapidly moving particles. We may compare this result with the properties ascribed by chemists to bodies when in the nascent condition, *i.e.* when they have only recently been liberated from chemical combination, and when they are likely to be partly in the atomic state, for atoms, as we have seen.

exert forces on electric charges in their neighbourhood vastly greater than those exerted by molecules.

We may compare the forces exerted by a neutral atom on the corpuscles with those exerted by an unelectrified piece of metal on a charged body in its neighbourhood. In consequence of electrostatic induction, the charge and the metal will attract each other. This attraction is dependent on the electricity in the metal being able to move under the electric forces exerted by the charge, and to rearrange itself in such a way that if the charge is positive, the negative electricity in the metal moves to the part of the metal nearest to the charge, while the positive electricity moves to the part remote from the charge. The force between the metal and the charge depends on the freedom of the electricity to move about in the metal under the action of the electric field. If the metal is replaced by a substance of high specific inductive capacity, like sulphur, in which the electricity has an appreciable amount of freedom, though not so great as in a metal, the attraction, though still appreciable, is very much less than it was with the metal. A very simple experiment will illustrate this point. I have on this cardboard disc, which is suspended from a long string, a number of magnets such as are used for compasses; if I mount the magnets on pivots, so that they are free to turn round, the system of magnets is strongly attracted when another magnet is brought near it; if, however, I take the magnets off their pivots, so that they are no longer free to turn, the magnet exerts very little attraction upon them.

FIG. 6.

A view of chemical combination which I gave some time ago in *The Philosophical Magazine*, and also in my "Corpuscular Theory of Matter," suggests that there is a very close analogy between the causes at work in the experiment we have just made and those which produce the difference between the behaviour of atoms and molecules. On that theory the atom was supposed to consist of a large number of corpuscles arranged inside a sphere of positive electricity, the corpuscles arranging themselves so as to be in equilibrium under their mutual repulsion and the attraction of the positive electricity. The configuration depends on the number of corpuscles, and the stiffness and stability of the system also change as the number changes. For some particular numbers of corpuscles the system is very rigid, and any movement of the corpuscles would be strongly resisted; since the movement of electricity inside the atom is brought about by the movement of the corpuscles, the electricity could only move with great difficulty inside these atoms, and they would therefore not be able to exert more than feeble forces on electrical charges outside the atom: they would therefore not enter readily into combination with other atoms. We may ascribe such a constitution as this to the atoms of the inert gases, helium, argon, and neon. A system with one, two, or three more corpuscles than the system we have just described would not be nearly so stable, and there would be a tendency to discard the extra corpuscles from the atom so that it might return to the more stable form. We may roughly picture to ourselves the atom with one extra corpuscle as consisting of a number of fixed corpuscles plus one which is free to move about; the freedom of this corpuscle would enable the electricity in the atom to move about, and would endow the atom with the property of attracting any electrical charges which might be near it. If there were two corpuscles in the atom more than the number required for the most stable form, we can picture the atom as having two corpuscles free and the rest fixed. Similarly, if we had more than two extra corpuscles. Thus we may regard the atom as possessing 0, 1, 2, 3 corpuscles which are able to move about with more or less facility, and the free corpuscles will give to the atom the power of exerting attractions on electrical charges to an extent which depends on both the number of corpuscles and the freedom with which they can move about. On the theory to which I have alluded, the number of these "free" corpuscles determines the valency of the atom.

Now let us suppose that two such atoms come into such close connection that the corpuscles in the one exert considerable forces on those in the other. The system consisting of the two atoms will rearrange itself so as to get into a more stable form, if necessary, corpuscles passing from one atom to the other to enable it to do so. The greater stability, however, implies a loss of mobility; the free corpuscles have become parts of a more stable system, and have therefore lost to a greater or less extent their mobility. But with the mobility of the corpuscles goes their power of exerting forces on electrical charges, and thus the combination of the atoms diminishes to a great extent the attractions they exert outside them. Speaking generally, we may say that on this view the combination of atoms to form molecules, either of compounds or elements, fixes corpuscles which were previously mobile and converts the atoms from conductors of electricity into insulators with a small specific induction capacity.

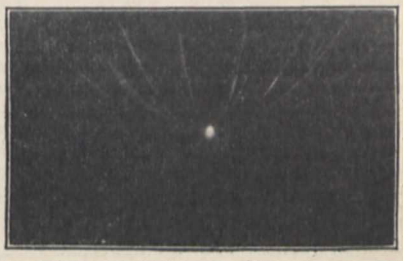

FIG. 7.

I have brought these illustrations before you with the object of showing that we have now methods which are capable of dealing with much smaller quantities of matter than the methods now used by chemists, methods which are capable of detecting transient phases in the processes of chemical combination, and I am hopeful may be of service in throwing light on one of the most interesting and mysterious problems in either physics or chemistry—the nature of chemical combination.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

EDINBURGH.—Mr. A. D. Darbishire has been appointed to the newly instituted lectureship in genetics, and will deliver a course of six lectures on heredity during the summer session, the course to be free to all matriculated students. Dr. W. G. Smith has been reappointed Combe lecturer in psychology. The executive committee of the Chiene portrait fund has resolved to hand to the University the balance of the fund (a sum of from 310*l.* to 320*l.*) for the foundation of a bronze medal, to be called the "Chiene medal in surgery."

M. TISSOT, an assistant in the Paris Museum of Natural History, has been appointed professor of physiology in the museum.

DR. D. FRASER HARRIS, lecturer on physiology in the University of Birmingham, has been appointed the Thompson lecturer in natural science for 1911–12 at the United Free Church College, Aberdeen.

SIR J. CAMERON LAMB, C.B., C.M.G., has been appointed to represent the Royal Society of Arts at the forthcoming

five hundredth anniversary of the foundation of the University of St. Andrews.

MR. R. NEWSTEAD, lecturer in economic entomology and parasitology in the Liverpool School of Tropical Medicine, has been appointed to the newly established Dutton memorial chair of entomology in the University of Liverpool.

THE Mathematical Society and the Society of Applied Physics of Göttingen have given 100,000 marks to a fund for the creation of an Institute of Mathematics in connection with the University of Göttingen. Two donations of 50,000 marks from manufacturing houses have also been received.

WE learn from *Science* that the Alabama legislature has made the University of Alabama an additional grant of 60,000*l.*, to be expended during the next four years for maintenance and new buildings. On his recent visit to Pittsburg, Mr. Carnegie presented the Carnegie Technical Schools with a valuable 725-acre tract of land that he had owned for some years, twenty-five miles up the Allegheny River from Pittsburg. It will be converted at once into an experimental station and engineering camp.

WE learn from the Journal of the Royal Society of Arts that a system of schools and stations to teach agriculture in the several States, in harmony with the plan for apprenticeship trade-schools, has recently been sanctioned by the Brazilian Government. At the head is to be a higher school of agriculture and veterinary surgery, situated at Rio de Janeiro. The school will give education fitting students for places as experts in the general extension of agricultural training. With the cooperation of the State Government, agricultural schools, experimental stations, model farms, and stock ranches will be established as soon as the general working out of the plans justifies such work. Elementary instruction in rural industries will be encouraged in schools for elementary education already established. By demonstrations at experimental stations and elsewhere it is intended to instruct farmers in the use of modern implements and methods necessary to success in farming.

THE Education (School and Continuation Class Attendance) Bill was presented to the House of Commons by Mr. Runciman on May 26. The principal objects of the Bill are to abolish the existing half-time system, to enable local education authorities to compel the attendance at continuation classes up to the age of sixteen of children who have ceased to attend a public elementary school, and, where this compulsion is not applied, to make fourteen the normal age for leaving school. At present a child under fourteen years of age can obtain exemption from school attendance in different ways, according to the district. These methods depend upon previous attendance at school, or proficiency, or a combination of the two. The Bill proposes that compulsory attendance at school up to the age of thirteen shall be universal, and not dependent upon local by-laws. Beyond thirteen years, under the Bill, every child must either continue to attend school up to the age of fourteen, or—where the principle of compulsion to attend continuation classes to the age of sixteen has been adopted in the locality—obtain special exemption from school attendance on the ground that he is entering beneficial employment, when he will, of course, attend the continuation school until the age of sixteen. An exception is made in the case of children beneficially employed in agriculture, for these may be specially exempted from school attendance at thirteen, even when there is no provision for compulsory attendance at continuation classes. If the Bill is passed, the half-time system disappears by which children employed during part of the day or week are compelled also to attend an ordinary elementary school for other parts of the day or week.

THE recently published report of the Apprenticeship and Skilled Employment Association, which deals with the work accomplished during 1910, is interesting reading. The object of the association is the promotion of the industrial training for boys and girls by apprenticeship and other methods, including arrangements for attendance at trade schools and at technical classes. The central office of the association is intended to bring all local agencies dealing with the skilled employment of boys and girls into cooperation with each other. It supplements, when necessary, the industrial information obtained by local committees; it encourages the formation of new committees; it arouses public interest in the objects of the association by organising conferences, and issues such literature as may be useful. The report shows that the association has been successful in maintaining cordial relations with the Board of Trade, the General Post Office, the London County Council, and other bodies concerned directly or indirectly with the objects of the association. It may be mentioned that the experiment referred to on previous occasions in these columns, of trying to find suitable employment for boys and girls who have hitherto been employed as laboratory monitors in secondary and higher grade schools, continues to receive the attention of the association. During the year under review, out of twenty-nine boys applying, fifteen have been placed by the association in appropriate situations. So far, the efforts to place the girl laboratory monitors have met with no success, although various firms—chiefly dyers and cleaners—have been applied to. The question of employing girls as laboratory attendants is, says the report, a doubtful one, and it would be well if the advisability of employing girls in this capacity were reconsidered. The offices of the association are at 36 and 37 Denison House, Vauxhall Bridge Road, S.W.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society May 25.—Sir Archibald Geikie, K.C.B., president, in the chair.—The Hon. C. A. **Parsons** and S. S. **Cook**: Experiments on the compression of liquids at high pressures. During the experiments on the behaviour of carbon under high pressures and temperatures, described in a paper by Mrs. C. A. Parsons, June 27, 1907, to the Royal Society, very considerable volumetric compressions were observed in the case of oils and other liquids. The present paper records some investigations into those compressibilities. The apparatus consists of a hydraulic press capable of exerting a maximum force of 2000 tons. Under the press is placed a massive block of gun steel, with a 4-inch hole and plunger of tool steel packed with a cup leather reinforced by a brass cup, which has been found to be satisfactory up to pressures of 40 tons per square inch, and quite tight for fluids. The estimation of the total friction by the method of the loop diagram, and the correction for the elasticity of the mould packings and ram by the method of replacing a known volume of the fluid by steel, are fully described, and the pressure in the mould is given by the water-gauge pressure on the rams of the press, plus the weight of the moving parts multiplied by the constants. The fall of temperature on sudden removal of pressure, and the curves for isothermal and adiabatic compression, are given for some fluids. From these data the internal work of the fluid is calculated for water, ether, and paraffin oil. In the preliminary experiments the pressure was carried up to 40 tons per square inch, but because no advantage was apparent and some inconvenience was involved, the pressure was limited to 4550 atmospheres, under which water is compressed to 87 per cent. of original bulk. The results as to compressibility are in close agreement with those of Amagat, so far as the latter were carried, *i.e.* 3000 atmospheres.—Prof. W. H. **Bragg** and H. L. **Porter**: Energy transformations of X-rays. There seems to be good reason to suppose that the energy of the secondary kathode ray comes from the energy of the primary X-ray. This leads to the "corpuscular" theory of the X-ray (and similarly of the γ ray). Each such ray must move without gradual change of form or energy until at last an atom through which it is passing causes the conversion of form, that is to say, the transformation to kathode-ray energy. On this view (1) the absorption of X-rays means simply the transformation of energy, and (2) the X-ray itself does not ionise at all. The pre-

sent paper describes experiments intended to test these deductions. The results show that in the cases considered the second deduction is verified, and the first also, when the test can be pushed to completeness. In some cases insufficient knowledge of the law of absorption of the kathode rays, and of other important processes, prevent the full application of the test, but it is satisfactory so far as it goes.—Prof. A. **Fowler** and the Hon. R. J. **Strutt**: Spectroscopic investigations in connection with the active modification of nitrogen. I.—Spectrum of the afterglow. (1) The paper gives a detailed account of the spectrum of the afterglow of pure nitrogen, with wave-length determinations of sufficient accuracy to indicate the series relationships of the various bands. (2) The characteristic bands of the afterglow in the red, yellow, and green are complex groups which have been found to be identical with some of the bands forming the sequence known as the first positive group of nitrogen. They represent a special development of three of the numerous series into which the first positive bands have been divided. (3) The second group of afterglow bands, extending from 4312 to 2503, corresponds with a group of faint bands which occur in the uncondensed discharge in air or nitrogen, and the third group is identical with the third positive group of nitrogen bands, as previously shown by Lewis. (4) The most characteristic feature of the condensed discharge which produces the afterglow is a series of seven complex bands, occupying the region 2904 to 2256, which have not previously been recorded as belonging to nitrogen. It is suggested that these should be designated the "fourth positive" group of nitrogen bands. (5) No afterglow is excited when the discharge is such as to give only the line spectrum of nitrogen.—C. **Cuthbertson** and Mrs. M. **Cuthbertson**: An optical method of measuring vapour pressures: vapour pressure and apparent superheating of solid bromine. The vapour pressures of solid bromine between −80° C. and the melting point have been measured by counting the number of interference bands which pass across the field of a Jamin refractometer as the temperature of the solid is gradually raised. The vapour-pressure curve obtained agrees well with that observed by Ramsay and Young down to −17° C. The behaviour of the vapour pressure near the melting point is remarkable, and suggests the inference that superheating of the solid occurs.—Dr. Frank **Horton**: The vacuum-tube spectra of mercury. Under certain conditions, mercury vapour may be made to give several different line spectra in which the number of lines appearing ranges from 5 in the simplest case (the yellows 5791, 5770, the green 5461, the blue 4916, and the violet 4359) to a very large number in the case of the "many-lined spectrum" first observed by Eder and Valenta. The observations were made directly by means of a direct wave-length reading spectroscope, and several new bright lines are recorded in the red and orange regions of the spectrum. The luminosity was excited in three different ways:—(1) by means of the discharge from a glowing lime kathode; (2) by an induction-coil discharge through the vapour at different pressures, and with different amounts of capacity in the circuit; (3) by means of the electrodeless ring discharge. Five distinct spectra were recognised, all of which may be obtained with the induction-coil discharge by suitably regulating the conditions. The glowing lime discharge gives one of the simplest spectra; the electrodeless ring discharge gives the spectrum containing most lines.—R. **Whiddington**: The production of characteristic Röntgen radiations. A characteristic radiation can usually only be excited when the velocity of the kathode rays within the X-ray tube supplying the primary rays exceeds a certain value, depending on the radiator. The value of this critical speed, v_c, has been accurately determined for the radiators Cr, Fe, Ni, Cu, Zn, Se; that for Al has been given in a previous paper. It appears that, for the radiators studied, v_c is proportional to the atomic weight of the emitting element, being very nearly 10^8 times the atomic weight. The potentials corresponding to these velocities range between 7320 volts and 15,400 volts. An interesting result obtained during the course of the investigation is that the energy emitted in the form of Röntgen radiation by a kathode particle when suddenly stopped is proportional to the fourth power of its velocity.

Linnean Society, May 4.—Dr. D. H. Scott, F.R.S., president, in the chair, afterwards Prof. Poulton, F.R.S., vice-president.—Rev. T. R. R. **Stebbing**: John Vaughan Thompson and his polyzoa, and on Vaunthompsonia, a genus of sympoda. In comparing the claims of polyzoa and bryozoa to be the name of a class, the paper submits the following propositions:—(1) A majority of writers use bryozoa. (2) As used by Thompson, *polyzoa* is a word in the singular number; as used by Busk and his followers, it is in the plural; therefore, as Busk candidly points out, the words are not synonymous. (3) For a class-name the plural is essential, and thereby Ehrenberg's bryozoa obtains priority. (4) *Polyzoa* in the singular was first used by Lesson, who gave the name to a genus of compound ascidians. (5) Thompson himself placed the genera and species in which he had observed "*Polyzoae*" in the class *Mollusca acephala*. (6) It was not Thompson, but Grant (in his observations on Flustræ) who first drew the distinction between these polyps and the hydroid polyps with which they had been confused. This again is pointed out by Busk. (7) As Waters long ago, and again recently, has insisted, Thompson meant by Polyzoa, not a class, but a polypide, a structural element in certain organisms. Possession of vertebræ distinguishes a codfish from a crab-fish and a shellfish, but no one would think of proposing Vertebra as a plural word for the name of a class or phylum. A supplementary notice vindicates Vaunthompsonia as the correct form for Bate's sympodan genus in opposition to Vauntompsonia of later introduction, and gives reasons for discarding the term cumacea in favour of sympoda.—Dr. F. E. **Fritsch**: Fresh-water algæ collected in the South Orkneys by Mr. R. N. Rudmose Brown. Comparison was made between the algal floras of the South Orkneys and South Georgia, and special attention was directed to the constituents of the "Yellow Snow."—Prof. Sydney J. **Hickson**: Polytrema and some allied genera. The discovery of some very large specimens of foraminifera belonging to the species described by Carter as *Polytrema cylindricum* in the material collected by Prof. Stanley Gardiner in the Indian Ocean led the author to make a careful examination of this and of other species attributed to the genus Polytrema. The result of this examination was to prove that the specimens usually labelled Polytrema in collections may belong to three quite distinct genera. *Polytrema cylindricum* of Carter is the type of a genus for which the generic name Sporadotrema is proposed. The specimen described by Carpenter under the name *Polytrema rubra* (Lamk.), and many other specimens that are labelled *Polytrema miniaceum* (Pallas) in collections belong to another genus, for which the generic name Homotrema is proposed. The specimens described by Merkel, Lister, and others under the name *Polytrema miniaceum* belong to a genus distinct from the other two, and for this it is proposed that the generic name Polytrema be retained. A description of the principal characters separating the three genera is given in the paper.—J. M. **Brown**: Observations on some new and little known British rhizopods.—R. **Shelford**: The British Museum collection of Blattidæ enclosed in amber.

British Psychological Society, May 6.—Prof. Carveth **Read**: The psychology of genius. The chief condition of genius is sensitiveness to analogy supported by extraordinary power of registering experiences, perhaps without consciously attending to them, in such a way that, although they cannot normally be reproduced, they influence by analogy future constructive or analytic processes.—Miss E. M. **Smith**: Some observations concerning colour vision in dogs.—W. H. **Winch**: Some new exercises in reasoning suitable for the mental diagnosis of school children.

Zoological Society, May 9.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—Lieut.-Colonel Neville **Manders**: The phenomena of mimicry amongst butterflies in Bourbon, Mauritius, and Ceylon. The author had investigated the habits by observation and experiment of the insectivorous reptiles and birds of these islands, and had been unable to accept the view that their relations to butterflies were such as to be effective in producing Batesian or Müllerian mimicry.—R. I. **Pocock**, F.R.S.: The palatability of some British insects, with notes on

the significance of mimetic resemblances. At Prof. Poulton's request the author undertook in the summers of 1909 and 1910 to make a series of experiments in the gardens of the society to test the edibility of various British insects, most of which were sent to him, together with some slugs, by Dr. G. B. Longstaff. The insects comprised Lepidoptera, Coleoptera, Orthoptera, Hemiptera, Diptera, and Hymenoptera, and the most interesting of the experiments were those made with the bumble-bee (Bombus) and its mimetic fly (*Volucella bombylans*) to test the theory of mimicry. The Bombus proved to be unpalatable to nearly all birds. The birds would try them a varying number of times. When they had learnt their distastefulness by experience, they refused to touch them, and then when offered the Volucella refused that likewise. A considerable number of species of insectivorous birds were tested in this way, and always with the same result; and the one specimen of *Volucella bombylans* that did duty for some thirty or forty experiments went through the ordeal untouched.—Prof. G. C. **Bourne**, F.R.S.: The second portion of his paper on the morphology of the group Neritoidea of the aspidobranch gastropods, which dealt with the Helicinidæ. The author stated that this family was capable, by some unknown means, of wide dispersal across seas and oceans, and that the conditions most suitable to its existence were found in proximity to the sea. In describing the anatomy, the genus Alcadia was taken as the type, and the differences between it and the other genera were pointed out, but the species, and even the genera, of Helicinidæ were closely similar, anatomically, from whatever part of the world they came.—J. J. **Lister**, F.R.S.: The distribution in the Pacific of the avian family Megapodidæ.

Mathematical Society, May 11.—Dr. H. F. Baker, F.R.S., president, in the chair.—G. T. **Bennett**: The kinematical and geometrical theory of a deformable octahedron.—J. W. **Nicholson**: The scattering of light by a large conducting sphere (second paper).

Physical Society, May 12.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Sir G. **Greenhill** and Colonel R. L. **Hippisley**: Diagrams of stream lines past an elliptic cylinder.—J. T. **Morris** and T. H. **Langford**: The method of constant rate of change of flux as a standard for determining magnetisation curves of iron. The research described was instituted with the object of finding what differences there were between the magnetisation curves for a given sample of iron when determined (1) by the older methods in which the flux is changed suddenly, (2) by a method in which it is changed exceedingly slowly and at a uniform rate. The methods experimentally examined were:—(1) method of constant rate of change of flux; (2) "slow cyclic" hysteresis loops by method (1); (3) "step by step" magnetisation curve; (4) "step by step" hysteresis loops; (5) method of reversals"; (6) alternating-current magnetisation curve. Details are given of the theory and practical working of method (1). In this method the magnetising current is continuously increased through a primary winding by a specially designed resistance at such a varying rate as to maintain a constant voltage generated in a secondary winding. A certain amount of skill is required in operating the resistance, but an average experimenter may easily acquire this with a little practice. The complete change of the current occupied times varying from one up to some five minutes. Tables are given of the magnetisation curve determined by the six different methods at a number of values from **H** 0·3 up to 70·0, and of the permeability from **B** 500 up to 17,000. At low values of the magnetising force the uniformly varying flux method gives results of some 200 lines per square centimetre in excess of the older methods. As regards the time required for determinations by the various methods experimentally examined, ballistic methods are undoubtedly the most tedious. The alternating-current method (method 6) has considerable advantages in this respect, a full set of readings of magnetising current and induced voltage occupying a very short time. When, however, it is necessary to take oscillograms at various points in order to plot curves of form factors, the time required is enormously increased. The method of uniformly varying flux (method 1) is peculiarly adapted for use where time is a consideration, and at the same time a high degree of accuracy is desired. A complete magnetisation curve may be taken in a very few minutes, and the mean of many such curves obtained in, say, one hour, the iron being demagnetised between each test. The method of "uniformly varying flux" appears to possess advantages, both scientific and practical, over the older methods in use for the testing of ring samples of magnetic materials. It avoids difficulties due to eddy currents and magnetic viscosity, which effects are themselves due primarily to rapid or irregular changes of flux. Besides rapidity of experiment, it also has the advantage of accuracy of repetition under standard or predetermined conditions of magnetic change. The method is, therefore, commended for the carrying out of magnetic tests, especially where great accuracy under definitely known conditions of experiment are essential.

Royal Anthropological Institute, May 23.—Dr. A. C. Haddon in the chair.—S. H. **Warren**: The classification of the prehistoric remains of east Essex. The district of eastern Essex is formed of a plateau deeply trenched by river valleys. On the plateau, and also at lower levels, are numerous Palæolithic deposits. The paper deals in detail with the later prehistoric remains only. The river valleys were cut at a time when the land stood higher, relatively to the sea, than it stands to-day. As submergence set in, the lower reaches of the valleys were invaded by the sea, and they became partially silted up with tidal clay. Upon the former dry land surface, now buried beneath the tidal clay, large numbers of prehistoric remains have been found. These include polished axe-heads, knives, arrow-points, and other flint implements. Among the pottery, some remains of the "drinking-cup," or "beaker," have been found, and it is to this archæological stage that this buried prehistoric surface is referred. Beneath this surface, deposits of rain-wash are found which yield an earlier series of prehistoric remains. These are post-Palæolithic, as they include polished stone axes, barbed arrow-points, and pottery. The question of the position which these remains should occupy in the prehistoric succession was discussed. The advantage of using a sequence date scale, rather than a succession of epochs with indefinite and overlapping boundaries, was insisted upon.—Dr. A. **Keith**: A prehistoric skeleton. The skeleton, described in an appendix to the foregoing paper, belonged to the horizon of the buried surface. It was remarkably perfect, and was that of a woman of about twenty-five to thirty years of age. Although of small cranial capacity, it was of fairly high type. The skull inclined to the round-headed form, the index being 77·8. The stature, 5 feet 4 inches, or slightly less, the limb bones slender, the hands and feet small. It was buried in the contracted position. The body had been swathed in the tough roots of the sand-grass, while within the cavity of the body a considerable quantity of the seeds of the blackberry and the dog-rose was found. These were undoubtedly the remains of food.

CAMBRIDGE.

Philosophical Society, May 8.—Prof. Seward, F.R.S., vice-president, in the chair.—H. Hamshaw **Thomas**: The spores of some Jurassic ferns. A preliminary note recording the discovery in the estuarine shales of the Yorkshire coast of the spores and sporangia of *Coniopteris hymenophylloides* (Brongn) and *Todites Williamsoni* (Brongn). In the case of the former species, further evidence is afforded for the inclusion of this Jurassic type in the Cyatheaceæ, while the spores of Todites are shown to be almost identical with those of the recent *Todea barbara*.—C. E. **Moss**: A new species of Salicornia from Angola. The specimens on which this communication is based were collected by Welwitsch during his travels in Angola between 1853 and 1861, and are preserved in the British Museum (Natural History). By Mr. Hiern ("Catalogue of African Plants collected by Dr. Friedrich Welwitsch," iv., 1900, pp. 899–900), the plant is referred to *Arthrocnemum macrostachyum* (=*Salicornia glauca*). Welwitsch himself regarded it as a species new to science, wrote out a full description of it in Latin, and provisionally named it (in MSS.) *Arthrocnemum angolense*. There can be no doubt that Welwitsch's surmise was correct, as

the plant differs from all described species of Arthrocnemum and Salicornia in habit, colour, vegetative segments, flowers, and seeds. Moreover, *A. macrostachyum* is not known outside the Mediterranean region. As Arthrocnemum (Moquin-Tandon, Mon. Chen. Enum., 1840) is better regarded as a subgenus of Salicornia than as a separate genus, it is proposed to describe Welwitsch's Angolan plant under the name of *Salicornia angolensis*.—S. **Mangham**: The detection of maltose in the tissues of certain angiosperms. By the method of forming osazones *in situ* introduced by Senft in 1904, it is possible to distinguish between maltose and other plant sugars. The formation of maltose phenylosazone in definite crystalline masses closely associated with the phlœm of the vascular bundles in the midribs and petioles of several starch-forming plants, together with the occurrence in the sieve-tubes of a yellow semi-crystalline liquid like that from which the crystals arise, suggests that maltose is translocated as such in the sieve-tubes. It has been observed that while the distal portions of the sieve-tubes frequently contain only the yellow, syrupy liquid, this to some extent is replaced by definitely crystalline osazones [dextrose?] further down the sieve-tubes, as if in the course of translocation the maltose were hydrolysed.

MANCHESTER.

Literary and Philosophical Society, April 25.—Mr. Francis Jones, president, in the chair.—Dr. Henry **Wilde**: The periodic times of Saturn's rings. In the paper on the origin of Saturn's rings, read by the author last year, a new determination was made of the periodic times of the rings based on the commonly accepted distance of Mimas, 3·36 Saturnian units, from observations made by Herschel, and subsequently adopted by all astronomical writers. Recent observations of American astronomers have reduced the distance of Mimas to 3·16 units, with the consequent increase in the times of rotation of the rings. The difference between the older and later determinations is sufficiently large to induce the author to place on record the results computed from both observations and Kepler's third law. The later result shows for the outermost circumference of the outer ring a periodic time of 14h. 4m., and for the inner edge of the dusky ring a period of 5h. 45m. It is evident that the rings are ejectamenta from the interior of Saturn. The same conclusion may also be drawn with reference to the origin of the two satellites of Mars.—Dr. A. N. **Meldrum**: The development of the atomic theory: (7) the rival claims of William Higgins and John Dalton to the chemical theory. The resemblance between William Higgins's chemical theory, published in 1789, and John Dalton's, formed in 1803, is so close that there is no denying that Dalton was forestalled by Higgins. The closeness of the resemblance is accounted for by the fact that in their speculations Higgins and Dalton each took Newton's atomic theory as a starting point. Dalton's unquestionable merits in connection with the atomic theory are based, first, on his persistent efforts to bring the theory to bear in every direction both in physics and chemistry. He was the first to draw up a table of atomic weights. Again, the utmost credit is due to Dalton for his attempts, again and again renewed, to arouse the attention of scientific men to the value of the theory.

DUBLIN.

Royal Irish Academy, April 24.—Rev. Dr. J. P. Mahaffy, president, in the chair.—James **Murray**: Clare Island Survey—Arctiscoida. The author adopts this name instead of the better known Tardigrada, which is preoccupied. Thirty-three species were collected in the Clare Island district, of which five are described as new species—*Macrobiotus richtersii*, *M. scabrosus*, *M. hibernicus*, *Echiniscus militaris*, and *E. columinis*. In the list are several Canadian species hitherto unknown in Europe. *Echiniscoides sigismundi* is the first marine water-bear recorded from the British Isles.

PARIS.

Academy of Sciences, May 22.—M. Armand Gautier in the chair.—Pierre **Termier** and Jean **Boussac**: The existence, in the Ligurian Apennines to the north-west of Gênes, of a lateral passage of the crystallophyllian series, the so-called *schistes lustrés*.—A. **Perot** and Mlle. **Lindstedt**: The wave-length of the solar line b_2. The wave-length measurements of the magnesium line b_2 were obtained by the interference method previously used by Perot for one of the iron lines. The method has the great advantage of not making use of the terrestrial line, which cannot be produced under the same conditions of temperature, pressure, and density. If the centres of absorption of the line are animated by a centripetal movement in addition to their movement of rotation, the wavelengths at different points would be of the same order as those actually found.—Léon **Autonne**: Certain commutative groups and pseudo-zeros of hypercomplex quantities.—L. **Creux**: The transformation of the movement of expansion into a movement of rotation by the development of the circle.—L. **Riéty**: The electromotive force produced by the flow of a solution of sulphate of copper through a capillary tube. A solution containing 1 per cent. of crystallised copper sulphate, when forced through a capillary tube under a pressure of 90 atmospheres, develops a difference of potential of about 0·03 volt. The potential is proportional to the difference of pressure between the two ends of the tube. For solutions containing between 0·2 and 2 per cent., the product of the conductivity by the potential difference reduced to one atmosphere is practically constant.—Georges **Claude**: Luminescent neon tubes. The use of an electromagnetic valve, proposed by Moore, for the automatic admission of fresh neon to a tube which has been in use for some time, although ingenious, the author regards as impracticable, and proposes a simpler alternative arrangement. The disappearance of the neon is directly connected with the vaporisation of the metal of the electrodes, and if the dimensions of these are increased, the vaporisation is correspondingly reduced, and the life of the tube increased.—Jean **Perrin**: New measurements of molecular magnitudes. Starting with an emulsion of gutta formed by the precipitation of an alcoholic solution by water, by a prolonged process of fractional centrifugation, particles of magnitudes between 0·5 μ and 2 μ were obtained. A further process of fractionation gave particles of a uniform size, 0·75 micron. The application of Einstein's formula to measurements of Brownian motion made with these particles gave for the electrostatic charge of the electron the value $4{\cdot}2\times10^{-10}$.—M. **Bancelin**: The viscosity of emulsions. In an emulsion formed of a liquid with a coefficient of viscosity k, containing small solid spheres in suspension of total volume ϕ, the coefficient of viscosity of the emulsion k', according to the calculations of Einstein, will be $k'=k(1+\phi)$. The author gives an experimental verification of this formula with uniform emulsions of gutta obtained by the methods of Jean Perrin, described in the preceding paper. In accordance with the Einstein theory, the increase of viscosity is found to be independent of the size of the particles, and depends only on the total volume of the particles per unit volume. Instead of the increase of viscosity, however, being proportional to $(1+\phi)$, it was found to be in the ratio $(1+2{\cdot}9\phi)$. A colloidal solution of methylene blue gave analogous results.—E. **Henriot**: The radiation from rubidium. As in the case of potassium, the greater portion of the radiation is distinct from the α rays. The 10 per cent. of the radiation which is more easily absorbed may be the α rays, but the examination of the salts did not admit of the proof of the existence of these rays by their radiations. As showing the atomicity of the phenomenon, various salts from different sources were examined, and there was found to be a good proportionality between the radiation and the percentage of rubidium.—Paul **Bary**: The mode of solution of colloidal materials.—Jacques **Duclaux**: The constitution of water. According to the conception of Röntgen, now generally admitted, water is a solution of ice in hydrol. Ice would have the formula $n(H_2O)$, and the accepted value for n is 3. Evidence is adduced to show that this is too low a value, 12 being a more probable value, if it be assumed that ice retains its density in solution.—Marcel **Delépine**: The pyridinepentachloro-iridites.—A. **Duffour**: Some new complex derivatives of iridium: iridotetrachloroxalates and tetrachloroiridites.—L. **Barthe**: Phosphates of uranyl and amines. Definite compounds of uranyl phosphate with methylamine,

ethylamine, and trimethylamine have been prepared and analysed.—M. **Hanriot** and A. **Kling**: The action of alkalis on the chloraloses.—James **Lavaux**: The action of methylene chloride upon *pp*-ditolylmethane.—P. **Lemoult**: Researches on derivatives of styrolene: rectification of some experimental errors. Some new determinations of the heats of combustion of some unsaturated hydrocarbons.—A. **de Schulten**: The determination of the crystallographic constants of some artificial apatites.—E. **Decrock**: Silica in the seminal tegument of Ravenala.—R. **Robinson**: Studies on the question of the determination of sex. Deficient secretion of the suprarenal glands appears to lead to an excess of female births. The use of adrenaline is suggested in cases where there are troubles in nutrition, excessive vomiting, &c.—Jules **Regnault**: Suprarenal optherapy in the vomiting of pregnancy. *Rôle* of the internal secretions in the determination of sex.—Henri **Piéron**: The determination of the period of establishment in mnemonic acquisitons.—F. **d'Herelle**: An epidemic of a bacterial nature ravaging the grasshoppers of Mexico.—L. **Mercier** and Ph. **Lasseur**: The experimental variation of the chromogenic power of a bacterium, *Bacillus chlororaphis*.—Ch. **Gravier**: Some incubating annelids arising from the second French Antarctic expedition.—P. **Achalme** and M. **Bresson**: The function of viscosity in the variations of the action of invertine according to the concentrations in saccharose. By taking into account the effect of viscosity of sugar solutions on diastatic action, the influence of concentration can be reduced to a simple and general law.—E. **Kayser**: The disease of cider known as *la graisse*.—Pierre **Thomas**: Some substances which accompany oxyhæmoglobin in its crystallisation.—G. **Vasseur**: The *facies* of the marine Stampian formation in the Aquitaine basin.—V. **Roussanof**: The goniatite fauna of the Lower Carboniferous and Upper Devonian found in Nova Zembla.

DIARY OF SOCIETIES.

THURSDAY, JUNE 1.

ROYAL SOCIETY, at 4.30.—Experiments on the Restoration of Paralysed Muscles by means of Nerve Anastomosis: Dr. R. Kennedy.—The Morphology of *Trypanosoma evansi* (Steel): Col. Sir D. Bruce, C.B., F.R.S.—The Pathogenic Agent in a Case of Human Trypanosomiasis in Nyasaland: H. S. Stannus and Dr. W. Yorke.—The Experimental Transmission of Goitre from Man to Animals: Capt. R. McCarrison.—The Action of Radium Radiations upon some of the Main Constituents of Normal Blood: Dr. Helen Chambers and Dr. S. Russ.—The Mechanism of Carbon Assimilation. Part III.: F. L. Usher and J. H. Priestley.—A Contribution to our Knowledge of the Protozoa of the Soil: T. Goodey.

ROYAL INSTITUTION, at 3.—Changes Effected by Light: T. Thorne Baker.

RÖNTGEN SOCIETY, at 8.15.—On a Possible Therapeutic Use of Strongly Ionised Air: C. E. S. Phillips.—The Photographic Investigation of the Forms assumed by the Brush Discharge in Air at Reduced Pressure: C. W. Raffety.

LINNEAN SOCIETY, at 8.—On the Occurrence of Amphidinium in Quantity at Port Erin: Prof. W. A. Herdman, F.R.S.—The Fauna of the Coal Measures: Dr. A. Smith Woodward, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—A Flame Test for the Estimation of Oxygen and Black-damp in Naked-light Mines: Dr. J. S. Haldane, F.R.S.—An Experiment on the Effect of Reversing the Main Air-current: James Bain and Dr. J. S. Haldane, F.R.S.—Notes on Contrivances Designed to Prevent Overwinding, with some Instances of their Failure: W. H. Pickering and Granville Poole.—The Otto-Hilgenstock Direct-recovery Process and its Application: Ernest Bury.

FRIDAY, JUNE 2.

ROYAL INSTITUTION, at 9.—Radiotelegraphy: G. Marconi.

SATURDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—Types of Greek Women: Dr. W. L. Courtney.

TUESDAY, JUNE 6.

ROYAL INSTITUTION, at 3.—Charnwood Forest and its Fossil Landscape: Prof. W. W. Watts, F.R.S.

WEDNESDAY, JUNE 7.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—Practical Progress in Wireless Telegraphy: T. Thorne Baker.

MATHEMATICAL SOCIETY, at 5.30.—On the Multiplication of Dirichlet's Series: G. H. Hardy.—On the Range of Borel's Method for the Summation of Series: G. H. Hardy and J. E. Littlewood.—On the Convergence of Fourier Series and of the Allied Series: Dr. W. H. Young.—On some Two-dimensional Problems in Electrostatics and Hydrodynamics: W. M. Page.

FRIDAY, JUNE 9.

ROYAL INSTITUTION, at 9.—Applications of Physical Chemistry to the Doctrine of Immunity: Prof. S. Arrhenius.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—The Lüders Lines on Mild Steel: W. Mason.—Exhibition of a Model illustrating the Passage of a Light Wave through Quartz: Dr. H. S. Allen.—Tables of Circular and Hyperbolic Functions for Complex Values of the Argument: A. Johnstone.—On the Measurement of Contact Differences of Potential: Prof. Anderson and J. G. Bowen.—Exhibition of Gyroscopic Apparatus: Sir G. Greenhill.—A New Method of Approximate Harmonic Analysis by Selected Ordinates: Prof. S. P. Thompson, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—Description of a New Species of Acmæa from Bombay and Notes on other Forms from that locality: E. A. Smith.—Description of Three New Species of Operculate Land Shells from Grand Cayman Island: H. B. Preston.—Further note on Preoccupied Molluscan Generic Names and Proposed New Names: G. K. Gude.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of the District of the Bergen Arches: Dr. C. F. Kolderup.—The Rock Formation of the Bergen District: Horace W. Monckton.

SATURDAY, JUNE 10.

ROYAL INSTITUTION, at 3.—Types of Greek Women: Dr. W. L. Courtney.

ARISTOTELIAN SOCIETY (at Corpus Christi College, Oxford), at 9.—Real Being and the Object of Thought: G. F. Stout.

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