THURSDAY, JUNE 15, 1911.

RURAL DENMARK.

Rural Denmark and its Lessons. By H. Rider Haggard. Pp. xi+335. (London: Longmans, Green and Co., 1911.) Price 6*s.* 6*d.* net.

MR. RIDER HAGGARD'S book is the outcome of a recent visit to Denmark, made in order to inquire into the actual conditions of farming prevailing there, and particularly into the success of the small holders, who form so marked a feature of Danish agriculture. Mr. Rider Haggard's further object was to gather information as to whether such small holdings are likely to succeed better on the leasehold system that has been established in this country by the recent Act, or whether, as advocated by the other party in the State, it is essential for success that small holdings should be owned by their occupiers. Mr. Rider Haggard also wished to ascertain the working of the various forms of credit banks and State loans to farmers to enable them either to purchase their holdings or to provide working capital when they were already in occupation. For the last generation Denmark has been the standard example to all agricultural reformers of how the farming of a country can be made efficient by taking thought, either through the medium of cooperation or more directly by State aid. Denmark has to live by its agriculture alone, and it is well known that the productivity of the country, the wealth of its population, and the value of its exports have been raised to an astonishing degree during the forty years or more that have elapsed since the war with Germany; so that, despite many natural disadvantages, Denmark has been able to maintain its position as a free-trade country in face of the unprecedented competition from America, which has so severely shaken the status of agriculture in other European countries.

Mr. Rider Haggard went provided with the best introductions, and he reports, with the clearness and the power of description for which he is so well known, the impressions which he formed as he passed from one agricultural enterprise to another. For example, he tells us of the operations of a cooperative dairy, of a milk supply company, and of an egg export association; he visited one of the great capitalist farms worked by its owner, carrying more than 1000 cows, and earning a net profit estimated at 20,000*l.* a year. As a contrast, he also describes in detail the mode of working some of the State-created small holdings of about six acres each, and compares them later with other privately acquired peasant properties of from five to thirty acres.

In his survey education also bulks largely; the elementary schools, the high schools which take young men and women between seventeen and twenty-five for three months in the winter, the agricultural school proper, and the great central college at Copenhagen were all visited, and one cannot fail to be impressed throughout the whole of the book by the manner in which the success of the Danish farmer seems to depend upon the high standard of education he has reached, and his attitude towards the things of the mind.

Finally, Mr. Rider Haggard reports the substance of his discussions with various authorities on the particular questions about which he was making inquiries. For example, he shows that even in Denmark men are not agreed as to the value of small farms as compared with large, still less so as to the desirability of the State making loans and subventions in order to create a community of small farmers. After a general discussion of the present position of Danish agriculture, he emphasises the fact that the success of the small farmers, even the possibility of their existence, is dependent upon the way they have learned to work together, and the almost universal adoption of the form of cooperation in both buying and selling. Not only is cooperation necessary to enable the small man to buy somewhere near prime cost and to realise a due return for his produce, but the cooperative societies form the great medium for the technical education of the farmer. For unless men in a district have learned to act together it is impossible to deal properly with such questions as the improvement of stock and crops, the eradication of disease, &c.

Mr. Rider Haggard's book is extremely interesting reading, and though at times we may feel a little inclined to doubt whether his working knowledge of agriculture was quite sufficient to enable him to appreciate the real bearing on the situation before him, his book is most valuable because it is free from that indiscriminate laudation of the Danish farmer and his methods, which has been preached somewhat *ad nauseam* to the English agricultural community.

Mr. Rider Haggard has been too wise to suppose that an economic revolution can be effected in the English countryside by merely copying Danish methods, and he sees that any attempt to impose Danish organisation upon our farmers at the present time would only end in disaster. Organisations, methods, institutions, really count for little except in so far as they are the outcome of the spirit of the men and women who are working through them, and agriculture on a Danish model will be impossible here until we have a community possessing the same mental outlook. Mr. Rider Haggard rightly lays stress in almost every section of his book on the high pitch of education to which many of even the smallest occupiers of land in Denmark have reached, and again and again it comes out that this education is general and not merely technical. The Danish small farmers, even the Danish peasant or milkmaid, seek for education in order to become free and effective men and women, and it is almost incidentally that they learn certain other things which they can turn to direct pecuniary account. It is through education, and through an education founded on a respect of things of the mind, that cooperation has become possible there, and it has made so little headway in this country just because its immediate returns are but a small inducement to men who live in an atmosphere of distrust of the unknown and suspicion of all joint actions.

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If for this reason alone, his insistence that the success of small holdings depends upon cooperation, and that cooperation ultimately depends upon education, we can most cordially recommend Mr. Rider Haggard's book to everyone who is interested, either directly or indirectly, in the welfare of the rural population.

THE SEWAGE PROBLEM.

Sewage Disposal. By Prof. L. P. Kinnicutt, Prof. C. E. A. Winslow, and R. W. Pratt. Pp. xxvi+436. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 12*s.* 6*d.* net.

THE economic solution of the important problem of sewage purification depends for its success on the careful application of engineering principles to the numerous physical, chemical, and biological changes involved. It is therefore with pleasure we find a volume devoted to the subject which is the result of collaboration between distinguished American representatives of chemistry, biology, and engineering, particularly so when each of the individual authors has had wide experience in the practice of sewage purification and disposal.

It is stated in the preface that this work was in progress before several of the recent publications on sewage purification had appeared; the authors, however, claim that there is still room for a general survey of the subjects with particular reference to the conditions of American practice. This claim is certainly justified by the careful way in which world-wide information in regard to the various methods of sewage purification has been collected, and by the admirable manner in which the subject-matter is presented.

From the point of view of American practice it is not surprising to find that separate chapters are devoted to the consideration of the questions of sewage purification or disposal by dilution, and of intermittent sand filtration. The former question receives thorough treatment, and the conditions necessary for the adequate purification of sewage discharged into waterways are discussed at length. Interesting examples are given of the self-purification of rivers receiving sewage. While this method of disposal is rendered possible in many cases in America by reason of the relatively large volume of the rivers, it is, of course, for obvious reasons, scarcely practicable in the case of inland towns in England.

The question of the preliminary treatment of sewage by the various tank processes, and also that of the disposal of sludge, is thoroughly dealt with in chapters iv. to vii., inclusive. Under the head of the septic process, the Hampton hydrolytic tank is described in detail, and the Emscher tank of Imhoff receives notice. The Hampton doctrine on the theory of sewage purification is given careful attention, and the authors' conclusion in regard to the relative value of this theory as compared with the views advanced by Dunbar will probably meet with general approval by those actually engaged in the work of sewage purification.

It is interesting to note that when discussing the bacteriology of intermittent filtration, no reference is made to the theory recently promulgated of direct nitrification of organic nitrogen, the authors evidently being in agreement with the generally accepted view of the preliminary formation of ammonium compounds.

In subsequent chapters is given a comprehensive survey of the question of the purification of sewage on contact beds and percolating filters respectively, illustrated by numerous examples of purification works in England, America, and on the Continent. The authors' review of the relative merits of the two systems of filtration may, in general, be commended. It is to be feared, however, that the quantities of sewage actually dealt with by percolating filters will be found on investigation to be considerably lower than those given in table lxxxv., especially when the time the filters are out of operation is taken into consideration.

Exception must also be taken to the authors' statements that the results obtained at Croydon, which are quoted on p. 372, afford an excellent idea of the comparative efficiency of contact beds and percolating filters.

These results give an entirely erroneous impression as to the possibility of contact beds, inasmuch as the purification mentioned of from 40 to 47 per cent., is certainly much below the results generally obtained when working at so low a rate as 46 gallons per cubic yard per day.

The concluding chapters are concerned with the disinfection of sewage and sewage effluents, and the methods of analysis.

In view of the present tendency amongst certain English sanitarians, it is important to observe that in the opinion of the authors, it has not yet been demonstrated that any electrolytic process for making chlorine at the sewage plant, unless free power is available, is as economical as the purchase of the ordinary commercial product.

This work can be thoroughly recommended to all interested in sewage purification, more particularly as the authors themselves do not dogmatise on the subject, but are successful in presenting in a lucid manner both the principles involved in the problem of sewage treatment, and the various views and theories which have been advanced by leading investigators. A clear statement of the present position of the subject is thus afforded. The value of the book is enhanced by the excellent list of references, which will be found of considerable use to those engaged in sanitary work.

EDWARD ARDERN.

FACT AND HYPOTHESIS IN BIOLOGY.

Lectures on Biology. By Dr. Curt Thesing. Translated from the second edition by W. R. Boelter. Pp. viii+334. (London: J. Bale, Sons, and Danielsson, Ltd., 1910.) Price 10*s.* 6*d.* net.

THIS book could be heartily recommended to readers who wish for a modern presentation of general biological discovery were it not for the pseudo-philosophical limitations which the author imposes upon each and every hypothesis that has been advanced to account for the facts. The arguments that

go to prove the truth of evolution are skilfully and attractively marshalled, but that is not the author's chief object. What he aims at is to show that the selection-hypothesis only applies to a limited field, that use-inheritance has its restricted place, and so on; in short, that all our explanations are partial, and that in none of them can we have complete confidence.

When we come to ask on what grounds this want of confidence is asserted, we find the old objections answered fifty years ago by Huxley put forward as if they were discovered yesterday. "Darwinism yields no information concerning the causes of variability" (p. 210); "the theory of natural selection is the doctrine of chance"; "the theory of mutation plays with chance even more than selection." What is Darwinism but a method? The author uses this word as if it implied a corpus of knowledge which could not be extended, and was to be judged by its expression in the writings of casual essayists. In only a single place does he refer either to the "Origin" or to "Variation under Domestication," though he quotes extensively from modern critics. It is idle talk to say that Darwin did this, but not that as though one man could do all, or as if Darwin claimed a complete supremacy for his selection hypothesis. Are we to have no confidence in the theory of natural selection because its discoverer was not able to give a complete treatment of variation? One would really conclude from this book that variation was a subject to which Darwin gave no serious consideration. The old goddess "chance" is once more used as a stick to beat the dog "selection" with, and we become rather tired at the iteration of arguments urged and rebutted any time these thirty years. Even the old crude presentation of the Miltonian "creation" is made to stand up in order to receive fresh blows.

The book is sadly in need of competent revision. The number of misprints is really irritating. Amongst the animals of the tropics we are told there is the leopard and the *gepard*, a creature the nature of which is wholly problematical. The choristers at Rome have well developed "mammals" (p. 148); "*Omni* vivum e vivo" (p. 97); "like all other infusorians, no bell-animalcule is able to reproduce by simple fission" (p. 230); the vermiform appendix "has no function whatever, its object being rather apparently to create suffering." On p. 129 Balanoglossus is classed with Vermes, and the larvæ of Crinoids are termed Bipinnaria, whilst on p. 130 the larvæ of starfish are correctly called by that name, but the figure refers to an Auricularia or Holothurian larva. In his condemnation of sexual selection the author entirely overlooks the careful observations by Mr. and Mrs. Peckham on the spiders of the family Attidæ, and as these support the Darwinian position the whole criticism falls to the ground.

Apart from critical matters, the book is full of interest, and its summary of recent work on heredity is but one example of the wide reading and careful exposition which the author exhibits. Read with due caution the book can only do good.

AN AMERICAN COLLOQUIUM.

The New Haven Mathematical Colloquium. By E. H. Moore, E. J. Wilczynski, and Max Mason. Pp. x+222. (New Haven: Yale University Press; Oxford: University Press, 1910.) Price 13*s.* 6*d.* net.

IN the autumn of 1906, at the meeting of the American Mathematical Society, three short courses of lectures were delivered to the assembled experts, and are here published for the benefit of the world at large, or at any rate for that of such persons as are interested in the most recent aspects of pure mathematics. The authors assume that their hearers have a good knowledge of analysis, and the reviewer must do the same, in order to keep within due limits.

Prof. Moore's discourse is an introduction to general analysis, which may be described as an essay on the "functional theory" of Fréchet and others. A free use is made of the Peano stenography, and this is one more sign of a fact which some of us will admit with regret, namely, that students of the logical side of mathematics must become proficient in Peanese.

Two important ideas play a leading part in Prof. Moore's discussion. The first is the dominance of one function by another; μ_1 is dominated by μ_2 if, for every argument p, the absolute value of $\mu_2(p)$ is not less than the absolute value of $\mu_1(p)$. The other, which appears to be both new and important, is that of uniform convergence relatively to a function σ. Thus we have a notation

$$\mathrm{Lt}_n\, \mu_n = \mu \ (\mathrm{R}\ ;\ \sigma),$$

meaning that when R is the range of the variable x, and $(\mu_1, \mu_2, \ldots)$ is a sequence of functions of x, this sequence converges in such a way that, by taking n large enough, and for all greater values of n, $|\mu - \mu_n| < e|\sigma(x)|$, where e is any assigned positive number; and if n can be determined by means of e alone (without x), we have uniform convergence relative to σ. When σ is constant, we come back to the usual definition of uniform convergence. The second part of the essay is on composition of classes, which may be described as a generalisation of the theory of the composition of moduli and ideals in the theory of numbers.

In connection with a certain notation, the author remarks that "the intention is to discriminate sharply between function and functional value." With this we confess we are in sympathy, though, of course, we shall be told that a function is merely an enumeration of values, either actually or potentially complete. In the abstract, of course, this is undeniable; but consider the function $\sin x$, for example. Its property of being periodic is intrinsic, and was actually realised before there existed a table of its values, or rather it was made part of a generalised definition of $\sin x$. Again, the class of algebraic numbers, or that of algebraic functions, surely has a significance apart and beyond the aggregate of values associated with it.

The next essay is upon projective differential geometry, especially in connection with ruled surfaces. Various results of great interest and generality are obtained by the author; for instance, it appears that

an arbitrary space curve being given, it can be considered as one branch of the flecnode curve of an infinity of ruled surfaces, into the general expression of which there enters an arbitrary function. On the other hand, two curves taken at random cannot be connected, point to point, so as to be the complete flecnode curve on the ruled surface thus generated. As the author remarks, there is no doubt that the field thus opened promises valuable results. So far as the analysis goes, it follows the lines of the known theory of differential invariants, constructed by Halphen, Lie, and others.

Finally, Prof. Mason gives an interesting summary of various boundary-value problems of differential equations. Perhaps one of the most elegant things in this essay is the construction of a doubly periodic Green's function G, which satisfies the equation $\Delta u = 0$ within the period rectangle, except at two points where it is logarithmically discontinuous. This is followed by a remarkable application to the equation $\Delta u = f(x, y)$, where f is periodic in x, y independently, with periods a, b equal to the lengths of the sides of the period rectangle of G.

It is noteworthy to find the United States maintaining so many distinguished mathematicians, both native, and, if we may be excused the term, imported. When will the English nation wake up to the fact that it is not waste of money, or at best a concession to dilettante ideals, to provide a living for a first-rate mathematician, even if he proposes to devote his life to varieties in n dimensions, or the theory of aggregates, or the distribution of primes? Surely, and at an accelerating rate, the dominion over nature and over their fellow-men is coming into the hands of the star-gazers, the speculators, the originals, who have been lampooned and pilloried from the age of Aristophanes to that of Swift, and from his days to our own. Or rather, the material profit, the worldly dominion, will come to those nations that have the sense to see that by attracting these creators of new ideas they are encouraging every kind of higher invention, and buying in the cheapest market the best of goods—brains.

G. B. M.

IMPRESSIONIST ASTRONOMY.

The Night-Skies of a Year: Being the Journal of a Star-gazer. By J. H. Elgie. Pp. xii+247. (London and Leeds: Chorley and Pickersgill, Ltd., 1910.) Price 6*s.* net.

TAKING sections for each month of the year as basis, the varying aspects of the constellations are presented in a series of discursive notes purporting to describe the impressions of the writer on the occasions when he observed the various objects. The author takes as his aim the task of teaching the geography of the sky by means of a journal showing how the constellations alter in their relative aspects from night to night, and at different times on any night. So far this is commendable. It is evident, however, that the desire to produce a volume of impressive magnitude has induced the decision to inflict a superfluity of purely personal impressions; if these were in the main likely to be experienced by other observers, they might be helpful, but from the nature of many of them it is very questionable if they can be. Take as an example the following:—

"Ten o'clock! Ugh! How drear and dismal is the night, a night unrelieved by star or moon. Rain is beginning to fall. The tempting gleam of a brightly burning fire comes out to me through my window, so I will indoors and try to think that this really is the opening of the 'merrie month.' Then, to round off the evening presently, I will study anew an appropriate article on the old, old question of 'Is the climate changing?' If matters do not mend soon I shall alter my opinion on that subject and persist that the climate is changing."

This quotation is a fair sample of the style of the whole, though here and there one finds an oasis of more acceptable material.

The book is illustrated by numerous rough sketches of constellation groups, and if these were not specially intended for instruction they might be passed over. The author specially directs attention to these sketches, and says:—

"I am convinced from the letters of numerous correspondents that the difficulty of recognising the main outlines of the constellations at any hour from the charts accessible to them has damped the enthusiasm of thousands of beginners in the study of astronomy."

Our opinion is, however, that the star alignment diagrams are perhaps the most unsatisfactory feature of the book. Taking any one constellation, even such a well-known one as Orion, for instance, it is shown with the component stars, in different relative groupings on consecutive pages, due, it must be assumed, to defective drawing. We would advise the "numerous correspondents" to purchase a trustworthy star atlas, and endeavour to commandeer the help of a capable friend for about five minutes each week. This would do away with all the damping of their enthusiasm.

SNAKES OF CEYLON.

The Snakes of Ceylon. By A. F. Abercromby. Pp. vi+89. (London: Murray and Co., 180 Brompton Road, S.W., 1910.) Price 2*s.* 6*d.* net.

THE author, being of opinion that the "many works and treatises" in which the snakes of Ceylon are described are "more suited to the scientist than the naturalist," and that "natural history books, on the other hand, seldom give sufficiently detailed information about snakes," has produced a volume which the discerning reader will see at once to be not in the roll of common art. The systematic part being an admitted compilation from well-known works on the fauna of India, we may restrict our inspection to those parts of the book which reveal the originality of the writer.

In dealing with the anatomy and physiology of snakes, the author laments that "the effect of, and antidotes for, snake poison is a subject which has been much written about and much discussed, but very little has been discovered about it." He has heard of permanganate of potash at least, but this, "although a very successful absorbent remedy, is

reported to have a poisonous effect upon the blood." His views on cures for snake-bite are those of a Rip Van Winkle; what we want is—

"not so much a remedy which will absorb and neutralise the poison, as a means by which this neutraliser may be enabled to reach the poison, or a treatment for keeping up the vitality of a patient until the poison becomes absorbed by the system."

In short, he makes the words "absorbed" and "absorbent" as odious as the word "occupy" was to Doll Tearsheet.

In the chapter on "hunting" snakes, our author is as coherent and profound as honest Dogberry himself. The "necessary point" in this hunting to be borne in mind is that "it is less important to go where there are a great many snakes than to go where the nature of the country facilitates seeing and catching of them." So also, "a cobra is best obtained by digging one out of an ant-heap or hole," but "the cobra must have been seen to enter the hole a short time before," for all is vanity. As to smoking a snake out, "it takes a lot of smoke to have any effect on a snake, owing to the latter's lung capacity." The snake has only one lung, but that, like the one eye of Mr. Midshipman Easy's friend, the master's mate, is of prodigious power. When the author tried smoke "it was so suffocating and so blinding that the capture of the snakes was extremely difficult and somewhat risky"; little wonder that he regards it as "an unsatisfactory proceeding." The way to comprehend vagrom pythons "can only be learnt by practice"; but if the python be asleep "it can often be captured without any trouble."

Touchstone and his shepherd could not improve the chapter on snakes in captivity.

"When feeding a tame python great care has to be exercised lest the snake should seize your hand in mistake for a rat, especially if your hand has just been in contact with the latter."

Truly it requires the careful experiments of a natural philosopher to discover

"that cold is not so injurious to these reptiles as is commonly believed, but that it is the infrequency of the sun's rays that renders a climate such as that of England unsuitable for serpents."

Finally, we would commend this weighty precept:

"Those who are desirous of keeping a serpentarium of live snakes should study as much as possible the conditions under which the various snakes live when in the wild state,"

otherwise they labour in vain on their "serpentarium."

THE METHODS OF ANTHROPOLOGY.

The Racial Anatomy of the Philippine Islanders. Introducing New Methods of Anthropology. By Prof. R. B. Bean. Pp. 236+25 photographs. (Philadelphia and London: J. B. Lippincott Company, 1910.)

THE most recent literature dealing with the study of man's physical characters reveals manifold signs of a widespread revolt against the domination of mere anthropometry in this field of research. It is often urged that no kind of investigation can claim the title "exact," or even be called "science," unless it deals with evidence that can be expressed in figures or mathematical symbols. But in all biological inquiries a primary sorting of the material is an indispensable preliminary to its mathematical treatment, and until the obviously heterogeneous elements in any series have been sifted, one species of material being separated from another, and males distinguished from females, any attempt to deal statistically with measurements of such unsorted material can produce only confusing and misleading conclusions.

The most urgent need in anthropology at the present time is the determination of those characters of the human body and its parts, which have definite significance as indications of race, and the investigation of the exact value and meaning of such traits, and of the bond of union between them and other distinctive characters, which are associated in groups in different individuals.

The comparative sterility of recent work in anthropology, so far as the determination of racial characters in series of skeletons is concerned, is due mainly to the common neglect of such preliminary studies and the immediate resort to blindly-made measurements as the sole means of investigation. It is the great merit of Sergi's work that he insisted on this return to the ordinary methods of zoological investigation in dealing with human remains, and by the use of such methods, crude and unsatisfactory as some of them undoubtedly are, he has been able to recover a great deal of true history of man's movements, and information concerning his affinities.

Prof. Bean's interesting book on the people of the Philippine Islands claims the consideration of the anthropologist, not so much for what he has accomplished, as from the fact that it is an attempt to direct the investigation of racial anatomy into its proper channel, for in it he has attempted to discriminate between the peculiarities of conformation of the external ear in the different racial elements in the Philippines, and use them as indices of race in precisely the same manner as the zoologist or "the man in the street" would distinguish a cat from a dog, even if these animals were of precisely the same size and quite irrespective of the measurements of their crania or other bones.

Dr. Bean has correlated the various types of ear with a large series of other physical characters, as well as with stature, proportion of limbs and trunk and head; and, like others who have undertaken similar investigations upon man or other living creatures, he finds that "the method of grouping reveals types that apparently represent *character-complexes* composed of unit characters," which "hang together in heredity or break up when crossed with other *character-complexes*."

Throughout the book the author is ever on the alert to detect Mendelian phenomena, and in chapter x. he builds up a scheme for the explanation of heredity in human mixtures.

The most unfortunate feature of Dr. Bean's sug-

gestive essay is his application to the peoples of this far-eastern island of terms such as "Alpine," "Adriatic," "Iberian," "Cro-Magnon," and others, which are not without objections even when applied to the population of Europe, but become doubly misleading when applied to Filipinos, who are partially hybridised with real Iberians.

G. ELLIOT SMITH.

PROF. GROTH'S CHEMICAL CRYSTALLOGRAPHY.

Chemische Krystallographie. By P. Groth. Dritter Teil, Aliphatische und hydroaromatische Kohlenstoffverbindungen. Pp. iv+804. (Leipzig: W. Engelmann, 1910.)

DESPITE the duties appertaining to a professorial chair and the unremitting labour attaching to the editorship of his flourishing *Zeitschrift für Krystallographie und Mineralogie,* Prof. von Groth proceeds steadily and rapidly to the completion of the great task he has set before him. The successive volumes have appeared at intervals of two years, and now, four years since the publication of the first, we welcome the issue of the third and penultimate volume. It includes the various aliphatic and aromatic compounds that have been obtained in crystallised form, and meets a widely and long-felt want. Putting aside a few oxalates which occur in nature, it has hitherto been impossible to turn up readily the crystal character of any of these substances; even the most comprehensive text-books on organic chemistry rarely define the forms more exactly than as being plates or needles.

The volume is composed of two parts, of which the first is by far the longer. In it the paraffins and the corresponding olefines are grouped together according to the number of carbon atoms in the molecule, the concluding chapter being devoted to the ureas and the derivatives of uric acid. In the second part the hydrobenzol derivatives and the terpenes and camphors are considered. For each substance the physical characters are stated tersely, but as completely as possible, the information including the melting point, the specific gravity, the morphological characters—the axial ratios, the indices of the observed forms, the values of the principal interfacial angles, and the directions of cleavage, if any, illustrations of crystals possessing features of exceptional interest being given—and the optical characters—the principal refractive indices for light of various standard wavelengths, the nature of the refraction, the relation of the optical indicatrix to the crystalline symmetry, and the optic axial angle; the authority for the data is recorded, and references to the original papers are given in footnotes. Each section is prefaced by a brief but interesting discussion of the substances dealt with and the relations subsisting between them. The book closes with two complete indices; in one the substances are arranged alphabetically by their names, and in the other by their formulæ in ascending order of the number of carbon atoms in the molecule. Little difficulty should therefore be experienced in tracing any particular compound. It is abundantly clear that every effort has been made to keep the book as free from errors as possible; in a work of this kind accuracy is everything.

The name of the publisher is sufficient guarantee for the excellence of the printing, which is, in fact, beyond criticism.

APPLICATIONS OF PHYSICAL CHEMISTRY.

(1) *Themen der physikalischen Chemie.* By Prof. E. Baur. Pp. iv+113. (Leipzig: Akademische Verlagsgesellschaft, m.b.H., 1910.) Price 4 marks.

(2) *Das chemische Gleichgewicht auf Grand mechanischer Vorstellungen.* By Prof. H. v. Jüptner. Pp. v+367. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 11 marks.

THE two volumes here noticed are not text-books of physical chemistry in the ordinary sense. They deal with selected parts of the subject, and are distinguished by the prominence given to its technical application.

Prof. Baur's book contains the substance of a series of vacation lectures delivered in the Brunswick Polytechnicum at the instance of the Society of German Engineers. The lectures are models of clear exposition, and are invariably terse and to the point. The experimental illustrations, directions for the repetition of which are included in the text, are well chosen, and calculated to stimulate inquiry. After a preliminary lecture on the principles of modern physical chemistry, the author proceeds to discuss such varied matters as voltaic cells, the blast-furnace, Deacon's process, the contact process for sulphuric acid, the production of atmospheric nitrate, catalysis, gas explosions, explosives in general, metallography, and colloidal chemistry. Students, both of industrial and of pure chemistry will find much to interest them in the little volume.

Prof. von Jüptner's work on chemical equilibrium is based on the following conceptions. The maximum external work which a chemical process is capable of performing is a measure of the chemical affinity of the process. This work can be measured by the gas pressures of the substances concerned. Hence chemical processes may be treated as mechanical, one substance being pumped into another (production of a compound) or being pumped out of another (decomposition of a compound). Thus dissociation phenomena may be considered as being at the root of all chemical processes. If the dissociation-pressure curves of all compounds are known, the behaviour of the compounds when they are brought together may be predicted; those with greater dissociation pressures will be decomposed, those with smaller dissociation pressures will be formed. The process will come to an end when the partial dissociation pressures of the common product (*e.g.* oxygen pressures of oxides) become equal.

Proceeding on these principles, the author considers the equilibrium conditions in systems with solid, liquid, and gaseous phases. As the book is intended in the first instance for practical men engaged in chemical industry, it is characterised by a wealth of

numerical data for dissociation pressures. The equations employed are often only approximate, but though subject to future correction, they cannot fail to be useful. In the study of iron and steel the author has achieved special eminence, so that the last chapter, which is devoted to the application of the above principles to the chemical reactions occurring in the blast furnace will be read with peculiar interest.

OUR BOOK SHELF.

The World of Dreams. By Havelock Ellis. Pp. xii+288. (London: Constable and Co., Ltd., 1911.) 7*s.* 6*d.* net.

MR. ELLIS very truly remarks that in the past the literature of dreaming has often been vitiated by bad observation and reckless theory. In the volume under review he gives a large number of carefully recorded dreams—chiefly his own—and is sparing of hypothesis. The drift of the book may be indicated as follows:—

The sleeping consciousness is weak in apperception and in will. It is, in fact, partly dissociated, as in insanity. But it can *reason;* and dreams are its serious and careful attempts to construct an adequate theory of the phenomena. These latter psychical facts may be sensations derived from external stimuli such as sounds—as when the drip of water from a burst pipe upon the floor near a dog's bed caused his owner to dream that the dog was being crushed in a mangle—or from visceral disturbances, as when indigestion causes dreams of terrifying situations. Stimuli of any kind are magnified by the sleeping consciousness, and the theory (the dream) is consequently out of proportion to their real importance, as when the singing of a canary caused a dream of the performance of Haydn's "Creation." Fear-dreams are often exaggerations of dimly-realised bodily discomfort, as when a lady had a horrible dream of murder after a supper of pheasant. The interesting point about this is that the dream is the result, and not the cause, of the emotion. Unpleasant feelings are really experienced, and the dream-consciousness invents a theory to account for them. This is in line with the James-Lange theory of emotion in general.

As to ultimate psychical origins, Mr. Ellis thinks that Freud presses his sexual-wish theory too far. The great Vienna psychologist has done brilliant work, but has become obsessed by his pet formula. His key will not fit all the locks. Probably most psychologists will now agree with Mr. Ellis on this point.

The chapter on dreams of flying and falling is particularly good. It can scarcely be doubted that the absence of pressure against the soles of the feet—a vague mass of sensation always present when standing or sitting—must have a great deal to do with these dreams. The other sensory nerves over the body being relaxed and inactive, the bed ceases to be felt; and the consequence is a dream of floating unsupported in the air. This suggests an explanation of the subjective feeling of levitation in the case of many saints. In ecstasy there is considerable anæsthesia, both of the soles of the feet and elsewhere.

The book is popular in style, but is thoroughly scientific in method, and Mr. Ellis has a wide acquaintance with the work of other investigators in this field. His contribution is a welcome one.

The Economy of Food: a Popular Treatise on Nutrition, Food, and Diet. By J. Alan Murray. Pp. xii+253. (London: Constable and Co., Ltd., 1911.) 3*s.* 6*d.* net.

THE subtitle of Mr. Alan Murray's book and the following extract from the preface will indicate its scope:—"The book is intended for students of domestic economy, cooks, caterers, housekeepers, and managers of institutions rather than for specialists in physiology, chemistry, and hygiene. The subject cannot be treated adequately without reference to the principles of these sciences; but the more difficult parts have been relegated to footnotes, and the use of technical terms in the text have been avoided as far as possible. The first section deals with the requirements of the body. The origin, properties, and composition of the commoner kinds of food are discussed in the second. In the third an attempt is made to combine these two branches in a form suitable for everyday use—to translate protein, carbohydrates, &c., into terms of bread and meat, *i.e.* of breakfast, dinner, and supper."

Mr. Murray has been very successful in his attempt; the scientific portions are accurate and up-to-date, the practical parts will fill a long-felt want, and the whole is presented in a clear and readable manner. In these days when so much rubbish is printed for popular consumption in the daily Press and elsewhere on the subject of food and diet, it is a godsend to have a really trustworthy and popular guide which it is a real pleasure to be able to recommend. Food, of all other subjects, is one which lends itself to the exploitation of fads. There is nothing of the sort in the present volume; we have no advocacy of any particular system, no hysterics on the subject of the Chittenden diet, or sour milk, or standard bread, but just plain, simple, sober, common sense. W. D. H.

A Text-Book of Botany. By J. M. Lowson. Seventh impression (fifth edition), revised and enlarged. Pp. viii+607. (London: W. B. Clive, University Tutorial Press, Ltd.; Cambridge: University Tutorial Press, 1910.) Price 6*s.* 6*d.*

ALTHOUGH there have been numerous and material alterations of the subject-matter for this edition, there is no change in the general arrangement, and the book still maintains its very apparent examination character—that is to say, the dominating idea is not to stimulate the observational and thinking faculties but to provide in the space as much information as possible, duly punctuated and diagrammatised. The general arrangement is not unsatisfactory, but it is not apparent why there should be such an early insertion of a chapter and various sections dealing with histology; also it may be suggested that the heading of chapter iv. would nowadays be more applicable to the chapter on ecology. The latter is a new introduction and requires revision, as the exposition is disjointed, and there is no mention of that important unit of classification, the formation. For the most part, however, the presentment of the information is essentially explicit and well ordered, and the trend of recent investigation and modern theories is carefully indicated. A useful series of physiological experiments is outlined, and the importance of combining practical work with reading is emphasised. The selection of cryptogamic types and the general scope of the book follow the requirements of the intermediate examinations at London University.

Le Chaos et l'Harmonie universelle. By Félix le Dantec. Pp. 195. (Paris: Félix Alcan, 1911.) Price 2.50 francs.

TO a long list of previously published works, M. le Dantec has added a book dealing with a variety of subjects treated sometimes from a philosophical point of view, and at others from the mathematical side. To give the titles of a few of the sections is to indicate the range of the treatise. "Heredity and education," "the definition of chance," "living bodies," and "life," may be mentioned.

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.]*

Breath Figures.

ON reading Lord Rayleigh's short article on breath figures in NATURE of May 25 and finding he was not satisfied with the explanation I offered of them, I thought it would be as well to see if it was possible to get some further information on the subject. For this purpose I repeated the experiments with variations in the conditions. As the writer of the article seemed to think that the hot gases act in some way in cleaning the surface of the plate, the experiments were now made at lower temperatures. In place of the blow-pipe flame a Bunsen burner was used, and in order to protect part of the surface from the action of the hot gases, the plate was supported on two thick iron bars, so as to confine the action of the gases to the narrow space between them, and further, the glass plate was kept as cold as possible. It was intended to use ice for this purpose, but it was found that it kept the under surface always dewed, so that the gases could not come into contact with the plate. Wet blotting-paper placed on the upper surface was found to keep the plate cool enough, and yet not so cold as to cause the deposition of dew. It was found that it was not necessary to pass the plate through the flame to get the breath figures; it could be held some distance above it with a similar result, but, as might be expected, a longer time was necessary than when in the flame, not only on account of the lower temperature of the gases, but also on account of the plate getting heated by the longer exposure.

In these experiments it was noticed that it is not enough to allow the hot gases to travel along the space between the two bars, as the hot gases only produce the effect where they first strike the surface of the plate, and if it is dust that is the cause of the action, it will be deposited where the gases first touch the cold surface, the onward flowing gases near the plate being nearly free from dust, as well as being at a lower temperature. The plate should therefore be moved over the stream of hot gases in such a way that fresh gases come in contact with the different parts of the exposed surface. The plate should also be held at a considerable angle to allow of a free flow of the gases over it.

If the action of the hot gases is a cleansing one, then heat alone ought to produce the same effect as the flame, and cause the glass to take an even film of dew. To test this a cleaned plate was placed—clean side up—on a metal plate somewhat larger than itself, and the metal plate highly heated with a Bunsen burner. Some plates were heated slightly, others to a temperature far higher than those acted on directly by the flame, yet when cold these plates were unchanged. Part of the plate was freshly cleaned, when it was found that the deposit of moisture was the same all over the plate. Heat alone evidently has no effect. I may here mention that those breath figures are best developed by rubbing the back of the plate with a piece of ice. By this process the image remains longer in view, and gives time for inspection.

An examination, by means of a short-focussed lens and proper illumination, of the moisture condensed on the surface of a glass plate, reveals some interesting points. When the dew first begins to appear the water is seen to be deposited in the form of very small lenses nearly touching each other. On looking through the plate while the dew is still condensing, nothing can be seen through it. It acts very much like a piece of ordinary ground glass, a landscape being invisible; even the sky-line does not show. If the cooling be now stopped and the deposit allowed to evaporate it will be noticed that the spaces between the lenses widen, the lenses drawing in their edges and leaving clear glass. Objects can now be seen through the plate, the transparency increasing as the dew evaporates. If, however, in place of stopping the condensation at its early stages we keep the plate cooled so as to cause more moisture to be deposited, the lenses will be seen to grow into each other and coalesce, until at last the regular deposit of little lenses grows into irregularly shaped blotches of water of considerable size. If the condensation be stopped at this stage and the plate dried and again cooled, it will be found that the appearance of the condensation is not the same as it was the first time. The surface of the plate has been changed by the first condensation. On the dew making its appearance the second time the uniformity in the lenses is gone. In addition to a general ground of small lenses there now appears a number of much larger ones, and as these are distributed over the plate at about the same distance from each other as that occupied by the large evaporated blotches of water, they would appear to be produced by something left by the water on the glass. By observing a particular group of blotches near a mark on the plate, it was noted that each one of these reappeared on each successive dewing. The something which is left after evaporation has evidently a considerable affinity for water, as these large lenses condense more water than an equal area of small ones. They stand high, and are the last to evaporate.

But perhaps it will be asked, How can anything be left after the evaporation of pure distilled water? At first sight one might feel inclined to say that nothing could be left. It is, however, evident that something has been left—probably dust and gaseous impurities condensed along with the water—and I may point out that something similar happens when cloud particles of water are formed on ions in the presence of certain gases. In this case there are no solid nuclei, yet the drops do not thoroughly evaporate, but leave behind them something large enough to be nuclei of condensation in air only very slightly above saturation. These observations on the behaviour of glass plates show how delicate their surfaces are and how easily the condensation on them may be altered.

The something which produces these breath figures formed by flames is of such a nature that it acts more powerfully the higher the temperature of the gases, that is, the greater the difference in temperature is between the gases and the glass. Of course, it is possible that the effect may be due to some gas or gases condensed on the glass, and these gases having an affinity for water. On the other hand, it may be due to the gases depositing their fine dust; and while what we call clean glass repels water, dust, on the contrary, attracts it. The fact that this form of breath figure is easily washed off the plate seems to point rather to dust than absorbed gases as the cause.

The formation of these breath figures does not appear to be so much a question of cleanliness as of the nature of the foreign matter on the surface of the glass. If the impurity is of a water-repelling nature we get the lenticular deposit; if it has an affinity for water we get the uniform film. For instance, if the plate has been previously touched with paraffin oil, it will, even after a good deal of cleaning, give a very white obscure deposit, due to the great convexity of the lenses. On the other hand, if the surface has been previously treated with caustic soda, the lenses are flat and the plate more transparent.

As these experiments have generally been made with gas flames, and as the flame is an important factor, it was thought advisable to try other flames. Hydrogen when burned in filtered air, I have shown, gives rise to no fine dust, and, so far as I know, this is the only form of combustion which does not. It therefore ought to have been tested, but as the apparatus required would be somewhat complicated, it has not been done. Alcohol, however, was tried; with it I could only succeed in getting very slight indications of any action, though the plate was heated far more by it than what gave a marked effect with the Bunsen flame. This result is what we might expect if the figures are due to dust. A sulphur flame was also tried, and, as might be expected, gave very marked results with a very small flame. This might be given as a typical case of the effect of condensed vapour. Something of this kind may play a small part in the figures produced by gas flames.

It was thought it might be interesting to see how the fine dust on our windows acted towards condensed water. The fine dust in the air is deposited on our windows in the

same way as I imagine the dust of the flame to be deposited on the plates, namely, by difference of temperature, our rooms being warm and windows cold at night. The only difference is in the rate of deposit, due to there being less dust in the room air and to the smaller difference in temperature in the case of the window. Cleaning a small part of a window which had been clean ten days previously, a piece of ice was rubbed over the outer surface until dew began to deposit on the inside. The deposit on the ten-day-old surface was different from the newly cleaned one, but not greatly so. While the newly cleaned part was covered with the usual little lens-like discs, the older surface was covered with much larger and irregularly shaped blotches of film. As the nights had not been cold since the window was cleaned, we can hardly expect much dust to have collected in ten days; so another window was tried which had not been cleaned for some months. Repeating the cleaning and cooling on this window, it was found that while the newly cleaned part carried a ground-glass-like deposit, the uncleaned part was sufficiently clear for the landscape to be seen through it. These tests show that dust on glass does tend to cause water condensed on its surface to spread and take the film form in the same way as glass that has been exposed to flame or to hot gases.

Coming, now, to Quincke's experiment, referred to by Lord Rayleigh, in which sulphuric acid is shown to produce the same effect as the blow-pipe flame, this and the experiment with hydrofluoric acid seem to have inclined Lord Rayleigh to think that cleanliness was the cause of the breath figures. But does either sulphuric acid or hydrofluoric acid prove cleanliness? I have doubts. I know I am on dangerous ground in differing from Lord Rayleigh on anything connected with surface action, yet I have recently had my lesson on how some substances cling to glass in spite of efforts to get rid of them, and I think it is not improbable that some residual of both sulphuric and hydrofluoric acid may cling to the glass in spite of washing. Recently I was making an investigation in which was required a little iodine vapour, and for this purpose put a small crystal of iodine in a flask from which the vapour was drawn as required. Afterwards the investigation took another turn, and the flask was used for other purposes, but many days' work were lost owing to that flask. Results were obtained with it which were contrary to previous experience. As suspicion centred on the flask it was discarded, and not until a new flask had replaced it could satisfactory work be done. Yet all this loss of time was occasioned by a residual quantity of iodine, which the washings with alcohol, acids, soap water and a sponge, had not succeeded in removing. After that experience I confess to being sceptical of absolute cleanliness of glass after being touched with sulphuric or hydrofluoric acid. Any residual of these substances, as they have an affinity for water, would tend to form films and not little lens-like patches. Though breath figures may be formed by dust, yet there are evidently other ways of altering the surface of the glass and causing it to repel or attract water, and so making the surface capable of giving breath figures.

JOHN AITKEN.

Ardenlea, Falkirk, June 5.

The "Vernal Phytoplankton Maximum."

IN NATURE for April 27 it was stated, in connection with the plankton statistics taken periodically in the Irish Sea from the Port Erin Biological Station, that (p. 289) "the outstanding fact in this season's work, so far, is that the diatoms are unusually scarce and late. The vernal phytoplankton maximum has not yet arrived."

That statement referred to the collections up to the middle of April. During the rest of April the catches remained small—for the most part 1, 2, or 3 cubic centimetres in a standard haul of the fine silk net. In May the approximate quantities (they have not yet been accurately measured), in the same net, run as follows:—

	c.c.		c.c.
May 1	2	May 22	35
,, 4	1	,, 25	10
,, 10	10	,, 29	15
,, 13	40	June 1	15
,, 16	60	,, 3	60
,, 19	50	,, 5	50

The large catches on May 13–22 were mainly composed of Chætoceras (*C. debile*, and a few other species of diatoms), while the sudden increase in the beginning of June is due almost wholly to Rhizosolenia (mainly *R. semispina*).

Last year we found that the vernal phytoplankton appeared as two well-marked maxima, one in April, caused by species of Chætoceras and Lauderia, and a second in June, composed of Rhizosolenia and Guinardia.

It is evident that the "vernal maximum" is really a complex made up of the maxima of several different species or groups of species which seem to occur in a definite sequence, but may be earlier or later, more spread out in one year or more telescoped together to form a single diatom maximum in another. Moreover, the individual species or groups of species may be more abundant one year than another.

In the present year, if we look at the three genera that usually bulk largest in our spring and early summer collections, we find that Biddulphia reached its climax in March (but continued throughout most of April in fair abundance), Chætoceras not until the latter part of May, and Rhizosolenia in early June. Rhizosolenia is usually as late as or later than this; Biddulphia is always one of the first forms to appear, sometimes causing a slight increase in the plankton as early as February, so it is really Chætoceras (some of the species of which are usually the most abundant of our April diatoms) that is this year unusually late.

I have just returned from Port Erin, where, during the first few days of this month, Rhizosolenia seemed to be unusually abundant. The water of the bay is visibly discoloured by it; when a tow-net at the end of a fifteen minutes' haul is raised from the sea it contains a column of thick soupy fluid, which runs out very slowly, as the meshes of the silk are largely clogged up with the diatoms; on a calm surface, with the sun shining, the peculiar iridescent glistening appearance characteristic of Rhizosolenia can be seen from the boat, and anything put into the water is at once covered by a slimy layer of the slender needles. It may be that Rhizosolenia has not even yet attained its climax, but a week ago the June increase in diatoms had certainly set in with unusual force. The "vernal maximum" has, then, this year been spread out and divided into three parts—a slighter increase in March (Biddulphia), a much greater one, later than usual, in May (Chætoceras), and another great increase (Rhizosolenia) early in June.

W. A. HERDMAN.

Liverpool, June 10.

On the Action of the Latex of *Euphorbia peplus* on a Photographic Plate.

IN August, 1909, our attention was directed to certain properties of surgical importance possessed by the milky juice of *Euphorbia peplus*, a spurge naturalised in this colony. During the examination of the milky juice or latex, we exposed during two days in the dark a highly sensitive photographic plate some millimetres above a sheet of glass on which we had dried a few drops of the juice. On development, a sharp image of the dried juice appeared on the plate. We propose to describe briefly a few results from the many experiments since made to determine the conditions and nature of the action on the photographic plate.

Thirty drops of the juice were spread on a sheet of glass as the letters EUPHORBIA, and the glass dried in an oven at 100° C. for two hours. A sharply defined image of the letters was produced on development of a photographic plate (speed 325) placed 5 mm. above the dried juice after an exposure of forty-eight hours or longer. The density of the images increased with greater length of exposure, with thicker films of dried juice, and with less distance between the plate and the film. The edges of the images were well defined, as if focussed on the photographic plate. No image appeared with short exposures of twenty-four to forty-eight hours unless the films were very thick. With long exposures, up to thirty days, the images were more dense, but showed a little diffusion at the edges of the letters. When a distance of 15 mm. separated the photographic plate from the film, the plate was unaffected. Action on the plate diminished

rapidly when the distance from the film exceeded 5 mm. The dried juice retained the action with undiminished effect for months. When the dried films were heated from 150° C. to 200° C. they charred, but did not lose their action on the plate. As the temperature was raised further the power of affecting the plates was diminished, as the ash of the juice became white. Even the white ash had a slight action on the plate (potassium salts).

The introduction of screens between the film and the photographic plate led to notable results. The interposition of tissue paper slightly delayed the action on the photographic plate. Thick black paper (0·13 mm.) employed by the makers to enclose photographic plates, and found by us impenetrable to the rays from phosphorescent salts, served only to delay the time in which an image of a definite intensity was formed. The effect was produced through a celluloid screen (0·07 mm.) and through paraffined paper (0·03 mm.). We were unable to obtain screens of glass or mica less than 0·02 mm. in thickness. These screens completely protected the plates from action by the film. Screens of aluminium foil 0·002 mm. thick made no alteration in the intensity of the image of the film. When eight layers of the aluminium foil were superimposed, the density of the image on the plate was increased.

Examination of the dried material with a zinc sulphide screen failed to show any scintillations due to the α particles.

When a rapid current of dried air was passed obliquely between the plate and the film at a rate of 300 c.c. per minute the image of the letters on the film was sharp and well defined. The distance between the plate and the film was 0·5 mm. Any gas or emanation would have been carried along by the current, especially any gas having such a slow action on a photographic plate.

H. G. CHAPMAN.
University of Sydney, May 3. J. M. PETRIE.

Musical Sands of Eigg.

SINCE Hugh Miller's brief reference ("The Cruise of the *Betsey*") to the musical sands of the Bay of Laig, Isle of Eigg, much has been done with these, and sands of a similar character, to enable us to account for the cause of the phenomenon; and the interest taken by physicists in certain experiments which I conducted some years ago induces me to offer the results of some further observations for publication.

There is no musical sand in the Bay of Laig, and, so far as I can ascertain, its sands have never been musical within the memory of any inhabitant of the island. At the present time the psammological conditions are such as to preclude entirely the possibility of its existence there.

In a small bay—about a mile and a half along the shore to the north of Laig Bay—known as Camas Sgiotaig, musical sands occur. This bay is divided into two portions by a reef of calcareous sandstone jutting out from the cliffs seawards. In both portions, but especially close to the cliffs, a white quartzose sand has accumulated, and this is the only place where musical sands are found in Eigg.

The sands are derived from the waste of the calcareous sandstone referred to. In places the grains have accumulated in small rifts and cavities in the rocks, and in all such it was found to be equally musical, showing that long, flat stretches of sand are not essential conditions for the selective action of the winds and sea-waves.

The usual experiments with various vessels and plungers, &c., were carried out *in situ*, and the musical effects were in all cases much more pronounced than those produced by the Studland Bay sand.

An extraordinary volume of sound was obtained by dragging the convex part of a wooden bowl along the surface of the sand patches, one of which was only about 6 feet square. When the same bowl was partially filled, and the sand struck with a wooden plunger, it emitted a noise like the deep bark of a dog, and this could be heard for a considerable distance along the shore.

These musical sands are only found in calm weather; in the winter the huge waves carry away all fine matter, and only the rocks remain—for which reason we must regard it as a fine-weather phenomenon in this island.

Eigg, June 6. CECIL CARUS-WILSON.

P.S.—Since the posting of my letter respecting the musical sands of Eigg, I have read the letter from Mr. Thomas which appeared in NATURE of June 8.

Prof. Poynting, I think, informed me of the occurrence of these sands at Barmouth some time ago, and I have found them also at Penally, near Tenby, at Longland Bay, and in Swansea Bay.

I have frequently pointed out that the pitch of the notes emitted from musical sands depends (*a*) upon the size of the grain, (*b*) the area of the plunger's striking surface, and (*c*) the form and composition of the vessel used. In some vessels of particular form I have succeeded in producing from the same mass of sand, and during the one thrust of the plunger, notes of both high and low pitch!

The vessel containing the sand is first well shaken in order that the smaller grains may settle at the bottom of the mass and the larger ones at the top. The plunger is then thrust sharply upon the surface, and coming first in contact with the larger grains, it produces a low note; this merges into a note of higher pitch as the plunger penetrates the mass and reaches the finer grains at the bottom of the vessel.

As a matter of fact, the notes from all natural musical sands appear to be a cumulative effect due to a combination of high and low pitch within a given range. The only sand which seems to emit a pure and definite note is that which I have produced artificially.

June 10. C. C.-W.

Botanical Research in Ceylon.

THE letter from Cambridge with the above title, which appeared in your issue of May 25, has evidently been written without knowledge of the difficulties which have arisen at Peradeniya within the last few years and under a complete misapprehension of my views.

The letter reproduces, without the context, a single sentence from a memorandum of mine. In this memorandum special stress is laid on the importance of maintaining Peradeniya as a centre of botanical research, and it is suggested that Dr. Willis should remain as its director under such conditions as would allow of his conducting botanical investigations which in recent years he has found it impossible to undertake.

The letter seeks chiefly to justify Dr. Willis's position as a botanist, which has not been called in question. Neither have the services which Peradeniya has rendered to the botanical workers who have visited it been questioned.

The sentence quoted from my memorandum refers to the two principal members of the staff and the difficulties which admittedly have rendered botanical research impossible for them owing to the pressure of other work.

My suggestion, as a solution of the difficulties which have arisen, was to maintain Peradeniya "as a great reference garden and centre for botanical research in the tropics"—to reproduce my own words—distinct from, though cooperating with, the Agricultural Department which the Government of Ceylon, most wisely, now desires to establish. Whilst I should have preferred this solution, I am satisfied that the decision to incorporate the Royal Botanic Gardens at Peradeniya with the Agricultural Department will secure what the colony chiefly needs in the interests of tropical agriculture, for the advancement of which the whole community, European and native, is so deeply concerned.

WYNDHAM R. DUNSTAN.

June 3.

The Extinction of the Egret.

IT will be remembered by those who are interested in the protection of the white heron that the feather dealers have urged that the breeding haunts, or garzeros, of these birds are guarded, and that the moulted feathers are picked up from the ground. From information which has been sent to me from the National Association of Audubon Societies, based on the sworn testimony of a man who

has been personally engaged in feather collecting in Venezuela, it appears that while a few moulted feathers, worth possibly a fifth of the value of those taken from living birds, are collected, there is not the slightest foundation for the statement that the breeding places are protected for the purpose.

Mr. A. H. Meyer, who has come forward, adds the following to his account:—"The natives of the country, who do virtually all the hunting for feathers, are not provident in their nature, and their practices are of a most cruel and brutal nature. I have seen them frequently pull the plumes from wounded birds, leaving the crippled birds to die of starvation, unable to respond to the cries of their young which were calling for food in the nests above. I have known these people to tie and prop up wounded egrets on the marsh, where they would attract the attention of other birds flying by. These decoys they keep in this position until they die of their wounds or from the attacks of insects. I have seen the terrible red ants of that country actually eating out the eyes of these wounded, helpless birds that were tied up by the plume hunters."

The story that the aigrettes used in the feather trade are picked up on the ground in Venezuela is stated by those interested to have been based on a letter written by Mayeul Grisol, naturalist and explorer of the Honorary Mission of the Museum of Natural History of Paris. Prof. Osborn, president of the American Museum of Natural History, recently sent the following cablegram to the Museum of Natural History of Paris:—

"Is Mayeul Grisol of scientific standing? Has he been an accredited explorer for your museum to South America?"

This is the answer:—"Mayeul Grisol unknown."

WILFRED MARK WEBB.

42 Bloomsbury Square, W.C.

THE NATIONAL EXPERIMENTAL TANK.

TO the present-day shipbuilder or shipowner there are probably no more important problems than those of getting the best or least wasteful form of hull with the limitations of dimensions imposed by its service or internal arrangements, and of obtaining a trustworthy forecast of the power required to propel a ship of that form at a given speed.

It is the exhaustive investigations of such problems as these which constitutes the primary object of an experiment tank. Such a tank is to the naval architect what the research laboratory is to the chemist, or the testing house to the engineer. Forty years ago model experiments were looked upon as "remote from practical use," and it was largely due to the fertile brain and the carefully conducted epoch-making experiments of the late Dr. William Froude that this impression has been removed, and replaced by a continually growing confidence in the application of the results of experiments with models to the full-sized ship.

FIG. 1.—National Physical Laboratory Experimental Tank. View looking North (empty).

Many early investigators, amongst whom may be numbered Bernouilli and Euler, attempted to solve the problem of least resistance mathematically.

Later on, in 1770, experiments on a small scale were made by D'Alembert, Abbé Bossut, and Condorcet, and an attempt was made to frame *formula* for forms of least resistance. These were followed by M. Romme, and later by Marc Beaufoy, who for five years (1793 to 1798) made experiments with various models in the Greenland Dock. Unfortunately, owing

to lack of financial support, Beaufoy's experiments were never extended to ship-shape forms, and although he insisted that such experiments would and did determine the relative merits of models, his results were neglected by the naval architects of his time, and only fitful attempts were made to revive interest in model experiments until the time of Froude and Rankine.

Rankine in 1862 read his paper on waves, &c., and in this and various papers published during succeeding years he developed the application of what is now known as the "stream-line theory" to all moving bodies.

Froude at this time, working on much the same lines, had produced his well-known "law of corresponding speeds" [1]—the true connecting link between ship and models—and had verified it by experiments on the river Dart with similar models varying in length from three to twelve feet; and in his "explanations" in the British Association Report of 1869 he insists on the trustworthiness of experiments with models of rational size. At the suggestion of Mr. E. Reed (afterwards Sir Edward Reed), a proposal and estimate was made for an experiment tank, and this was soon afterwards built at Torquay, and became the pattern on which all other tanks were modelled.

Shortly after this, in 1871, on the recommendation of the "Committee on Designs for Ships for War," Froude conducted for the Admiralty the towing experiments on the *Greyhound*, which, in conjunction with the experiments made on a small model one-sixteenth the dimensions of the ship, completely vindicated his theory, and led the Government to establish the experiment tank at Haslar, which was completed in 1879, where his son, R. E. Froude, has since superintended the work. The applicability of results of model experiments to full-sized ships has more recently been verified by some experiments conducted by Mr. Yarrow on a torpedo-boat, and published in 1883.

Such tanks are now possessed by every nation that has any pretence to marine power, and by several of our leading shipbuilding firms, and the national experiment tank, which is now approaching completion at Teddington, is the sixteenth to be built.

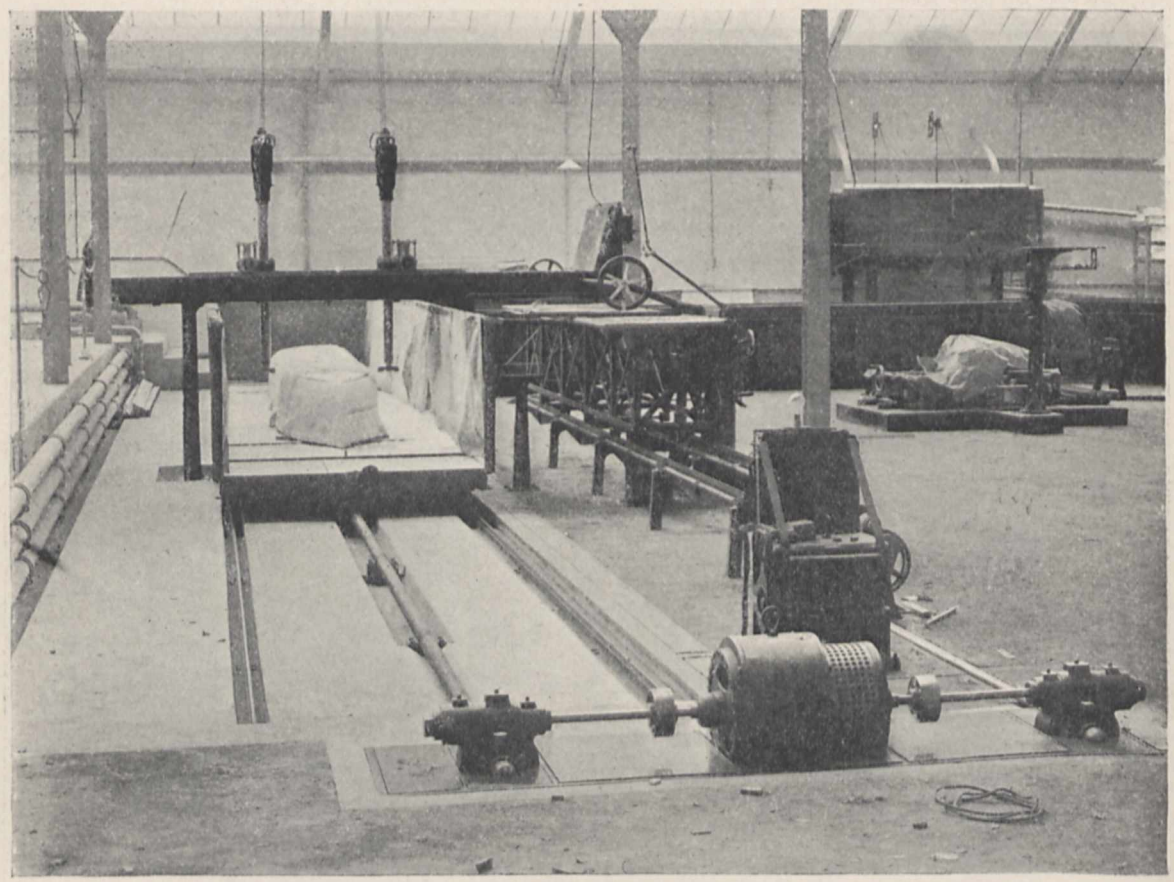


FIG. 2.—National Physical Laboratory Experimental Tank. Model-making Apparatus.

Suggestions for the establishment of a national experiment tank have been put forward from time to time by the council and various members of the Institution of Naval Architects, and among its chief advocates has been Sir William White. It is due to the munificence of Mr. A. F. Yarrow, a vice-president of this institution, that the proposal has become a reality, the whole of the first cost being defrayed by him. It will be largely supported by the leading shipowners and shipbuilders of the country, and will be open for the trials of any ship, but its chief purpose is to carry out research work in fluid resistance and ship propulsion. The site chosen for the tank is at Bushy Park, and it will be worked as a branch of the National Physical Laboratory.

[1] Dr. Froude's enunciation of this is as follows:—"If the ship be D times the 'dimension' (as it is termed) of the model, and if the speeds are V_1, V_2, V_3 . . . and the measured resistances are R_1, R_2, R_3 . . . then for speeds $\sqrt{DV_1}$, $\sqrt{DV_2}$, $\sqrt{DV_3}$ . . . of the ship, the resistances will be D^3R_1, D^3R_2, D^3R_3 . . . To the speed of model and ship thus related it is convenient to apply the term 'corresponding speed.'"

The chief features of the building are shown in Fig. 1. The main waterway is 30 feet wide, 12 feet 3 inches deep, and 500 feet long, clear of beach and docks, the latter being for storing models and for allowing access to them for ballasting and trimming purposes. The walls and floors are of concrete varying from 2 to 3 feet in thickness, except at the shallow docks, where the sides are 7 inches reinforced concrete.

A large steel carriage for towing the models has been erected across this waterway. It runs upon four wheels on rails which are bolted to continuous iron supports secured to the tops of the concrete walls. This carriage is driven by four motors—one over each wheel—the necessary power being obtained from conductors supported along the west wall of the building; these conductors are fed by a generator, which again is driven by a motor working on fifty-five cells. There are complete arrangements for controlling the voltage of the supply, so that the carriage may be brought to any speed up to fifteen miles per hour, and the speed be kept constant over the main portion of the run down the basin. This towing carriage will carry a dynamometer and other recording instruments for the measuring of the resistance, &c., of the models. These will be towed through the water in such a manner that though free to trim or move fore and aft to any extent necessary for equilibrium, no side motion will be possible, special guides being fixed under the carriage to ensure this.

The models will be made of hard paraffin wax of about 2 inches in thickness, the length being generally 20 feet, but varying according to the form. The paraffin wax is melted in a large tank through which hot water is circulated in pipes, and back through the surrounding casing, and the wax drawn off through pipes into a clay mould prepared to the shape of the model, but with an allowance of about a quarter of an inch for finishing.

The model when set is transferred to the shaping machine (Fig. 2). This machine works on the copying principle, and consists of two tables, each capable of being drawn longitudinally by a nut working on separate screws, which screws can be geared to revolve at any desired velocity. A plan of the ship is pinned on one table and the rough model secured keel up on the centre line of the second. Over this latter table there are two revolving cutters between which the model passes. Each of these is driven by a small electric motor attached directly to the upper end of its spindle. They can be set at any desired height, and their transverse motion be made to imitate (by means of a pantagraph mechanism), the lateral motion of a tracer, which the operator keeps in contact with the waterline on the plan corresponding to the height of the cutters on the model. By adjusting the fulcrum of this pantagraph, and the gearing between the driving screws, any proportion of length and breadth can be cut from the ship's drawing.

The model when it comes from the machine has upon it a series of horizontal guidance grooves, the wax between which is trimmed off with spokeshaves

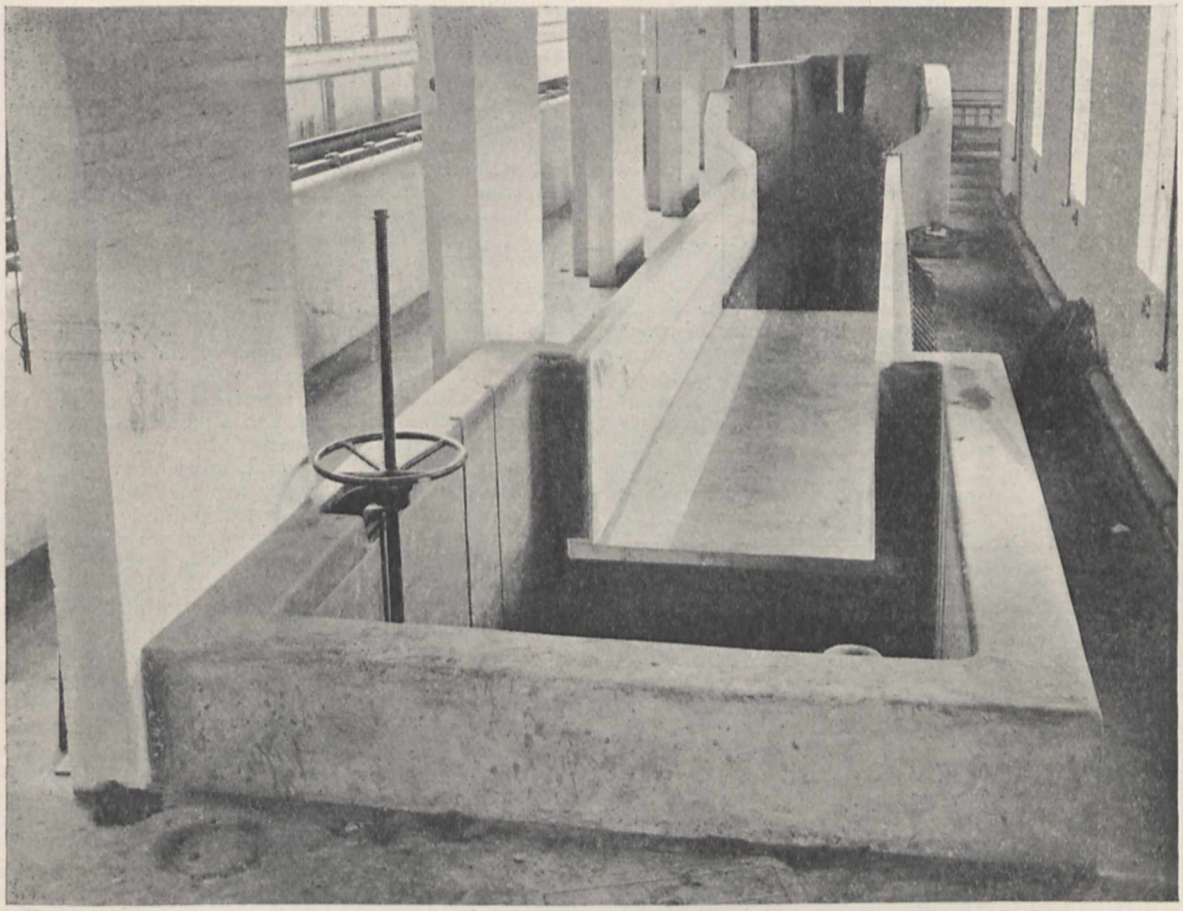


FIG. 3.—National Physical Laboratory Experimental Tank. The small tank for still or flowing water experiments.

and a smooth surface obtained by the use of scrapers. This surface may be varnished or treated in any desired manner, and the model, after being ballasted and trimmed as necessary, is ready for an experimental run. A measuring table has also been installed, by means of which the lines of any model may be taken off, or the correct position for appendages may be marked on the model.

In addition to the main waterway already described, a smaller basin some 64 feet by 5 feet by 3½ feet has been built (see Fig. 3). Experiments can be made in this with models up to 6 or 7 feet in length. These may be either propelled through the water the latter being at rest, or the model may be held at rest at the end of a dynamometer arm in the centre of the basin and the water caused to flow by it. A large power rotary pump has been fixed in this tank for this purpose.

The problems which remain to be solved by such a tank are many and wide. Chief amongst them are: the exploration of stream-line motion, frictional resistance on straight and curved bodies, the action and propulsive power of screws and the effect of form of hull, and size of waterway, on the resistance of a ship. Some of these fields have been partially explored already, but systematic research has not extended beyond the fringe of the remainder, and the rapid and continuous advance of naval science is ever bringing forward new problems.

That such a tank, though costly to establish and maintain, amply repays for its support, a single example will tell. It would not be a matter of much difficulty to effect an improvement of, say, 5 per cent. in the resistance or the propulsive efficiency of many ships of our mercantile navy. Such a saving in power would mean a reduction of 750 tons of coal on a yearly bill of 15,000 tons, and the whole cost of the upkeep of the tank now approaching completion at Teddington would be more than met by the consequent reduction in working expenses on some eight or ten ships.

UNIVERSITY EDUCATION IN LONDON.

THE second volume of evidence [Cd. 5528, price 3*s.* 8*d.*] has been issued by the Royal Commission on University Education in London, containing the minutes of evidence for the period June, 1910, to November, 1910, with numerous appendices. The first volume of evidence, published in April, 1910, contained the evidence from July, 1909, to the date of publication.

The appointment of this Commission, it may be recalled, originated indirectly from a letter reprinted in *The Times* of June 29, 1903, signed by Lord Rosebery, and addressed to Lord Monkswell, chairman of the London County Council, which directed attention to the failure to provide instruction and facilities for research in technology, and stated that Messrs. Wernher, Beit, and Co. had offered to place a large sum of money in the hands of trustees, to be applied as a contribution towards the cost of building and equipping an institution for advanced technology. The new institution, like the Royal College of Science and the Central Technical College, was to become a "school" of the University of London. Mr. (now Lord) Haldane conducted some negotiations on the subject with the London County Council, who undertook conditionally to support the new institution by an annual grant of £20,000.

At about that time the Board of Education was considering the future organisation and government of the Royal College of Science, and in April, 1904, the President of the Board, Lord Londonderry, appointed a Departmental Committee to consider and report on the question. The report of this committee, over which Sir Francis Mowatt, and later Mr. (now Lord) Haldane presided, recommended the establishment of a large college at South Kensington, to embrace the Royal College of Science, the Royal School of Mines, and the Central Technical College, and to take over, as it were, Lord Rosebery's scheme. On the question of the relation of the proposed college to the university, there was a division of opinion in the committee, for and against the incorporation of the college in the university. The senate of the university proposed certain changes in its own constitution in the direction of increasing the representation of technical interests, and at one time it appeared possible that the college would be incorporated in the university at its establishment. But in the result, the recommendation contained in the report of the Departmental Committee has been adopted; the college, known as the Imperial College of Science and Technology, was established by the Royal Charter in 1907 as a "school" of the university, and the question of its future relations to the university has been referred to a Royal Commission.

The Commission was appointed on February 24, 1909, with terms of reference of the widest character, corresponding to the title which it has taken, the Royal Commission on University Education in London. Lord Haldane is chairman, and the other members are Lord Milner, Sir Robert Romer, Sir Robert Morant, Mr. Laurence Currie, Mr. W. S. M'Cormick, Mr. E. B. Sargant, and Mrs. Louise Creighton. It is important to note the judicial character of the Commission—none of the members can be regarded as specially representative of any interest connected with university education in London. The evidence which is being published periodically acquires thereby an exceptional interest, for the findings of the Commission must be based, to an unusual degree, on the weight of the evidence tendered before it. The impartiality of the Commission is certainly reflected in the exceedingly able examination of witnesses by Lord Haldane and other members, which seldom suggests any bias for or against the contending opinions which have been expressed, though it may not always appear to show a friendly disposition to the existing organisation of the university in some of its aspects.

Within the limits of a short article, it is only possible to select a few of the more important questions on which evidence has been presented. The dominant issue is undoubtedly the constitution of the ultimate authority for the control of university education in London. Even such a simple statement as this assumes that, apart from the London County Council, whose statutory powers over higher education must not be ignored, there will be only one controlling authority, a matter on which opinion is by no means unanimous. The Commission has so far concentrated its efforts on this dominant issue, with its subsidiary questions of the constitution and powers of lower authorities, including faculties, board of studies, and committees.

Briefly stated, the main issue before the Commission in regard to the constitution of the ultimate governing body of the university relates to its principal characteristic, whether it should be representative or judicial. Evidence has been presented in favour of the creation of a large and representative court, with legislative functions, on the model of some of the northern universities, together with a small executive council, in the constitution of which no attempt would be made to represent all the interests existing in or related to the university. On the other hand, there is a large body of evidence which finds the solution of the present difficulties in a slight re-constitution of the present senate, including

the amendments proposed during the negotiations which followed the publication of the report of the Departmental Committee of the Board of Education. A special question, on which opinion is sharply divided, is whether the colleges incorporated in or affiliated to the university should be accorded direct representation on the senate. There appears to be fairly general agreement that the senate should have greater powers of delegation than are given by the existing statutes. The organisation of the faculties, composed of the teachers of the great groups of university studies in which degrees are granted, should, it is suggested, be made more effective, faculty boards being formed in the case of the larger faculties to exercise the administrative functions of the faculties. General approval has also been expressed of the existing organisation of the boards of studies for special subjects. The boards of studies, the faculty boards, and, lastly, an academic council, in which all the faculties would be represented, would form an administrative chain which would become largely responsible for the educational side of the work of the university, subject to the supreme control of the senate.

The existence of the external side of the university presents some difficulties in the way of such an organisation of the educational work of the university. Very little substantial evidence has so far been published in favour of the abolition of the system of external degrees, and a good deal of cogent reasoning has been adduced in its support. But it is admitted on all sides that the present statutory requirements for the equivalence of internal and external degrees have caused serious difficulties in practice, and that means should be found for averting these difficulties in the future. In this connection, the extension of the system of common examinations has been suggested, or, alternatively, the complete separation of the work of examination on the internal and external sides.

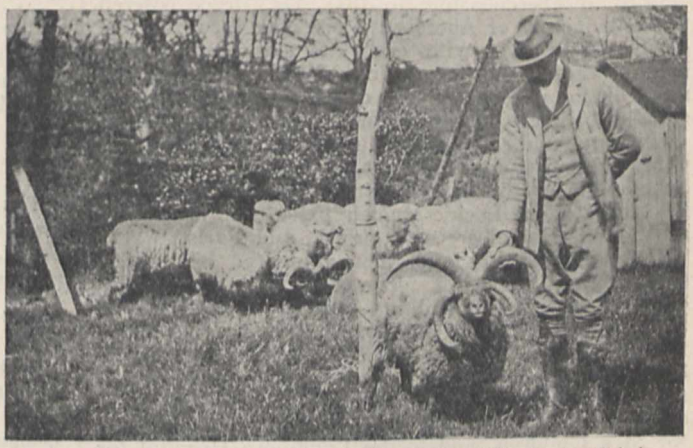
As already suggested, the Commission appears to be anxious to defer consideration of the future status of the Imperial College until some understanding is reached on other issues. Some interesting evidence has, however, been presented by Sir Alfred Keogh, on the actual working of the college. He states that it is the intention of the governing body to do nothing but post-graduate work eventually (Question 4521), and to get rid of the elementary students. As the evidence of the governing body has not yet been published, it will be wise to defer discussion of this policy for the present, except for the remark that its adoption will have far-reaching effects on the work at present carried on at South Kensington. Some valuable reports on the future work of the various departments of the college, prepared for the governing body, including a report on the organisation of a department of applied science, are printed in an appendix to the volume of evidence.

It should be mentioned, in conclusion, that the volume contains a large amount of information in regard to university work in London and elsewhere, both in its educational and financial aspects. Full statistics relating to the work of the University of London are printed in the reports of the various councils, faculties, and committees, which are included in the volume. Conditions in the United States and Canada are described in the evidence of President Murray Butler, of Columbia University, New York, and Principal Petersen, of the McGill University, Montreal.

BRITISH SHEPHERDS AND THEIR FLOCKS.[1]

IN this volume, which, as stated on the title-page, mainly consists of extracts from the writings of others, the author has succeeded in bringing together a large amount of valuable and interesting information concerning, not only the shepherds, but likewise the sheep, of the British Isles. In regard to the latter item, Miss Gosset has certainly not done herself justice in the title she has chosen, and it may perhaps be permissible to suggest that a better designation would have been the one standing at the head of this review. Neither, perhaps, has she conveyed an adequate idea on the title-page of her own contributions to the volume, at least one of which, namely, the article on sheep and shepherding in the Isle of Man, contains much interesting and little-known information.

Nor do shepherds and sheep by any means exhaust the contents of this fascinating volume, for we find a large collection of articles on sheepdogs, with others relating to shearing, to wool in connection with manufactures, and yet others on the arts, implements, crafts, and pastimes of shepherds, with a final series on pastoral folklore. There appears to be no mention in the index of black-horned sheep, which are stated in the preface to include some of the oldest British breeds; but possibly the author intended to write black-faced in place of black-horned. With this exception there seems no fault to be found with the book.



Mr. J. C. Bacon's Flock of Loughton Manx Sheep. From "Shepherds of Britain."

Since sheep-farming has for several centuries been one of the most important industries in the British Islands, it is not a little curious that it has been reserved for the author—as she herself remarks—to treat of shepherds and their flocks in the full manner such an interesting subject undoubtedly demands. The charms of shepherd-life (with allusions here and there to its obvious discomforts and trials at certain seasons and on certain occasions), and the manners, customs, and nature-lore of the old-time shepherd—who, by the way, is fast disappearing from the face of the country, at least in our southern counties—are illustrated by a series of apposite extracts from a number of well-known writers on country life, among whom may be specially mentioned the late Mr. Richard Jefferies and Mr. W. H. Hudson. Several of these contain some delightful anecdotes, while others serve to bring out the accurate and comprehensive

[1] "Shepherds of Britain." Scenes from Shepherd Life, past and present. From the best authorities, by Adelaide L. J. Gosset. Pp. xxiv+331. (London: Constable and Co., Ltd., 1911.) Price 7s. 6d. net.

knowledge of climate, stars, plants, and nature generally possessed by the old-fashioned shepherd, who, as I have mentioned on a previous occasion, was, despite his frequent inability to write or read, thoroughly and completely educated and equipped for the purposes of his calling.

Much has been made in works on the Bible and in sermons, of the fact that Syrian shepherds lead, instead of driving, their flocks; but, as the author points out, and as everyone who has lived in the country ought to be aware, this is by no means a peculiarity of Eastern lands. Very interesting are the notes on sheep-bells, which are stated to date from a remote antiquity, and it is therefore the more remarkable to find that they are apparently unknown in the Isle of Man and Scotland. With this I must take leave of a delightful book. R. L.

DR. ALEXANDER BRUCE.

NEUROLOGY and medicine have sustained a heavy loss in the death of Dr. Alexander Bruce, of Edinburgh, physician and editor of *The Review of Neurology and Psychiatry*. It was known for some time that Dr. Bruce was in ill-health. The news of his death, however, came as a shock to many.

Born in Aberdeenshire in 1854, Dr. Bruce entered the arts faculty of Aberdeen University in 1870. He graduated in 1874 with first-class classical honours, being awarded the Town Council gold medal as the most distinguished graduate of his year. He had an equally brilliant career in medicine at Edinburgh University, and, on his graduation in 1879 as M.B., C.M., with first-class honours, he obtained the Ettles Scholarship as the best student of his year. During his tenure of the Leckie-Macteir Fellowship he studied at Vienna, Heidelberg, Frankfort, and Paris.

Returning to England, he commenced his professional career by being for a time assistant clinical clerk at the West Riding Asylum, Wakefield. In 1882 he took his M.D. degree, obtaining a gold medal for his thesis. Settling in Edinburgh, he gradually built up a large general practice. He became a lecturer on pathology at the Surgeons' Hall and pathologist to the Royal Infirmary, to the Royal Hospital for Sick Children, and to the Longmore Hospital for Incurables. He also lectured at the Surgeons' Hall on neurology, and later on the practice of medicine, while he was appointed a physician and lecturer on clinical medicine at the Royal Infirmary.

By this time he had acquired a considerable reputation as a consultant, especially in diseases of the nervous system. His contributions to the literature of this subject were very numerous, being marked especially by the care with which pathological lesions were investigated and described. The chief characteristic of his work was thoroughness, and in the preparation of these published reports of cases no labour, whether of bedside observation or of microscopic work, was spared. He did not restrict himself to neurological subjects, but published communications on general pathology and medicine. He also translated Thoma's "Lehrbuch der Pathologie."

It was characteristic of Dr. Bruce that he should undertake pioneer research into the minute anatomy of the brain and spinal cord. It is with this work that his name will perhaps be most associated. He began by publishing "Illustrations of the Mid and Hind Brain" and "Topographical Atlas of the Spinal Cord." Numerous researches on the nuclei of the cerebral and spinal nerves, on cranial nuclei, and on the nerve-fibre connections of these we owe to him. A notable example of this work is "Distribution of the Cells in the Intermedio-Lateral Tract of the Spinal Cord" (Trans. Roy. Soc., Edin., 1906), a research which must form the basis of all subsequent work on this subject. Feeling the need of a "Centralblatt" in English which should contain short, original communications and provide abstracts and a complete bibliography of recent work on neurological subjects, he founded in 1903 *The Review of Neurology and Psychiatry*. To the interests of this work he devoted a large part of his time, with what success only those who work on neurological subjects can adequately appreciate. Just before his last illness he had finished a translation into English of Oppenheim's great "Lehrbuch der Nervenkrankheiten," while he was busily engaged, along with Dr. Dawson, in an investigation on the lymphatics of the spinal cord.

Dr. Bruce was a strenuous worker. It was only by systematic economy of his time that he was able to keep abreast of his multifarious duties. His influence over the younger workers with whom he was associated was great. Among his *confrères* he was held in highest respect, as well for his uprightness and generosity as for his ability. As a mark of his distinction in neurology he was in 1899 made a corresponding member of the Neurological Society of Paris. In 1906 the Royal Society of Edinburgh awarded him the Keith prize for his work on the intermedio-lateral tract, and in 1909 the University of Aberdeen conferred on him the degree of LL.D. He is survived by a widow, two daughters, and three sons, one of whom has already made important contributions to neurological science.

NOTES.

THE council of the London Mathematical Society has awarded the De Morgan medal for 1911 to Prof. H. Lamb, F.R.S., in recognition of his researches in mathematical physics.

THE British Empire League and the British Science Guild are combining to entertain the Colonial Prime Ministers and other distinguished visitors at a banquet at the Savoy Hotel to-morrow, June 16. His Grace the Duke of Devonshire (president of the British Empire League and vice-president of the British Science Guild) will take the chair.

THE annual meeting of the Association of Economic Biologists is to be held at the rooms of the Linnean Society, Burlington House, London, on July 6.

ACCORDING to the June number of *The Selborne Magazine*, the annual conversazione of the Selborne Society held in London on May 5 was the most successful of the whole series. It was announced that the original MS. of Gilbert White's Nature Calendar is to be published shortly.

MR. FRANK A. PERRET, of Springfield, Mass., is proceeding to Hawaii to open and take charge of the volcanic observatory which has been established there through the combined efforts of the Massachusetts Institute of Technology, the Smithsonian Institution, and the Carnegie Institution of Washington.

A PROPOSAL will be laid before the members of the Aëronautical Society to reconstitute the society by the institution of the following five grades of membership, viz. ordinary members, associate members, fellows, associate fellows, and students, the last three categories being reserved for persons engaged in technical work connected with aëronautics, while the first two are open to all who are interested in the work of the society.

THE death is reported, in his seventy-fourth year, of Dr. Cyrus G. Pringle, botanical collector to Harvard University and curator of the herbarium of the University of Vermont. His best known work was done in connection with the exploration of the flora of Old Mexico, about fifty of the most important herbaria in the world having benefited by his researches in that country. Before his Harvard appointment he was a collector for the American Museum of Natural History in New York.

THE vessel carrying the collection of wild animals presented to H.M. the King by South Africa arrived in the Thames on June 1. The collection, which was brought home in charge of two keepers sent out by the Zoological Society, is stated to include about 200 animals. These are now housed in buildings specially erected for their reception in the Zoological Gardens, Regent's Park, and are exhibited to the public as the King's South African collection. They were inspected by the King on June 4.

REPRESENTATIVES of the Hessian Government, of the town of Darmstadt, and of numerous chemical works joined with many others on June 1 in congratulations to Dr. Willy Merck, of E. Merck, Darmstadt, upon the celebration of the twenty-fifth anniversary of his entry into the firm as a partner. In the name of the Grand Duke of Hesse, the representative of the Hessian Government handed to Dr. Merck the grand medal for art and science conferred upon him in recognition of his services, not only in promoting the advance of chemical research work and in developing this branch of the country's industry, but also as a distinguished patron of art.

MR. HARVIE BROWN writes to us suggesting that the great Scots pine trees on Auchnacarry are probably of much greater age than the two hundred or three hundred years at which they were recently estimated in our columns (June 1, p. 447). Mr. Harvie Brown is very probably in the right. But we are informed by the timber merchants, Messrs. Souness and Spiers, Edinburgh, that they will be at work in the forest within the next two or three weeks, and that plenty of trees and logs will then be available for ascertaining the actual age.

A BILL has been introduced in the House of Representatives of the United States of America "to establish in the District of Columbia a laboratory for the study of the criminal, pauper, and defective classes." We understand from Mr. Arthur MacDonald, of Washington, who has been prominent in advocating the establishment of such laboratories, that the Russian Government has already set aside a large sum of money for this purpose. The fundamental problem in such studies, it seems to us, is to determine which individuals among the criminal, pauper, and feeble-minded population occupy that position through accidental misfortune, and which are congenitally defective. It is useless, or worse, to spend money in the hope of curing the latter class. Permanent care and control is for them the only hope, and for society the most feasible way of preventing the ever-growing burden of their criminal or incompetent descendants.

A VIOLENT earthquake occurred in Mexico on June 7 at 4.35 a.m., and gave rise to unusually large disturbances in distant seismographs. In Mexico city many poorly-built houses were destroyed, and 172 persons were killed. The shock or shocks lasted there for about six minutes. The total number of deaths is estimated at 1300, of which 500 occurred at Zapotlan. The volcanoes of Colima and Popocatapetl are also said to be in active eruption. The position of the origin is still unknown. An earthquake capable of affecting European seismographs so strongly must have caused widespread destruction in the central area, and it is possible that this area may be isolated from the surrounding country, so that the full extent of the disaster may not be realised, or, for political reasons, detailed telegrams may be censored. It is clear, however, that the epicentre was at some distance from those of the Mexican earthquakes of 1905 and 1907. In those years the towns which suffered most were Chilpancingo and Acapulco, which lie from 200 to 250 miles south of Mexico city. Zapotlan is about 275 miles west of that city, and is situated in a well-known seismic district, having on several occasions been damaged or destroyed by earthquakes.

FOR the use of the members of the sixteenth annual Congress of the South-Eastern Union of Scientific Societies, held at St. Albans last week, the Hertfordshire Natural History Society and Field Club has issued an excellent guide to the topography, natural history, archæology, &c., of the city and the surrounding neighbourhood, the account forming part iii. of vol. xiv. of the society's Transactions. Mr. John Hopkinson has acted as editor, and has himself contributed the sections on topography, geology, hydrology, and climate, while the other sections have been written by various members of the society. The guide is illustrated by a map of the district, a plan of modern Verulamium, and several local views, and will be of permanent value to residents in and visitors to the neighbourhood. The congress lasted from June 7 to 10, and at the inaugural meeting a resolution was passed expressive of the hope that the negotiations between the Society of Antiquarians and the Earl of Verulam for the excavation of the site of Verulamium, which—owing in part to the death of King Edward—fell through last year, may be resumed and brought to a successful issue. Lieut.-Colonel D. Prain, F.R.S., was nominated president of next year's congress in succession to Sir David Gill, K.C.B., F.R.S.

THE Huxley lecture at the University of Birmingham was delivered this year, on May 29, by Prof. Henri Bergson. He chose "Life and Consciousness" as the subject of his lecture. He proposed the view that a world-wide antagonism exists between matter, which is essentially automatic and governed by necessity, and consciousness, which is characterised by the power of choice and creation. Consciousness, he believed, entered matter in order to entice it to organisation; but in thus binding itself to matter, consciousness lost much of its original liberty, and was continually being dogged and cramped by automatism. Prof. Bergson conceived consciousness as flowing through matter much as a stream of fluid flows through a tunnel; in digging galleries in this hard rock, consciousness found itself impeded at point after point. Thus it had repeatedly to make fresh starts in its ceaseless efforts to create, until finally, in the course of this crooked path of evolution, it created man. In man alone, the chains which elsewhere bound consciousness to matter were broken. Here, maintained the lecturer, every contracted habit could be opposed by another habit, every kind of automatism by another automatism. Consciousness thus acquired its liberty by setting one necessity to fight another. In this way it has expanded to such a state of freedom that in man, perhaps, it may be able to endure beyond his earthly life.

THE fine series of big-game and other sporting trophies arranged in a special building at the Festival of Empire and Imperial Exhibition at the Crystal Palace, and opened

to the public last week, is of interest from two points of view. It is, for instance, the first attempt to bring together in this country a collection of the big-game animals (exclusive of zebras, wild asses, and giraffes) to be found within the limits of the British Empire, while, in the second place, it includes many of the finest heads of animals of this nature which have fallen during the last thirty or forty years to the rifles of (mainly British) sportsmen. Although it was found impossible to render the series absolutely complete, the exhibition affords an excellent idea of the wonderful extent of the big-game fauna of Greater Britain, and how vastly it exceeds that of any other empire in the world. The specimens are arranged according to countries, and thereby afford an excellent object-lesson in geographical zoology, so far as it can be learnt from a few groups of mammals. Those who visit the Crystal Palace exhibit will at once realise how much is lost by the lack of a geographical section in the zoological department of the Natural History Museum. A considerable proportion of the specimens exhibited at the Crystal Palace were shown last year at Vienna, but, on the other hand, there are many new objects, a few of which are of more than ordinary interest. To particularise these on the present occasion is, however, out of the question, and we may conclude by offering congratulations to Lord Wolverton, the president, Mr. C. E. Fagan, the hon. organising secretary, and the other promoters of this extremely successful and instructive exhibition.

We have received a booklet entitled "Vergiftungen durch Tiere und animalische Stoffe," by Dr. Kanngiesser (Jena: Gustav Fischer, 1911, price 1 mark), which gives a brief but simple and comprehensive survey of animal poisons, *e.g.* those of insects and arthropods, molluscs, fish and toads, snake venom, &c. Some of the subjects, however, being infections rather than intoxications, *e.g.* amœbic dysentery, coccidiosis, trypanosomiasis, and trichinosis, seem somewhat out of place.

In a review on "Salvarsan" which appeared in Nature of May 25 (p. 412), it was stated that Ehrlich had introduced trypan red for the treatment of piroplasmosis. Prof. Nuttall writes pointing out that this is an error; it was tried by Ehrlich for the treatment of trypanosomiasis. Trypan red was first used by Prof. Nuttall in conjunction with Dr. Hadwen for the treatment of canine piroplasmosis, but proved unsatisfactory, and trypan blue, a drug which emanated from Mesnil, has been used instead with considerable success in the treatment of piroplasmosis in different parts of the world.

No. 42 of the Scientific Memoirs of the Government of India deals with the cultivation of the leprosy bacillus. The cultivation of this micro-organism has almost baffled investigators, only a few undoubted cultures having been obtained. Major Rost makes use of a culture medium prepared by steam distillation of rotten fish, and to this distillate some weak Lemco broth and milk are added. Inoculated with material from leprosy patients, masses of "acid-fast," leprosy-like bacilli develop in a few days. Captain Williams, using Major Rost's medium, or a somewhat similar one, in which distilled water replaced the fish distillate, has also obtained cultures of what he considers to be the leprosy organism. An interesting fact brought out by the work is the extreme variation of the leprosy organism; sometimes it has the ordinary bacillar form and is "acid-fast," at others it is non-acid-fast, while diphtheroid and streptothrix forms frequently appear, the streptothrix often breaking up into bacillar forms. Both these observers have prepared vaccines with which promising results, as regards the cure of the disease, have been obtained.

In the report of the Horniman Museum and Library for 1910 attention is directed to the gift, by Mr. A. R. Brown, of a number of specimens illustrative of the ethnology of the Andaman Islands. During the year, the museum has lost the services of Mr. F. Slade, whose appointment as naturalist considerably antedates the transference of the institution to the County Council.

In an article in the May number of *The Museums Journal*, Dr. Bather directs attention to the palæontological exhibit at the "White City," the leading idea of which is to display the scientific results attained by the study of palæontology, and more especially such as can be obtained only by means of this science. The restoration of extinct animals constitutes one section of the exhibit; a second is devoted to extinct faunas and floras in connection with their bearing upon the present distribution of animal and plant life upon the surface of the globe; while a third section illustrates contemporary individual variation in a species. The last-named feature leads on to the evolution of species and genera, which is also exemplified by actual examples.

The Scientific American of May 11 contains an illustrated account on the so-called "dinosaur-mummy"—that is to say, a skeleton of Trachodon still covered with the skin obtained in 1908 by Mr. C. H. Sternberg from the Cretaceous of Wyoming. One of the illustrations shows the finely tuberculated, or granulated, structure of the external surface of the skin, while a second reproduces the latest restoration of the entire animal. The tenuity of the skin suggests aquatic habits on the part of these dinosaurs, and this view is strengthened by the circumstance that the relatively small fore-legs terminated in a broad expansion of the skin, converting the toes into a kind of paddle, and projecting beyond their tips. The expansion of the extremity of the muzzle into an edentulous, duck-like beak seems likewise indicative of aquatic habits.

To *La Nature* of May 27 Dr. E. Trouessart contributes an account of a specimen of the New Guinea long-beaked Echidna (*Zaglossus*, or *Proechidna*, *bruyni*) now living in the Zoological Gardens at Amsterdam, which is probably the first example of its kind ever brought alive to Europe. It belongs to the race for which Mr. Rothschild proposed in 1892 the name *Z. b. nigro-aculeatus*. The communication is illustrated by two photographs, which show that the pose of the creature is quite different from the one given in pictures and mounted specimens. In these the animal is represented with the belly resting on the ground, and the claws of the hind-legs directed like those of a lizard. In reality, it stands up on its legs in elephant-fashion, with the hind-claws directed outwards and slightly forwards, this being a remarkable attitude for a burrowing animal. Unlike the ordinary echidna, which refuses to touch them, the long-beaked species exhibits a marked partiality to earth-worms.

A palæontological communication by Mr. E. W. Berry, published in the Proceedings of the United States National Museum (No. 1821), presents a revision and reduction of species referable to fossil gymnospermous genera from the Potomac group. Of eight genera reviewed, Sequoia is represented at the present day, Arthrotaxopsis and Cephalotaxopsis indicate by their names their relationship to modern genera, Brachyphyllum and Sphenolepis are *sedis incerta*; the two latter genera are

possibly composite. Cones and seeds of a pine, *Pinus vernonensis*, are abundant in the group.

THE modification of plants induced by the extremely dry summer in West Australia furnishes the subject of a contribution by Dr. A. Morrison to the Journal of the Natural History and Science Society of Western Australia (vol. iii., No. 1). A thick development of woolly hairs on stem and leaves is shown by *Eragrostis eriopoda*; rolling back of the leaf margins is the device exhibited by *Grevillea oxystigma*; *Plagianthus Helmsii* furnishes an instance of extreme specialisation in an arrangement of closely set minute leaves. *Daviesia euphorbioides* is an interesting case of a leguminous plant which has developed a succulent cactus-like form, while *Calandrinia primuliflora* is provided with a water-storing tubercle.

THE concluding portion of Dr. C. B. Robinson's article on Philippine Urticaceæ, published in *The Philippine Journal of Science* (Botany, vol. vi., No. 1), contains the diagnosis and illustration of a new generic type, Astrothalamus, segregated from Maoutia, and several new species, notably under the genus Leucosyke. In the same number Mr. O. Ames presents a list of new records and species of Orchidaceæ, with an introductory note summarising his conclusions regarding the orchid flora of the Philippines. Dendrochilum, Dendrobium, and Eria stand out as the most important genera. No genus is entirely confined to the islands, but the numerous species contained in one section of Dendrochilum are all endemic.

THE current number of *The Gardener's Chronicle* (June 10) contains the first part of an article by Mr. H. N. Ridley, describing a botanical expedition to Lower Siam, undertaken with the object of demarcating the boundary between the two distinct floras of Malaya and Tenasserim. On the island of Alostar the northern element was already recognisable in the shape of a common species of Corypha palm and a yellow vetch, a species of Geissaspis, growing as a weed in the rice fields. *Crinum Northianum* and a Lepadanthus were notable discoveries, as also the growth of *Leea rubra* in the mud flats. Attention is also directed to a contribution by Mr. R. Farrer, presenting a systematic synopsis of European species of Primula, with the object of clearing up some of the confusion which exists owing to changes in nomenclature.

VARIOUS problems, mainly economic, are discussed by Mr. A. D. Blascheck in an article contributed to *Science Progress* (April) on the subject of afforestation in the United Kingdom. He proceeds to show that the climate is suitable, that land is available, and that Great Britain has a smaller proportion of land under forest than any other European country. But the crux of the situation lies in the financial aspect, with reference to which the opinion is expressed that forests, as a rule, yield less profit than Government securities, so that the benefits derivable are indirect, chiefly in the extra employment of workers required for the timber and allied industries. These arguments lead to the recommendation of measures that were proposed in the Development and Roads Improvement Funds Act, 1909, *i.e.* "the conducting of inquiries and research for the purpose of promoting forestry and the teaching of methods of afforestation," as also "for the purchase and planting of land found after inquiry to be suitable for afforestation."

MR. F. MUIR has recently published an account, in Bulletin No. 9 of the Experiment Station of the Hawaiian Sugar Planters' Association, of some new species of leaf-hopper (Perkinsiella) on the sugar-cane. The genus was investigated by Kirkaldy in 1903; it is particularly attached to the sugar-cane, and only occasionally goes on to other grasses. At present there are thirteen known species.

MR. L. D. LARSEN has recently collected his work on the diseases of the pineapple, and published it as Bulletin No. X. of the Hawaiian Sugar Planters' Association. The fungus *Thielaviopsis parodoxa* is by much the most destructive micro-organism involved, causing three distinct and important diseases, in addition to being responsible for a good deal of the decay in pineapple roots. It is in general saprophytic, but in certain conditions it becomes parasitic. A disease known as brown rot was traced to Fusarium. The fungus causing the very serious pineapple wilt is not yet isolated with certainty.

THE fifth annual report of the work at Rosslynlee, by Messrs. Lauder and Fagan, on the variation in composition of cow's milk, shows what a small effect ventilation of the cowshed has on the yield of milk. The shed was divided by a wood and felt partition into two parts, one of which was freely ventilated, even in the coldest weather; the other was only partially ventilated, so that its average temperature was higher by about 9° F. In the cool, well-ventilated part the average yield per cow per day was 27·54 lb., and in the warm, badly ventilated part it was 27·14 lb., the percentages of fat being respectively 3·74 and 3·70.

MESSRS. SCHREINER AND SKINNER have published, in Bulletin No. 75 of the United States Bureau of Soils, an account of the soils most suitable for lawns in the United States, and of the detailed cultivation and manuring necessary to obtain a good growth of grass. Some of their recommendations, however, seem quite inconsistent with the official views of the Soil Bureau; thus their advice to use phosphatic manures seems intelligible only on the old view that phosphates are needed to feed the young plant. It is significant that gardening has become of sufficient importance in American life for a great State department to undertake such an investigation as the present one.

AN article by Dr. H. v. Ficker on the interesting subject of the advance of cold waves in Asia and Europe appears in the Proceedings of the Vienna Academy of Sciences for December last. The data upon which it depends are drawn chiefly from the Russian Meteorological Annals for 1898–1902. About fifty cold waves were investigated, and nearly 200 charts drawn, in this laborious work; a few typical cases only, with charts, are included in the article, with a short discussion of the majority of the other periods. The greater frequency of cold waves in winter would lead one to suppose that they proceeded from the cold centre in north-east Siberia, but this view has not been confirmed. In the majority of cases they were found to come from the Arctic coast, between long. 30° and 90° E. Distinction is drawn between those proceeding from the west of Novaia Zemlia, accompanied with north-west winds, and those proceeding from the east of that island, accompanied by north-east winds. The spread of the cold air is found to take place earlier towards Europe than towards Siberia. The maximum velocity of the waves is about twenty-five miles an hour, and thus corresponds fairly well to the rate of propagation of thunderstorms. Their irruption causes a sharp rise of the barometer; they are preceded by low pressure, and generally with a rise of temperature.

THE classification of the visible forms of the various sextic plane curves forms the subject of a paper by M. W. Sierpinski in the *Bulletin international* of the Cracow Academy, No. 10 A (1910).

THE Proceedings of the Royal Society of Edinburgh, xxxi., 3, contains three papers by Dr. T. Muir, F.R.S., dealing with the historical development of certain determinants up to 1860. The papers refer respectively to "Wronskians," "Recurrent Determinants," and "The less common special Forms."

IN two notes contributed to the *Atti dei Lincei*, xx., 5, 7, Dr. U. Cisotti works out *in extenso* the solution of the problem of discontinuous stream-line motion of a jet which is divided in two by impact on a fixed plane, the jet being of finite breadth and bounded by free stream lines.

IT is announced that after the close of the present volume the *Annals of Mathematics*, hitherto published in October, January, April, and July, under the auspices of Harvard University, will be transferred to Princeton University, New Jersey, to which address editorial and other communications are in future to be sent.

IN the Bulletin of the American Mathematical Society for May Prof. Florian Cajori publishes a paper in which it is claimed that the now familiar "Horner's method" of solving an algebraic equation had been previously given by Paolo Ruffini in an Italian paper. The methods adopted by Ruffini and Homer seem to have been identical to a very great extent; the main differences which Cajori mentions are that Horner explained a special procedure for separating a pair of nearly equal roots, and, further, that he contemplated the application of his method to transcendental equations. It need hardly be pointed out that the solutions of such equations as $\tan x = x$, which can be expanded by Taylor's theorem, constitute some of the most useful and well-known applications of Horner's method.

WE have received a copy of Mr. W. J. Lyons's paper read before the Royal Dublin Society recently on a method of exact determination of the continuous change in absolute density of a substance in passing through its fusion stage. The apparatus consists of a dilatometer bulb, from the lower end of which a capillary issues, and is bent first upwards and then horizontally. This tube and the lower part of the bulb are filled with mercury. The upper part of the bulb contains the substance the expansion of which is to be determined, and the magnitude of the expansion is calculated from the motion of the mercury meniscus in the capillary tube. Experiments on wax show that the fusion lasts over a considerable range of temperature, and that in the neighbourhood the volume on cooling is, at the same temperature, greater than on heating. As the apparatus only differs from Pettersson's of 1881 in the absence of taps for the admission of the substance, it is to be regretted that Pettersson's name is not mentioned in the paper.

THE address given by Prof. Planck to the Société française de Physique on April 21, and reproduced in the May number of the *Journal de Physique*, constitutes one of the clearest expositions we have seen for some time of the present difficulties of the attempt to express the relation between energy and temperature. The doctrine of the equipartition of energy amongst the various degrees of freedom of a molecule, deduced by Boltzmann and Gibbs, has led to serious difficulties owing to the smallness of observed specific heats as compared with the calculated values. Planck's own theory, that energy exists in multiples of a certain atomic quantity, leads to difficulties with regard to absorption of energy, and, as we pointed out in these columns on March 16 (p. 90), he has now modified it so that only emission takes place by the step by step process, absorption being continuous and energy content of a body no longer an integral multiple of the atomic energy. Whether this change gives us a satisfactory theory only time can show.

The Builder for June 9 contains an illustrated article, by Mr. Percy J. Waldram, on the need for horizontal tie-rods in arched timber roofs. Generally, the introduction of such rods is owing to the designer assuming that the joints are flexible, and constructing a force-diagram based on this assumption. Actually, the stiffness of the joints as constructed in practice renders the fitting of tie-rods quite unnecessary in a properly designed arched roof. The author cites the case of the fine arched hammer-beam roof of Eltham Parish Hall, which has no tie-bars, and gives account of an interesting experiment carried out on one truss, which was mounted on pipe rollers on the ground and loaded with bricks laid on a platform slung from the truss. With a span of 42 feet and a load of 7 tons the calculated outward spread was 0·63 inch. Upon the first application of the load, the spread was found to be slightly more than 1 inch, owing partly to the tightening up of the joints. On removing the load, the truss came back 0·75 inch, and in each of the two reimpositions of the load, at intervals of two days, the spread was found to be 0·75 inch. The object of the test was attained, inasmuch as the district surveyor withdrew his requisition for tie-rods.

THE report of the Indian Association for the Cultivation of Science for the year 1909 has now been received. The association's chief work seems to be the arrangement of lectures on scientific subjects. During the year about 280 lectures on various branches of physics and chemistry were delivered, and in addition upwards of a hundred practical demonstrations were arranged. The chemical laboratory conducted by the association has been remodelled, and it is hoped soon to inaugurate a research department. The report also contains a set of meteorological observations taken at Calcutta during 1909.

IN a review of Prof. Leduc's book on biological aspects of osmotic phenomena in NATURE of May 25 (p. 410) the writer gave examples of the need of proof-reading, and stated that there were errors in the title of a book by Rhumbler. He inferred, unfortunately without verification, that the strange words "organismischer" and "anorganismischer" were typographical errors, but Prof. Leduc writes to point out that they are the words Rhumbler used in his title. The reviewer regrets that he was guilty of the kind of carelessness for which he reproached Prof. Leduc, but he is afraid that his remark as to misprints remains true.

OUR ASTRONOMICAL COLUMN.

A REMARKABLE METEORIC PHENOMENON.—In No. 4503 of the *Astronomische Nachrichten* Dr. Max Wolf describes a curious phenomenon observed on May 22, at about 11h. 49m. (Königstuhl M.T.), at Heidelberg. A faint meteor, pursuing a 4° path obliquely from east to west, passed over the star γ Aquilæ with great velocity; its breadth was about 15′, and it left a faint trail, which disappeared immediately. But although this trail was only momentarily visible, the star remained invisible for at least 3·5 seconds, its light apparently cut off by the material left behind by the evanescent meteor.

THE DIFFERENT QUALITY OF THE LIGHT REFLECTED FROM DIFFERENT PARTS OF THE MOON'S SURFACE.—The results obtained by Herren A. Miethe and B. Seegert in photographing the moon's surface through colour-selective screens are further described in No. 4502 of the *Astronomische Nachrichten*, and illustrated by a two-colour

reproduction of a composite drawing made from their photographs. On this drawing those parts which reflect a greater amount of light from the red end of the spectrum are shown in red, and those which reflect chiefly light of shorter wave-length are represented in green. The complex mixture of colour cannot be described in detail here, but we note that the walls and several streaks about Tycho are red, as are also the greater parts of the Mare Serenitatis and the Mare Humorum. On the other hand, Tranquilitatis, Fecunditatis, and Crisium are almost wholly green, while the Mare Imbrium is quite an intricate mixture.

THE SILVER DISC PYRHELIOMETER.—In 1909 Mr. Abbot, director of the astrophysical observatory of the Smithsonian Institution, designed a pyrheliometer which, although not readily providing results reducible to calories per sq. cm., furnishes readings proportional to the intensity of the solar radiation, and can be made of a standard form, so that a number of widely distributed observers may work in consonance. This instrument, as described in No. 19, vol. lvi., of the Smithsonian Miscellaneous Collections, consists of a silver disc in which a radial hole has been bored. Into this hole a thermometer bulb is inserted and packed, a mercury filling ensuring good conduction. The whole is carried in a tube provided with suitable diaphragms, exposing shutters, and packing, on an equatorial stand, and the observations simply consist of reading, very carefully, the thermometer at definite intervals. In order to secure cooperation, the Smithsonian Institution has furnished several other institutions with copies of the standard instrument, and is willing to furnish others. Standardised and packed ready for shipment, such an instrument costs the institution about 100 dollars.

THE PHOTOGRAPHIC DETERMINATION OF STELLAR MAGNITUDES.—Two sections of the Harvard College Observatory Annals recently received deal with the difficult but important question of the determination of stellar magnitudes by photography.

In No. 1, vol. lxxi., Prof. E. C. Pickering discusses the numerous difficulties attending the determination of standard magnitudes, and briefly reviews the various methods that have been tried. He then shows by tables and curves that the method adopted at Harvard, in which the photographic magnitude can be derived from the photometric by adding a constant depending upon the class of spectrum of the star, gives results in which the deviations, at least for the brighter stars, are probably too small for determination at present. A comparison of the results obtained by thus treating the magnitudes given in the Uranometria Oxoniensis and the Potsdam Catalogue shows the smallness of the residuals. The photographic magnitudes of all stars of mag. 4·25 and brighter from these two catalogues and the Harvard Revised Catalogue are given in Table V., and should prove a useful reference for standard photographic magnitudes; other tables give the magnitudes of double stars and of stars having a photographic magnitude of 3·0 and brighter. The paper concludes with an interesting note on the apparent changes well-known groups of stars would undergo if we saw their photographic, instead of their photometric, brightness; Betelgeuse would become from 0·5 to 1·0 mag. fainter than the belt stars; Antares would appear a little less bright than σ and τ Scorpionis, and the Southern Cross would be greatly altered by γ Crucis becoming much fainter than δ.

In No. 6, vol. lix., Mr. E. S. King gives the photographic magnitudes of 153 stars determined by the method of measuring images taken at different foci; these magnitudes are absolute, and the scale is independent of any other system. The determination of these absolute magnitudes provides a surer basis for the derivation of the constant corrections to be applied to existing photometric magnitudes according to the class of spectrum, and these corrections are tabulated. Mr. King also discusses his material to educe evidence of the absorption of light in space, and finds, from the increased redness of the more distant stars, that there probably is some such absorption.

JUPITER'S EIGHTH SATELLITE.—The eighth satellite of Jupiter was observed at Heidelberg on May 22, and at 10h. 26·2m. (Königstuhl M.T.) its position (1855·0) was 14h. 19m. 37·4s., −13° 56·8′. Its magnitude was between 16 and 17, and Dr. Wolf remarks that its position is so low as to place its observation with the reflector on the limit of possibility, mechanically (*Astronomische Nachrichten*, No. 4503).

THE BRITISH SOLAR ECLIPSE EXPEDITION.[1]

H.M.S. "Encounter."

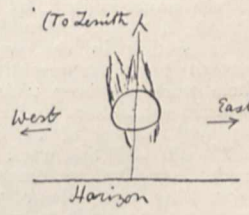
April 29,

Eclipse Day, 11.30 p.m.

THE eclipse is over, and we have only seen quite a little of it. For a long time we have been making our preparations, and for more than a week we have been drilling nearly daily. The weather has not been very kind, and either heavy showers or light rain have fallen during the day or night. However, it seemed that we might be lucky and secure a cloudless moment, or we might repeat the Palma eclipse of 1905 and be partially clouded out. Well, it has been very much worse than Palma.

The early morning of the eventful day was far more cloudy than usual, in fact, there was a great amount of cirrus cloud and numerous cumuli. As eclipse time came along, evidently the reduction of the temperature in this very humid climate (nearly always 75 per cent. or more of saturation) caused the aqueous vapour to condense into cloud, and the cloud increased and increased in amount as the time for second contact approached. So cloudy was it, and so disturbed was the air, that the observer who was watching the cusps could not be certain of giving the correct observed time of totality by them.

By chronometer time the eclipse clock was started, and the whole party went through their programme as if it were a rehearsal. The greater part of totality was hardly observed at all, and the whole of it was seen through fairly thick cirrus cloud. After the eclipse was over the clouds gradually dispersed, and long before fourth contact was reached a nearly cloudless sky was *en évidence*. The whole affair has been a great disappointment, both to the astronomers and the ship's company.



The corona was distinctly of a minimum type, the fish-tail portion of it being pointed towards the zenith (see sketch). One large prominence in the north-west quadrant was conspicuous towards the end of totality, and gave a ruddy hue to the corona in that quarter. Owing to the great amount of cloud, long extensions could not be observed, but the fish-tail portion extended, to my eye, one diameter away. Clouds prevented me from seeing any conspicuous feature on either the east or west limbs, but on the lower limb there seemed to be the indication of the stump of a large streamer.

At the time of writing, the following results have been secured, but only a few plates of some of the instruments have been developed. Steward equatorial, three plates developed, two of which may be useful. These show the lower corona only, including the stumps of some streamers. Two plates only of the De la Rue coronograph have been developed, and they are not dense, owing to the cloudy nature of the sky. One plate from the 4-inch 16-foot coronograph has been developed, and this seems very much underexposed. No plates of the large grating spectrograph have as yet been developed, but one (the only plate developed), taken with the 6-inch prismatic camera near the end of totality, shows a considerable number of lines in addition to some continuous spectrum. In fact, the photographic results so far obtained seem to be better than what was anticipated from the cloudy conditions.

One may really sum up the whole results of the expedition as a failure, considering what we might have obtained had the weather been more propitious.

Nearly all, if not all, the eclipse parties have obtained almost similar results; but it is early yet to say for certain until the plates have been developed.

W. J. S. LOCKYER.

[1] Continued from p. 499.

SCIENCE AT THE WHITE CITY.

AT the Coronation Exhibition, which was recently opened at Shepherd's Bush by Prince Arthur of Connaught, a section devoted to pure science has again been included. This is the third of these science exhibitions, the first having been in the Franco-British Exhibition some three years ago. The formation of such a section at that time was suggested by the British Science Guild, and it was managed by a committee nominated by the Guild. The second science section was in connection with the Japan-British Exhibition last year, and it was larger and more comprehensive than the previous one, and was managed by a separate committee of the exhibition; and the third, which is now to be seen at the White City, is again on a still larger scale, and occupies no fewer than three large courts in what are called the "overhead buildings" leading from Shepherd's Bush Station to Wood Lane. That sections devoted to pure science are now being included as a matter of course in most of the important exhibitions is shown by the fact that the International Exhibition now open at Turin has a rather large science collection, including two laboratories actually at work.

The object of such sections is to bring together the methods and results of recent scientific research and invention in a form which will attract the notice of the general public, and will have an educative effect on all who may examine the exhibits. The results of the two previous science sections in the White City have been very satisfactory, and many men of science have been much surprised at the intelligent interest taken in the collections by the ordinary visitors to the exhibition, who must be entirely unacquainted, as a rule, with pure science and with the nature of scientific investigations.

The section in the present exhibition is divided into fourteen parts, representing the different sciences. The whole work has been under the control of a strong representative committee, and each division has been under the care and control of an expert in the particular science dealt with. All this work has been honorary, and grateful thanks are due to those gentlemen who have devoted much time and labour to the work of collecting and arranging the exhibits, while equally grateful thanks are due to the many investigators of science who have so kindly lent their apparatus and the products of their researches for exhibition. It must, however, be clearly understood that the domain of science is so wide and large that the collections merely illustrate portions of the fields of various sciences, and only such portions, indeed, that lend themselves easily to demonstration in an exhibition.

In the present exhibition an attempt is made to give parts of the collection a more living interest than had hitherto been possible by showing certain apparatus actually at work. To take, for instance, the section devoted to physical science; in this, by the courtesy of the Marconi Company, an apparatus is being installed for sending and receiving Marconi telegrams. The apparatus is that which is actually employed in sending messages to shore from a Cunard steamer, and it will be possible to send wireless messages from the end of one of the long science courts to the end of a second, and visitors to the exhibition will be able to send off and receive such wireless messages without charge.

A good many of the pieces of apparatus too in the physical science section will be actually at work, being driven by a separate electrical installation, which has been erected at considerable cost.

It is almost impossible to review all the fourteen divisions of the science section, but a few of the exhibits perhaps may be mentioned.

A large and important collection is shown under astronomy, including some excellent photographs and transparencies of star clusters and nebulæ, while M. Deslandres sends some illustrating clouds of calcium and hydrogen in the upper atmosphere of the sun. There is also a collection of sundials and astrolabes, including one belonging to Mr. Knobel, and dated so far back as A.D. 1224.

In meteorology, the Meteorological Office is well represented. In anthropology, a very complete collection of skulls (or casts of them) is shown which have been found in different parts of Europe, and which throw light upon the ancient history and evolution of mankind. Anthropometric measurements will also be made in this division. Very interesting, but rather technical, collections are shown in geology and palæontology, while in the mineralogy and crystallography section the emerald exhibited by the Duke of Devonshire is said to be the largest in the world. A very fine collection is shown under the head of chemistry, one case, dealing with the rusting of iron and the corrosion of propeller blades, being specially noticeable, while vanadium steel and ferro-silicon are also shown. The last-named compound, it may be remembered, has sometimes caused loss of life when carried on ships, and the conditions of such accidents are explained.

The London School of Tropical Medicine has also a most important and interesting exhibit dealing with such diseases as sleeping sickness, plague, &c. Under agriculture, the remarkable experiments of Prof. Percival, of Reading, on the growing of wheat are illustrated, while other exhibits deal with stone-ground flour. Models are also shown of the methods of growing crops by the help of high-tension electricity, such as would be used in a field or in a greenhouse. Under seismology, the delicate instruments used for recording earthquakes, and also Prof. Milne's tide recorder, are shown, while one seismograph has had to be erected in the Machinery Hall, as it has to rest on the ground itself, while the science attractions are housed in raised buildings. This seismograph will be at work throughout the exhibition, and will record any earth tremors or earthquakes which may happen during this time. Interesting collections are also shown under the head of geography and oceanography.

ANTHROPOLOGICAL EXPEDITION TO NEW GUINEA.

AN interesting anthropological expedition to New Guinea is about to take place under the auspices of the University of Oxford as represented by the Committee for Anthropology. The sum of money required for the purpose has been made up out of considerable grants of equal amount furnished by the Common University Fund (with the condition that whatever specimens of native handiwork are procured, duplicates excepted, shall be offered as presents to the Pitt-Rivers Museum) and Balliol, Magdalen, and Brasenose Colleges, whilst smaller but still considerable contributions of varying amount have been made by University, Exeter, Lincoln, Corpus Christi Colleges, Christ Church, and Jesus College, Sir William Anson and Dr. Arthur Evans having likewise in a private capacity afforded welcome help to the expedition fund. The Committee for Anthropology has selected Mr. D. Jenness, of Balliol College, to undertake the work of exploration. Mr. Jenness holds the Oxford diploma in anthropology, and went on to Balliol as the holder of several scholarships from New Zealand, where he not only graduated with first-class honours in classics at the University, but likewise had occasion to acquire practical experience of the conditions of camp-life in the bush.

So far as can be foreseen at present, Mr. Jenness will reach Papua in November, and will take as his base of operations Bwaidoga, on Goodenough Island, one of the almost unknown D'Entrecasteaux Group, off the south-east coast of New Guinea. When Sir W. Macgregor arranged for the partition of British New Guinea amongst the various missionary societies, the islands of south-east New Guinea fell to the Methodists, and the station of Bwaidoga is one of the latest fruits of their enterprise. The Rev. A. Ballantyne, who is in charge of the D'Entrecasteaux Group, will render Mr. Jenness all the assistance in his power, and the help of all the Methodist missionaries in that region is similarly assured. Further, the Lieutenant-Governor of Papua, the Hon. J. H. P. Murray, has given his full approval to the expedition as thus arranged, and has promised it his official support.

Mr. Jenness will probably begin with a general survey of the D'Entrecasteaux Group, but as soon as he has got thoroughly into touch with the natives, hopes to be able to settle down to a detailed study of Goodenough Island

in particular. The examination of its trade relations, however, may entail a visit to the neighbouring Trobriands. If it prove possible, he will also proceed so far afield as Rossell Island, where certain ethnological problems of peculiar interest await solution.

SOME AMERICAN ORE DEPOSITS.[1]

NEW MEXICO has one of the longest mining histories of the western United States, for its semi-civilised aborigines, the Pueblo Indians, mined gold and turquoise before the arrival of the first white explorer in 1534. The Jesuit missions converted the Indians to Christianity, and then sweated them as miners until they were goaded into revolt, and the Spaniards were only readmitted on condition that their industrial operations were confined to agriculture. Mining was only resumed with the discovery of the copper-bearing sandstones at the close of the eighteenth century. Placer mining was started in 1828; the modern era of active mining was begun about 1866 upon the silver-lead ores, followed during the present century by the opening of mines of copper, lead, and zinc. The State contains large deposits of bituminous coal of Cretaceous age.

The geology of the country has a long and scattered literature. A general survey of its metalliferous mining fields was made in 1905 by Dr. W. Lindgren, Louis C. Graton, and C. H. Gordon, and a preliminary account of their results was issued as a Bulletin (No. 285) by the United States Geological Survey in 1906. The volume containing the detailed account of their researches consists of a general summary of the economic geology, followed by descriptions of the separate fields and mines. The work will no doubt remain for years the standard authority on the mines of New Mexico, and will repay study by all students of ore deposits. It contains, moreover, instructive evidence on some problems of general geology. The volume is illustrated by instructive topographic maps, mine plans, and plates; a geological map of the State, however incomplete, would have been very useful.

New Mexico has a base of Archæan crystalline rocks covered unconformably by Cambrian quartzites. The northern part of the State shows the stratigraphical gap so characteristic of the Rocky Mountain sequence, for the Cambrians are followed by the Carboniferous; but the intermediate Palæozoic systems are represented in the Southern districts. The Mesozoic series, usually complete in the Rocky Mountains, is imperfect, as the Jurassic is sparsely represented. The Carboniferous beds include marine limestones, followed by "Red Beds," some of which belong to the Trias. The Cretaceous system includes 6000 feet of marine beds; their deposition was followed by active earth movements, and the intrusion of sheets and laccolites of granodiorites which lifted the overlying Cretaceous rocks into domes. Igneous activity was renewed in the middle Cainozoic, when wide lava flows were erupted from numerous volcanic vents; at the close of the Cainozoic came a third period of igneous activity, and the outpouring of vast sheets of basalt. The last eruptions were of very recent date.

The "metal deposits," as the Monograph calls them, for the term metallisation is replacing mineralisation, though both assume similar limitations—are divided by the authors into six groups. The oldest series, the ores in the pre-Cambrian rocks, contain gold and copper, and were developed as fahlbands in shear-zones.

The second group of ores are contact-formations around the laccolites. The evidence offered by the mines as to the range of the contact metamorphism is of much interest. The shales are altered for a very narrow width, but the limestones may be completely changed for half a mile. The authors are emphatic that the metasomatic are more important than the paramorphic changes, and that the addition of silica, iron, and sulphides from without is "positively proved." The fresh materials are attributed to emanations from the intrusive magmas. The limitation of contact metamorphism "simply to a rearrangement of molecules in a single bed is absolutely contrary to the facts." That these ores were not introduced in solution after the intrusive rock had cooled is shown by the unaltered condition of its border.

The igneous rocks belong to that granodiorite- and quartz-monzonite series which is so often associated with ore deposits. The rocks are granular, although they solidified at the comparatively shallow depth of sometimes only 2000 feet. The toughness of their cover appears to have prevented their reaching the surface.

The third series of ores are veins connected with the granodiorite intrusions. They are usually pyritic gold-quartz fissure-veins. The veinstones include albite, tourmaline, and fluorite, and the ores often include much blende. They are usually normal fissure veins, one of which is illustrated by a fine coloured plate of part of the vein. Such figures are very useful. The regular trend of the veins is doubtless due to compression during the intrusion of the igneous rocks.

Ore bodies and veins due to the replacement of limestone form a fourth group. They are associated with the igneous rocks, but occur some distance from the contact. The chief ores are of silver, lead, and zinc; the two chief minerals are galena and calcite. The most famous of these deposits is the ore-body known as the Bridal-Chamber, a mass of almost pure kerargyrite found in limestone beneath a cap of andesite. The authors regard the ore as older than the andesite, and as formed above a hidden intrusion of porphyry.

The fifth group of ores are veins connected with the Cainozoic volcanic rocks. They occur in shoots where the lavas have been propylitised, and have no doubt been formed by the action of hot mineral waters at a slight depth below the surface.

In connection with these veins the authors describe an interesting fluorite vein formed in gneiss by the hot springs at Ojo Caliente. The vein contains barite, limonite, oxide of manganese, silver, and gold. The richest examples assayed contained $75 of silver and $30 of gold to the ton. The mineral waters, owing to their predominant sodium carbonate and chloride, are described as of well-defined volcanic affinities (p. 71), and they supply an interesting addition to the known mineral veins formed by existing hot springs.

The last group of minerals are copper ores, usually chalcocite, in the Red Sandstones. The ores are epigenetic, but their distribution shows no relation to that of any igneous rocks; they contain no gold and very little silver. A coloured plate of these ores includes one in which the chalcocite has replaced coal. In the San Miguel Mine tree trunks 60 feet by 2½ feet in diameter have been almost completely replaced by glance. The widespread occurrence of copper in Red Sandstones of late Palæozoic and Triassic age has given rise to considerable discussion, and is a very suggestive fact. Dr. Lindgren discusses the origin of these ores, and rejects the theories of their precipitation from solution or formation by adsorption; and he concludes that they are due to minute traces of copper, some of which may have been sedimentary, by meteoric waters containing chlorides and sulphate. Mr. Graton offers a somewhat different explanation owing to the lack of evidence of descending acid solutions. He regards the chalcocite as introduced by ascending alkaline carbonates containing metallic sulphides in solution. As in the historic case of Mansfeld, the ores in the Sandstones appears to be most abundant above the richest copper-bearing veins in the underlying rocks, a fact which is in favour of Mr. Graton's view.

Mr. E. C. Harden's bulletin on the manganese deposits gives a summary of the known manganese deposits in the United States, and brings up to date Penrose's well-known monograph. The author's personal observations were made during a tour from January to April, 1908. The information then collected is supplemented from the literature and by chapters on the manganese deposits of other countries and on the chemistry and uses of the metal. The manganese ores of the United States belong to four main series. The first includes residual peroxides left by the

[1] "The Ore Deposits of New Mexico." By W. Lindgen, C. C. Craton, and C. H. Gordon. Pp. 361.
"Manganese Ore Deposits of the United States," with sections on Foreign Deposits, Chemistry, and Uses. By E. C. Harden. Pp. 298.
"Some Ore Deposits in Maie and Milan Mine, New Hampshire." By W. H. Emmons. Pp. 62. (Washington: Government Printing Office, 1910.) (U. S. Geological Survey-Bulletins 432, 427, and Professional Papers 68).

decomposition of manganiferous silicates in crystalline rocks. The second type includes bedded ores; their manganese was derived from the silicates of crystalline rocks, and was deposited in the sedimentary rocks and then concentrated; this group includes the Appalachian ores, the most important in the United States. The two last groups comprise the manganese minerals associated with the silver ores of Leadville and other western mining fields, and the deposits with the Jurassic radiolarian jasperoids of California, which, according to Prof. Lawson, were deposited by suboceanic springs.

The chapter on the protean chemistry and uses of manganese describes the introduction of manganese steel in consequence of Hadfield's discovery that though the addition of 5 per cent. of manganese renders steel brittle and useless, the presence of about 12 per cent. produces a metal so hard, tough, and nonmagnetic that it has very important industrial applications.

Maine and New Hampshire are States in which mining is of secondary importance, but Mr. W. H. Emmons' short and interesting bulletin shows that ore deposits occur which have some features in common with those in the adjacent provinces of Canada. The geology is well known from Hitchcock's memoir and the later researches of Dr. G. O. Smith. The valuable minerals include gem-bearing pegmatites, which are not described in this bulletin, and some pyritic veins and ores of lead, zinc, silver, copper, and molybdenum. The basement of the area consists of metamorphic rocks, which are regarded as probably Archean; they are succeeded by sediments and volcanic rocks attributed to the Cambrian; the volcanic rocks were followed or accompanied by some igneous intrusions, beside which ores were formed as contact deposits. These rocks were then crushed to schists, at a date which is pre-Silurian, "but how much older is not known." Granitic intrusions followed in the Devonian.

The most interesting ores are the pyritic bodies, which here, as in other cases, give clear evidence of the depth at which the rocks were foliated, for the change took place where the ores were in the zone of fracture and the slates were in the zone of flow.

The bulletin contains some excellent illustrations of the microstructure of the ores. One of the most novel is of molybdenite ore from the Catherine Hill Mine. It is given to illustrate the author's view that the molybdenite was a primary constituent of the granite, and that the felspars floated in the liquid molybdenite; whereas the photograph, showing that the sulphide is permeating the large crystal of orthoclase and that a thin felspathic tongue with a disconnected end projects into the solid ore, rather indicates the secondary nature of the molybdenite.

J. W. G.

RECENT CONTRIBUTIONS TO THE STUDY OF HEREDITY.[1]

(1) PROTOZOA have as yet played but little part in the literature of heredity, and there are even some writers who belittle and disparage the evidence afforded by this group of animals on the ground that there is in them no separation of germ-plasm from somato-plasm. On the other hand, Jennings and Bateson have pointed out the importance of following the behaviour of conjugating and dividing Protozoa, since at such phases of life the phenomena of heredity are seen in a simple form. It is now known that this simplicity is deceptive. The protozoon does not simply cleave into two daughter cells, but first of all absorbs certain organs of its body, and after dividing its substance between the two or more descendants, leaves to them the further task of reforming these lost organs and other parts afresh. Moreover, in such a way is the cleavage carried out that the regenerating parts required by each daughter cell are not optically symmetrical. One may form a "head," the other a "tail," from what was the middle of the parental body. In other words, a dividing protozoon exhibits heredity under the form of alternate symmetry.

In the first paper on our list, this form of heredity is dealt with as fission. The particular animal studied is a species of Euplotes, a genus of ciliate infusoria commonly found on Hydra. Before division takes place, a new mouth is formed, independently of the existing one, by a depression of the ectoplasm, and a modification of its substance develops into a definite peristome. Meanwhile, the meganucleus elongates and becomes segmented into definite regions. The old cirri are gradually absorbed, and are replaced in the daughter cells by new structures. The author describes these changes in great detail, and promises another contribution upon the changes in Euplotes during conjugation.

(2) The pomace-fly, Drosophila, has been the subject of much recent investigation in America owing to its short life-history and the ease with which it breeds in captivity. The present paper, by Mr. F. E. Lutz, deals with the inheritance of abnormal venation in the wings of this fly. The facts, put very briefly, are that in wild specimens a few additional veins are occasionally, but rarely, met with, and the experimental evidence shows that in a large number of matings the percentages of such abnormally veined specimens are:—normal × normal, 9·6 per cent.; abnormal ♂ × normal ♀, 35·8 per cent.; normal ♂ × abnormal ♀, 54·7 per cent.; abnormal ♂ × abnormal ♀, 85·9 per cent. Discussing these remarkable increases in the ratio of abnormal to normal offspring, the author suggests that in *all* Drosophila gametes there is a factor tending to produce additional veins, but that its effects are often obscured, and only become visible in what may be called the upper part of its range. Especially interesting is the rise in the intensity of this factor when an abnormal strain is selected for breeding, and its rise and subsequent fall in a normal strain. Another point of importance is the observation that normally veined flies select normal mates when given a choice of both kinds. Mr. Lutz also gives a most interesting appendix on the question of disuse and degeneration of wings in this fly. Drosophila is a good flier, but when bred for forty generations under conditions that preclude the use of the wings, no degeneration or diminution in these organs can be detected. Altogether this is a very laborious and careful piece of research with bearings on many problems.

(3) The next two papers deal chiefly with the ovarian tissues of mammals. Much importance has been attributed to Guthrie's experiments on the transplantation of hen's eggs to foster-mothers of a different colour from that which produced the egg. According to this writer, the offspring of such foster-birds developed from the transplanted egg and were influenced by the foster herself. Davenport has recently denied both of these results, and now we have a contribution by Prof. Castle and Mr. Phillips upon similar experiments in guinea-pigs and rabbits. The results arrived at are not a little confusing. In the clearest case the procedure was as follows. The two ovaries of an albino were removed at intervals of a week, their places being taken by an ovary from each of two black sows of differing ancestry. After recovery, the albino foster-mother was put to an albino guinea-pig. Two hundred days later two ♀♀ were born, both of which were black with red hairs, and two months later one ♂ of the same colouring. Some three months afterwards the albino died of pneumonia, and was found pregnant with three full-grown ♂♂, again black and with red hairs interspersed. One of her daughters mated with the same albino ♂ threw two albinos and one black. A control mating between a pure black ♀ and the same albino ♂ gave five young, all of which were black with red hairs.

These results are held to show that the engrafted ovarian tissue was the source of the black young produced by this cross albino × albino, and that no foster-mother influence could be detected. But, on the other hand, all the remaining cases go to show that, as in Davenport's fowls, extirpation of the ovary is not complete, and is followed by regeneration, the regenerated ovary being the source from which the young produced

[1] (1) "Euplotes Worcesteri II. Division." By L. E. Griffin. *Philippine Journal of Science*, Vol. v. No. 6, December, 1910. Pp. 322–336+5 plates.
(2) "Experiments with Drosophila Ampelophila concerning Evolution." By F. E. Lutz. Pp. iii+40. (Carnegie Institution, Washington: Publication No. 143, March, 1911.)
(3) "On Germinal Transplantation in Vertebrates." By Prof. W. E. Castle and J. C. Phillips. Pp. 26. (*Ibid.*: Publication No. 144, March, 1911.)
(4) "The Maturation of the Egg of the Mouse." By J. A. Long and E. L. Mark. Pp. iv+72+6 plates. (*Ibid.*: Publication No, 142, April, 1911.)

during the experiment are derived. A review of recent work on this difficult subject is appended to this paper.

(4) The last paper on our list deals with the egg of the mouse. By most observers the egg of this animal has been regarded as an exception to the rule that two polar bodies are formed during maturation. In order to clear up this point and to settle many other doubtful features of this egg, Prof. Mark and Mr. Long have undertaken an elaborate research involving the examination of 1000 eggs from 147 mice. The methods employed are given in welcome detail, and a special feature of the apparatus was a balance and recording drum so arranged as to indicate automatically the time of parturition. The histological results show that all mouse-eggs form two spindles and a first polar cell, and that all eggs on coming into contact with spermatozoa form a second polar cell. With regard to details, the authors conclude that the number of chromosomes is twenty. The chromosomes of the first spindle are "tetrads," and show indications of both transverse and of longitudinal fission, whilst those of the second spindle are "dyads," and divide longitudinally. The work is most carefully executed, and is fully illustrated, but the cytoplasmic structures are scarcely visible in the plates. The paper is one of great value to embryologists.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held at Philadelphia on April 20–22, and more than sixty papers on scientific and literary topics were presented.

It has been the custom for several years to devote one half-day session to a symposium on some special subject in science. This year the afternoon of April 22 was devoted to this feature, the topic being modern views of matter and electricity; and the following papers were offered:—The fundamental principles, by Prof. D. F. Comstock, of Boston; radio-activity, by Prof. B. B. Boltwood, of New Haven; thermionics, by Prof. O. W. Richardson, of Princeton; the constitution of the atom, by Prof. H. A. Wilson, of Montreal. The general conclusion seems to be that the atom of matter, groups of which compose the molecules of different substances, is built up of much smaller parts, called electrons, identical with the smallest unit of negative electricity. It was also explained how it is possible to estimate the actual number of electrons in any particular atom. As the inertia of an electron emitted from an atom of a radio-active substance, such as radium, has been experimentally proved to be a function of its speed, the evidence is strong that all inertia or mass may be electrodynamic in its nature.

Physiology.

The secretion of the adrenal glands during emotional excitement, by Prof. W. B. Cannon, Harvard University. The adrenal glands and the sympathetic nervous system are intimately related. The sympathetic system innervates the glands, and the glands in turn secrete a substance that affects bodily structures precisely as the sympathetic system affects them. The sympathetic system is aroused to activity in states of emotional excitement. Examination of the blood of excited animals reveals the presence of adrenal secretion, which was not found in the blood before the excitement. Possibly the adrenal secretion continues the excited state. Possibly also the adrenal secretion caused by emotional disturbances has some of the effects produced by injection of the substance, such as glycosuria and atheroma of arteries. Indeed, two of the author's students, Shohl and Wright, have recently shown that glycosuria can be produced in the cat by fright. The suggestion, however, must be put to further experimental test.

Coagulation of the blood, by Prof. W. H. Howell, Johns Hopkins University. The theory of the coagulation of blood most commonly accepted at the present time holds that three of the four necessary factors in the process are present in the circulating blood, but that the fourth, which initiates the process in shed blood, is furnished by the tissues outside the blood or by the disintegration of corpuscular elements in the blood itself. This fourth factor is an organic substance of the nature of a kinase, which, in conjunction with the calcium salts of the blood, serves to activate the prothrombin, also present in the blood, to thrombin. The thrombin then acts upon the fibrinogen and converts it to fibrin, which constitutes the essential phenomenon of clotting. In opposition to this theory, the author gave experimental evidence to show that in normal blood the fluidity is due to the constant presence of an antithrombin, and that in shed blood the tissue elements furnish a substance, thromboplastin, which neutralises the antithrombin, and thus allows clotting to take place. In the vertebrates below the mammals, the thromboplastin is furnished by the cells of the outside tissues, and without their cooperation clotting would not occur. In the mammals, thromboplastin is furnished by elements in the blood itself, the platetets, so that the blood may clot promptly without cooperation on the part of the outside tissues. In human beings, the condition known as hemophilia, in which there is delayed clotting and danger of fatal hæmorrhage, the defect is due, not to a lack of kinase in the tissues as a whole, the view usually taught at present, but to an excess of the antithrombin normally present in the blood.

The cyclic changes in the mammalian ovary, by Leo Loeb, director of the Pathological Department, St. Louis Skin and Cancer Hospital. In the mammalian ovary cyclic changes of a very far-reaching character take place. They concern the follicles, corpora lutea, and ova. There exists in the ovary a mechanism (in the corpus lutem) regulating those changes; the corpus lutem prolongs the sexual cycle, not by retarding the maturation of the follicles, but by preventing the rupture of the mature follicles. The author's recent observations make it very probable that a partial parthenogenetic development of some ova accompany those cyclic changes in the follicles in a certain percentage of animals.

Electrical Engineering.

The high voltage corona in air, by Prof. J. B. Whitehead, Johns Hopkins University. The author described the limitation to the long-distance electrical transmission of power imposed by the insulating properties of the air, and a new method for determining accurately a voltage at which the air in the neighbourhood of electric wires and cables will break down, and also gave the results of a series of experiments on the influence of the size of the wire, the stranding of the wire into a cable, the frequency, the pressure, the temperature, and the moisture content of the air. He also reviewed the bearing of present physical knowledge on the nature of the phenomena which are involved.

Geology.

Supposed recent subsidence of the Atlantic coast, by Prof. D. W. Johnson, Harvard University. The author briefly reviewed the evidence in support of the generally accepted theory that the Atlantic coast is subsiding at the rate of from 1 to 2 feet per century, and showed that the phenomena supposed to indicate subsidence might be produced by fluctuations in the height of ordinary high tides resulting from changes in the form of the shore-line. A study of the Atlantic shore-line indicates that conditions are there favourable to marked local changes in the height of the tides, independently of any general movement of the land. On the other hand, the structure of certain beaches along the coast afford very strong proof that there can have been no long-continued progressive subsidence of the coast within the last few thousand years. The theory of fluctuating tidal heights, and the theory of stability of the land mass, were illustrated by selected examples of shore-line phenomena.

Alimentation of existing continental glaciers, by Prof. W. H. Hobbs, University of Michigan, Ann Arbor. It was in the Alps of Switzerland that the early studies, and by far the larger number of subsequent investigations, of glaciers have been made. The Swiss type of glacier is one of the most diminutive, but as the theory of former continental glaciation was derived from these studies of puny glaciers, it is not surprising that their attributes were carried over unchanged to the reconstructed extinct types thousands, and even tens of thousands, of times larger,

and this before any continental glaciers had actually been studied. The recent explorations of Norwegian, German, Swedish, and Danish explorers, but more than all of Peary in Greenland, and of Scott, Nordenskiöld, von Drygalski and others, but especially of Shackleton in Antarctica, have at last afforded us observations upon the existing continental glaciers. When these reports are carefully studied and compared, it is found that, as regards their form, their erosional processes, and especially their nourishment and waste, continental glaciers are as different as possible from those of the Alpine type. Instead of being nourished by snow precipitated from *surface* air currents, which are forced to *rise*, their snow supply is derived from the fine ice grains contained in *high-level* cirrus clouds which have been *drawn down* to the glacier surface, been melted, and there reprecipitated. This action is the work of a refrigerating air engine, which is developed directly by the snow-ice mass itself.

Front range of the Rocky Mountains in Colorado, by Prof. W. M. Davis, Harvard University. The front range of the Rocky Mountains in Colorado, now easily accessible by various railroad lines which enter and cross it from Denver and Colorado Springs, is an unusually fine example of a mountain highland, which in a former cycle of erosion was reduced to moderate relief, and since elevation to its present altitude has been submaturely dissected by its streams. The highland is surmounted by numerous hills and mountains of from 500 to 2500 feet relief, which represent the unconsumed residuals of the former cycle of erosion, and therefore presumably consist of the most resistant rocks of the region. The uplift of the mountain belt to its present altitude was not perfectly uniform, but arched gently from the plains westward; thus the crest of the range seems to correspond to the crest of the arched uplift. A notable feaure of the higher valley heads, among the surmounting mountains near the range crest, is the occurrence of numerous amphitheatres or cirques, and over-deepened valley troughs, the work of glaciers which for a moderate time, as geological time is reckoned, replaced the water streams in the highest districts. The contrast between forms due to ordinary or normal erosional processes and to glacial erosion is thus displayed with unusual clearness.

Astronomy.

An important astrophysical paper was presented on the solar constants of radiation, by Mr. C. G. Abbot, director of the Astrophysical Observatory, Smithsonian Institution, Washington. If we had no eyes we should still know of the sun by the feeling of warmth. The most exact measurements of the intensity of the rays of the sun, whether they be visible to the eye or affect the photographic plate or not, are made by an electrical thermometer called the bolometer. This instrument is so sensitive that a millionth part of a degree change of temperature is recorded by it. For seven years the bolometer has been used by the staff of the Astrophysical Observatory of the Smithsonian Institution to measure the solar constant of radiation. This constant represents the number of degrees (centigrade) which 1 gram of water would rise in temperature if all the solar radiation which could pass through an opening 1 centimetre square outside the earth's atmosphere, but at the earth's mean distance from the sun, could be used for one minute to heat the water. As all life, and almost all forces on the earth, depend on the supply of solar rays, the solar constant of radiation is at least equal in importance to the knowledge of the sun's distance.

The value of the solar constant was unknown within wide limits only five years ago. It is now believed to be within 1 per cent. of 1·93 calories per square centimetre per minute. Measurements made at Washington (sea-level), Mount Wilson (1 mile elevation), and Mount Whitney (nearly 3 miles elevation) agree in fixing this conclusion.

Nearly 500 determinations have been made. They indicate that the value is not really a "constant," but fluctuates about the mean just given within a range of 8 per cent. This conclusion means that the sun is a variable star. It is hoped soon to verify it completely, and it may prove for meteorology hardly less important than the determination of the mean value of the solar constant itself.

On the evening of April 21 Prof. Arrhenius, of Stockholm, gave an illustrated lecture on the physical conditions of the planet Mars. He directed attention to the many similarities between Mars and the earth which have caused some to think that Mars is inhabited, but gave it as his opinion that later investigations are not favourable to this view.

At the executive session on Saturday, April 22, the following new members were elected:—*Residents of the United States:* Dr. G. A. Barton, Bryn Mawr, Pa.; Dr. B. B. Boltwood, New Haven, Conn.; Dr. Lewis Boss, Albany, N.Y.; Dr. J. M. Clarke, Albany, N.Y.; Dr. W. M. Late Coplin, Philadelphia; Dr. J. Dewey, New York City; Dr. L. O. Howard, Washington, D.C.; Dr. J. P. Iddings, Chicago; Mr. Alba B. Johnson, Rosemont, Pa.; Dr. A. A. Noyes, Boston; Dr. G. H. Parker, Cambridge, Mass.; Mr. A. Lawrence Rotch, Boston; Dr. L. S. Rowe, Philadelphia; Dr. William T. Sedgwick, Brookline, Mass.; and Dr. A. Trowbridge, Princeton, N.J. *Foreign residents:* Prof. Svante Auguste Arrhenius, Stockholm; Prof. J. B. E. Bornet, Paris; and Sir John Murray, K.C.B., F.R.S., Edinburgh.

As has been customary, the meetings ended with a banquet at the Bellevue, Stratford, on Saturday evening, at which the following toasts were responded to:—"The Memory of Franklin," by President Schurman, of Cornell; "Our Universities," by Count von Bernstorff and President Hadley, of Yale; "Our Sister Societies," by Sir John Murray and Prof. W. M. Davis, of Harvard; and "The American Philosophical Society," by Prof. E. C. Pickering, of Harvard. Thus ended one of the most successful meetings in the history of the society.

ARTHUR W. GOODSPEED.

PHOTOGRAPHY AN AID TO ASTRONOMY.[1]

IN my address last year I endeavoured to put before you some of the problems which confronted the astronomer, and to illustrate the reasons why the most refined methods of physical measurement available were necessary in order to secure data for the solution of such problems. To-day I propose to deal rather with the methods in use, and the progress which has been, and is being, made in securing the necessary data for discussion, and in particular to sketch to you the advances which have been rendered possible through the introduction of photography as an aid. In these days, when portable hand cameras are accessible to everyone, when photographs can be taken by the mere expedient of pressing a button, leaving the manufacturers who supply the material to "do all the rest" at a trifling cost, or when even the processes of development can be performed by an inexperienced operator without the aid of any more elaborate equipment than a supply of fresh water, one is apt to forget how recent is the development of photography, not merely as a science or art in itself, but still more as a useful adjunct to almost every other branch of scientific investigation.

To appreciate the use of photography, try to imagine, if you can, a state of existence deprived of the sense of sight, not only in the individual, but throughout the human race. The phenomenon of light could doubtless still exist, and even be capable of exerting certain physiological action, but this phenomenon is one with which we are primarily cognisant through the direct physiological action on the optical nerves, and without which the intercourse of the individual with the external world is, perhaps, limited by the further senses of "sound," "touch," "smell," and "taste." All these senses, even including the first, are brought into operation only by closely adjacent surroundings, whereas the additional sense of sight, apart from its use as a means of communication between individuals, is the sole remaining sense by which we can obtain information regarding unexplored and otherwise inaccessible regions. I venture to doubt whether, under such conditions, the human intellect would have

[1] Presidential address delivered before the Royal Society of South Africa on April 19, by Mr. S. S. Hough, F.R.S.

risen to such primary conceptions as that of a "point" and a "line," let alone a "straight line," and whether even the most primitive of the sciences—that of geometry—could have originated, though, perhaps, a sense of geometrical form might have been developed through the touch. Be that as it may, however, it is perhaps not too much to say that our knowledge of the extra-terrestrial universe has at least until recently been derived solely through the medium of those æthereal vibrations which we call light, to which our eyes respond, thus communicating with the brain, and though this physical phenomenon might conceivably have existed apart from the existence of human or other eyes, its existence could scarcely have been recognised, and the science of astronomy, which deals primarily with extra-terrestrial phenomena, could hardly have been. Thus it is that the development of this science has been largely concurrent with the development of those instruments by which the optical efficiency of the eye has been increased. The earliest observations were made with the unaided eye, the results of which have come down to us, being duly recorded either in the form of descriptions or drawings, or even, in some cases, by more or less exact measurements. The introduction of the telescope not only immediately opened up fields of vision previously inaccessible, but facilitated in a very marked degree the precision with which measurements could be made, and for about three centuries the telescope has been used as a direct aid to the visual organ. It is improbable that this method of observation will ever be superseded, but there is to-day a growing tendency to replace the human eye at the end of the telescope by the photographic camera.

The advantages of the method are two-fold:—(1) objects which are too faint to be seen with the eye may yet be photographed by a sufficient extension of the time of exposure, and our powers of penetrating the confines of space is thereby increased; (2) the photographs themselves form a permanent record of what is seen more trustworthy than can be obtained from any drawing or description executed at the hands of man. The early application of the art of photography to astronomy related to the subject from its descriptive aspect rather than to those branches of the science which depend on exact measurement. With the aid of reflecting telescopes of large aperture, it was found possible to delineate with certainty the forms of vast nebulæ, so as to establish with great nicety the extension of their convolutions into regions where to the eye alone their traces were quite invisible, even with the aid of powerful telescopes. But, fascinating as these photographs are in aspect, valuable as they are as early records, and suggestive as they are with regard to the cosmical significance of the objects photographed, it can scarcely be maintained that they have so far been prolific in scientific results. Such phenomena as the wonderful spiral forms assumed by many of the nebulæ, though proved to be far more common than was previously realised, remain as obscure as ever in their origin. In making this statement, I do not wish to underrate the work of the earlier pioneers in astronomical photography. They have developed methods which we continue to use, and have but little to improve on, and they are not to be blamed if the full value of their work has not been attained in their own generation. Visual work had already been carried so far that the extended vision afforded by photography could hardly have been expected to lead instantaneously to any new and startling phenomenon which should revolutionise existing ideas of the extra-terrestrial universe. It is only as time lapses, and we are able to study the changes which are taking place since these photographs were secured—changes which, as a rule, take place so exceedingly slowly as not yet to be fully established—that the full advantage of the new method over the old will be realised.

The earliest attempts at the photography of celestial objects seems to date back so far as the year 1840, when photographs of the moon were obtained by daguerreotype processes, but beyond its use for pictorial representation—to which, perhaps, I might add the daily photographic record of the sun's surface, instituted at Greenwich in 1873, the unsuccessful attempts by Pritchard at the instigation of Warren de la Rue to utilise it for the determination of the constant of nutation—for a long time it seems to have been regarded with suspicion for purposes requiring the use of exact measurements. While photography might supplant the astronomical draughtsman, its limitations were in other respects similar to those affecting the draughtsman's art and skill. The latter aspects of its uses are those which I propose chiefly to deal with to-night, not that I wish to underrate the importance of other applications, but that I prefer rather to confine myself to those branches with which I have myself been more directly concerned. The year 1882 saw the first introduction of astronomical photography into the Cape Observatory. No special appliances for the purposes were at the time included in its equipment, but the unexpected appearance of the great comet of that year demanded that an effort should be made to secure a representation of this comet by photographic methods, which had been vigorously developed elsewhere for such purposes. Accordingly, the services of a local photographer were secured, and in order to obtain a sufficiently long exposure to bring out the faint detail of the comet's tail, his camera was attached to one of the equatorial telescopes of the observatory, so that it might partake of the motion imparted to the telescope, and thus be kept pointed on the comet for a prolonged interval. Valuable photographs showing much detail of the structure of the comet were obtained, but the feature to which particular attention was directed was the large number of stars, some of them extremely faint, which, besides the comet, were all duly recorded on the plate. Moreover, the sharpness of the photographic images suggested that they would permit of very accurate measurement, and that, if only similar definition could be obtained in photographs on a more open scale, it might be possible to replace many of the laborious methods of measurement hitherto conducted by direct visual observations on the sky itself by somewhat similar methods applied to the photographs.

There existed at the time no comprehensive survey of the southern skies. A complete catalogue of the stars in the northern heavens, known as the Bonn "Durchmusterung," giving the positions and magnitude of all stars down to the ninth visual magnitude, with a precision at least accurate enough to ensure their identification in the sky, had been formed by Argelander, and extended to a portion of the southern hemisphere by his successor, Schönfeld, but the remainder of the heavens from 23° S. declination to the South Pole was still comparatively unknown. The photographs I have above referred to suggested a means by which this lacuna might be filled, and no sooner was this idea conceived by Sir David Gill than steps were taken to put it into active execution. Partly at his own personal expense, and partly by means of assistance from the Government Grant Fund, administered by the Royal Society of London, the necessary equipment and the services of a photographer were secured, and between the years 1885–9 a complete series of photographs of the region extending from 18° S. declination to the South Pole was obtained. In order, however, that these photographs might be of value to science, it was necessary that the facts duly recorded on them should be minutely examined and rendered accessible to astronomers generally, in the form of a catalogue. As more than 400,000 stars were involved, this in itself was no light task, and might well give rise to the question as to whether the necessary measurements could not be more advantageously made on the sky rather than on the photographic plates by which it was represented. The method which was subsequently adopted for the formation of this catalogue forms sufficient answer to this question. The resources of the observatory were unequal to so large an undertaking, at least without the cessation of a large proportion of its normal work, and it appeared probable that the photographs would have to remain in the record room of the observatory, valuable for consultation regarding specific points which might arise, but that their complete discussion would have to be relegated to a perhaps remote future. The difficulty was at this juncture met by a generous offer received from Prof. Kapteyn, of Gröningen. Prof. Kapteyn was himself an enthusiastic astronomer, eagerly desirous of devoting himself to work of this character, with full appreciation of its value, but unfortunately unprovided with an observatory equipment. He foresaw that, with the aid of a comparatively small laboratory equipment,

much of the work of a character which had hitherto been performed by reference to the sky could be effectively and rapidly carried out through the medium of photographic representations thereof. The series of photographs secured at the Cape formed a promising field for research, and he voluntarily undertook the laborious task of the measurement of these plates and the preparation of a catalogue, which has since been issued among the publications of the Cape Observatory, and to-day is in constant use by astronomers concerned with the southern hemisphere. Besides many incidental results of high interest, the catalogue forms the basis for statistical investigations of stellar distribution, &c.

The success of the project, even in the early stages of its execution, pointed to the possibilities of a still more extended use of the photographic methods, and gave a direct stimulus to the study of the details by which its efficiency could be increased. The surveys of Argelander and Schönfeld, completed by the "Cape Photographic Durchmusterung" (as the above catalogue is entitled), and independently by a visual "Durchmusterung" emanating from the observatory at Cordoba, under the direction of Dr. Thome, could but be regarded as preliminary pioneer surveys; but, stupendous as the task seemed, the possibility was recognised by Sir David Gill of utilising the photographic method for the production of a complete map of the heavens, which should be on a sufficiently large scale and sufficiently precise in its detail to meet all the requirements of modern astronomy of precision. He succeeded in securing the interest of astronomers generally, and in particular of Admiral Mouchez, the then director of the Paris Observatory, at whose instance, with the support of the Paris Academy of Sciences, an international conference of astronomers was invited to meet in Paris in 1887 to discuss the possibility and desirability of carrying out this extended project. While the plan in outline met with universal acceptance, much useful discussion took place at this and at subsequent conferences as to the details of its execution, such as the type of instrument to be employed, the scale of the photographs, the duration of exposure which would serve to bring out what should be considered essential detail, &c. The outcome was that an agreement was arrived at by which the execution of the work was partitioned among eighteen cooperating observatories, who between them undertook to secure photographs of the whole sky with instruments of similar dimensions and design, and, so far as possible, similar conditions of exposure. Two series of photographs were to be taken, one of long exposure, designed for direct photographic reproduction to form an atlas which should show all stars down to the fourteenth visual magnitude, and a second series, of shorter length of exposure, designed for exact measurement, which would form the basis of a catalogue of precision of all stars to the eleventh magnitude. Minor details were largely left to the discretion of the directors of the cooperating observatories.

It would take too long to describe in detail the progress of this work from its initiation, and I propose, therefore, to confine my attention to the share in it which has been taken by the observatory over which I have the honour to preside, a share which, partly from the origin of the project and partly from the scarcity of suitably situated observatories of a sufficiently permanent character in the southern hemisphere able to offer cooperation, has exceeded that assigned to any other single establishment. The type of instrument agreed upon was the photographic refractor, similar in dimensions to that which has been used by the Brothers Henry in Paris, giving pictures on such a scale that 1 millimetre on the plate corresponds with a minute of arc on the sky. The plates were to be 160 mm. square, so as, apart from the marginal edges, to yield an effective field of views of two degrees square. The area covered by each plate will perhaps be better presented to you by the statement that the length of the edge of the plate corresponds, roughly, with four times the apparent diameter of the sun or moon, *i.e.* four suns and four moons photographed side by side on the same plate would just reach from one edge of the plate to the other. On this scale it would require rather more than 10,000 plates to cover the whole sky. The programme, however, provided not merely for the photographing of each region once, and once only, but that the various regions covered by the separate photographs should overlap in such a way that every star would be contained in two of the regions at least. Thus any doubtful features shown in one plate could be verified by reference to the second plate, which includes the same area. This requirement raised the total number of separate regions to be photographed to 22,054, of which 1512 were assigned to the Cape Observatory. The construction of the telescope and the provision of suitable housing accommodation was sanctioned in 1888, and the telescope arrived at the Cape in 1890. About two years were spent in its erection, adjustment, and testing, the delay being largely due to the necessity for returning the object-glass for necessary alterations and the remodelling of the breech-piece, which could not be effected locally. From July, 1902, onward, the work of taking the photographs was steadily proceeded with until its completion in 1910. At the present time we have stored at the Cape three almost complete series of photographs of the 1512 regions, besides many duplicates and triplicates, which, though not attaining the desired standard of perfection, are still available for reference with regard to many issues that arise. Of these plates, one series of long exposure is destined for direct photographic reproduction; the other two series of shorter duration of exposure for measurement for the purposes of the catalogue. On account of the comparatively insignificant amount of work involved in taking these catalogue plates as compared with the more laborious work of measurement, after its original completion in 1896 it was decided to repeat the whole series of catalogue plates, so as to bring the dates of the photographs nearer to the epoch 1900, and thereby more fully attain the ideal before the International Conference of leaving for a future generation as exact a record as possible of the appearance of the heavens at the beginning of the twentieth century.

After some early experiments with the view of ascertaining the most economical means by which these plates might be measured with the desired accuracy, the definitive programme of measurement was commenced in 1897, and completed last year. The number of stars measured on a plate varies between 45 and 3431, the total number of star images which have been measured exceeding a million. To illustrate the precision attained, the discordances in the position of a star, relatively to the stars immediately surrounding it, as derived independently from the measures made on two overlapping plates, but rarely amount to so much as a second of arc, *i.e.* apparent angular distance between the two edges of a halfpenny at a distance of about three miles from the observer. Now, however exactly the measurable features of each plate may be determined, it will be clear that the information thus derived can be of little value without some external data to enable the identification of the region on the photograph with the corresponding region of the sky from which it is derived. A plan of this room might have been useful to enable you to find your seats to-night in positions corresponding to the numbers on your tickets, but I venture to think a stranger visiting Cape Town for the first time would prefer to have been provided with a map of the town, which would indicate the position of this hall, rather than to have to search the town for a room arranged according to such a plan. So with our photographs, the detailed study of each photograph can be of minor value without some indications enabling us to identify the field shown on the photograph, not only in relation to the surrounding fields, but in relation to the sky as a whole. It is certainly a desideratum that these indications should be not less precise than those involved in the measures themselves. Of course, if each photograph contained some familiar group of stars, such, for instance, as the constellation Orion, the identity of the region could not be easily mistaken; but the scale of which the plates are taken is such that two such familiar stars are rarely to be found within the limits of a single plate, while many plates are devoid of stars to which accurate positions could have been previously assigned.

The necessity has thus arisen of determining with high accuracy the absolute positions as opposed to the relative positions indicated by the plate itself, or at least two stars contained on each plate. The distance between the

images of these stars as compared with the corresponding apparent distance on the sky serves to furnish a determination of the scale of the plate, while the direction of the line joining them serves to fix the orientation of the plate, *i.e.* enables us to turn the plate round in its own plane, so that the true N. and S. line may be placed exactly in a truly horizontal, truly vertical, or, in fact, any other desired direction. With these quantities correctly assigned, either star will be sufficient to correlate the plate exactly with the sky. In practice it is customary to refer to a larger number of stars than two on each plate. Not only are the determination of these necessary "plate constants" strengthened thereby, but in the consistency with which the photographic pictures reproduce the actual distribution of the stars, we have a valuable check on our methods and a test of the faithfulness with which also other features on the sky are represented on the photographs. For the Cape plates, the determination of the "plate constants," *i.e.* of those elements which serve, as it were, for the coordination of the isolated maps contained on each plate with a general map of the whole, has been made to depend on a number of stars on each plate varying, as a rule, between 8 and 12. In all, 8560 stars, so far as possible evenly distributed over the whole of the zone, were selected as comparison stars. These stars constitute a framework to which the detailed results derived from the photographs may be attached, but the structure of which requires to be independently built up. For such a purpose, photographic methods have not as yet proved available, and recourse was necessary to the older method of visual observing with the meridian circle. From observations made in the years 1897–1900 with the transit circle an accurate catalogue of these 8560 stars has now been formed, and has been utilised for the purpose of standardising each of our plates. The heavy arithmetical work involved in applying to each of our original measures more than two millions in number, the derived correction to refer the whole to a common standard is now rapidly proceeding, and at the present time is about half completed.

I have above referred to the catalogue of 8560 comparison stars as framework for the support of the more extensive photographic catalogue. Such a framework, at least on the basis on which the one was constructed, is not entirely self-supporting, and it thus behoves us to carefully consider its foundations and to ensure that they possess the necessary solidarity. Not the least of the important questions brought up for discussion at the last meeting of the International Committee charged with the conduct of the photographic work was that of the steps to be taken for this purpose. It was recognised on all sides that even the best existing meridian catalogues were inadequate, and that they would have to be supplemented by extensive additional observations. The main object of the discussion was to secure the most extensive cooperation from observatories provided with suitable meridian equipment, and to classify the work in various grades of accuracy, so that each establishment might devote itself primarily to that branch for which its equipment was best adapted, at the same time keeping in view the coordination of its work with the larger scheme. The resolutions adopted have since been favourably received by meridian observers, and we may look in the future to a systematic organisation of meridian astronomy throughout the world, the results of which, apart from the mere economic aspect, cannot fail to be of the highest importance to science. It may well be asked, What is the use of such a chart as you have been describing? or, Will it repay the enormous cost involved in compiling it? As regards its use, I endeavoured to indicate in my address last year some of the problems which awaited solution, and which serve to inspire the astronomer in conduct of the lengthy routine operations involved. These motives are, perhaps, for the most part scientific and intellectual rather than utilitarian, and it is possible, even probable, that to many of the questions arising answers which will afford complete satisfaction will not be forthcoming at least for a generation or two to come. I think I am sufficiently voicing the view of those who took part in the original discussions at Paris when I state that they, as a body, attached greater importance to the complete and thorough systematic record of the phenomena prevailing during their own generation than to the immediate interpretation of these phenomena. It was felt to be a scientific duty, incumbent on them to provide, so far as lay within their means and capacity, data which should be beyond reproach. By this means they were preparing the ground and planting the seed, which they hoped would yield a rich crop of scientific results, even though it should remain for their children's children to reap the harvest.

Much has already been attained. The ghosts which beset the use of photography in relation to the science of exact measurement have in a large measure been laid, and photographic methods have now been successfully used for some of the most delicate measurements ever attempted even by direct visual operation. I have in mind such questions as the determination of the distance of annual parallaxes of the fixed stars, and of the parallax of the sun, in connection with which, under the auspices of the Paris conference, an extensive photographic campaign, combined with visual methods, was undertaken on the occasion of the near approach of the planet Eros in the years 1900–1. The discovery of the latter planet was itself a product of photography, while by similar means the number of known minor planets has within the last few years increased by leaps and bounds, until at the present day they are nearly seven hundred in number. Photography has also been prolific in the discovery of variable stars and new stars, and the tracing of their light changes. All these purposes will be greatly facilitated by the existence of a trustworthy chart or catalogue containing more especially the fainter stars about which our exact knowledge hitherto has been almost non-existent. Time must elapse before we may expect to be able to evaluate with any certainty the slow changes of position due to the proper motion, at least, in relation to the previously uncatalogued faint stars; but this is to-day one of the greatest desiderata for the advancement of our knowledge of the universe, and is one of the purposes for which the photographic catalogue was primarily intended. By photographic methods and by cooperative effort throughout the world alone has it been possible to collect evidence on a sufficiently wholesale scale, so that already we are beginning to feel the solution of some of the most profound problems relating to the universe almost within our grasp.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Public Orator, Dr. Sandys, spoke as follows in presenting for the degree of Doctor in Science, *honoris causa*, (1) Dr. G. E. Hale, director of the Solar Observatory on Mount Wilson, California, and (2) Prof. T. W. Richards, professor of chemistry in Harvard University:—

(1) Adest vir in republica maxima transmarina caeli in orbibus observandis iam per annos plurimos maximo cum fructu exercitatus, qui Californiae sub caelo sereno, montis Wilsonii in vertice excelso, instrumentis novis adhibitis, solis ipsius materiem exquisivit et stellarum remotissimarum mutationes investigavit. Rerum caelestium auguri tam perspicaci stellarum ipsas origines nebularum (ut aiunt) formae obscurae illustrant; stellae autem colore primum candido, deinde flavo, denique rubro coruscantes, orbium illorum vitam per seriem exorientem, maturescentem, deficientem indicant; orbis denique terrarum noster quasi imago stellae est ex qua lumen calorque iam dudum evanuerunt. Newtoni nostri in Opticis dicitur in montibus summis, supra nubes densiores, in aëre maxime sereno et tranquillo, stellas melius posse observari:[1] gratulamur auguri nostro caelesti quod Californiae in monte altissimo arcem nactus est, caelo observando tam opportunam, unde orbis terrarum incolis vallium et camporum in obscuritate degentibus rerum naturae lucem ipsam possit desuper transmittere. Viro tot titulis aliunde cumulato, etiam nostram coronam libenter donamus.

Duco ad vos astronomum insignem, Georgium Ellery Hale.

(2) Filiam suam, aequore Atlantico a se divisam, studiorum communium amore coniunctam, mater alma

[1] Newton's "Optics," Book I., part i., *ad finem*.

Cantabrigiensis non sine superbia quadam contemplatur. Ergo matris almae nomine scientiae chemicae professorem Harvardianum non sine gaudio salutamus, virum et inter suos et inter Germanos doctrinae in sedibus sex praeclaris educatum. Quod si Latino potissimum in sermone de meritis eius vultis admoneri, videor mihi "propter egestatem linguae et rerum novitatem"[1] rem admodum difficilem ingredi. Peritis tamen comprobavit, sese, in rerum elementis fere quindecim, atomorum pondera ipsum comperisse, atque discipulis suis primordiorum tam minutorum subtilissime examinandorum exemplum praetulisse viamque ostendisse. Idem primus indicavit, elementi cuiusque in atomo quo minor vis insit, eo artius elementum illud comprimi posse. Idem etiam metallorum in provincia, computationibus usus accuratissimis, Faradii legem quandam praeclare confirmavit. Academiae nostrae, scientiarum accuratarum cultrici tam assiduae, pro certo novimus rerum exploratorem tam accuratum perquam esse cordi.

Duco ad vos scientiae chemicae professorem accuratissimum, Theodorum Willelmum Richards.

The general board of studies has reappointed the following university lecturers from October 1, 1911, until September 30, 1916, and the appointments have been confirmed by the special boards with which they are connected:—Botany, A. G. Tansley; mathematics, H. W. Richmond and R. A. Herman; pathology, Dr. Cobbett.

Dr. James, Provost of King's College, has been nominated to represent the University at Rennes on the occasion of the inauguration, in October, of new university buildings and of a monument commemorative of the union of Brittany with France.

The board of managers gives notice that an Arnold Gerstenberg studentship will be offered for competition in the Michaelmas term of 1912. The competition will be open to men and women who have obtained honours in part i. or part ii. of the natural sciences tripos, and whose first term of residence was not earlier than the Michaelmas term of 1906.

GLASGOW.—Captain Lyons, F.R.S., has announced his resignation of the University lectureship in geography, on his removal to London to take up his duties at the Royal Geographical Society. He has succeeded in establishing a flourishing department at the University, where geography is now recognised as a subject for the M.A. and for the B.Sc. degree. The University Court will proceed to make an appointment to the office during the summer.

Prof. R. A. Stewart Macalister, of Dublin, has been appointed Dalrymple lecturer in archæology for the ensuing academical year.

A scheme for the affiliation to the University of the Glasgow and West of Scotland Technical College has received the approval of the Scottish Universities Committee of the Privy Council. Ordinances for the purpose of carrying the scheme into effect and admitting the students of the college to university privileges and degrees will now be framed and laid before Parliament in due course.

The Royal Infirmary of Glasgow has received a new charter, which, *inter alia*, provides for the representation of the Court and Senate of the University on its board of management. From the University side an ordinance has been promoted, and now awaits the approval of his Majesty in Council, which establishes four new professorships at the Royal Infirmary, namely, in medicine, surgery, obstetrics, and pathology. The existing (regius) chairs in these subjects continue to be connected with the Western Infirmary. Both institutions, which between them contain about 1200 beds and well-equipped extern departments, will thus have equal rank as the clinical schools of the University. All the instruction provided at the Royal Infirmary will be open to women students of the University on the same terms as to men. A new clinical laboratory for study and research has been erected at the Western, to which a director will presently be appointed. A pathological institute on a large scale, including a clinical laboratory, is approaching completion at the Royal; and by the gift of an anonymous benefactor, a similar building is in progress at the Victoria Infirmary, which will also be available for university students. The medical school of Glasgow is becoming one of the best equipped in the country, especially as regards its provision for scientific teaching and investigation.

[1] Lucretius, i. 139.

OXFORD.—On Tuesday, June 13, another stage was reached in the discussion of the proposed statute exempting students of natural science and mathematics from compulsory Greek. An amendment prohibiting exempted candidates from offering themselves in any other final honour school except these two was carried by 93 to 36. A further amendment, moved by the Master of Balliol, which sought to limit the exemption to candidates who should obtain certain qualifications before entering the University, was rejected by 105 to 39. The statute as amended will now be submitted to Congregation, and if it passes will come before Convocation for final decision.

Prof. John Milne, F.R.S., has been appointed Halley lecturer for 1912.

WE learn from *Science* that Mr. T. C. Du Pont has given 100,000*l.* to the Massachusetts Institute of Technology toward its proposed new site. Announcement is also made of two bequests of about this amount. A trust fund of between 100,000*l.* and 120,000*l.*, created by Mr. Francis B. Greene some five years ago, will be received by the institute for the assistance of students, and it will receive nearly 100,000*l.* from the bequest of Mrs. Emma Rogers, widow of the first president of the institute. These large gifts, in addition to the 20,000*l.* for ten years voted by the State, will make it possible for the institute to purchase a new site and erect the necessary buildings. From the same source we learn that, by the will of Mrs. Lydia A. Barnard, of Milton, Mass., Radcliffe College receives 23,000*l.* and Harvard University 12,000*l.*

THE fourteenth annual Conference of the National Head Teachers' Association was held in Manchester last week. The association adopted a resolution to the effect that no exemption should be allowed from school attendance until the age of fourteen has been reached; that there be compulsory attendance at continuation schools from the age of fourteen to seventeen; that a well-devised scheme of physical development of young people should form part of the curriculum of every continuation school; that it be the statutory duty of every local education authority to make suitable provision for the carrying on of such continuation schools in its area as may be necessary; that the Government provide suitable grants for this purpose; and that it should be the statutory duty of employers of young persons under seventeen to enable them to attend continuation classes at such hours as may be required by the Act.

THE Department of Agriculture and Technical Instruction for Ireland would appear to have adopted the view that geography is a science, and should be taught as such in schools. For the session 1911–12 a course of physical and commercial geography will form one of the subjects of experimental science which may be taken up in Irish intermediate schools. Anticipating the difficulty which principals of schools may experience in finding teachers competent to deal with geography in a scientific manner, the Department is arranging for a summer course of instruction in the subject, to be held, from July 4 to 28, at the Royal College of Science, Dublin, for teachers who have already qualified themselves in elementary experimental science. The Department has circulated an outline syllabus in physical and commercial geography suitable for pupils in their third and fourth years. The work for the former year includes a practical study of the geography of the home district; the figure, motions, and position of the earth; the atmosphere; the land; and the general geography of Ireland. The fourth year's work comprises the physical geography of the sea and a course of commercial geography of a general kind.

THE second volume of the report of the U.S. Commissioner of Education for the year which ended on June 30, 1910, is now available. The 746 pages are devoted almost exclusively to statistics, which supplement in an admirable manner the descriptive articles in the previous volume, already noticed in these columns.

During the year under review, the Bureau of Education at Washington received reports from 602 universities, colleges, and technological schools in the United States. Of these, 142 are for men only and 352 for both sexes. The entire teaching force of these 602 institutions of higher education numbered 27,279. The aggregate enrolment of students reached 301,818, including students in all departments—preparatory, collegiate, graduate, and professional. The aggregate of gifts and bequests reported by the 602 institutions for the year 1909–10 was 3,747,430*l*. Of this amount, 1,228,700*l*. was given for buildings and improvements, 1,954,200*l*. for endowment, and the remainder for current expenses. The largest amounts were received by the following institutions:—Columbia University New York, 409,000*l*.; Yale University, Connecticut, 403,000*l*.; Princeton University, New Jersey, 342,000*l*.; University of California, 248,000*l*.; University of Chicago, Illinois, 239,000*l*.; and Bryn Mawr College, Pennsylvania, 142,000*l*. Twenty-seven institutions altogether each received 20,000*l*. or more during the year.

THE report for the year 1910 of the council to the members of the City and Guilds of London Institute is now available. During the year a petition was made to the King for a supplemental charter to enable the institute to cooperate more effectively with other bodies in the coordination of technological work, more especially in the metropolis, and on December 16, 1910, the supplemental charter was granted, and its provisions are printed in the report. The Imperial College of Science and Technology has obtained from the Commissioners of the Exhibition of 1851 a grant of a large piece of land at South Kensington, on part of which a building is being erected which will eventually be added to the Central Technical College, and will with that college form the engineering section of the Imperial College. The enlarged college, towards the cost of which the Goldsmiths' Company has made a grant of 50,000*l*., will be known as "The City and Guilds College" (Engineering), thus perpetuating the connection of the institute with the engineering work in London. Among other matters, it may be noted that the course in railway engineering for post-graduate and other duly qualified students, organised by the college in 1908–9 in connection with the Imperial College of Science and Technology, has been continued and considerably enlarged. Reports are included also of the year's work at the City and Guilds Technical College, Finsbury, the South London School of Technical Art, and the Department of Technology.

IN a suggestive article on "Scientific *versus* Personal Distribution of College Credits" (*Popular Science Monthly* for April), President William T. Foster, of Reed College, Portland, Oregon, directs attention to the want of a uniform standard in the classification of students in different subjects in American universities and colleges, but his criticisms are equally applicable to similar institutions on this side of the Atlantic. Adopting the system of grading students in five classes, of which four represent a pass and the fifth represents failure, the author tabulates for several colleges the percentages of students receiving the several grades in different departments, and the numbers show very large discrepancies. Thus in Harvard College in one year the percentage of students in the highest grade varied from 1 per cent. in English to 35 in Greek; in the second grade from 11 per cent. in English to 33 per cent. in fine arts, and so forth. The result of these discrepancies is that the poorer students seek the courses which give the larger proportions of high grades. The author points out that to all students who are prompted by unworthy motives his charts indicate the easiest way to a degree; moreover, it is useless to suppress such information, as students in all colleges are guided by such charts more or less accurately plotted. In the University of Missouri, on the other hand, a system has been introduced of equalising for different departments the percentages of students placed in the several classes, with the result that "we come nearer to knowing what a grade stands for at the University of Missouri than at any other institution in the country." For this purpose a normal distribution is adopted in which 25 per cent. of the students are in the first two classes, 50 per cent. in the middle class, and 25 per cent. in the fourth and fifth. The author suggests that instructors should be required to tabulate the actual distribution of grades in their departments each year, and that all marked divergences from the normal distribution should be made the subject of a special report.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society June 1.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. R. **Kennedy**: Experiments on the restoration of paralysed muscles by means of nerve anastomosis. This communication is the first of three series of experiments on restoration of paralysed muscles by means of nerve anastomosis. The present series consists of ten experiments on monkeys and dogs, in which, after division of the facial nerve, the peripheral segment of the latter was attached to a neighbouring nerve. Sometimes the hypoglossal and sometimes the spinal accessory was the substitute. The experiments also varied in mode of uniting the nerves, and in interval of time elapsing between section of the facial and union with the substitute. Among the conclusions are the following:—Where spinal accessory or hypoglossal is substituted for facial nerve, restoration of voluntary co-ordinated movements of facial muscles is possible. Restoration commences sooner when the hypoglossal is used, although the ultimate results, so far as recovery of facial movements is concerned, do not appear to show much difference. On the other hand, the new paralysis produced temporarily or permanently in the distribution of the substitute nerve is more serious when the hypoglossal is employed. Where association movements are present in consequence of the anastomosis, these are more objectionable when the hypoglossal is used. As regards interval of time between section of the facial and performance of anastomosis, there is no decided difference in date of commencing recovery between immediate anastomosis and a secondary anastomosis after the lapse of one month. An addendum gives a report, twelve years after operation, of a case of spino-facial anastomosis published in Phil. Trans., 1901; also of a case of facial paralysis of three years' standing in which spino-facial anastomosis was done, and in which recovery commenced three years subsequently.—Sir David **Bruce**: The morphology of *Trypanosoma evansi* (Steel). In previous papers published in the Proceedings the morphology of various trypanosomes, such as *Trypanosoma pecorum*, *vivax*, *uniforme*, *nanum*, and *brucei*, has been described somewhat more fully than is usually done. It is proposed to do the same for *T. evansi* in this paper. This trypanosome causes the disease in elephants, camels, horses, cattle, and dogs known in India as surra. It was discovered in 1880 by Evans in the Punjab. It is curious that in India this is the only pathogenic trypanosome of the domestic animals which has up to the present been described. In Africa many species are known—in fact, here may be said to be the home of the trypanosome diseases. In Africa these diseases are associated with tsetse-flies. In India there are no tsetse-flies. The carrier of surra has not yet been identified. It is generally thought that surra has been introduced into Africa by means of the camel, but this is by no means established. Up to the present it has been usual to look upon the trypanosomes of surra and nagana as indistinguishable morphologically. In this paper 820 individuals of *T. evansi* have been carefully measured, and a curve representing the distribution in respect to length made. This curve is very different from that of *T. brucei*. It is therefore evident there should be no difficulty in future in separating these two species by this means. Again, on comparing the curve of the Indian camel disease with that of the African, the similarity is very striking, and affords some proof that the two diseases are caused by the same species of trypanosome.—H. S. **Stannus** and Dr. W. **Yorke**: The pathogenic agent in a case of human trypanosomiasis in Nyasaland. During the past three years a considerable number of cases of human trypanosomiasis have occurred in Nyasaland, notwith-

standing the fact that *Glossina palpalis* has not, as yet, been discovered in the Protectorate. The authors have examined the trypanosome obtained from the blood of a European infected in the Dowa sub-district of Nyasaland. The parasite was also examined in the blood of a monkey, rabbit, and goat infected from the patient. Morphologically the trypanosome was found to present the same peculiarity as was observed in the case of a trypanosome from a patient infected in the Luangwa Valley of north-east Rhodesia. This peculiarity consisted in the fact that amongst the short forms some have the nucleus at the posterior (non-flagellar) extremity. In a condition of heavy infection these posterior nuclear trypanosomes form from 2 to 5 per cent. of the total parasites present. A second interesting point in the morphology of this parasite is that the cytoplasma was frequently found to be vacuolated in a remarkable manner. Whether or not this is a constant feature we are unable to state from the small amount of material at our disposal. A monkey, rabbit, or goat inoculated with the parasite became infected, and in all the disease ran an acute course. As a result of their observations, the authors are of opinion that the trypanosome in question is not *T. gambiense*. On the other hand, it very closely resembles *T. rhodesiense*, and is probably identical with it. The disease was contracted in a district (Dowa sub-district of Angoniland) where *G. palpalis* has never been found, but where *G. morsitans* is known to exist in large numbers. It appears probable, therefore, that this trypanosome (*T. rhodesiense*) is a distinct species, capable of transmission by some other agent than *G. palpalis*, probably *G. morsitans*.—Captain R. **McCarrison**: The experimental transmission of goitre from man to animals.—Dr. Helen **Chambers** and Dr. S. **Russ**: The action of radium radiations upon some of the main constituents of normal blood. Experiments have been performed *in vitro* with the following results:—When blood is mixed with radium emanation hæmolysis occurs with gradual conversion of oxyhæmoglobin into met-hæmoglobin. The hæmolysis is a gradual process, and has been found to occur as a direct result of α radiation. Leucocytes show marked degenerative changes when exposed to α rays. During the process of clothing leucocytes appear to move away from a region radiated by α rays. This motion is not due to a direct action of the rays on the leucocytes, but has been attributed to changes found to occur in the surface tension of blood serum when radiated. The specific properties of opsonin and hæmolytic complement are lost when serum is exposed to α rays. The progressive changes caused by these rays indicate the separate identity of opsonin and complement. The β and γ rays have yielded negative results in analogous experiments.—F. L. **Usher** and J. H. **Priestley**: The mechanism of carbon assimilation.—Part iii. Details are given of further experiments supporting conclusions arrived at in parts i. and ii. of this series, as to the primary products of photolytic reduction of aqueous solution of carbon dioxide. By the use of other sources of energy, viz. (1) α and β rays from radium emanation and its products, and (2) the radiation from a quartz mercury vapour lamp, solutions of carbon dioxide have been decomposed with formation of small quantities of formaldehyde and hydrogen peroxide. The hydrogen peroxide formed was identified by the titanium sulphate reaction; the formaldehyde by Schryver's reaction. Further experiments with chlorophyll films are described, leading to the conclusion that bleaching of chlorophyll in sunlight, whether carbon dioxide is present or not, is due to formation of hydrogen peroxide; but the production of formaldehyde in such condition and quantities as to be recognisable by the use of Schiff's reagent seemed only to occur when carbon dioxide was present. Evolution of oxygen from green tissues in which the catalase has not been killed, and from gelatin films containing catalase over which a film of chlorophyll has been spread and exposed to light in an atmosphere containing carbon dioxide, has been established by further experiments. Qualitative tests for emission of oxygen have been made by methods involving the utilisation of Beijerinck's photo-bacteria; quantitative tests by the use of apparatus enabling very small quantities of oxygen to be measured. Further evidence that some of the energy supplied to a film of chlorophyll by sunlight is used in the photolytic reduction of carbon dioxide has been obtained by an experimental proof that such film in sunlight, in presence of carbon dioxide, is at a lower temperature than a similar film also in sunlight, but in air free from carbon dioxide. The paper concludes with brief replies to some criticisms upon the experimental evidence and conclusions recorded in parts i. and ii. of this series of papers.—T. **Goodey**: A contribution to our knowledge of the protozoa of the soil. The paper is an account of work carried out on the soil protozoa which are considered to be chiefly instrumental in limiting the activity of bacteria in the soil, and thus in helping to render the soil comparatively infertile. Methods of obtaining protozoa in cultures of soil are described, and a list of the different species found so far is given. An experimental method for quickly finding the earliest ciliated protozoa occurring in a soil culture is described, in which use is made of the galvanotactic response which many of the protozoa show when stimulated by means of a continuous electric current. By means of this method, active ciliated protozoa have been found in from 1½ hours to 4 hours. Experiments on the length of time required for a ciliated protozoon, *Colpoda cucullus*, to develop from its resting cysts have also been conducted in similar media and at the same temperature as used in the soil cultures. It has been found that the times required for development in both soil and cyst cultures are comparable, and that the first *C. cucullus* to occur in soil cultures are almost identical in appearance with those which emerge from resting cysts. The conclusion drawn from the experiments is that the ciliated protozoa are only present in the soil in the encysted condition, and do not, therefore, function as the factor limiting bacterial activity in the soil.—G. **Stead**: The anode and kathode spectra of various gases and vapours.

Geological Society, May 10.—Prof. W. W. Watts, F.R.S., president, in the chair.—Prof. E. J. **Garwood**: The Lower Carboniferous succession in the north-west of England. The area dealt with includes Westmorland north and west of the Dent Fault, North Lancashire to the north of the Lune Valley, and the northern corner of Yorkshire. The value of the zonal indices selected is discussed and their distribution described. Whereas the zonal indices chosen for the larger groups of beds are often sporadically distributed in the zone, the bands form remarkably trustworthy horizons, extending over large areas. In no one district is a complete development of all the zones observed, and only by taking a broad survey of the whole area can the detailed faunal sequence be established. In the Shap area the *Michelinia megastoma* zone is scarcely represented, while farther west the fauna of this horizon is one of the richest in the whole of the north-western province. The changes in the fauna of certain zones often depend more on the lithological characters of the rocks than on the introduction of new forms at definite horizons. The deposits are shown to be, for the most part, of shallow-water origin. The lowest deposits are characterised by highly magnesian limestones. The majority of the limestones throughout the series are rich in foraminifera, and the more shaly layers in ostracods and bryozoa. Both silicification and dolomitisation of the limestones were practically contemporaneous with the deposits in which they occur. The movements which have affected the rocks in the Arnside district have been the result of nearly horizontal thrusts, and it is shown by means of zoning that the beds have in places been inverted, and are dipping at more than 120°. The palæontological divisions are correlated with their probable equivalents in the Bristol area. Several new species of corals and one new genus are described, and the affinities of several corals and brachiopods are discussed.—Prof. S. H. **Reynolds** and Dr. A. **Vaughan**: The faunal and lithological sequence in the Carboniferous limestone (Avonian) of Burrington Combe, Somerset. Lithology.—The series is almost continuously calcareous from the base of Z to D_1, where the section ends; the K beds are, to a large extent, shales. Crinoids are the prevalent limestone-builders throughout K, Z, and C_1; in C_1 the rock is of the crinoidal type, known as *petit granit* by the Belgian geologists. A band of oolite occurs in the upper part of K_1. C_2 and

S_1 are very largely oolitic, conspicuous white oolite prevailing at the top of C_3. There is much oolite in the upper part of S_2. An important point is the prominent part played by foraminifera, which are the principal limestone-builders in C_2, S_1, and much of S_2. In the upper part of S_2, peculiar concretionary limestones, showing imperfect "Cotham-Marble" structure, occur. The Burrington section agrees with the other sections in showing dolomitisation in the upper C_1 beds.

Linnean Society, June 1.—Dr. D. H. Scott, F.R.S., president, in the chair.—Prof. W. A. **Herdman**: The recent occurrence (April) of the minute dinoflagellate *Amphidinium operculatum*, Clap. and Lachm., at Port Erin in the Isle of Man, in such profusion as to discolour the sand between tide-marks in patches extending on some days for many yards. *A. operculatum* has been recorded from several places on the coasts of Europe and America, but has apparently not been previously found in Britain.—Dr. A. Smith **Woodward**: The fauna of the Carboniferous period, so far as it has been discovered in the same deposits as the Carboniferous flora. The fauna agrees with the flora in consisting, for the most part, of highly specialised representatives of the lower groups, but is singularly modern in some respects. Some of the freshwater and land Mollusca are scarcely distinguishable from genera still existing. All the crustaceans are of primitive groups, and some of the most interesting are related to Anaspides, which still survives in Tasmania. The myriapods, scorpions, and spiders are similar to those of later date, but a few of the scorpions retain obvious remnants of the characters of their aquatic ancestors. Limuloids also occur. Insects are numerous, but all belong to the lower groups in which there is no complete metamorphosis, and there are many generalised types which can scarcely be referred to existing orders. Cockroaches are numerous, but have transparent fore-wings. Primitive dragon-flies occur, and some of these are the largest known insects, with a span of wings measuring 2 feet. Among fishes, the spiny acanthodian sharks, which are typically Lower Palæozoic, are still found in the Carboniferous fauna, and are known to have been preyed upon by the higher fishes. The pleuracanth sharks are characteristic of the period, and interesting as showing a more generalised vertebrate skeleton than any later fishes. The cochliodont sharks with grinding teeth appear to be closely related to the existing Cestracion, but have many of the teeth fused into extensive plates. Some of the sharp-toothed sharks also seem to have had their teeth fused into rigid masses. The highest fishes are the palæoniscids and platysomids, which exhibit all the fundamental characters of the present-day sturgeons, obscured beneath a normal covering of ganoid head-plates and scales. Large dipnoan fishes are numerous, and differ little from Ceratodus, except in showing traces of the separate points of which their dental plates are composed. Most important are the crossopterygian fishes, of which Rhizodus and Megalichthys are typical genera. These fishes make a closer approach to the earliest lung-breathers than any fishes which have existed before or since. Lung-breathers were certainly in existence just before the beginning of the Carboniferous period, and all seem to belong to a very primitive group of Amphibia, variously termed Stegocephalia or Labyrinthodontia in allusion to the complete roofing of their cheeks by bone and to the complicated structure of their teeth. In their possession of supra-temporal plates and often of post-temporal bones, as also in the marking of their superficial bones by the course of the slime-canals, these amphibians more closely resemble fishes than any later members of the order. Towards the end of the Carboniferous period some of the smaller Stegocephalia, the so-called Microsauria, seem to have passed into true reptiles very similar to the surviving Sphenodon or Hatteria.

Mathematical Society, June 8.—Dr. H. F. Baker, president, and temporarily Mr. J. E. Campbell, vice-president, in the chair.—Dr. H. F. **Baker**: The roots of multiple θ functions.—G. H. **Hardy**: The multiplication of Dirichlet's series.—G. H. **Hardy** and J. E. **Littlewood**: The range of Borel's method of summation of series.—Dr. W. H. **Young**: The convergence of Fourier series and of the allied series.—W. M. **Page**: Some two-dimensional problems in electrostatics and hydrodynamics.—Prof. W. **Burnside**: The determination of all groups of rational linear substitutions of finite order which contain the symmetric group in the variables.—Dr. W. H. **Young**: The nature of the successions formed by the coefficients of a Fourier series.—Lieut.-Colonel A. **Cunningham**: Note on Mersenne's numbers.—Prof. A. E. H. **Love** and Dr. T. J. I'A. **Bromwich**: The conditions that a homogeneous strain may be reducible to a plane strain and an extension at right angles to the plane.

CAMBRIDGE.

Philosophical Society, May 22.—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—Prof. **Pope** and J. **Read**: Attempts to resolve asymmetric nitrogen compounds of low molecular weight.—Dr. **Fenton** and W. A. R. **Wilks**: "Aldehydo-glyceric" acid. All of the eleven possible direct oxidation products of glycerol are now known with the exception of tartronic dialdehyde, hydroxypyruvic aldehyde, and one other. The latter is either hydroxypyruvic acid or tartronic semi-aldehyde (aldehydo-glyceric acid). One of these is Wills's acid, which is obtained from nitro-cellulose by the action of alkalis, but, owing to the contradictory evidence of different observers, its constitution still remains uncertain. An acid having the same composition, but different properties, is formed by the oxidation of glyceric acid in presence of iron, and probably by the initial decomposition of dihydroxymaleic acid. The present authors have now succeeded in isolating this acid, and are making experiments with the view of establishing its constitution.—S. **Ruhemann**: Triketohydrindene hydrate.—J. E. **Purvis, McHattie,** and **Fisher**: The non-nitrification of sewage in sea water. Systematic chemical and bacterial investigations on the decomposition of sewage in sea water have been described in researches previously published. The results proved that sewage undergoes slow decomposition in sea water, and the primary cause appears to be the rapid destruction of the nitrifying organisms. To meet the criticism that the method of incubation partially eliminated the oxygen necessary for the growth of the nitrifying organisms, the authors have passed dry air, and containing no CO_2, through various mixtures of sewage and sea water for more than seven weeks. The mixtures were examined from time to time for the two ammonias and for nitrites and nitrates. Neither nitrites nor nitrates were found at any time, and the total ammonia was only slightly decreased. The results confirm the earlier researches, and that even when abundant oxygen is there no nitrification occurs in sewage when mixed with sea water.—H. O. **Jones** and C. S. **Robinson**: Complex thio-oxalates. Salts of nickel, cobalt, iron, and palladium form complexes with salts of dithio-oxalic acid, which show intense colours even in dilute solution. Several salts of nickelo-dithio-oxalic acid, $Ni(CSO)_4H_2$, with metals and organic bases, have been isolated, and also several salts of the corresponding palladio acid, $Pd(CSO)_4H_2$. The salts of the cobalt acid with metals and with organic bases correspond to the formula $Co(CSO)_6H_3$ for cobalti-dithio-oxalic acid.—J. A. **Crowther**: (1) Further experiments on scattered Röntgen radiation; (2) the energy of the scattered Röntgen radiation from different radiators. Experiments have been made to determine the relative amounts of Röntgen radiation scattered by equal masses of different substances. It has been found that the amount so scattered is not independent of the nature of the radiator, but increases with the atomic weight.—R. **Whiddington**: The production of characteristic Röntgen radiations.—A. Ll. **Hughes**: The velocities of the electrons produced by ultra-violet light.—F. **Horton**: (1) The origin of spectra; (2) the positive ionisation produced by phosphates when heated.

PARIS.

Academy of Sciences, June 6.—M. Armand Gautier in the chair.—H. **Deslandres**: Complementary remarks on the weak magnetic fields of the solar atmosphere.—Emile **Picard**: A general theorem on integral equations of the third species.—A. **Laveran**: The unhealthiness of Corsica and the possibilities of improvement. The author emphasises the necessity of the methodical destruction of

mosquitoes, mechanical protection against their bites, and the systematic use of quinine.—Pierre **Termier** and Jean **Boussac**: The mylonites of the Savone region.—M. **de Forcrand**: The fluorhydrates of the alkaline fluorides. All the alkali metals form salts of the type MF.HF, some thermochemical data of which are given.—Ch. **Lallemand**: The changes of level of the soil in Provence resulting from the earthquake of June 11, 1907. A re-survey of the district showed that the changes of level were very slight, not exceeding 4 cm. in the neighbourhood of the epicentre.—Louis **Maneng**: Elements of the orbit of a new small planet.—Maurice **Gevrey**: The solutions of certain partial differential equations.—S. **Lattès**: The reduced forms of point transformations with two variables. Application to a remarkable class of Taylor's series.—Jean **Perrin** and Niels **Bjerrum**: Molecular agitation in viscous liquids. For liquids the viscosity of which is 100 times that of water the laws of perfect gases are applicable.—André **Blondel**: A new method of hydro-telegraphy.—F. **Croze**: The second spectrum of hydrogen in the extreme red. The lines photographed, after three hours' exposure, included wave-lengths from λ 8000 to λ 6836. No well-defined regularity in the distribution of the lines could be detected.—M. **Chanoz**: The physical development of a radiographic image after fixing with sodium hyposulphate and prolonged washing of the exposed sensitive plate.—L. **Brüninghaus**: Stokes's law and a general relation between absorption and phosphorescence.—Jacques **Duclaux** and Mme. E. **Wollman**: The osmotic pressure of colloids.—L. C. **Maillard**: The action of colloidal sulphur upon sulphide metabolism. Contribution to the study of sulpho-conjugation.—H. **Colin** and A. **Sénéchal**: The catalytic action of ferric sulphocyamide. The oxidation of phenols by ferric sulphocyanide in presence of hydrogen peroxide is due only in part to the specific catalytic action of the iron; the formation of persulphuric acid by oxidation of the sulphocyanide group also has an important bearing on the reaction.—A. **Berg**: The chromotellurates.—Marcel **Delépine**: The pyridinopentachloroiridates.—A. **Dufour**: Some new types of iridoxalic acids and complex iridoxalates.—F. **Bodroux**: The action of acid chlorides, of acid anhydrides, and of acetones on the monosodium derivative of benzyl cyanide.—M. **Hanriot** and A. **Kling**: The action of ammonia on the chloraloses.—Ernst **Zerner**: Some ethyl derivatives of acetone.—G. **Darzens**: The action of thionyl chloride in presence of a tertiary base on some esters of hydroxyacids. Ethyl lactate treated with thionyl chloride in presence of pyridine gives a good yield of ethyl α-chloropropionate. The method has been also applied to ethyl malate.—A. **Arnaud** and V. **Hasenfratz**: The oxidation of the higher acetylenic fatty acids.—Henry **Hubert**: The microlitic rocks of the loop of the Niger.—L. **Blaringhem**: The function of traumatisms in the production of hereditary anomalies in plants. A reply to some recent criticisms by P. Becquerel.—M. **Gerber**: The diastases of the latex of *Broussonetia papyrifera*. This latex contains three active ferments. Of these, the proteolytic ferment is remarkable for its resistance to high temperatures and to the action of poisonous ferments.—A. **Chevalier**: An attempt at a botanical, forest, and pastoral map of French Western Africa.—Eugène **Pittard**: Castration in man and the resulting modifications in size of different parts of the body.—Jules **Amar**: Observations on the yield and evaluation of mechanical work in man.—Pierre **Achalme**: Viscosity and diastatic actions. Hypothesis on the nature of diastases.—M. **Mazé**: Researches on the formation of nitrous acids in the living cell. Up to the present, the cholera comma bacillus is the only micro-organism capable of producing nitrous acid in organic media deprived of nitrates. The author has succeeded in isolating some species possessing the same property from plant juices. It has been proved that atmospheric nitrogen does not take part in this operation.—C. **Alliaud** and F. **Vles**: The electrocution of fish and hydrostatic stability. Specimens of Labrus, Crenilabrus, Gobius, and Motella temporarily paralysed by electric shock, showed that the centre of gravity was above the centre of hydrostatic pressure, and it is only by a constant muscular effort that the animal retains its normal position. These results confirm the views put forward by Dunoyer in 1866.—Henri **Bierry**, Victor **Henri**, and Albert **Ranc**: The action of ultra-violet light on saccharose. Under the action of the rays from a quartz mercury lamp, cane sugar is first partially hydrolysed, and the hexoses thus formed undergo a further change, resulting in the formation of formaldehyde and finally carbon monoxide.—Charles **Nicolle**, E. **Conseil**, and A. **Conor**: Experimental typhoid in the guinea-pig.—P. and N. **Bonnet**: A cretaceous layer in the valley of Nakhitchevan (Charour-Daralagoz, Transcaucasia).

DIARY OF SOCIETIES.

THURSDAY, JUNE 15.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: A New Conception of the Glomerular Activity: Prof. T. G. Brodie, F.R.S.—On the Action of Senecio Alkaloids and the Causation of Hepatic Cirrhosis in Cattle. Preliminary Note: Prof. A. R. Cushny, F.R.S.—Note on Developmental Forms of *T. brucei* (*pecaudi*) in the Internal Organs, Axillary Glands, and Bone-marrow of the Gerbil: G. Buchanan.—A Preliminary Note on the Extrusion of Granules by Trypanosomes: Capt. W. B. Fry.

LINNEAN SOCIETY, at 8.—The Anatomy of *Enhalus acoroides*, Rich.: Miss H. M. Cunnington.—On the Life-history of *Croce filipennis*, Westw.: Prof. A. D. Imms.—Eight Papers relating to the Fauna of the Seychelles: (1) Cynipidæ; (2) Proctotrupoidea: Prof. J. J. Kieffer.—Apoidea: Prof. T. D. A. Cockerell.—Lepidoptera: J. C. F. Fryer.—Wasps: G. Meade-Waldo.—(1) Borboridæ; (2) Phoridæ: J. E. Collin.—Culicidæ: F. V. Theobald.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Report on River Investigation: Dr. A. Strahan.

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