Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME LXVII

NOVEMBER 1902 to APRIL 1903

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

London

MACMILLAN AND CO., LIMITED

NEW YORK: THE MACMILLAN COMPANY

RICHARD CLAY AND SONS, LIMITED,
BREAD STREET HILL, E.C., AND
BUNGAY, SUFFOLK.

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REVIEWS AND OUR BOOKSHELF:—

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R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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THURSDAY, NOVEMBER 6, 1902.

LINEAR DIFFERENTIAL EQUATIONS.

Theory of Differential Equations. By A. R. Forsyth, Sc.D., LL.D., F.R.S. Part iii. Ordinary Linear Equations. Vol. iv. Pp. xvi + 534. (Cambridge: The University Press, 1902.)

IN this volume Prof. Forsyth deals with a part of his subject which, for many reasons, is full of interest. Ordinary linear differential equations concern the physicist, on the one hand, by their occurrence in the analysis required for many of his most important problems; on the other, they offer the pure mathematician an attractive field of research which appears to be almost inexhaustible.

Thanks to the contributions of a host of analysts, the theory of linear equations has now reached a high stage of development, and, as in other like cases, it is extremely interesting to see how different parts of it, which at first seemed isolated, are being gradually brought into organic connection. One of the first great steps in this direction was made by Gauss in his memoir on the hypergeometric series; this is another example of the extraordinary and almost uncanny way in which Gauss transformed and generalised every subject that he touched. It is as if his predecessors had been hewing stones for him to fit together into the lower courses of a stately building which he left for others to complete. And worthy successors have not been wanting, of whom, perhaps, Riemann is as yet the chief. For his brief memoir on the P-function marks an epoch by introducing several new notions of the very highest importance—the indices associated with the critical points, the analytical continuation of a branch of the function which satisfies the equation and the group of linear substitutions generated by describing cycles including critical points.

The real significance of Riemann's paper became fully evident only after the appearance of the celebrated memoir of Fuchs. It is, of course, impossible to say how Fuchs arrived at his discoveries; very likely he could not have explained his induction completely himself. In the introduction he refers to Briot and Bouquet as well as to Riemann, and acknowledges his obligations to Weierstrass. Fuchs deals with an equation of quite general order, the coefficients being functions of x with a limited number of singularities. He shows that in the neighbourhood of each critical point a there is a solution of the form $(x-a)^k\phi$, where ϕ is a one-valued analytical function and k is a constant determined by an equation which can be constructed from the differential equation itself. He also shows how the simplest independent solutions group themselves according to the multiplicities of the roots of the indicial equation.

The importance of these expansions near the critical points is that, besides giving us information about the analytical properties of the function defined by the differential equation, they enable us to investigate the group of substitutions associated with it. Suppose, for instance, we have an equation of the second order, and that in the neighbourhood of a there are two solutions of the form $(x-a)^h\phi$ and $(x-a)^k\psi$; if the independent variable starts near a and describes a small circuit round it, the solutions, by continuous variation, are multiplied by $e^{2\pi hi}$ and $e^{2\pi ki}$ respectively; thus with these solutions we have a substitution of the form $y'_1 = sy_1$, $y'_2 = ty_2$, where s, t are constants. When the indicial equation for a has multiple roots, the associated substitution is less simple, but can always be determined. If we start from *any* ordinary point with a set of independent solutions, then by Weierstrass's principle of continuation we can (in theory at least) follow up their values as x approaches a critical point a, then find the substitution which takes place as x goes round a, and finally bring back x to its original position. The effect of any closed circuit can thus be determined; and we have, on the whole, a group of linear substitutions, with generators corresponding to the critical points.

The singularities of an integral are determined by the coefficients of the differential equation; they may be poles or they may be essential singularities. One of the most remarkable things in Fuchs's paper is the determination of the form which a differential equation must have if all its integrals are regular in the neighbourhood

of each critical point; that is to say, if near any critical point a each integral can be put into the form

$$y = (x-a)^k \left\{ \phi_0 + \phi_1 \log(x-a) + \ldots + \phi_m [\log(x-a)]^m \right\}$$

where $\phi_0, \phi_1, \ldots \phi_m$ are one-valued functions not infinite at a. These equations are called by Prof. Forsyth "equations of Fuchsian type." The equation of the hypergeometric series is of this type, and is remarkable as being the only one, of order higher than the first, which is completely determined when the positions of the critical points and the indices associated with them are assigned.

An equation of Fuchsian type may have one or more algebraic integrals. If all the integrals are algebraic, the group of the equation must be finite; so here we have a most unexpected concurrence of two apparently disconnected theories. A very interesting problem is that of determining linear equations the groups of which are isomorphic with known finite groups; another is that of finding out whether a given equation has any algebraic integrals.

All the foregoing theory is discussed and illustrated by Prof. Forsyth in a very attractive and lucid manner; thus chapter i. deals with the existence of a synectic integral near an ordinary point and sets of independent integrals; chapter ii. with the expansions near a critical point and with Hamburger's method of grouping them; chapter iii. with regular integrals; chapter iv. with equations of Fuchsian type; and chapter v. with equations of the second and third orders possessing algebraic integrals. Illustrations are supplied by the familiar equations of mathematical physics, by the equation of the elliptic quarter-period, and by that of the hypergeometric series. It is delightful to see how the discussion of these equations is illuminated by the general theory.

After a chapter on equations w th only some of their integrals regular, we come to the consideration of integrals with essential singularities. The most familiar example of a function with an essential singularity at a finite place is $\exp(x^{-1})$, which is the integral of $x^2y' + y = 0$; and it is easy to see that if P is any polynomial in x^{-1}, the expression expP has an essential singularity and satisfies a linear equation of the first order.

Suppose now that we find that a given equation has an integral with an essential singularity at the origin; it may be possible to express it in the form $\exp P.x^\rho\psi(x)$, where ρ is constant and $\psi(x)$ holomorphic. Such an integral has been called "normal"; the discussion of these integrals, and others obtained by putting $x^{1/k}$ for x, is given in chapter vii., which contains important results due to Thomé, Hamburger, Poincaré and others. There is also a brief account of "double-loop integrals" after Jordan and Pochhammer, and of Poincaré's theory of asymptotic integrals.

In his paper on the motion of the moon, Hill was led to the solution of a linear equation by a method involving the use of infinite determinants. In chapter viii. Prof. Forsyth discusses this method in some detail, after giving a preliminary account of infinite determinants and their properties. The subject of this chapter is not very attractive in itself, but on account of its practical importance has naturally attracted a good deal of attention.

Chapter ix. deals with equations with uniform periodic coefficients, and gives an account of this part of the subject which ought to encourage young mathematicians to read the original sources and experiment on their own account. It is, of course, the equations with doubly periodic coefficients that are most interesting. Thanks principally to Hermite, Halphen and Picard, some extremely beautiful results have been already obtained in this field, and there can be no doubt that others are awaiting discovery.

The last chapter of this volume, on equations with algebraic coefficients, must have been very difficult to write, and appeals mainly to the specialist. Its principal topic is Poincaré's celebrated theorem that the integrals of any linear equation with algebraic coefficients can be expressed by means of Fuchsian and Zetafuchsian functions. As Prof. Forsyth justly remarks, we cannot hope to make practical use of Poincaré's theorem until the analysis of automorphic functions has reached a higher state of development. To this end the treatise by Klein and Fricke, now in course of publication, will doubtless contribute largely.

In conclusion, it may be well to remark that this volume is in great measure independent of its predecessors, and that a great part of it will be quite intelligible to junior mathematicians provided that they know the elements of the theory of a complex variable. To them, therefore, as well as to their seniors, this book may be heartily commended. G. B. M.

SCIENTIFIC PSYCHOLOGY.

Grundzüge der physiologischen Psychologie. Von Wilhelm Wundt. Fünfte völlig umgearbeitete Auflage. Erster Band. Pp. xv + 553. (Leipzig: W. Engelmann, 1902.) Price 10*s.* net.

THIS volume of 553 pages is the first of the three volumes in which the fifth edition of Prof. Wundt's great work is to appear. The rapid increase in size of the work in each of the successive editions is thus maintained in the present one, and, as in the case of the previous editions, has been necessitated by the rapidity of the growth of the youngest of the natural sciences, experimental or, as Prof. Wundt prefers to call it, physiological psychology. And even the increase in bulk of this book does not by any means fully express the rate of growth of the science, a growth towards which this country has contributed so lamentably little. For the book is primarily a record of the work and the views of the author and of his pupils in the great Leipzig school. Nevertheless, Prof. Wundt has found it necessary to rewrite almost the whole of the book, so that, as he tells us, it must be regarded as almost a new one.

The greater part of this first volume is concerned with matters not strictly psychological, but rather with those studies which form an essential part of the equipment of the psychologist, namely, the fine and coarse anatomy, the embryology and the physiology of nervous tissues, both special and comparative. It is, perhaps, open to question whether it is wise to attempt to treat so vast a range of subjects in the scope of a single volume. For

the psychologist may be tempted to content himself with the cursory review that is alone possible in such a work. It should certainly be possible nowadays for the writer on psychology to assume on the part of his readers a competent knowledge of the gross anatomy of the nervous system and of the principles of the conservation of energy. (In the anatomical section occurs an error that is, perhaps, of the nature of a slip. In Fig. 79 and in the accompanying text the uncrossed fibres of the optic nerves are represented as going to the nasal sides of the retinæ. Now although v. Kölliker and others still maintain that the decussation of the optic nerve-fibres in the chiasma is complete, and although there is some ground for believing that there occur considerable individual variations in the proportion of crossed and uncrossed fibres, yet all authorities agree that the uncrossed fibres go to the temporal sides of the retinæ.) The propriety of including an account of the general physiology of nerves is less open to question, the less so as Prof. Wundt is here on his own ground and can speak with authority. In this section Wundt makes a timely protest against the uncritical acceptance and wholesale application of Hering's doctrine of assimilation and dissimilation now so common among physiologists, and yet he teaches somewhat dogmatically a view that differs but little from the one he rejects. He too groups together under the term "inhibition" (Hemmung) all phenomena to which it can in any sense be applied, and assumes that one and all are manifestations of constructive metabolic processes, thus affording one more instance of the fact that the study of logic cannot prevent a man forming illogical conclusions. It cannot be too frequently pointed out that we have no evidence of active inhibitory processes within the nervous system and that all the numerous cases of "inhibition" may, and in the present state of knowledge should, be regarded as cases of interference or prevention only. Wundt goes so far as to assume a differentiation of the bodies of nerve-cells into two parts, the anabolic inhibitory and the katabolic augmentor parts, and applies this hypothesis to the explanation of the valve-like nature of the paths of the spinal cord. But although the hypothesis seems to have been devised in order to explain this phenomenon, it is not by any means clear that it can be made to do so.

The discussions of the functions of the cortex and especially of the "speech-centres" are admirably thorough and suggestive, and here Wundt gives a great development to the conception of a "brain-centre." It is, perhaps, to be regretted that he retains the term "centre," for it properly expresses a crude conception of which the period of usefulness is now at an end.

In treating of the fundamental constituents of psychical processes, Wundt distinguishes two fundamental kinds of psychical element, the sensations and the feelings (Empfindungen und Gefühle), the former including all those that have an objective reference and that are determined directly or indirectly by stimulation of sensory nerve-endings both within and on the surface of the body, the latter being the purely subjective elements. Compounded of sensations is the presentation (Vorstellung) and of feelings the emotion (Gemüthsbewegung). Wundt thus sets aside the old distinction of sensation and idea as that which is excited from without and from within respectively, asserting that the distinction is purely logical and not at all psychological. Though we may admit that Wundt's use of the terms is a convenient one, yet it is impossible to follow him in denying the psychological character of the distinction usually made by English authors, or to admit his claim that the occurrence of hallucinations, which are purely pathological states, necessitates this denial. If the distinction were not psychologically valid, if we did not immediately recognise in the presentation the peculiar quality of reality that distinguishes it from the representation, the term hallucination would have no meaning.

Perhaps the most interesting part of the volume is the discussion of the "law of specific nervous energies." This principle Wundt would replace by one which he declares to be directly opposed to it, and which he describes as "the principle of the adaptation of the sensory functions to the stimulus and of the sensory apparatus to the functions." This is based upon and assumes the truth of the following principles: that of the original similarity of function of all nerve-elements, which Wundt establishes by tracing in a most interesting manner the differentiation of the various senses from the general sensibility of the amœba upwards; the principle of the adaptation of nerve-elements through use or habituation; and the possibility, which we seem compelled to assume in some cases, that nerve-elements may come gradually to discharge the functions of others when those others are in any way rendered incapable of functioning. Now, admitting that the "law of specific nervous energies," as set up by Johannes Müller and by Helmholtz, is not in any sense an explanatory principle, but merely a *résumé* of a large group of facts, and admitting that it demands genetic treatment such as Wundt supplies, yet it is not possible to admit that even the most complete account of the evolution of the specific differentiations of sense can abolish the truths of which this "law" is the summary expression; to account for the origin of a thing or belief is not necessarily to explain it away. The fact remains that any specialised nerve of sense, when subjected to stimuli whether normal or abnormal, leads only to the kind of affection of consciousness peculiar to that sense. Wundt's account of the adaptations of the senses to stimuli is admirable and no doubt true so far as it goes, but it is far from being a complete explanation of the genesis of the specific functions.

Reducing the problem to its simplest terms, suppose a primitive sense-organ to be affected in the same way by two classes of stimuli, say two rates of vibration of the circumjacent medium—and then suppose that either rate of vibration comes in the course of evolution to determine a differentiation of one part of the nerves of the organ, so that one set of nerves comes to respond in one way to the one vibration-rate only and the other set in another way to the other (or that all the nerves come to respond in two distinct ways), and suppose the difference of response to consist in a difference in rate of vibration of the substance of the nerves, or in a difference of propagated chemical changes. Up to this point we may accept Wundt's account of the differentiation-process as adequate. But when we inquire—How comes it that the soul reacts to these two vibration-rates (or two kinds of chemical change) with two different

qualities of sensation? then we find ourselves still completely in the dark. Wundt himself seems to have felt this inadequacy and to have introduced in consequence towards the close of his exposition a new factor, the "entgegen kommende Triebe des empfindenden Wesen." This introduction of the "feeling being" amounts, it would seem, to nothing more than an admission of our ignorance. And indeed we have here reached the very kernel of the problem of life, of that mystery of the relations of soul and body which has vexed the thinkers of all ages, of that "master knot of human fate" of which the Persian poet wrote eight hundred years ago

"There was the door to which I found no key,
There was the veil through which I might not see."

And these words remain equally true to-day, in spite of the splendid labours of Johannes Müller, of Fechner, of Wundt and of many others.

It is interesting to note that Wundt assumes the principle of the inheritance of acquired characters as absolutely necessary to the explanation of the evolution of the nervous system, and that in this he is in agreement with most of the psychologists who have considered the problem. For the principle of natural selection, which is so satisfactory when we are dealing with the neck of the giraffe or the protective colouring of a butterfly, seems hopelessly inadequate when we have to account for those million-fold coordinated details of nervous disposition which together determine in large part, if not wholly, the tendencies and character of a human being.

In the last section Wundt deals with Weber's law and maintains his well-known psychological interpretation of it, in opposition to the now very generally accepted physiological interpretation. The attention of English readers may be called to the novel and ingenious explanation suggested by Heymans in the *Zeitschrift für Psychologie*, Bd. 26. W. McD.

THE MODERN DYNAMO.

The Generators of Electricity at the Paris Exhibition of 1900. By C. F. Guilbert. Pp. iv + 766. (Paris: C. Naud, 1902.) Price 30 fr.

THERE were probably few who went to the Paris Exhibition two years ago who did not pay a visit to the Palais d'Électricité; and no one who did so can have failed to have been impressed by the enormous size of the electric generators exhibited there. We even know of feminine sightseers, on pleasure bent, sparing a few hours from the fascinating display of M. Worth to look at, and possibly learn a little about, the "purrin' dynamos." The massive grandeur of these magnificent machines, examples of the best design and workmanship of all nations; the complicated nature of their parts working in perfect harmony and smoothness, and obedient to the control of one or two men; their spotless cleanliness and the impression of reserved power which they conveyed; all these must have moved even the most matter-of-fact observer into sympathy with the ideas which inspired Mr. Kipling to write "M'Andrew's Hymn." Such a collection merited the permanent record which it has obtained in the pages of M. Guilbert's book. Something of the spirit of the machines which he describes seems to have entered into the author, for his book, like the dynamos, is very large. There are nearly 800 pages, with, to use the author's own words, "615 engravings and plans, of which 118 plates." M. Guilbert has adopted a somewhat novel plan with the laudable desire of making his book attractive to foreign readers. The title pages and preface are in the language of the country in which the copy is to be sold; the chapter and section headings, the descriptions of the illustrations and the tables, are given in French, German and English. We rather doubt the wisdom of this innovation, since it increases the size of a volume already bulky, and still the most important part, the text, remains only in French. The result of the translation, too, is apt at times to be rather humorous, as, for example, when the author translates *résumé* (which the mere Englishman is content to use in the original French) into a non-existent English equivalent.

Criticism of a book of this kind is almost out of the question. M. Guilbert begins by describing the system of classification which he has adopted, and then, taking each division in turn, gives a more or less detailed description of the principal exhibits which come within it. Photographs of the generators and clearly executed diagrams of the whole machine or of important details greatly help out the letterpress. The book is therefore, in a way, like a descriptive catalogue, but it is one which gives a large amount of very valuable information, and M. Guilbert deserves great credit for the painstaking way in which he has collected and the clear manner in which he has arranged the data supplied by the manufacturers. It may be objected that the work is two years out of date and that the machines of 1900 are almost ready for the scrap heap in 1902. But rapid as the advance of electrical engineering is, there are few engineers who will not benefit to-day by the careful study of what was best two years ago, especially as it is the best, not of one country only, but of all countries; there will be many also interested in the design and improvement of electric generators who will desire to possess this book, even though it should become in the course of a few years of historical interest only.

As we turn over the pages of M. Guilbert's book, we find difficulty in selecting any particular machine for special notice. As the most noticeable feature in dynamo development in recent years has been the steadily increasing size of the unit, we may perhaps be pardoned if we pick out one of the largest machines exhibited at Paris. The Allgemeine Elektricitäts Gesellschaft exhibited a three-phase alternator of 4000 h.p. The output of this machine was 3000 kilovolt-amperes with a power factor of 0·9, making 2700 kilowatts. This alternator is one of a set of twenty-two, eight of which are already installed at the Berlin Electricity Works, the remaining thirteen being under construction. To bring this machine to Paris and to erect it in the German annexe, where there was no travelling crane, was a work of no small difficulty. The total weight was 160 tons, the armature frame weighing 80 and the field magnet 70 tons, the remaining 10 tons being due to the bedplate. The armature and field magnet were brought to the exhibition in quarters, each quarter being carried mounted between two railway trucks in the position most suited

for its subsequent erection. The whole work of erection was successfully completed in three weeks.

The A.E.G. alternator was not in actual operation at Paris, but was rotated for exhibition purposes by a small motor. An equally large generating set was exhibited by the Helios Company, driven by a triple-expansion engine and used for the lighting of the exhibition. This machine was of special design, as the makers desired to satisfy the requirements of the exhibition authorities and also to make the alternator suitable for subsequent disposal for other purposes. Another alternator of special interest was that exhibited by the Société l'Éclairage Électrique, which generated at 30,000 volts. This was designed more as an experimental machine, to show the possibility of directly generating at very high pressure and so dispensing with step-up transformers. The alternator had only an output of 180 k.v.-a. It is interesting in this connection to recall that last February Messrs. Schuchert and Co. completed three 1500 kw. three-phase alternators generating at 20,000 volts, for supplying power to the Valtellina Railway.

M. Guilbert has collected together all the chief data of the various machines in ten tables as an appendix at the end of the book. There is also given as an appendix a series of twenty oscillograph curves showing the potential wave-forms of a number of the alternators. These, which were taken by means of M. Blondel's oscillograph, though very interesting, are hardly accompanied by sufficient data to make them of great value. A casual inspection is, however, sufficient to show that, as M. Guilbert remarks, much progress remains to be made in the construction of alternators before a practically sinusoidal potential-curve is obtained. Yet though much remains to be done, much has already been accomplished, and the manufacturer of the modern dynamo has nothing of which to be ashamed. His machines are efficient, and he has shown that he is capable of making them of a size suitable to the ever-increasing requirements, and there can be little doubt that when the time arrives he will be able to meet still greater demands. It is not likely to be long before these are made, especially for generators for traction work. But a year or two ago the Westinghouse Company built two 2700 kw. generators for the Boston Elevated Railway; one is inclined to ask what the size of the units will be when, say, the London and North-Western or the Canadian Pacific Railway is run electrically. We can only hope that it will not be long before an answer has to be given to his question; that our progress in the future will be as rapid and as sound as it has been in the past; and that the next seventy years will be as full of development and improvement as have been the seventy which have passed since Faraday "did not despair of being able to construct a new electrical machine." M. S.

OUR BOOK SHELF.

Thirteenth Annual Report of the Local Government Board, 1900–1. Supplement containing the Report of the Medical Officer for 1900–1. (London: Eyre and Spottiswoode, 1902.)

THE scientific memoirs contained in this volume are of considerable interest. Drs. Klein and Houston have investigated the behaviour of pathogenic organisms when inoculated upon various farinaceous media, and conclude that the likelihood of infection of the human subject from such source is probably remote. A number of food-stuffs were similarly examined by Dr. Klein for the presence of pathogenic organisms, with the result that none was found. Dr. Gordon has continued his studies upon the bacteriology of scarlatina, and he adduces further proof that the *Streptococcus scarlatinae* is a species distinct from other streptococci and that it may be the causative organism of this disease. Two papers are concerned with the behaviour of micro-organisms when inoculated into the soil. In the first, Dr. Houston inoculated soil with crude sewage, and found that on the whole the soil-microbes ousted the sewage ones and that the addition of sewage to soil resulted in a temporary increase only of the sewage microbes. In the second, Dr. Sidney Martin has continued his work upon the nature of the antagonism of the soil to the typhoid bacillus; this organism survives but a short time in the soil, being destroyed by the products of the putrefactive bacteria which exist therein. Dr. Klein also reports on the infection of cockles and mussels with the typhoid and cholera microbes, and shows that these organisms may persist in the interior of the molluscs for some time after the source of infection has been removed. The importance of rats in the dissemination of plague has induced Dr. Haldane to devise an apparatus for generating carbonic oxide gas for destroying these pests in plague-infected ships. This is described and some experiments with it are detailed. There is also an interesting report upon research work in connection with glycerinated vaccine lymph. The volume concludes with a number of well-executed photographs illustrating the various papers. R. T. HEWLETT.

The Flora of the East Riding of Yorkshire. By J. F Robinson. Pp. vii + 253. (London: A. Brown and Sons.) Price 7*s.* 6*d.*

THE "Flora of the North Riding of Yorkshire," compiled by Mr. J. G. Baker so long ago as 1863, furnishes a delightful account of the plants and the plant-associations of that division. Dr. F. A. Lees is responsible for a "Flora of the West Riding" which is equally successful. The present work, therefore, fills up an important gap and completes the botanical survey of the county. The enumeration of plants is preceded by a historical review of earlier compilations and a series of sketches referring to the physiography, meteorology and plant distribution of the district. These, taken in combination with the geological map, add greatly to the interest of the book. At the same time, these chapters seem capable of some improvement. The physiographical chapter brings out very clearly the interesting features of the division, the ancient lake-area now represented by a single lake and patches of marsh in the plain of Holderness, the estuary of the Humber, the Cretaceous formation of the Wolds and the mixed character of the deposits in Derwent-land. But the ecological chapter suffers by being too condensed, and "xerophiles," "pelophiles," "arenophiles" are tumbling over one another. The contrast of "xerophiles" and "pelophiles" on pp. 35, 39, represents a confusion of terms. A more detailed and localised account of the plant forms on the different alluvial deposits and an extension of the very brief indication of successive littoral colonies, as well as fuller descriptions of other local formations, might well be given, and the extra space could be more than gained by a less generous use of type and spacing in the flora proper. In the enumeration of plants, the author and his colleagues have endeavoured to sift out the aliens which are especially abundant round Hull Docks, and also the recorded localities have received personal confirmation as far as possible. The author and the Hull Scientific and Field Naturalists' Club deserve the thanks of botanists for a

compilation which represents much hard work and which will serve to stimulate interest in that division of the county, inasmuch as it indicates a somewhat unexpected wealth and variety of plant forms. Mr. J. J. Marshall has furnished a list of the mosses of the Riding.

A Revolution in the Science of Cosmology. By George Campbell. Pp. 210. (London: Sampson Low, Marston and Co., Ltd., 1902.)

IN spite of the author's description of himself as "a professor and teacher of the natural sciences for many years," this attempt to revise the generally accepted theory of planetary evolution shows a very imperfect acquaintance with scientific principles. The leading idea is that the earth was never in a molten condition, but is now undergoing the process of fusion in consequence of the pressure of the external strata on the interior mass. The sun also is declared to have once been an opaque body, and to represent more or less what the earth and other planets will become. In this connection it is only necessary to point out that while a gaseous mass contracting under the influence of its own gravity will rise in temperature, there is no ground for extending this principle to masses which are liquid or solid.

Among the other unacceptable ideas met with is that which accounts for a prehistoric change in the polar climate by supposing that the North Pole of the earth was "suddenly" turned from the sun and remained in that position for ages, having ceased for the time being to rotate on its axis (pp. 35 and 140). Again, on p. 64, speaking of the Whirlpool nebula, it is stated that "the violent agitation of the mass must result in a very low temperature," whereas a high temperature would be expected.

The author appears to have a vague idea that electricity plays an important part in the development of worlds, and that "atoms of interstellar space" represent the primary state of all matter, but he makes no contribution of value to the subject.

The Reliquary and Illustrated Archaeologist. Edited by J. Romilly Allen. Vol. viii. Pp. 287. (London: Bemrose and Sons, Ltd., 1902.) Price 12*s.* net.

STUDENTS of any branch of archæology will find something to interest them in this volume. The periodical, of which the numbers issued during the present year are included in the volume, is "a quarterly journal and review devoted to the study of the early pagan and Christian antiquities of Great Britain; mediæval architecture and ecclesiology; the development of the arts and industries of man in the past ages; and the survivals of ancient usages and appliances in the present." Notes on interesting and important papers contributed to some of the separate numbers of the *Reliquary* have already appeared in these columns, so that it is only necessary to say here that the eighth volume, with its numerous, well-produced illustrations, would make a handsome addition to the library of the student of antiquities.

Earth and Sky. A Second and Third Grade Nature Reader and Text-Book. By. J. H. Stickney. Pp. viii + 118. (Boston, U.S.A., and London: Ginn and Co., 1902.) Price 1*s.* 6*d.*

THIS is a reading book for young children. Its object is, the author says in his preface, "to bring before children's minds their own relation to the natural world in such a way as to appeal to imagination and reflection." The lessons will probably prove interesting to those for whom they are intended, but they do not sufficiently encourage the child's own activity. It is not enough to tell young pupils about natural objects; they should be encouraged to observe for themselves, instead of being content with the descriptions of others.

LETTERS TO THE EDITOR.

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

The Waste of Energy from a Moving Electron.

THE subject of the dynamics of a moving charge being of considerable interest now, I have thought the following may be useful. I have shown that a charge Q on a sphere of radius A, when suddenly jerked into motion at speed u, generates a spherical electromagnetic shell of depth 2A, in which the magnetic force H tends to the value given by

$$2AH = \frac{Q}{4\pi R}\,\frac{u\sin\theta}{1-\frac{u}{v}\cos\theta}, \qquad (1)$$

when R, the distance from the initial centre of Q, is great. Along with this H, we have perpendicular electric force in the shell, according to $E=\mu vH$, or vectorially, $\mathbf{E}=V\mathbf{vB}$, if $\mathbf{v}$ is the vector velocity of the shell. The angle θ is that between $\mathbf{u}$ and $\mathbf{R}$. The energy wasted by this shell equals the energy left behind, that is, $U-U_0+T$, if U_0 is the initial, U the final electric energy in the field, and T the final magnetic field energy. On its first formation, $\mathbf{H}$ and $\mathbf{E}$ in the shell are different; they then include in accumulated form all the $\mathbf{H}$ and $\mathbf{E}$ which are left behind by the shell as it expands. The applied force impulse follows from my formula for the force on the ether, viz. $\mathbf{F}=(d/dt)V\mathbf{DB}$ per unit volume. Denoting the time integral by $\mathbf{M}$, then $\mathbf{M}=\mathbf{M}_1+\mathbf{M}_2$, where $\mathbf{M}_2$ belongs to the shell ultimately, and is lost, whilst $\mathbf{M}_1$ is left behind in the field. We have $T=\frac{1}{2}M_1u$ and $U-U_0=\frac{1}{2}M_2u$; so that altogether

$$\tfrac{1}{2}Mu = U-U_0+T. \qquad (2)$$

Both $\mathbf{M}_1$ and $\mathbf{M}_2$ are parallel to $\mathbf{u}$.

If, now, a second impulse acts, changing the velocity from $\mathbf{u}_1$ to $\mathbf{u}_2$ say, another spherical shell is generated. Disregarding the part left behind, (1) above shows that the magnetic force in it is

$$2AH = \frac{Q}{4\pi R}\left(\frac{u_2\sin\theta}{1-\frac{u_2}{v}\cos\theta}-\frac{u_1\sin\theta}{1-\frac{u_1}{v}\cos\theta}\right), \qquad (3)$$

when the direction does not change. More generally, substitute the vector change in the quantity on the right side of (1) properly vectorised. Then the change in θ will be allowed for as well.

The energy lost in this second shell may be calculated by (3). It amounts to

$$\left\{\frac{u_2P_2-u_1P_1}{u_2-u_1}\left(1-\frac{u_1u_2}{v^2}\right)-P_0\right\}Q, \qquad (4)$$

where P is the potential function

$$P=\frac{Q}{4\pi A\epsilon}\left(1+\frac{1}{3}\frac{u^2}{v^2}+\frac{1}{5}\frac{u^4}{v^4}+\ldots\right) \qquad (5)$$

investigated by Searle and Morton. Take $u=0$, u_1 and u_2 to obtain P_0, P_1, P_2. It may be shown that the substitution of two impulsive changes in the same direction for a single one reduces the waste; that is, the one impulse u_2 wastes more energy than the two successive impulses u_1 and u_2-u_1. In fact, the saving is great, and ten equal partial impulses in succession waste not much more than one-tenth part of that wasted by a single impulse of size equal to their sum. There is a residuum, however, and that is what appears as continuous waste when u varies continuously.

When Δu is small

$$2AH = \frac{Q}{4\pi R}\,\frac{\sin\theta\,\Delta u}{\left(1-\frac{u}{v}\cos\theta\right)^2}, \qquad (6)$$

and now the waste of energy in the shell wave corresponding to Δu is

$$\frac{\mu Q^2}{12\pi A}\,\frac{(\Delta u)^2}{\left(1-\frac{u^2}{v^2}\right)^2}. \qquad (7)$$

The magnetic force in the above shells is uniform in the depth of the shell, when the impulse acts strictly at the front of a shell.

But if Δu be distributed uniformly over the time $2A/v$, the shell will be doubled in depth, and H will rise at uniform rate from 0 to the same full value in the middle of the shell and then fall similarly to zero in the second half. Now if a second equal Δu acts in the same way, beginning as soon as the first Δu has made H reach full strength, H will continue of that full strength. And so on with a third Δu. Finally, if $2A=v\Delta t$, and $\Delta u/\Delta t$ is steady, and allowing for the variable depth of the shell according to (11) below, we come to

$$\Delta t \cdot \frac{\mu Q^2}{6\pi v}\left(\frac{\Delta u}{\Delta t}\right)^2 \frac{1}{\left(1-\frac{u^2}{v^2}\right)^{\frac{1}{3}}} \qquad (8)$$

to represent the waste in time Δt. Or, if W is the rate of waste

$$W=\frac{\mu Q^2}{6\pi v}\left(\frac{du}{dt}\right)^2 \frac{1}{\left(1-\frac{u^2}{v^2}\right)^{\frac{1}{3}}}. \qquad (9)$$

This holds when the acceleration and the velocity are parallel. By the manner of construction, it is necessary that du/dt should not vary sensibly in the time taken by light to traverse the diameter 2A.

By a fuller analysis, allowing for change of direction of motion, I find that the waste of energy per second from a charge Q with velocity $\mathbf{u}$ and acceleration $\mathbf{a}$ is

$$W=\frac{\mu Q^2 a^2}{6\pi v} \frac{1-\frac{u^2}{v^2}\sin^2\theta_1}{\left(1-\frac{u^2}{v^2}\right)^3}. \qquad (10)$$

when θ_1 is the angle between the velocity and acceleration (absolute). The dimension A does not appear. W is the same for any size, subject to the restriction mentioned. The smaller A the better, of course. It is exactly true with A = 0, only then the motion would be impossible.

This calculation of the waste may be confirmed by following up my investigation of the electric and magnetic field by the method I gave in 1889 ("Elec. Pa.," vol. ii. p. 504).

The waste is greatest when the velocity and acceleration are parallel, and least when perpendicular. There is another reservation, viz. u must be less than v. If not, special treatment is required, after the manner I have already published.

The meaning of waste is this. When Q moves through the distance udt, it casts off a spherical shell of depth

$$\frac{vdt}{1-\frac{u}{v}\cos\theta} \qquad (11)$$

and the energy of this shell when it has gone out to an infinite distance is Wdt.

When at a finite distance, $\mathbf{E}$ and $\mathbf{H}$ in this elementary shell are given by

$$\mathbf{E}=\mathbf{E}_1+\mathbf{E}_2, \quad \mathbf{H}=\mathbf{H}_1+\mathbf{H}_2, \quad \mathbf{H}_1=V\mathbf{u}\mathbf{D}_1, \quad \mathbf{H}_2=V\mathbf{v}\mathbf{D}_2, \qquad (12)$$

$$\mathbf{E}_1=\frac{Q}{4\pi R^3 c}\frac{\mathbf{R}-\frac{\mathbf{u}}{v}R}{\left(1-\frac{u}{v}\cos\theta\right)^3}. \qquad (13)$$

$$\mathbf{E}_2=-\frac{\mu Q}{4\pi R}\left\{\frac{\mathbf{a}}{\left(1-\frac{u}{v}\cos\theta\right)^2}-\frac{a\left(\mathbf{R}-\frac{\mathbf{u}}{v}R\right)\cos\phi^1}{\left(1-\frac{u}{v}\cos\theta\right)^3}\right\}. \qquad (14)$$

Here the part $\mathbf{E}_1$, $\mathbf{H}_1$ belongs to the steady travelling state of steady $\mathbf{u}$, whilst the other part $\mathbf{E}_2$,$\mathbf{H}_2$ is electromagnetic, and represents the waste. The angle between the acceleration $\mathbf{a}$ and $\mathbf{R}$ is ϕ^1. The waste part has $\mathbf{E}_2$,$\mathbf{H}_2$ tangential, that is, perpendicular to $\mathbf{R}$. $\mathbf{H}_1$ is also tangential to the sphere, but $\mathbf{E}_1$ is radially directed from the point which Q would reach at the moment in question (belonging to the sphere R) if it were not accelerated at all. This means the steady travelling state (see "El. Pa.," vol. ii. p. 511, equation 29). There is another way of treating the question, viz. by the vector and scalar potentials. The vector potential of the impressed current $Q\mathbf{u}$ is not $Q\mathbf{u}/4\pi R$, but (*loc. cit.*)

$$\mathbf{A}=\frac{Q\mathbf{u}}{4\pi R\left(1-\frac{u}{v}\cos\theta\right)}. \qquad (15)$$

This is referred to origin at the virtual position of the charge, not the actual. The actual is best for the steady state, the virtual to show the waves emitted. The factor $(1-u/v\cos\theta)^{-1}$ expresses the Doppler effect. Divide by uc to obtain the scalar potential Φ. Then

$$\mathbf{H}=\text{curl }\mathbf{A}, \qquad \mathbf{E}=-\mu\dot{\mathbf{A}}-\nabla\Phi$$

in Maxwell's manner. The trouble here is the differentiations, which require great care, since $\mathbf{u}$, $\mathbf{R}$ and θ all vary in a rather complicated way as Q moves. The relations (12) exhibit the field clearly.

For an infinitely small sphere of Q, the energies in the shell at distance R corresponding to the displacement udt of Q are

$$T=T_1+T_2+2T_{12},$$
$$U=U_1+U_2+2U_{12},$$

where $_1$ relates to the $\mathbf{E}_1\mathbf{H}_1$ part and $_2$ to the other part, whilst $_{12}$ refers to the mutual energy. They are connected thus :

$$U_2=T_2, \quad U_{12}=T_{12}, \quad U_1=T_1+\frac{Q^2vdt}{8\pi R^2 c}, \qquad (16)$$

$$T_1=\frac{Q^2vdt}{12\pi R^2 c}\frac{u^2/v^2}{\kappa^2}, \quad T_{12}=\frac{\mu Q^2 a}{12\pi R}\frac{udt\cos\theta_1}{\kappa^4}, \qquad (17)$$

$$T_2=\frac{\mu Q^2 a^2 dt_1}{12\pi v}\frac{1-\frac{u^2}{v^2}\sin^2\theta_1}{\kappa^6}, \qquad (18)$$

where $\kappa^2=1-u^2/v^2$.

The corresponding "momenta," or force-impulses, say $\mathbf{M}_1=\Sigma V\mathbf{D}_1\mathbf{B}_1$, $\mathbf{M}_2=\Sigma V\mathbf{D}_2\mathbf{B}_2$, $\mathbf{M}_{12}=\Sigma V\mathbf{D}_1\mathbf{B}_2$, $\mathbf{M}_{21}=V\mathbf{D}_2\mathbf{B}_1$, are given by

$$\mathbf{M}_1=\frac{2T_1}{\mathbf{u}}, \quad \mathbf{M}_2=\frac{2T_2\mathbf{u}}{v^2}, \quad \mathbf{M}_{21}=\frac{2T_{12}\mathbf{u}}{v^2}. \qquad (19)$$

These are all parallel to $\mathbf{u}$. But $\mathbf{M}_{12}$ is not, though it is in the plane of $\mathbf{u}$ and $\mathbf{a}$. Its components parallel to $\mathbf{u}$ and to $\mathbf{a}$ are

$$\frac{2T_{12}}{u}, \text{ and } \frac{2T_{12}}{u}\frac{1-\frac{u^2}{v^2}\sin^2\theta_1}{\cos\theta_1}. \qquad (20)$$

With the previous restriction, these are independent of the size of the sphere of Q. But to obtain exact formulæ without this restriction, either a very difficult integration must be effected over the surface of the sphere of Q, every element of which will usually have (effectively) a different velocity and acceleration, on account of the Doppler effect, or we may derive the resulting formulæ by a differentiating operator. Thus, for example, exhibiting it for Φ only, let Φ_0 be the formula when A = 0, then the real Φ is, by a previous investigation,

$$\Phi=\frac{\text{shin } qA}{qa}\Phi_0, \qquad (21)$$

outside the sphere, and

$$\Phi=\frac{\text{shin } qr}{qr}\Phi_{0A}, \qquad (22)$$

inside the sphere, where q is the differentiator $d/d(vt_1)$ and Φ_{0A} is the common value of both Φ's at R = A. But this t_1 is not the same as the previous t; it is the corresponding value; the place where the differentiations are performed is at the end of $\mathbf{R}$. The differentiations are troublesome. Thirdly, we may calculate the time integral of Φ_0, and then apply Taylor's theorem. Nearly all the trouble in the electronic theory is connected with the necessity of making A finite to have finite energy (though this does not apply to the waste) and finite moving forces, with the consequent resulting two superposed waves, one outward from the surface of Q, the other inward, and then outward again. The results for impulses work out easily enough, but not for continuous accelerations.

Details of the above will be published in vol. iii. of "Electromagnetic Theory" (and perhaps elsewhere), which is, as the advertisement says, "in preparation."

Returning to the waste formula, an electron revolving in a circle of radius r has $\theta_1=\frac{1}{2}\pi$, and $u^2/r=a$. So we want an applied force along $\mathbf{u}$ varying as u^3 to maintain the motion, since the waste varies as u^4. This revolving electron has sometimes been supposed to be a circular current. But it is really a vibrator. The free path followed under decay of energy without fresh supply would perhaps be difficult to follow

completely. It is rather hard for the "explanation" of magnetism.

The kinetic energy of molecules is the natural source of the radiation, but the connection between them and the electrification is very obscure, and how the electrons get knocked off is harder still, and what they are is hardest of all. Larmor thinks they run through the ether like knots on a string. If they do, as they may, *how* do they do it? Connections are wanted.

OLIVER HEAVISIDE.

Leonid Meteors, 1902. A Forecast.

THE historical interest which attaches to the Leonid star showers naturally renders the near approach of mid-November a subject of paramount importance to meteor observers. Nor is expectation lessened on the present occasion by the moderate though somewhat unexpected brilliance of the Leonid display witnessed last year in America on the morning of November 15. The question must naturally occur to many, will there be a revival of the phenomenon in the November of 1902, and if so, will it make its appearance in a less or a more intensified form than in the previous year? Generally speaking, the prospects of a star shower on the night of November 15 this year are very good. An analysis made by the writer of the conditions under which last year's shower appeared, and also of those connected with the more brilliant meteoric spectacles of the past, shows that the event of November 15, 1901, is likely to be much surpassed by the meteoric phenomenon of 1902. The display falls due on the night of November 15 on the present occasion, and not on that of November 14 as was the case last year and was duly predicted by the writer (*Daily Chronicle*, November 14), though the maximum occurred somewhat later on that night than had been expected. The first phase of the shower will take place, however, at an hour not very well suited for its observation in western Europe, the time of its maximum being November 15d. 10h. 45m. G.M.T., when the radiant will be not much more than just above the horizon. Meteors from a radiant in full activity as it emerges above the horizon afford an interesting spectacle, however, and though their numbers must in consequence be seriously diminished, they somewhat atone for their paucity by often long and rapid flights across the heavens. This first appearance of the shower will of course be best observed in places situated at least a few hours to the east of Greenwich, though it ought not to escape observation in our less favoured localities. This early display promises to vie in brilliancy with that observed on the western slopes of the Pacific in 1901, if atmospheric conditions turn out favourable in those places best suited for its observation on the night of November 15, and in all places where the radiant will be above the horizon at the time of its maximum it ought to render shooting stars pretty abundant during the early hours of that night.

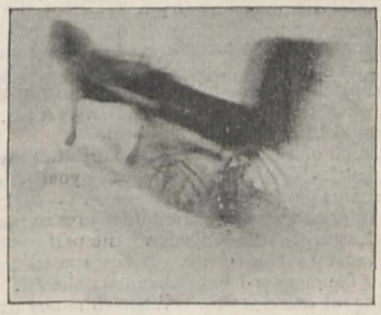
The second maximum of the Leonid display has been calculated to take place on November 15d. 18h. 45m., and promises to be the richest display of the night, though the time of its highest brilliancy will scarcely enable observers to obtain the most satisfactory view of it on this side of the Atlantic, as the increasing twilight between six and seven o'clock in the morning must somewhat impede observation. Along the eastern coast of America, on the other hand, the shower is likely to prove an attractive spectacle to observers, and its full strength can better and more accurately be subjected to calculation than with us, as its maximum will occur there at about two o'clock (local time) on the morning of November 16. Though that hour is rather early for its best observation, as the Leonid radiant is most favourably situated for purposes of meteoric observation in any place at about 4 o'clock in the morning (local time), yet on the present occasion at no other place can a better and more systematic watch be maintained for the anticipated star shower than along the Atlantic side of the American continent. Passengers on vessels crossing the Atlantic will no doubt find themselves specially favoured with opportunities for observing the phenomenon, as has been the case in previous star showers, such as that of 1868. The calculations made with respect to this meteor display go to prove that it will decline rather rapidly after 18h. 45m. on the night of November 15, the maximum showing a tendency to occur rather before th n after the time indicated, and on this account shooting stars are very likely to appear in unusual numbers to European observers throughout the night in question. As has been already stated, the shower expected in the present year gives considerable promise of surpassing in intensity that of 1901. Indeed, the calculated strength of the former is from ten to fifteen times that of the latter, but the presence of a full moon throughout the night of November 15 has not been taken into account in the determination of the foregoing comparison, and this circumstance must detract considerably from the relative splendour of the meteoric epoch of the present year. The full moon will probably obliterate the close of this year's shower, the end of which has been timed to take place on November 16d. 2h. 30m., and is generally of too weak a character to require any special consideration. It may be added that the foregoing calculations have been based on the assumption that the maximum of the Leonid shower of 1866 occurred at 1h. 15m. on the morning of November 14, G.M.T.

JOHN R. HENRY.

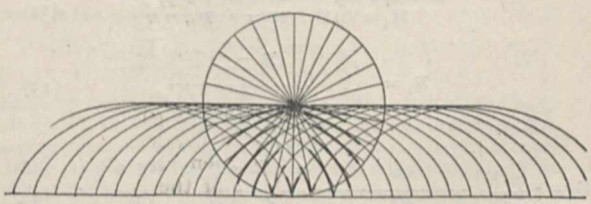
20 Rathmines Road, Dublin, November 3.

Curvature of Wheel Spokes in Photographs.

MANY people must have noticed the curious curved appearance presented in a photograph by the spokes of a moving vehicle. It is well known that the envelope of a diameter of a circle rolling along a straight line is a cycloid of half the dimensions of the cycloid traced by a point on the circumference. The part of the moving spoke which makes the strongest impression on the photographic plate will be where it intersects the consecutive position, so that the photograph really gives us



a small piece of the envelope of each spoke. The effect may be compared to the ordinary caustics of reflection or refraction. The accompanying photograph shows, not only the curvature of the spokes, but also the cusps of the envelopes of the spokes the ends of which have touched the ground during the exposure. In the diagram, the envelopes for a circle with fourteen equidistant diameters are drawn, and the parts of the envelopes which have



been put in strongly indicate the appearance that would be presented in a photograph, supposing that three spokes had touched the ground during the exposure. The spokes on the upper half of the moving wheel leave no impression on the plate, because their points of ultimate intersection lie *outside* the spokes themselves.

R. M. MILNE.

Royal Military Academy, Woolwich, S.E.

The Turkestan Earthquake of August 22.

INFORMATION received in India leaves no room for doubt that the earthquake of August 22, which left such conspicuous traces on the seismographs of Europe, had its origin in Central Asia. The representative of the Indian Government at Kashgar reports that there was a severe earthquake there at 8 a.m. on August 22, which lasted one-and-half minutes. Repeated

shocks were felt throughout the day, and shocks are reported on every day up to August 30. At 10 p.m. on September 2, a very sharp and severe shock was felt. It is said, though this has probably no direct connection with the earthquake, that the disturbance was followed by extreme heat, which lasted, at any rate, to the end of the month.

At Kashgar a good number of walls, made of sun-dried bricks, were knocked down, but masonry buildings do not seem to have suffered; sixteen deaths are said to have occurred through falling of houses. In the Artush district, to the north of Kashgar, the damage was much greater; nearly all the houses—presumably built of sun-dried brick—are said to have collapsed, and 667 deaths are known, besides more than 1000 persons severely injured. In Russian territory north of the Tian Shan range the shock appears to have been less violent, and it is reported that the damage done at Narin and Atbashi was not great. In the opposite direction the shock was felt at Yarkand, whence three shocks are reported to have been felt between 9 and 10 a.m. Some damage was done to the city wall and some private buildings; two children were killed by walls falling on them.

These particulars are sufficient to show that the earthquake was one of the first order of magnitude. Yarkand and Narin, at both of which it was destructive, are about 240 miles apart in a straight line, but are not sufficient to determine with certainty the position of the epicentre. This was evidently either to the east-north-east of Kashgar or more probably to the west-north-west among the mountains of the Alai Tian Shan range. It may consequently be taken that this earthquake, which will probably never be the subject of a detailed study, originated in about lat. 40° N., long. 74° E. of Greenwich.

Calcutta. R. D. OLDHAM.

Lectures on Anthropology and Ethnology.

THE letter of "Anthropotamist" in your issue of October 30 ought to meet with general approval.

In mentioning the educational institutions at which anthropology and ethnology are taught, your correspondent has entirely omitted London.

May I point out that courses of lectures in these subjects have been established at this college for the past two years, and have been attended by upwards of thirty students? Of these, two have previously contributed papers to the *Philosophical Transactions* and *Biometrika* dealing with questions of physical anthropology, while a third is the author of a volume treating of one phase of ethnology. It may be fairly claimed that to this college belongs the credit of being a pioneer in the systematic teaching of this subject in London.

H. W. MARETT TIMS.

Bedford College for Women (University of London), November 2.

THE ROYAL SOCIETY'S CATALOGUE OF SCIENTIFIC PAPERS.

THE following memorandum has been issued by the treasurer of the Royal Society:—

The Royal Society has been engaged continuously during the past forty years in cataloguing the various scientific papers which have been issued in all parts of the world since the beginning of the last century. The original scheme of the Catalogue of Scientific Papers provided that the papers should be catalogued only under the names of their respective authors arranged alphabetically. This "Authors' Catalogue" has now been carried down to the end of 1883, and comprises twelve quarto volumes.

More recently it has been decided to prepare also a subject index of the same papers, that is to say, a catalogue in which the papers are indexed according to the subject-matter of which they treat. Considerable progress has been made with this subject index, though nothing has as yet been published.

The expense of this work has been very large; since, although a great amount of gratuitous labour has been readily given by Fellows of the Society, it has been necessary to employ a considerable permanent salaried staff upon the preparation of the copy for the press. At first the printing and publication were undertaken by H.M. Stationery Office, the Treasury having determined that the Catalogue should be printed at the public expense. In coming to this conclusion, the Lords of the Treasury stated that they had regard "to the importance of the work with reference to the promotion of scientific knowledge generally, to the high authority of the source from whence it came, and to the labour gratuitously given by members of the Royal Society for its production." This arrangement, however, came to an end after the publication of the first eight volumes. The Treasury, in 1889, informed the Society that the Catalogue could no longer be printed and published by the Stationery Office. The unsold volumes were, however, handed over to the Society, and Parliament voted a sum of 1000*l.* to assist the Society in continuing the printing and publication. The four subsequent volumes have been printed and published by the Cambridge University Press, which has received subsidies from the Society for this purpose and receives the sums arising from sales.

The total sum expended by the Society upon the Catalogue down to the end of June last has been 14,790*l.* 5*s.* 5*d.* Towards this expenditure a donation of 2000*l.* was made by Dr. Ludwig Mond in 1892. Sums amounting to 524*l.* 11*s.* 9*d.* have been received as the proceeds of sales of the volumes handed over to the Royal Society by the Stationery Office, and, as already stated, 1000*l.* has been received from the Treasury. The Council has also hitherto devoted the income of the Handley fund (which they have power to apply as they may deem best for the advancement of science) towards defraying the cost of producing the Catalogue. The total sum received from this source has been 2394*l.* 11*s.* 10*d.* A sum of 341*l.* 11*s.*, arising from money invested until actually required, has also been available for the same purpose. These pecuniary aids amount in all to 6260*l.* 14*s.* 7*d.* As will be seen, they have not been nearly sufficient to meet the whole cost, and the Society has been compelled to make up the balance of 8529*l.* 10*s.* 10*d.* out of its general income.

As it became obvious that to continue permanently to prepare and publish catalogues of the ever-increasing stream of scientific literature was wholly beyond the means of the Society, the Council took steps to obtain international cooperation in this great work. Such co-operation has happily been secured, and the cataloguing of the scientific literature of the present century is now in the hands of an international council. The Royal Society has, however, incurred large special responsibilities in connection with the matter, having undertaken, *inter alia*, to act as the publishers of the Catalogue, and also to advance the capital required to start the enterprise.

The International Catalogue is concerned only with the scientific literature appearing after the commencement of the present century. The Royal Society's Catalogue, as already stated, is at present carried down to the end of the year 1883 only, and the subject index for that period is but partially dealt with. The foreign delegates, assembled to consider the establishment of the international council, expressed their sense of the great importance of the Royal Society's Catalogue and of the obligations which men of science in all countries were under to the Society for having undertaken it. They also expressed the hope that the Society would complete the Catalogue up to the close of the last century, so as to bring it into line with the International Catalogue.

In order to complete the Catalogue, it will be necessary to prepare and publish a catalogue of authors for the seventeen years 1883–1900, and to complete and publish the subject index for the whole of the past century. The Council of the Royal Society are satisfied that this work must be done, and have not felt iustified

in refusing to undertake it. They have accordingly commenced operations, and it is hoped that the copy may be produced ready for the press in about five years. Owing to the enormous increase in the number of scientific publications at the close of the last century, it is estimated that to complete the Catalogue and to subsidise a publisher for undertaking the printing and publication, he retaining the proceeds of the sale, will cost at least 12,000*l.*

The question now arises whether the funds of the Royal Society ought to continue to be burdened with any part of this expense. The activity and responsibilities of the Society have greatly increased in recent years, and it is much straitened by its inability to increase its expenditure, either on its own establishment or in other directions, owing to the incessant demands of the Catalogue. The Council consider that the time has now come for them to appeal to those who are in a position to afford substantial financial assistance, to enable them to complete this great undertaking without devoting any part of their funds, so sorely needed for other purposes, to this object. They are thankful to be able to announce that Dr. Ludwig Mond, F.R.S., has been so impressed with the importance of the Catalogue, with the necessity for producing the subject index of the scientific literature of the past century so far as possible in the same complete form as that adopted by the International Council for the literature of the present century, and with the justice of the view that the Royal Society ought for the future to be relieved of the cost of producing the Catalogue, that he has most generously added to his previous gift of 2000*l.* the munificent donation of 6000*l.*, payable in four annual instalments of 1500*l.*

The President and Council have also much pleasure in stating that Mr. Andrew Carnegie, fully appreciating the value of the Society's undertaking and the claims that it has on the liberality of those who, though not Fellows of the Society, are interested in the promotion of natural knowledge, has contributed the handsome sum of 1000*l.* towards its accomplishment. They venture to hope that others may be willing to contribute towards a fund to provide for the total cost of this national work.

November, 1902.

THE BERLIN TUBERCULOSIS CONGRESS.

THE Congress on Tuberculosis, which has recently concluded its sittings in Berlin, was instituted under the auspices of the Central International Organisation for the Prevention of Consumption, which is itself an outcome of the international congresses which have met during recent years in Paris, Berlin, Naples and London. An international association of this kind is to some extent a new departure and is not without political significance; its analogue may be found in the international systems at present existing for meteorological observations. Heretofore international co-operation against disease has been confined to sudden outbreaks of the more virulent epidemic maladies. It must be the sincere hope of every philanthropist that the result of this organisation may be the complete annihilation of one of the most potent and widespread causes of disease in existence.

The dissemination of tuberculosis was naturally one of the subjects which engaged the attention of the Congress. It is now recognised that tuberculosis is an infectious disease, and therefore that it is preventable. One of the chief sources of infection is the sputa of consumptive patients. In this connection much has been done recently to check the habit of indiscriminate spitting in public places. At the present time in Glasgow, Manchester, Liverpool and some other towns, it is a penal offence to spit on the corporation tramcars, and the Glamorganshire County Council has made a bye-law to the effect that spitting on the floor of public carriages, churches or other public buildings is punishable by a fine not exceeding 5*l.*

Another point of interest brought to light by the Congress was the growth during recent years of provision for consumptive patients in sanatoria. This has occurred through new hospitals being built and old ones being enlarged. As a marked instance of the latter, the Mount Vernon Hospital at Hampstead may be quoted. Four years ago there was accommodation at this hospital for fifty patients; when the present building operations are complete there will be accommodation for two hundred and fifty. At the present time in the United Kingdom there are, however, only about 1000 beds for poor patients and about 1200 for paying patients.

The question of the compulsory notification of tuberculosis and the disinfection by the municipal authorities after deaths from tubercular disease was also discussed. The opinion seemed generally in favour of compulsory notification, which already exists in Norway. An interesting paper was read on the subject of dispensaries for consumptives, which have been founded in Belgium. They are supported by private societies with the aid of town councils. The patients receive food, coal, clothes, bedding, antiseptics, lodging disinfection every three months, and family washing every week.

Perhaps the most interesting item in the proceedings of the Congress was Prof. Koch's address upon the transmission of bovine tuberculosis to man. This authority maintains the thesis he enunciated in London last year, that the meat and milk of tuberculous cattle are very rarely, if ever, the sources of tuberculous infection to the human subject. In this connection Prof. Koch laid special emphasis on the fact that though for more than a year past he had received official reports of all tuberculous cases coming under the notice of the German hospitals and the professors of pathology at German universities, no undoubted case of primary tuberculous infection of the intestines had occurred. He also drew attention to the fact that most drastic measures would be required if the meat and milk of tuberculous cattle were condemned as food, and that such an action would cause a great increase in the price of these foods, which would be to the detriment of the community.

F. W. T.

ANTHROPOLOGY AND GOVERNMENT IN THE UGANDA PROTECTORATE.[1]

IF the population of British East Africa, or even of the Uganda Protectorate only, can furnish as many anthropological problems as that of the little corner of the country between the north-eastern horn of Lake Victoria Nyanza and Mount Elgon, it is quite time that a scientific collection of the facts were commenced. Mr. Hobley's "Ethnological Survey" deals only with a district about 120 miles long by 60 or 70 miles wide. He enumerates within this area four distinct races, or at least peoples of four stocks, beside a number of miscellaneous tribes whose racial connections are at present unknown. It is obvious that with such a wealth of material a work of 95 imperial octavo pages must simply be of a preliminary character.

The only stocks with which the author attempts to deal in detail are the Bantu Kavirondo, interesting as being "practically the most northerly representatives of the Bantu race," the Ja-luo, a Nilotic people, and the Nandi and allied tribes, conjectured to be a mixture of

[1] "Eastern Uganda: an Ethnological Survey." By C. W. Hobley, Assoc. M.Inst.C.E., Sub-commissioner Uganda Protectorate. Occasional Papers, No. 1. (Published by the Anthropological Institute of Great Britain and Ireland, 1902.) Price 10*s.*

Negroes of the Nile Valley and some Hamitic people. The information furnished was collected in the first instance for administrative purposes. It consequently relates chiefly to such matters as would come more directly under the notice of a British official in the early stages of the settlement of the country. Mr. Hobley has in regard to such matters been minute and careful in his inquiries. He has made an excellent beginning, though, as he himself says, "it would be presumptuous to suppose that [his] observations do more than touch the fringe of inquiry into the habits and customs of these interesting people." As examples of the painstaking manner in which he has collected his material, his plans of the Kavirondo and Nandi huts, and his figures, placed side by side, of the hoe (the principal agricultural implement of the continent) used by the Kavirondo and that used by the Nandi, may be referred to. By the courtesy of the Anthropological Institute we are enabled to reproduce these.

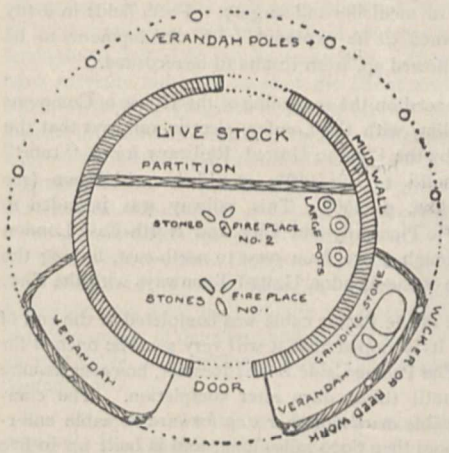


FIG. 1.—Plan of Kavirondo Hut.

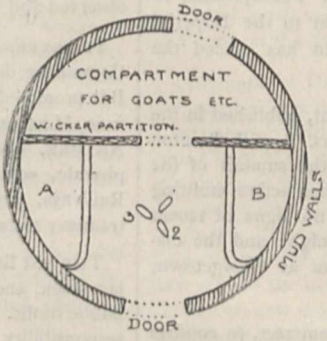


FIG. 2.—Plan of Nandi Hut.

The externals of native life and the outline of their customs, especially the customs relating to marriage and married life, are most fully treated. But there is evidently much detail still to be ascertained, and the underlying beliefs call for inquiry. The social organisation is hardly touched. Mr. Hobley's use of the words *clan* and *tribe* lacks precision. Both words seem to be used territorially; the clan is a local subdivision of the tribe, under a subordinate chief. By anthropologists the word *clan* is now generally used to indicate blood-relationship, actual or imputed. It should be kept strictly for this purpose and some other word found for a village settlement or other local subdivision the inhabitants of which may or may not be held to be blood-brothers. The important subject of religion, so intimately connected with social organisation, is almost a blank. The details concerning divination by the entrails of animals slain (in sacrifice?) and concerning the ceremonies in making peace, however, are interesting and valuable. These are matters likely to have come frequently under the sub-commissioner's eye. On the other hand, he is not likely to have suffered much from the medical practice of the Kavirondo. Hence his account of it is not very illuminating. The anthropologist who reads that the old women who are called in "put pebbles in a gourd and rattle them, and then advise certain remedies," will suspect that the pebbles are not only put into the gourd, but thrown out like dice, and that the practitioner divines from their fall, as among the more southerly Bantu, what is the matter and what remedies, if any, are to be prescribed. Probably Mr. Hobley has never witnessed the ceremony but writes from imperfect information. Useful plates of the Ja-luo are provided, and a plate of three Masai warriors. But nothing in the way of physical measurement has been attempted. Physical descriptions are vague, and evidence of race is chiefly made to rest on the deceptive basis of language. There is an excellent map of the district, showing the distribution of the various tribes. Vocabularies of several of the languages and grammatical observations are appended.

I have called attention to some of the deficiencies of this "Survey," not by any means for the purpose of finding fault, but in the hope that Mr. Hobley, who has commenced so well, will be induced to prosecute the work still further. Such investigations ought to have the most strenuous encouragement on the part of the administration, both for scientific purposes (to which no administration ought to be indifferent) and because everything that contributes to our knowledge of the people, their physical and mental capacities, their prejudices, customs and beliefs must make for good government. E. SIDNEY HARTLAND.

NOTES.

PROF. W. H. HOLMES, head curator for anthropology of the National Museum, has been appointed chief of the United States Bureau of Ethnology at Washington in succession to the late Major J. W. Powell, the former director. Prof. Holmes is well known to anthropologists for his studies on the pottery and decorative art of the aborigines of America, and on the manufacture of stone implements, &c. He has also decided and advanced views on the arrangement of ethnological museums.

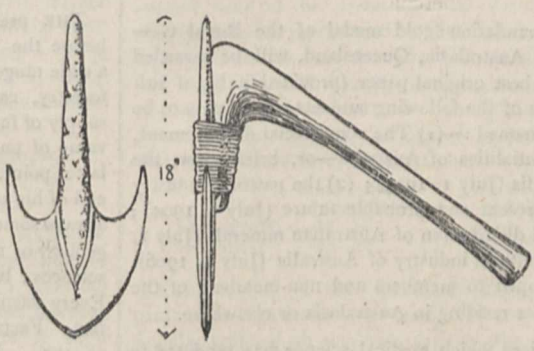


FIG. 3.—Kavirondo Hoe.

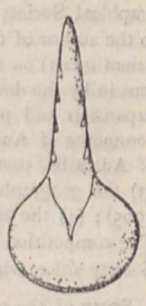


FIG. 4.—Nandi Hoe.

THE Lancaster Town Council has decided to confer the honorary freedom of the borough upon Mr. James Mansergh, F.R.S., past president of the Institution of Civil Engineers, who is a native of the borough.

LAST week the Bangor Eisteddfod Committee voted from its surplus a sum of 30*l.* to the University College of North Wales to assist in the development of the fisheries department.

In September Prof. White arranged for a fisheries exhibit in the arts and science section of the Eisteddfod, and partly owing to this as well as to the good work which the College has been doing in connection with the Welsh fisheries, the Committee decided to make the grant. The sum will be utilised in developing the fisheries collection at the College, which is in course of formation.

A RICH collection of Babylonian antiquities has been presented by the Sultan to Prof. Hilprecht, head of the archæological department of the University of Pennsylvania, in recognition of the services rendered by him to the Imperial Museum at Constantinople. Prof. Hilprecht has placed the collection in the University Museum.

A TELEGRAM from Kingstown, St. Vincent, published in the *Times*, says:—"The British botanists, Messrs. Powell, Quinton and Foster, spent an hour and a half on the summit of the Soufrière on October 28. The crater was then active, emitting steam and ashes. The new crater showed no signs of recent eruption. There was a slight eruption that night, and the disturbances continue, causing much excitement at Georgetown, where the tremors are continually felt."

MR. JOSEPH CLARK writes from Street, Somerset, to confirm Mr. Clayden's observations of recent remarkable sunsets (p. 659). On Friday, October 24, very brilliant colours were seen and particular notice was taken of the long time during which the clouds to the south-east retained a rosy tint. On Tuesday, October 28, there was a fine display of bright rose-colour on the eastward rolling clouds, an effect also noticed at Paris on the same evening.

WE regret to record the death, on October 23, of Mr. William Gunn, F.G.S. Mr. Gunn joined the staff of the Geological Survey in 1867 as assistant geologist, and attained the rank of district geologist in 1901. He was engaged during his long service in Durham and Northumberland, in the Scottish Highlands and latterly in Arran; and the results of his work appear for the most part in the maps and memoirs of the Geological Survey. His discovery of remnants of Secondary fossiliferous strata in a volcanic vent in Arran was brought before the Geological Society last year. Mr. Gunn had quite recently retired from the public service, having attained the age of sixty-five.

THE Thomson foundation gold medal of the Royal Geographical Society of Australasia, Queensland, will be awarded to the author of the best original paper (provided it be of sufficient merit) on each of the following subjects, the papers to be sent in by the dates named:—(1) The commercial development, expansion and potentialities of Australia—or, briefly put, the commerce of Australia (July 1, 1903); (2) the pastoral industry of Australia, past, present and probable future (July 1, 1904); (3) the geographical distribution of Australian minerals (July 1, 1905); (4) the agricultural industry of Australia (July 1, 1906). The competition is open to members and non-members of the Society alike, whether residing in Australasia or elsewhere.

SOME of the services which medical science has rendered to the State were referred to last week by Lord Roberts in an address delivered at the annual meeting for the distribution of the prizes gained during the past year by the students of the St. George's Hospital Medical School. Lord Roberts remarked that no section of the public was more deeply interested in the work and in the scientific researches of the medical profession than soldiers were, and that a deep debt of gratitude was due to those who, by their constant study, earnest inquiry and careful experiments, learned and taught how to heal the sick, to tend the wounded, to alleviate pain and suffering, to fight sickness and disease and to maintain health in camp and in quarters. A comparison of statistics as to the loss by sickness and disease in the Crimea and during the war in South Africa showed what a changed and improved condition of things prevailed now, changes and improvements which were largely due to the march of medical science. If great results were to be achieved, if success was to be won, there must be no slacking off in any pursuit or profession nowadays, least of all in the professions of medicine and surgery. Fresh fields in many directions remained to be explored, fresh developments to be observed and followed up, fresh results to be recorded.

IT was announced on the reopening of the House of Commons Committee dealing with the London electric railways that the Bill promoted by the London United Railways for a "tube" from Hammersmith to Piccadilly would be withdrawn (see NATURE, vol. lxvi. p. 296). This railway was intended to provide, with the Piccadilly and City and North-East London Railways, a through route from west to north-east, linking the tramway system of the London United Tramways with the City.

THE last link of the Pacific cable was completed at the end of last week, and it is hoped that it will very soon be opened for public traffic. The Pacific Cable Board does not, however, assume responsibility until thirty days after completion. The completion of this cable marks another step forward in cable enterprise. It is more than 8000 miles long, and is built up in five sections as follows:—Vancouver to Fanning Island (3653 miles), thence to Fiji (2181 miles), to Norfolk Island (1019 miles), and then to Moreton Bay, Queensland (906 miles) and New Zealand (513 miles). The cable has been laid by the Telegraph Construction and Maintenance Company at a contract price of rather under 2,000,000*l.*, and in less than two years; it is comforting to reflect that England still stands preeminent in this branch of electrical engineering. The completion of the line was made the occasion of the exchange of congratulatory messages between Mr. Chamberlain and the different governors of interested colonies. Among the most interesting of these are two sent by Sir Sandford Fleming to Lord Minto; these completely circled the world, one, in an easterly direction, in 10h. 25m., and the other, going westerly, in thirteen hours and a half. We have still some progress to make before we are able with Puck to "put a girdle round about the earth in forty minutes."

THE presidential address delivered by Mr. J. C. Hawkshaw before the Institution of Civil Engineers on Tuesday covered a wide range of subjects, among them being docks, timber and forestry, canals, means of traffic and transport, the world's supply of fuel, water-power available for industrial uses, and the value of purely scientific studies to the engineer. Upon the latter point, Mr. Hawkshaw made the following remarks at the end of his address:—"Wherever our work may take us we have always something at hand to observe if we give some thought to geology or some branch of biology. Geology calls to its aid all sciences; biology, even botany, is not one, but many sciences. Every science and every question of science is first a matter of fact. Facts observed which seem trivial in themselves may lead to much. Reaumur it was who first suggested that wood-fibre should be used for making paper. He was led to do so from observing the structure of wasps' nests. Out of that observed fact a great industry has grown which threatens to tax the forest supplies of the world. If we accept the view of M. Maurice Levy that from the study of celestial mechanics was derived later general mechanics, then all our progress has come from the study of what was useless at the time it was studied. We might well, I think, increase the number of optional subjects for our examinations. There is no branch of natural knowledge which may not be studied with advantage by an engineer as a change

and relaxation in the round of daily work, and as a training of his power of observation. For after all is said, it is only by observing that we can know."

AT a meeting of the Society of Engineers held on Monday, November 3, a paper was read on "The Effect of Segregation on the Strength of Steel Rails" by Mr. Thomas Andrews, F.R.S. In the course of the paper, the nature and primary causes of segregation in steel rails were described, and the influences of local transverse and longitudinal segregation on the loss of strength in such rails was demonstrated. Microscopic studies have specially indicated some of the latent sources of weakness which occur in segregated steel rails leading to their premature fracture in main-line service. Numerous chemical, physical and high-power microscopic examinations have been made on a considerable number of rails in which local segregation of some of the chemical constituents had been detected, and the author's investigations have demonstrated that local segregation of this nature distinctly reduces the general physical strength and main-line endurance of steel rails in which segregation exists. Reference was also made to the importance, in the interests of public safety, of detecting and eliminating from service, so far as practicable, rails having a tendency to segregated chemical composition.

SIR CHARLES TODD, Government Astronomer of South Australia, has published his valuable report on the rainfall of the colony for the year 1899, showing the monthly and yearly amounts and the averages for previous years at a large number of stations. The report is illustrated by maps showing clearly at a glance the rainfall characteristics of the year. Very few stations registered their average amount, principally owing to the failure of the rains during the latter part of the winter (July and August) and in October and December. The report contains a table showing the yearly rainfall at Adelaide for sixty-one years, 1839 to 1899, and the years when the fall was above or below the normal amount (20·85 inches).

WE have received from Dr. H. Hergesell, president of the International Aëronautical Committee, a preliminary report of the balloon ascents made during the three months April to June last. Austro-Hungary, France, Germany and Russia took part in the investigation, and twenty-one ascents were made. The following were the greatest altitudes attained by the unmanned balloons:—April 3, Itteville (near Paris), 14,260 metres, minimum temperature −60°·7 C., temperature at starting 7°. May 1, Berlin, 19,564 m., lowest reading −58°·5, on ground 6°·8. June 5, Berlin, 16,750 m., −58°·2, 18°·4. Vienna, 10,480 m., −62°·8, 15°. The greatest heights attained by manned balloons were in ascents from Berlin:—

April, 5403 m.,	temperature	−19°·4,	at starting 6°·6
May, 5510 m.,	,,	−30°·5,	,, 6°·2
June, 5936 m.,	,,	−18°·0,	,, 20°·9

In the latter case the observers were Dr. Berson, and Prof. Palazzo, of Rome. On each occasion Mr. Rotch sent up kites from his observatory at Blue Hill, near Boston, U.S. On the days of the ascents, areas of low barometric pressure lay over western Europe in April and May, and an area of high barometric pressure in June.

IN his report for the year 1900–1, the first volume of which is now to hand, the chief of the U.S. Weather Bureau directs attention to an important extension of the forecast work of the Bureau made during the year with which the report is concerned. At the end of 1900 was begun, by an arrangement with our own Meteorological Office, the transmission by cable from London to Washington of meteorological reports from certain observing stations in the British Isles and on the continent of Europe, and from Ponta Delgada, Azores. These reports, with observations from Nassau, Bermuda and Turks Island, have been regularly published on the daily weather maps issued at Washington, Baltimore, Philadelphia, New York and Boston, together with forecasts of the force and direction of the wind and the state of the weather for the first three days out of steamers bound east from American ports. Arrangements were also made with Portugal towards the end of 1900 for the receipt at Washington of reports from the meteorological observatory at Horta, in the Azores. Observations are now regularly transmitted by cable from this place, and have proved of much value in the work of forecasting the movements of storms on the Atlantic Ocean.

THE Imperial Department of Agriculture for the West Indies has issued a Report on certain economic experiments conducted in connection with the Antigua Botanic Station during the period from May, 1901, to April, 1902. Considerable variation was shown in the crop results, to a great extent attributable to the abnormally wet season, the year's rainfall amounting to 75·46 in., the total for the preceding year being 42·67 in. February was the only dry month. The experiments have for their objects the improvement of local food products, the introduction of new crops, and the placing on record of interesting facts bearing on insect and fungoid attacks, climatic conditions, &c. An investigation of the black-spot disease of pine-apples and of their rotting during transit to Europe has led to the conclusion that the former is due to injury, during the period of growth, from the attacks of a Penicillium, and the latter to injury, after cutting, from the attacks of *Trichosphaeria Sacchari* (rind fungus) and a species of Diplodia.

PROF. J. SCHNEIDER contributes an interesting paper, on the diurnal movements of the atmosphere at Hamburg, to the September number of the *Meteorologische Zeitschrift*. The wind observations published in the "Deutsche Meteorologische Jahrbuch" for the years 1887 to 1896 are dealt with by resolving into components in west-east and south-north directions, and the diagram of hourly movement shows that the daily curve is entirely closed, its form being egg-shaped, with the narrow end pointing north-east, and its total perimeter about 45 kilometres.

DR. A. SPRUNG describes a number of photographs of halos and parhelia, taken by him at Potsdam on March 23, in the August issue of the *Meteorologische Zeitschrift*. One of the photographs is reproduced. The phenomena are of special interest from the fact that they include both parhelia and the rare large halo, and that the dark spaces are indicated in the photographs. Measurements of the plates give the following mean results, which are compared with the means of direct measurements made by different observers:—

	Mean radius of small ring.		Distance of parhelia.		Mean radius of large ring.
Photograph...	22° 22′	...	23° 2′	...	46° 25′
Observers ...	22° 23′	...	24° 24′	...	46° 15′

THE problem of the representation by a finite number of parametric formulæ in two variables of the neighbourhood of a singular point of an algebraic surface was first solved in 1892 by Gustav Kobb, but his solution received criticism at the hands of Beppo Levi in 1897. Mr. C. W. M. Black, writing in the *Proceedings* of the American Academy of Arts and Sciences, now gives a new investigation of the problem, which is claimed not only to supply the deficiencies in Kobb's reasoning, but also to extend the discussion from the case of an algebraic surface to the more general case of any analytic surface whatever.

MR. C. H. HINTON has published, in the *Bulletin* of the Philosophical Society of Washington, a paper on the "Recognition of the Fourth Dimension." In it the author examines

what would be the general character of the motions of bodies in space of four dimensions. The most interesting feature of this line of inquiry is the possibility which is pointed out of constructing representations of the phenomena of electromagnetism by means of vortex motions in four-dimensional space. Thus a vortex with a surface as its axis affords a geometric image of a closed circuit, and there are rotations which by their polarity afford a possible definition of static electricity. Has it occurred to the author that the property that electricity which is free to move in a conductor assumes a superficial distribution may enable us to form a conception of matter in four-dimensional space assuming a three-dimensional distribution?

THE work done by Prof. Barrett and Messrs. W. Brown and R. Hadfield on the properties of alloys of iron is of very high importance to all engineers, whether electrical or civil. The third part of a paper on the subject is published in the *Scientific Transactions* of the Royal Dublin Society for September; the two first parts were published in 1899. In the present section, non-magnetic alloys of iron and alloys more magnetic than best Swedish charcoal iron are considered. Manganese added to iron to the extent of about 13 per cent. gives an alloy which is practically non-magnetic; a still more remarkable effect is seen with manganese-nickel-steels; magnetic alloys of iron with manganese or nickel can be made non-magnetic by adding a suitable amount of the other metal. There is possibly a great future for such alloys in shipbuilding. The alloys more magnetic than the best commercial iron are made with nickel, silicon and aluminium. The authors suggest that an iron alloy containing silicon and aluminium will very probably prove to be the best material to use for transformers. The great value of this work is obvious, and we should like to be able to deal with it more fully; fortunately, the results are easily accessible, as a paper covering practically the same ground as all three of the Dublin papers was read by the authors before the Institution of Electrical Engineers last February (*Journal* I.E.E., vol. xxxi. p. 674).

THE Health Department of the City of London has had a number of samples of ice-creams bacteriologically examined. A large proportion of the samples was found to be unsatisfactory; in several micro-organisms were very numerous, while in some virulent organisms of the *Bacillus coli* type were present; one contained pyogenic organisms and produced abscesses in guinea-pigs, and another contained an anaërobic organism, perhaps the bacillus of malignant œdema. Many of the ice-creams from which samples were examined had set up gastro-enteritis in boys employed by the Post Office. The London County Council (General Powers) Act, 1902, which came into force on November 1, contains clauses relating to ice-creams, regulating their manufacture, &c., and notices in Italian have been printed for distribution among the vendors.

WITH the publication of the October number (vol. ii. No. 4), the *Journal of Hygiene* completes its second volume and its second year of issue. Messrs. Wright and Windsor contribute a paper upon the bactericidal effect of human blood *in vitro*, and find that whereas human blood-serum has a powerful bactericidal action upon the typhoid bacillus and cholera vibrio, it is without action upon the *M. pyogenes*, *B. pestis* and *M. melitensis*. Dr. Haldane details the results of a lengthy experimental investigation upon the air of factories and workshops, Prof. Tunnicliffe discusses the digestibility of the various albuminous constituents of human milk and its substitutes, and Dr. Ritchie concludes his survey of the current theories regarding immunity.

PIOUSLY minded people have a tendency to accept as ancient anything which pretends to be a monument of Biblical history; as a consequence of this trait, Jewish shekels and half-shekels have been forged and even invented to supply the demand. An interesting exposure of these frauds is given by Mr. G. F. Hill in the *Reliquary and Illustrated Archaeologist* for October. There are other illustrated papers in this journal dealing with ecclesiastical architecture and stone-carving.

APART from the superstition bound up with the use of native medicinal remedies of the North American Indians, it is probable that their knowledge of herbs is much more extensive than that of the white man. Mr. V. K. Cheshunt, who has endeavoured to elicit from the Indians of Mendocino County, California, trustworthy information respecting the uses to which they put various indigenous plants, attributes our knowledge of *Cascara sagrada* to these tribes and suggests that other plants, such as Ceanothus, Croton and Eriogonum, would well repay investigation. The diet of the inland tribes is peculiar, as they regard young clover shoots as a delicacy, and make use of acorns and the variety of horsechestnut known as "buckeye" for making a porridge or baking into bread. The method adopted is to pound up the seeds into very fine flour and wash out the tannin and other stringent ingredients with water. A porridge or thick soup is formed by boiling the flour, while a favourite recipe for making bread consists in mixing the dough with red clay. The product is a heavy, black, cheese-like substance, in which the clay probably absorbs the oil and converts the last trace of tannin into a more digestible form. Another curious custom previously in vogue was the use of poisonous plants, soap root and turkey mullein, which were thrown into streams to poison the fish. These were then caught and eaten without any deleterious consequences.

NEW fields for research are continually opening up; the last illustration of this is the discovery by Prof. G. Elliot Smith that it is possible to map the convolutions of the brains of non-mummified ancient Egyptians. The brain is naturally preserved in the vast majority of the bodies in Egyptian cemeteries from predynastic to recent Coptic, the favourable conditions being burial in dry soil and removal from all direct access to the air. Prof. Elliot Smith gives an illustrated preliminary paper on the natural preservation of the brain in the ancient Egyptians in the *Journal of Anatomy and Physiology* (vol. xxxvi. p. 375). In a memoir, which will be published in a short time, he intends to give a full account of the structure of the brain in the predynastic and protodynastic Egyptians.

IN the Report of the Madras Museum for 1901–1902, the appointment of the director, Mr. E. Thurston, as superintendent of the Ethnographic Survey of Madras is an announcement which will be read with satisfaction by all anthropologists. The papers on the hill and other primitive Madras tribes already published by Mr. Thurston have placed him in the first rank among the students of anthropology and ethnography, and he will now doubtless have fuller opportunities of pursuing these subjects. Anthropological studies have, it appears, an amusing, if not a somewhat embarrassing, aspect in Madras. When on tour in one district, for example, Mr. Thurston was reputed to be collecting for the Victoria Memorial, inoculating for the plague and recruiting for the Boer war, the measurements that he took giving rise to the idea that he was an army tailor! The ethnographic reports of native assistants are, moreover, not exactly what they should be, as witness the following:—"They know how to make fire; *i.e.*, by friction of wood as well as stone, &c. They take a triangular cut of stone and one flat oblong size flat. They hit one another with the maintenance of coir or copper, then fire sets immediately and also by rubbing the two barks frequently with each other they make fire."

THE account of the "Plants of Chatham Island," which formed the subject of an address by Mr. L. Cockayne to the

members of the New Zealand Institute, not only possesses the interest which attaches to the impressions obtained by a personal visit, but is additionally so as it is still possible to trace the original vegetation and study the changes which are taking place owing to the introduction of animals and foreign plants. A remarkable and regrettable instance of the latter is the almost complete annihilation of the plant well named *Myosotidium nobile*, which originally lined the shore just above high-water mark. The sheep feed on the leaves and the pigs grub up the rhizomes, and now this plant is limited to quite a few localities. A striking feature of the island is the large Te Whanga lagoon, which occupies about one-third of the island. This, however, is not so important botanically as the swamps, which represent a transition stage from lagoon or lake to drier localities which rapidly become forest lands. Not the least curious feature, and one which has been noted but not satisfactorily explained in other countries, is the occurrence of plants with xerophytic characters growing in the swamps. Such an one is a peculiar Restiaceous plant, *Leptocarpus simplex*, which grows in the wettest parts, while another is *Olearia traversii*, which, however, may be taken as an indication that the swamp is passing into a dry condition.

MESSRS. JAMES SWIFT AND SON have sent to us, for trial, one of their compound microscopes of recent type, fitted with their newly patented "Ariston" fine-adjustment. The essence of this is the setting of the micrometer-screw and its milled head upon a closed tube, which, like a jacket, surrounds the pillar. By the attachment to the head of this jacket of a couple of levers, upon the upper part of which the screw reacts by means of a fine point, there is assured a successful elimination of the troublesome side-movement resulting from a bending of the metal composing the limb when the fine-adjustment is subjected to pressure. In thus ensuring to the operator the comfort of absolute rigidity, the conditions employed give with a coarse screw a slow rate of speed and a very delicate result. The apparatus is entirely satisfactory, and can be fitted to certain of Messrs. Swift's microscopes at small cost. It is worthy their newer mechanical stage, their ruled "finder," and the devices, simple but effectual, which they have from time to time introduced into the construction of their instruments for compensation in wear and tear. In these and other similar matters of recent years, Messrs. Swift have shown themselves constantly on the alert for improvement. In the excellence of their $\frac{1}{12}$-in. homogeneous oil immersion, they have produced an English-made lens of first-rate capacity which is a marvel of cheapness; and it must not be forgotten that in the early days of the modern student's microscope they were the first to introduce the Jackson type of stand, just as we believe it was the Englishman Collins who similarly first produced the iris-diaphragm, which, like it, was a triumph for British manufacture.

THE Report of the U.S. National Museum, under the direction of the Smithsonian Institution, for the year ending June 30, 1900, is, as usual, remarkable for the many interesting papers it contains and the wealth of beautifully executed illustrations which accompany them. The first part of the volume contains the report of the assistant secretary, and includes sections contributed by the head curators of the departments of anthropology, biology and geology. Part ii. makes up nearly 600 of the 738 pages to which the report runs; it contains seven contributions, some of which may fairly be called monographs. Mr. W. H. Holmes, head of the anthropological department of the museum, describes his anthropological studies in California, his contribution being illustrated with fifty excellent plates. The pictures of the baskets made by the Tulare Indians and the scenes showing incidents in their everyday life are particularly fine. An exhaustive study of aboriginal American harpoons, in which they are treated as a study in ethnic distribution and invention, is by Dr. O. T. Mason, the curator of the division of ethnology. Nineteen plates and nearly a hundred figures accompany this article. The Commissioner of the Imperial Maritime Customs Service of China, Mr. A. E. Hippisley, gives a sketch of the history, with twenty-one plates, of ceramic art in China, and supplies a catalogue of the Hippisley collection of Chinese porcelains. The remaining papers are, "Contributions to the History of Musical Scales," by Mr. C. K. Wead, of the U.S. Patent Office; "A Collection of Hopi Ceremonial Pigments," by Mr. W. Hough; a "Descriptive Catalogue of the Collections of Gems in the U.S. National Museum," by Mr. Wirt Tassin; and a catalogue of the meteorite collection, by the same author.

MESSRS. C. GRIFFIN AND CO., LTD., have recently published a ninth edition, revised and enlarged, of Prof. A. Jamieson's "Elementary Manual on Steam and the Steam Engine." From the same publishers we have received the fifth edition of Prof. Jamieson's "Elementary Manual of Applied Mechanics," which has also been enlarged.

A NUMBER of stereoscopic slides of scientific interest have been prepared by Messrs. Erdmann and Schanz, Bedford Hill, Balham, London, S.W. Among the subjects represented are type studies from India and Ceylon, hoar-frost scenes and wild animals. A compact and effective stereoscope with aluminium hood is supplied by the same firm.

TWO more volumes belonging to the *Scientia* series, published in Paris by M. C. Naud, have been issued. One, No. 14 of the biological series, by Prof. A. Imbert, of the University of Montpellier, is entitled "Mode de Fonctionnement économique de l'Organisme." The other, No. 20 of the physico-mathematical series, is by M. H. Laurent, "Sur les principes fondamentaux de la Théorie des Nombres et de la Géometrie." Each volume is a short monograph giving the present state of knowledge of the subject surveyed.

THE thirty-fourth volume of the *Proceedings* of the London Mathematical Society, which has now been published, contains the papers communicated to, or read before, the Society from March, 1901, to April, 1902, and some of the contributions included in the publication are of high mathematical interest. We have also received the second volume of "Mathematical Questions and Solutions from the *Educational Times*." The collection is edited by Miss Constance Marks, and is supplemented by papers and solutions which have not hitherto been published.

THE volume containing the physical papers of the late Prof. Henry A. Rowland, the preparation of which for publication was announced in April of this year, is now nearly ready for distribution to its subscribers. It has been edited under the direction of a committee, consisting of President Remsen, Prof. Welch and Prof. Ames, who have made every effort to present to the world, in a suitable form, this memorial of their colleague. The price of the volume will be one guinea per copy for orders sent in advance of publication, after which the price will be increased. Orders may be sent to Prof. Joseph S. Ames, Johns Hopkins University, Baltimore, Maryland.

A BRILLIANT address on "The Rise of the Experimental Method in Oxford" was delivered by Prof. Clifford Allbutt before the Oxford University Scientific Club last May, as the ninth Robert Boyle lecture. An abstract of the address was given in these columns on May 22 (p. 90), and readers of it could not fail to be struck by the richness and charm of the style in which Prof. Allbutt dealt with his subject. The complete discourse, which has now been published by Mr.

Henry Frowde at the price of one shilling net, should be obtained by everyone interested in the history of science.

IN a communication published in the May number of the *Transactions* of the American Microscopical Society, Messrs. Whipple and Parker discuss the connection between the amounts of oxygen and carbonic acid dissolved in natural waters and the occurrence in these of microscopic organisms. It has long been known that exhaustion of nitrates takes place in ground water supporting a vigorous growth of algæ, and it has been assumed that nitrates are the fundamental factor in the development of these. Nitrates are indeed important, but the inadequacy of this explanation became manifest when it was observed that some water, comparatively poor in nitrates, at times supported large growths of algæ. The authors point out the apparent importance of carbonic acid, and express the opinion that the algæ are influenced by it more than by the nitrates. The study of the number of organisms in water at different depths has given some interesting results. Water taken from Lake Cochituate was found to contain the following numbers of Mallomonas per cubic centimetre :—

Depth in feet ...	0	10	30	30	40	50
No. of organisms	0	0	1454	548	112	88

At the surface and throughout the circulating water above the thermocline, oxygen was abundant, but carbonic acid was absent. Near the bottom of the lake there was carbonic acid, but no oxygen, whereas just below the thermocline both gases were present, and as Mallomonas is a chlorophyll-bearing organism it found there conditions favourable for its development.

THE additions to the Zoological Society's Gardens during the past week include two Kusimanses (*Crossarchus obscurus*), a White-crested Tiger Bittern (*Tigrisoma leucolophum*), a Great-billed Touracou (*Turacus macrorhynchus*), a Sharpe's Wood Owl (*Syrnium nuchale*) from West Africa, presented by Mrs. Hurst; a Mute Swan (*Cygnus olor*), a White-fronted Goose (*Anser albifrons*), four Widgeon (*Mareca penelope*), two Pintails (*Dafila acuta*), four Pochards (*Fuligula ferina*), six Common Ducks (*Anas boscas*) European, two Black Swans (*Cygnus atratus*) from Australia, presented by Mr. W. N. McMillan; a Persian Gazelle (*Gazella subgutterosa*) from Central Asia, presented by Mr. B. T. Ffinch; two Emperor Boas (*Boa imperator*) from Central America, presented by Dr. Hans Gadow, F.R.S.; a Thick-tailed Opossum (*Didelphys crassicaudatus*) from La Plata, a Blue-fronted Amazon (*Chrysotis oestiva*) from South America, deposited.

OUR ASTRONOMICAL COLUMN.

VARIATION IN MAGNITUDE OF α ORIONIS.—Mr. D. E. Packer, of Birmingham, has recorded, in a letter to No. 1961 of the *English Mechanic*, the observation that α Orionis is increasing in brightness. Although a known variable, its general variations for the past thirty years have been so minute as to attract no particular attention, but Mr. Packer says that, on the night of October 15, the star was distinctly brighter than Capella and only slightly less bright than Sirius.

Herschel recorded very marked variations in the magnitude of this star between 1836 and 1840, and Sir W. Huggins noticed variations in its spectrum during a second period of variability, 1849–1852. Mr. J. E. Gore confirms Mr. Packer's observations.

THE NEBULA AROUND NOVA PERSEI.—Prof. C. D. Perrine publishes, in the *Bulletin* (23) of the Lick Observatory, several reproductions, and the measures, of the excellent photographs of the nebula around Nova Persei which were obtained with the Crossley reflector, and he also discusses the striking changes observed in the condensations of the nebula.

From measurements of the negatives obtained on March 29, 1901, and January 10–11, 1902, respectively, it appears that the inner ring of nebulosity is expanding radially, at an average rate of 1″·4 per day, whilst the outer ring is similarly expanding 2″·8 per day. These measurements of the inner ring would carry it back to the Nova on February 8, 1901, whilst the outer ring is similarly carried back on February 16–17; both the plates give the same dates. This does not imply the prior formation of the inner ring, for, considering the uncertainties of measurement, Perrine suggests their contemporary origin.

Many suggestions have been made to explain the apparent velocities of parts of the nebula, the two chief explanations being the transition of material particles, and the propagation of a wave of light through, and reflection from, the fine particles of matter making up the nebula. The former seems unlikely, because the movement contains a large tangential factor, whilst the latter theory would have to presume largely variant velocities of the light waves, a presumption which is inconsistent with our present knowledge of light. In order to test the "reflection" theory, Prof. Perrine introduced a double-image prism between the plane mirror of the Crossley reflector and the photographic film, and found that the light was not polarised, *i.e.* the two images were of equal intensity. On polarising the light from α Lyræ and treating it in the same manner, he found that the mirrors of the instrument had practically no effect on polarised light.

The final result points to the existence of little or no polarisation in the light from condensation D, and, with less certainty, in that from condensation A, and therefore refutes the reflection theory.

CORONAL DISTURBANCE AND SUN-SPOTS.—In No. 98 of *Popular Astronomy*, Prof. Perrine demonstrates the close connection between the coronal disturbance, photographed at Sumatra during the total eclipse of 1901, and the group of sun-spots and extensive faculæ which came round the limb of the sun on May 19.

From photographs of the solar disc obtained at Dehra-Dun, India, between May 18 and 28, inclusive—of which copies were kindly supplied to Prof. Perrine by the Astronomer Royal—it is seen that a fairly large group of spots and faculæ came round the limb on May 19, and that at the time of the eclipse this group would be very near to the limb. The position angle of the spot, as projected on to the limb, was 60°·2, whilst that of the apex of the coronal disturbance was 60°·0, and during the eleven days under observation this was the only group of spots photographed. This shows conclusively that the spot and the coronal disturbance were in the same line of sight, and further reductions have shown the probability that the origin of the coronal disturbance was also near to the limb at the time. The long, thread-like prominence seen projected almost tangentially from the sun's limb during the eclipse appears to have emanated from the same group of spots and faculæ, so that, in this case at least, all these phenomena appear to have had a common origin.

This aggregation of related phenomena seemed to point to the possibility of the existence of a great disturbance in the solar atmosphere on this date, and a further investigation was made in order to discover if any measurable displacement of the coronal masses took place in the disturbed region. The photographs compared were taken at an interval of five minutes, and no measurable displacement can, with certainty, be traced thereon; from this we may conclude that the velocity across the line of sight was less than twenty miles per second. A comparison between the photographs obtained at Mauritius and Sumatra, respectively, with an interval of one-and-a-half hours, would probably decide this question of movement.

THE VARIABLE STAR 13, 1902, LYRÆ.—Further observations of this Algol variable have given the following results :—

Approximate position for 1900, 19h. 12m. 31s. +32° 14′·8. Range of magnitudes, 10·98 to about 12·8. Period, 3d. 14h. 22m. 23s.·5.

The Variable Star Committee of the Astronomische Gesellschaft has assigned to this star the designation R.V. Lyræ (*Astronomische Nachrichten*, No. 3821).

NEW VARIABLE STAR, 15,1902, DELPHINI.—Dr. Anderson, of Edinburgh, has communicated to No. 3821 of the *Astronomische Nachrichten* his observation that a star, not mentioned in the B.D., but having the approximate position R.A. = 20h. 34m. 43s., Dec. = + 11° 21′·5 (1855·0), has proved to be a variable.

Assigning the magnitudes 9·5, 9·7 and 11·2 to B.D. + 11°·4353, B.D. + 11°·4358, and a star having the approximate position

20h. 34m. 37s. + 11° 18′·5, respectively, the following magnitudes have been observed for the newly discovered variable :—

Date, 1902.				Magnitude.
September	4	...	...	9·6
,,	6	...	...	9·6
,,	24	...	...	9·8
,,	25	...	...	9·8
October	7	...	...	10·2

EDUCATION AT THE BRITISH ASSOCIATION.

THOUGH the youngest offspring of the British Association, the Section of Educational Science has developed so rapidly that its growth in strength and influence is being watched with interest not unmixed with anxiety by several of the older sections. Most of the meetings devoted to the discussion of educational topics were largely attended this year, and all of them have been reported in detail, thus showing that science in education and education in science appeal to a wide public. The Section provides a platform on which it is possible, not only to state the place science should occupy in the curricula of school and college, but also to describe the character of the instruction which should be given, and to construct an organic educational science out of the disjointed body of opinion. It is easy to see that, rightly directed, the work of the Section may have an important influence in determining lines of progress in education ; and the success so far achieved justifies faith in the promise of the future.

One characteristic of the proceedings of the Section is especially noteworthy. Instead of accepting a variety of papers on diverse disconnected subjects, each meeting has been devoted to the discussion of a specific matter introduced by one or two papers. Attention has thus been concentrated upon definite points, and it has been possible to obtain the expression of competent opinion around them. Imperfections of scope and method have been pointed out, difficulties described and reforms advocated with a breadth of view and maturity of experience which command the attention of the educational world.

As an instance of the effect of the work of the Section, mention may be made of the discussion on the scope and teaching of elementary mathematics, opened last year by Prof. Perry, which led to the appointment of a committee with Prof. Forsyth as chairman. In the report presented by this committee, several desirable reforms were indicated, all of them of a kind capable of adoption by teachers and examiners. The committee considers that different methods of teaching mathematics might be adopted for different classes of students, and corresponding types of examination should be used. Emphasis is laid upon the recommendation that the teaching of demonstrative geometry should be preceded by the teaching of practical and experimental geometry, together with a considerable amount of accurate drawing and measurement. In demonstrative geometry, no single book should be placed in a position of authority, nor should there be a single syllabus in control of all examinations. It is recommended that some association of arithmetic and algebra with geometry is desirable in all cases where this may be found possible. Examining bodies are advised that no candidate should be allowed to pass unless he gives evidence of some power to deal with questions not included in the text-book adopted. With regard to arithmetic and algebra, regret is expressed that the decimal system of weights and measures has not been adopted in this country. Graphical methods should be used wherever possible, and tables of simple functions should be introduced as soon as the student is capable of understanding the general nature of the functions tabulated.

In opening the discussion on points arising from this report, Mr. A. W. Siddons described the recommendations of the Mathematical Association Committee, of which he is honorary secretary. Like the British Association Committee, that of the Mathematical Association recommends that a first introduction to geometry, and to each new branch of geometry, should be experimental with the use of instruments and numerical measurements and calculations. So far as deductive geometry is concerned, Mr. Siddons pointed out that there seem to be four alternatives :—(1) To have no one syllabus placed in the position of authority; (2) to replace Euclid by *one* standard syllabus ; (3) to modify Euclid by omission and readjustment ; (4) to retain Euclid in its present form.

The Mathematical Association Committee has recommended the adoption of a modified Euclid ; it is considered that the time is not yet ripe for the proposal of a standard to be adopted finally in place of Euclid. The modifications proposed include :—(1) The omission of some propositions which do not help on the course or which should be regarded as axiomatic ; (2) improved methods of proving other propositions, including the use of hypothetical constructions ; (3) the addition of a few propositions ; (4) the adoption of Playfair's axiom and the "limit" definition of a tangent ; (5) the use of angles greater than two right angles ; (6) that the exact treatment of incommensurables be regarded as a branch of higher mathematics.

The discussion upon the two reports was distinguished this year by the fact that mathematical masters from several public and other large schools were present and took part in it. It is evident from the opinions expressed that reforms in the directions advocated by the two committees would be welcomed by many teachers.

Mathematical ideas can be obtained by means of Froebel's boxes of geometrical solids and simple plane figures, but the school work after the kindergarten is not usually conducted on the same sound and systematic plan. An address on the subjects to be taught as science in schools and the order in which they should be taken, given by Dr. C. W. Kimmins, indicated desirable directions of study. Dr. Kimmins pointed out that the great reforms which have taken place in recent years in the teaching of science in schools have been due in large measure to the British Association report on the teaching of chemistry. Similar reports are needed on the teaching of other subjects suitable for instruction in schools, and it is hoped that the committee appointed on the teaching of botany will be of value in this connection.

Dr. Kimmins suggested that the interval between the kindergarten (pupils five to eight years of age) and the experimental science course should be utilised for suitable nature-study teaching. During this interval, thorough instruction should be given in practical mathematics, including the mensuration which is generally taken as part of the experimental science course. This should be given in the time devoted to mathematics, not science. Finally, it was considered that the subjects requiring special attention are the teaching of natural history and botany, and the correlation of science and art teaching.

When experimental science is introduced into schools, the best course of practical instruction to follow is one based upon heuristic principles, such as that which has been introduced into Irish national schools. Mr. W. Mayhowe Heller, who has organised the work, described the methods and results of the scheme. The Commissioners of National Education, in taking steps to introduce practical instruction into their schools, are attempting to do the work accomplished in the towns of England and Scotland by local educational enterprise. In elementary science, the typical course for boys and girls is based on the 1889 recommendation of the British Association Committee. Teachers attending training courses have to perform all experiments of the course themselves. Free equipment grants of apparatus for manual instruction and elementary science are given to necessitous schools. Very few schools at present have laboratories, but at the same time a great deal of individual experimenting can be accomplished. Object lessons are allowed as a substitute for a systematic course of instruction in experimental science, but these must attempt to achieve the same results as the science lesson, viz. accurate habits in observation, work, description and reasoning. Practical instruction of this kind is of the highest importance to Ireland ; for upon its successful introduction into the national schools depends the future of technical instruction.

The position of science in Irish intermediate schools was brought before the Section in two papers, one by Mr. R. M. Jones, head-master of the Royal Academical Institution, and another by Mr. T. P. Gill, secretary of the Department of Agriculture and Technical Instruction. Mr. Jones gave a survey of the working of the new scheme of intermediate education and indicated the probable tendency of developments. Practical work in physics and chemistry has been introduced into intermediate schools, the scheme followed being that of the Department of Agriculture and Technical Instruction. The result is that laboratories in which simple measurements and weighings can be conveniently carried on have been provided in many

schools, and the work done in them is of a most inspiring character both to teacher and pupil.

The science programme for the Irish intermediate or secondary schools was dealt with by Mr. Gill, who though by training and inclination a humanist, expressed his complete satisfaction with the aims and scope of the scheme. The programme was introduced for three reasons, which Mr. Gill expressed as follows:—

"First, because we believe that science has a part as well as letters in the science of general education—(remember, I am speaking now only of the science part of the programme, and only of the secondary schools)—and, secondly, because the teaching of experimental science according to this programme involves a method now commonly called the heuristic method, which we believe has a great educational value and may be applied to the advantage of the study of other subjects as well as science. The third reason is the special value of science in connection with technical instruction."

Mr. Gill confessed that in admitting the claim of science in general education, and standing as its champion, he did so as a convert, and one who has been brought to that realisation of the power and value of science which is forced upon every modern man. "Scientific physics," he remarked, "which have now their recognised place in public instruction, are admittedly no more difficult to learn or to teach than Latin or Greek, and in our Irish public schools at the present time I venture to say Latin and Greek are not so well taught as our experimental science, with all the great drawbacks and the difficulties which have beset us in the endeavour to provide teaching power. The secondary school which has to do with the future leaders, the industrial and intellectual leaders of the country, would hardly be true to its function as a preserver of the equipoise of general knowledge, would hardly be a living institution informed by the spirit of the age, if it failed to take notice in its curriculum of the place science occupies to-day in the mental and material life of society."

Dr. W. J. M. Starkie, Resident Commissioner of National Education in Ireland, created a sensation among Irish educationists by a paper in which he criticised the recent reforms of primary and secondary education, undertaken with a view to their co-ordination. He condemned the managerial control of national schools in Ireland, and pleaded for that which every civilised country in Europe has long since attained—a single local authority for education outside of technical schools and universities. Nothing can be done, however, until educated and independent laymen come forward in sufficient numbers to make their influence felt on such authorities.

As regards English schools, Dr. J. H. Gladstone read the report of the committee on the teaching of science subjects in elementary schools; but the changes which have been caused by the introduction of the Block grant in place of the former examination grants have made it difficult to arrive at definite information as to the number of pupils receiving instruction in science. It is felt that the time has now arrived for a general survey of the progress made since the committee was appointed in 1879, and such a statement will, it is hoped, be presented to the Association next year.

Before any subject can be taught with success, the health of the pupil and the training of the teacher have to be considered. A preliminary report of the committee on the conditions of health essential to the carrying on of the work of instruction in schools was presented by Prof. C. S. Sherrington, F.R.S. Attention has so far been directed to the following points:—The periods of day appropriate for different studies, the length of lessons, and periods of study suitable for children of different ages; anthropometrical and physiological observation forms in use in various schools with a view to preparing a typical form for general use; anthropometrical and physiological observations recorded in different schools for a series of years on the same children; investigations into the causes of defective eyesight in school children and a definition of the conditions necessary for preserving the sight; the practical knowledge of hygiene possessed by school teachers. Much interesting information has been collected and tabulated, and it is hoped that when the final report is presented next year some action will be taken upon its recommendation.

Given pupils in a condition to study with profit, it is desirable that the teachers should be trained to direct their mental activities. In a paper on the preliminary training of teachers, with special reference to women, Miss L. E. Walter described the various avenues to qualification as teachers in elementary schools, and suggested some practicable improvements in the courses of study pursued between the ages of about fourteen and eighteen years. She condemned the excessive book-work which must be done by pupil teachers who desire to pass their examinations, especially when scientific subjects are concerned. It was urged that in every pupil teachers' school or centre the students should be taught (1) how to read books with permanent profit; (2) how to increase their knowledge practically by simple experiments as distinct from book-work.

In the course of a brilliant address, Prof. H. L. Withers pointed out that the problem of the training of teachers is essentially different in a primary and secondary school. In the former a considerable, though incomplete, system has been in existence for the best part of a century, while in the latter the provision made is still so defective that at least in the case of boys' schools it may be said that we have everything to do from the beginning. For the primary teacher large Government grants are given, while nothing is as yet allowed for the secondary. Primary schools are fairly homogeneous. Secondary schools display a great multiplicity of types, social and educational, day and boarding. The problem in the two cases was, therefore, treated separately by Prof. Withers. As regards the latter, it was remarked that the multiplicity of types is so great that anything like a single stereotype system of training would be futile. The secondary schools themselves must take a large share in framing an elastic variety of systems, and the training provided must be consistent with all that is best and strongest in our existing tradition. Analogy with other professions suggests that a combination between the great schools and the Universities is essential for the institution of a complete system of professional training. Though in several respects the position of men as regards training is quite distinct from that of women, yet for the purposes of both who desire to obtain their professional training at universities, each university should, for the future, be equipped with a department of education as effective as its departments of law and medicine. As much as possible should be done to refer students to the principles of mental, moral and physical science, upon which the theory and practice of education must ultimately be based.

In secondary schools a knowledge of educational principles is not regarded as of much importance, and young men go to them to teach without having received any training. In the course of time some of them became good schoolmasters, gaining experience at the expense of their pupils. In such cases the school has the same relation to the teacher as the workshop to the engineer, but there is little doubt that the master and the engineer should receive some practical training before undertaking professional duties. Prof. Perry's presidential address on the training of engineers was discussed at a joint meeting with the Section of Engineering. Among the points brought forward in the course of the discussion were, that it would be an advantage if students of engineering could spend five months each year in a workshop and five months in a technical college; that preliminary training in habits of observation and accuracy was of the greatest value; that teachers should be kept in close touch with the practice of their profession, and their laboratories should be equipped with modern tools and machinery; and that we have little to learn from Germany in the matter of education or of turning out work, but much to learn as regards financial ability and the science of commerce.

Language is an important factor in determining commercial developments. It is therefore worth while to consider Sir Frederick Bramwell's suggestion that the great commercial nations—the United States, Germany, France and England—should each adopt a common language to be learnt in addition to their own, in order to facilitate intercommunication and save the trouble of learning several languages for business purposes. Italian was suggested as a suitable language for the purpose, because it is easy of acquirement, founded upon a classic basis, and could be adopted without arousing feelings of jealousy among the nations accepting it. Latin was also suggested as a suitable common language, as it was in mediæval times.

Many people believe that English will in the course of time become the language of commerce, but if this is to be realised more attention must be paid to the teaching of our mother tongue in schools than is usually the case. Mr. P. J. Hartog dealt with this subject in a paper which led to a good discussion. He held that a mastery of our language is as necessary for the so-called practical uses of the leaders in war, diplomacy, science and commerce as for the historian and the philosopher. Though

on the grounds of utility English ought to be given an important place in the school curriculum, it is one of the most neglected subjects. The result is that few boys leaving school are able to write a good letter, and many adults are unable to describe things or events in precise terms. On this account many misleading statements are made which might have been avoided. Mr. Hartog pleaded for the rational and systematic teaching of the mother tongue in our schools. By neglecting this subject the teacher is deprived of a very powerful instrument of education. Prof. G. M. Minchin gave, in a paper, a number of examples of the misuse of common English words and expressions, among them being split infinitives, *without* instead of *unless*, misplaced *shall* and *will*, and many others which should be avoided by all who desire to use words in their correct sense and place, and preserve our language from barbarisms.

Other subjects were considered during the meetings of the Section, but limitations of space will not permit descriptions of them, or of the many valuable points brought forward by speakers in the discussions. It was evident from what was read and said that a large amount of material of interest to men of science and practical teachers is available, so the Section is likely to be even more active in the future than it has been during its two years of existence. R. A. G.

BOTANY AT THE BRITISH ASSOCIATION.

THE semi-popular lecture was given on Monday, September 15, by Prof. F. W. Oliver, on ancient and modern seeds. The lecturer gave a clear and interesting description, illustrated with lantern slides, of the gradual evolution of the seed, and dealt with some of the more interesting questions concerning the morphology of various seed structures.

On Friday, September 12, the botanists paid a visit to the Belfast Botanic Gardens, and under the guidance of the able curator, Mr. McKimm, inspected the extremely interesting fernery which has recently been constructed. On Tuesday afternoon, the Rev. C. H. Waddell, the indefatigable local secretary of Section K, conducted a botanical excursion to Colin Glen. After an interesting ramble, the members were entertained to tea by Mr. and Mrs. Kidd, whose kindness was much appreciated.

Much interest was taken in a collection of characteristic Australian plants, exhibited by Mr. Thomas Steel during the meeting.

Prof. I. Bayley Balfour, F.R.S., exhibited and described specimens of the various forms of *Erica tetralix* found in Connemara. Mr. James Stirling, Government Geologist of Victoria, in a paper on the flora of the Australian Alps, dealt with the origin and distribution of the mixed types of plants now growing on the highest altitudes over south-east Australia, and their correlation with other Alpine and the Tertiary floras of the region.

Mr. R. Lloyd Praeger read a paper on the composition of the flora of the north-east of Ireland. This area includes the counties of Down and Antrim, and the flora numbers 820 species of flowering plants and vascular cryptogams, the total flora of Ireland being reckoned at 1020 species. There is in the local flora an almost complete representation of British type plants. English type plants are rather poorly represented. Scottish type plants reach in Antrim their maximum for Ireland; in Down they are somewhat fewer. Of Highland type species there is a fair representation; Antrim, though of less elevation, contains more Alpine plants than Down. Germanic plants are extremely few in Ireland. In Atlantic type plants, Down and Antrim are comparatively rich.

Mr. Herbert Wright (Ceylon) contributed a paper on foliar periodicity in Ceylon, in which he showed that some trees undergo complete defoliation twice per year; others exhibit incremental foliar activity several times per year, in addition to a complete annual renewal. The irregularity of foliar periodicity is very pronounced. There is not a month when all the trees are in full leaf.

In the department of plant physiology, Prof. J. C. Bose, of Calcutta, gave an interesting demonstration, illustrated by experiments, on the response of plants to stimulation (*vide Journ.* Linn. Soc., xxxv., 1902). Mrs. D. H. Scott gave an account of the movements of the flower-buds and flowers of *Sparmannia africana* up to the time of the setting of the fruit. At first the buds hang all in one plane; each bud has a joint on the stalk, which is much swollen below the flower. The buds rise one by one from the drooping position to the horizontal; then make a sharp curve inwards, and just before flowering the bud hangs down in an exactly vertical position. The flowers open during sunlight at a temperature not below 60° F. (15°·5 C.), so that on a cold day perhaps only one flower and on a hot day three or four may be open at the same time. The flowers reopen for several days; during this time they gradually take up a vertical position, pollen often being formed for five or six days. Then, if fertilised by bees, the flower-stalk falls again into the horizontal position, from which it rises again as the fruit ripens. Mr. Barnard and Prof. Allan Macfadyen, in a paper on luminous bacteria, stated that these organisms require particular and exact conditions in order to exhibit their luminous properties. They must have a suitable nutrient soil containing such proportions of salts as shall render the medium isotonic. A supply of free oxygen is essential; in the absence of oxygen the organisms live, but are non-luminous. The luminosity appears to be due to the vital processes of the cell, and an exposure to the temperature of liquid air does not destroy it. Prof. Macfadyen and Mr. Rowland also contributed a paper on the suspension of life at low temperatures, in which they showed that ten hours' exposure to the temperature of liquid hydrogen (about − 252° C.) had no appreciable effect on the vitality of the various organisms (bacteria and yeast) tested. Miss Gabrielle L. C. Matthaei (Cambridge) described experiments on the effect of temperature on carbon dioxide assimilation in the leaves of the cherry laurel. The lowest temperature at which assimilation could be detected was − 6° C. This is the first well-established case of assimilation below 0° C. For temperatures between −6° C. and 33° C. it was found that assimilation is affected in exactly the same way as is respiration. Provided the illumination is sufficient, the assimilation increases with the temperature. Dr. Henry H. Dixon (Dublin) gave an account of some experiments made to determine the resistance of seeds to high temperatures. The maximum temperature to which the various seeds were exposed and still retained their germinating power varied from 90° C. to 121° C. The president communicated a paper by himself and Mr. H. Jackson on the germination of fatty seeds. In the case of Ricinus, the reserves consist mainly of oil and aleurone, hardly a trace of carbohydrate being present. In germination, the oil diminishes and both cane sugar and glucose make their appearance, accompanied by the formation of lecithin, a fatty body which contains nitrogen and phosphorus.

Several important papers on fossil plants were read. Miss Margaret Benson described the seed-like fructification of *Miadesmia membranacea*, Bertrand. The foliage leaf bears a ligule in a longitudinal groove with thickened base and sides. In the sporophylls, the sporangia are inserted singly in the proximal end of the groove, and are large and pedicellate. In the megasporophyll, the sides of the groove are completely coherent above the sporange, and thus form a velum. The wall of the megasporange is composed of several layers of isodiametric cells, and encloses a single thin-walled megaspore or embryo sac. The microsporange has no velum, and the wall is formed of a palisade layer. Miss Benson also described the structure of some sporangia found associated with petioles and other fragments of *Lyginodendron oldhamium*. Mr. Lomax described two specimens obtained from Dulesgate, which show that Lyginodendron had a branching stem; also that the branch was given off in the one case between two leaf-stalks and in close proximity to several roots. The position of the roots shows that they must have been aërial roots, and not, as generally accepted, basal or confined to the basal regions of the stem. Mr. Lomax also read a paper on the occurrence of nodular concretions (coal balls) in the Lower Coal-measures. These bodies consist of a quantity of fragments of short pieces of stems, &c., some with the cortex, some without, some split in fragments, and so on. From an examination of these nodules it appears that, at least in this case, these plant remains have not grown on the spot where we now find them, and the author comes to the conclusion that the various portions of plants have been carried into their present position after being broken in fragments, and before petrification, or they have been carried from a parent bed after petrification. In a paper on sporangiophores as a clue to affinities among Pteridophyta, Dr. D. H. Scott, F.R.S., pointed out that some years ago he suggested the probability of an homology between the ventral sporangiophores of Sphenophyllum or Cheirostrobus and the similarly placed synangia of

the Psiloteæ; on this ground, among others, an affinity between the fossil and the recent family appeared tenable. This view has recently been supported by Prof. Thomas, of Auckland, N.Z., on evidence drawn from certain remarkable variations which he observed in the genus Tmesipteris. On the view suggested, the synangium of the Psiloteæ is neither a reduced strobilus nor a septate sporangium, but a ventral sporangiophore bearing a variable number of sporangia, normally two or three, according to the genus. Mr. A. C. Seward, F.R.S., and Mr. Arber gave an account of some fossil Nipa seeds from Belgium.

In the domain of plant morphology, several interesting papers were communicated. Mr. John C. Willis, director of the Royal Botanic Gardens, Peradeniya, described the dorsiventrality of the Podostemaceæ, and showed that it extends both to the vegetative and floral organs. The more modified types show a progressive increase in dorsiventrality of the vegetative system followed throughout by an increase in that of the floral. The same series, regarded ecologically, shows that though the flowers are steadily more and more zygomorphic—a condition usually regarded as an adaptation to insect visits—we have here flowers which stand stiffly erect, and are more and more anemophilous and autogamous. Miss Sibille O. Ford (Cambridge) gave an account of the morphology of the Araucarieæ, which include the two genera Araucaria and Agathis; they are characterised by the regularity of their branching and the persistence of their leaves. The apex of the stem shows no definite apical cell, but a somewhat irregular dermatogen. Well-marked annual rings may be found in the wood, and bordered pits are found on the tangential walls of the latest formed summer wood. Mr. Herbert Wright (Ceylon) described the sex relationships in Ceylon species of Diospyros. These plants have hitherto been regarded as dicœcious, but he finds from an examination of fresh material frequent departures from this condition, some being moncœcious, others dicœcious and polygamous, and others diœcious, monœcious and polygamous. Mr. Worsdell gave an account of the various theories as to the nature of the sporangial integuments in various groups of plants. The author maintains Čelakovsky's view that in the ferns the *soriferous segment of pinnule*, bearing as a rule sporangia on its lower (dorsal) surface, is the homologue of the outer integument of the ovule in Angiosperms, and *indusium* that of inner integument. Mr. Worsdell also read a paper on the nature of the vascular system of the stem in certain dicotyledonous orders, in which he comes to the conclusion, from anatomical data, that no hard and fast line exists between the two classes of dicotyledons and monocotyledons. The flowering stem and peduncle, as being those parts of the caulome which have undergone least modification owing to the necessities of adaptation to external conditions, exhibit, as a rule, most clearly the primitive structure which in the vegetative parts has become obscured. Mr. E. A. Newell Arber (Cambridge) read a paper on the morphology of the flowers in certain species of Lonicera. The genus includes about seventy species which belong to the section Xylosteum. In this section, the gynœcea of a two-flowered dichasium are more or less completely united together. In some cases, the two inferior ovaries are united in one plane by *the union of their receptacular walls*. In others they are for the most part free from one another, but surrounded by an outer parenchymatous tissue, arising from the base. This tissue is the result of the *fusion of the bracteoles* of the true flowers. Mr. Harold Wager communicated some of the results of his recent observations on the structure of the central body in various species of Cyanophyceæ which show that, although wanting some of the characteristics of the nuclei of higher organisms, it must be regarded as nuclear in character and possibly as a nucleus of a simple or rudimentary type. In another paper, Mr. Wager dealt with the function of the nucleolus. This body, in the cases examined by him, appears to be intimately connected with the nuclear network, and contains chromatin material which contributes directly to the formation of the chromosomes. Prof. Oliver and Miss Edith Chick had a paper on the morphology of *Torreya myristica*, in which some interesting features of morphological importance were described.

Among other papers brought before the Section were the following contributions from mycologists:—Miss Lorrain Smith described a disease of the gooseberry which attacks the hard stem of the bushes above and below the ground level. The inner bark is permeated and completely destroyed by the mycelium of a fungus. The outer bark cracks and splits, and sclerotia are formed on the outside or half embedded in the cortex. Mr. Barker (Cambridge) gave an account of the fungus of Samsu, a fermented drink of Eastern Asia, obtained by the distillation of a fermented liquor prepared from rice. The conversion of the starch into fermentable sugars is due largely to a species of Monascus. Hitherto this genus has been placed in the Hemiasci on account of a supposed formation of spores in a sporangium, surrounded by an investment of hyphæ. It is, however, one of the simplest sexual Ascomycetes. Mr. E. M. Freeman (Cambridge) contributed a paper on the darnel seed fungus, in which several new and important facts were brought forward.

H. W.

CARLSBAD MEETING OF THE GERMAN ASSOCIATION OF NATURALISTS AND PHYSICIANS.

THE seventy-fourth annual meeting of the Association of German Naturalists and Physicians was held on September 21–28 at Carlsbad, after an interval of not less than forty years. At the meeting, very naturally, the hot springs for which the place is famous suggested a suitable subject for discussion. Geologists and chemists alike concentrated their attention upon them. Prof. van 't Hoff, who may be regarded as the veritable creator of modern theoretical and physical chemistry, was there to elucidate the subject. Prof. Meyerhofer applied the latest teaching of that particular science to the springs, exciting a keen interest by his masterly method of dealing with the subject, more particularly when entering into the newest discoveries with regard to the theory of osmotic pressure and of ions which van 't Hoff and Arrhenius have effectively established. The entire organism in biology may be shown to be a collection of osmotic cells, enclosing saline solutions, and the movement of liquids in them is to a high degree, if not entirely, determined by the laws of osmotic pressure.

The Carlsbad springs have been again and again subjected to osmotic analysis, and this has led to a considerably deeper insight into the cause of their hygienic action than the merely chemical analysis which had first been judged sufficient. Mineral waters of high osmotic pressure, so it has been ascertained, remain in the stomach longer than waters of low osmotic pressure, and this fact enables the physician the better to judge what kind of water should be selected in dealing with any particular affection of the stomach. The study of the waters has been carried further, and the value of certain distinct rules and modified methods has been ascertained as facilitating comparison in respect of osmotic pressure between mineral springs and liquids occurring in the human body. Among other results, it has been shown that natural mineral waters are much more efficacious than artificial imitations. Very possibly this is due to the presence in the natural springs of certain chemical substances held in solution in such infinitesimal quantities that make them escape the notice of the purely chemical analyst. Such undiscovered ingredients may very well act by catalytic methods and so increase the efficacy of the solution.

That question, indeed, requires further elucidation, which is likely to prove of much benefit to balneological science, to the relief of suffering humanity.

Another lecture of great interest was that delivered by Prof. Suess, of Vienna, on the nature of hot springs. The mineral springs which are due to infiltration from surface water go by the name of "vadose" springs; they may be either cold or hot, according to their depth. It has been proved in the case of more hot springs than one that they run along earth crevasses formed before their own origin. Thus at Carlsbad the springs have followed the preexisting metallic veins (ore-lodes) which thousands of years ago found an outlet from the interior to the surface. The Carlsbad springs yield yearly about 5·6 million kilogrammes of solid ingredients which originate in the interior of the earth and contain in correspondingly small quantities the same elements as the ore-lodes the course of which they follow. Carlsbad is therefore manifestly a "juvenile," *i.e.* volcanic, water. Attempts made to search for an area of infiltration (as for "vadose" waters) or to estimate the depth of its origin from any kind of a so-called thermal scale have proved absolutely futile. Nor yet can the presence of mineral ingredients be explained by the nature of the granite through which they run to the surface. The cavities which were long supposed to have been formed by the continual effusion of 5·88 million

kilogrammes of fixed ingredients annually are due to an entirely different cause. Carlsbad, it ought to be remembered, stands on a spathic lode of horn stone. Whether its hot waters in the depth still precipitate heavy metals and are active in building up a metallic vein, reaching finally daylight in an impoverished state, or whether the conditions of to-day do not admit of such an activity, it is impossible to say. The presence of arsenic, antimony and zinc, indeed, favours the former conclusion.

The Congress held general meetings in which very interesting communications were made. Thus, Prof. Weber, Amsterdam, had much to say upon the Malay Archipelago and the history of its fauna. He reconstructed, so to speak, the great bridge between the people of East Asia and Australia. Again, Prof. Voller, director of the Electrotechnical Institute of Hamburg, explained the foundation and methods of electrical wave telegraphy. Communications showed that very substantial progress has recently been made, thanks to the theoretical study of the subject by Prof. Braun, of Strassburg, and the practical experiments of Prof. Slaby, of Charlottenburg. Some practical demonstrations of what has been called the Slaby-Braun system, for which the Congress was indebted to the General Electrical Company, of Berlin, and the Society for Wireless Telegraphy (by the Braun and Siemens-Halske process), of Berlin, helped to make the matter very much clearer.

The Carlsbad Congress, which was, according to established usage, held in a number of distinct sections—28 in all—was opened with a very interesting address on the constitution of the molecule of albumen, by Prof. Hofmeister, of Strassburg. Investigation of this important subject is beset by difficulties. However, in spite of this, modern science has, by means of continued inquiry, succeeded in establishing certain valuable facts which promise to lead to a clear knowledge of the subject. Thus it has been ascertained that glycocol, which is derived from albuminoid bodies, becomes transformed into urea. Therefore the road to further discovery must, one would think, lie across glycocol, and we can unconstrainedly trace back the other principal nitrogenous final products, just like urea, to the splitting up of the molecule of albumen, and *vice versâ* we might reconstruct the molecule of albumen from the final products.

Prof. Emil Fischer, of Berlin, in the Section of Chemistry, spoke on practically the same subject in an intensely interesting way. He was able to state that he succeeded in obtaining albuminoid substances by synthesis the possibility of which had so far only been dreamed of.

Furthermore, Prof. Leube, of Würzburg, reviewed the whole question of physiological albuminuria (both "manifest" and "latent"). He showed that in some healthy individuals albumen passes in the urine regularly after standing, whereas it disappears when the persons affected alter their position to sitting or lying. Muscular exertion may also be productive of albuminuria, but only in a standing position. Food of itself causes no albuminuria. It may, indeed, result, after the eating of raw eggs, but only when the person eating them has been standing. Such disposition to albuminuria is probably owing to an innate greater transfusibility of the filtrating membrane of the kidney. It is innocuous. Prof. v. Eiselsberg, of Vienna, dealt with the subject of the thyroid gland. His paper showed that goitre is caused by some mineral constituents occurring in certain geological formations and transmitted by water. In all probability, cretinism is due to similar causes, made effective through the action of the thyroid gland. Prof. v. Wettstein, of Vienna, made "Neo-Lamarckism" his subject, and explained the great importance of "selection" in the development of species, showing that by "selection" alone is it possible to account for the remarkable variety of forms to be observed in the same scale of organisation. The argument is, however, manifestly incomplete. For "selection" cannot account for the progress of development which, on the other hand, "direct accommodation" does explain.

Prof. Penck, of Vienna, in his paper on prehistoric man, proved that the interval between the older and the younger Stone age can only have been a very short one. In future, therefore, we will have to consider rather an advance of the culture of the younger Stone age than an immigration of Neolithic people, bearing in mind that, according to the present standard of our knowledge, Europe is the scene of a prehistoric culture the beginning of which lies a few hundred thousands of years back.

So much for the general meetings. The sectional gatherings proved no less interesting and instructive. In the Pedriatric Section, Dr. Moser, of Vienna, threw new light upon the theory, still to be proved, of the unity of species of the streptococci in scarlet fever. He has used a mixture of bouillon-cultures of streptococci from various cases of scarlet fever for immunising animals. In this way he has obtained a serum from horses which was shown to possess a specific curative value in scarlet fever when tried in the pedriatric clinic of the University (Prof. Escherich). The serum, which was prepared in the Serotherapeutical State Institute (Prof. R. Paltauf), has been used in the clinic since November, 1900. Of 699 scarlet fever cases of St. Anna Hospital, the worst were picked out and 81 received injections. It is the clinical aspect which in all these cases speaks for the specifically curative effect of the serum. If the injection is made on the first or second day there is no death; at a later period the result is less certain. The effect of the injection is that the fever vanishes or subsides, the general feeling improves in a remarkably short time, the nervous disturbances disappear very rapidly, the children feeling surprisingly better. Up to now it has proved necessary to inject the serum in considerable quantities, and the effect has sometimes been that sensitive children have suffered in consequence from eczema. This, however, passes away speedily without causing any injury. In the St. Anna Hospital it was found possible to lessen mortality to 8·9 per cent. out of almost 400 cases, whereas in the other hospitals of the town the average mortality was 13·09 per cent. Yet these results were obtained under partial application of the method, owing to the insufficient quantities and low concentrations only of the serum being available, so that only a fraction of the sick could be subjected to this treatment. Prof. Escherich spoke energetically of the favourable action obtained with the serum. Prof. Paltauf expressed regret that the quantity of serum necessary cannot yet be precisely determined, as is the case with the diphtheria serum. The Government has, however, granted the Serotherapeutical Institute an exceptional subsidy of 10,000 kr. so as to produce this scarlet fever serum in sufficient quantities.

In the Section of Dentistry, Dr. Sickingen furnished really astounding material illustrating the necessity of paying careful attention to the teeth of soldiers. As a result, an appeal was made to the Ministry of War recommending that garrison dentists should be appointed in the army. Furthermore, the Section of Hygiene adopted a resolution urging that as a means of raising the general hygienic condition of the people, special district dentists and school dentists should be appointed by the State and prohibited from engaging in private practice. Dr. Sternberg, in the Section for Pathological Anatomy, related that dead tubercle bacilli may bring about the same anatomical changes as living ones, causing the death of the animals experimented upon. Dr. Kraus, Vienna, spoke of the action of immune-hæmolysine (the serum of rabbits treated previously with canine erythrocytes); small quantities of such serum have been found to produce a grave disease which has been characterised as hæglobinæmia, hæmoglobinuria, grave anæmia or possibly icterus. Prof. Takahasi (Tokio) spoke on poisonous fish. Of such he showed the Tetrotone (called "Tugu" in Japan) to be the most poisonous of all. Its ovary contains most of the poison, the next dangerous being the liver; the muscles, on the other hand, are entirely free from the poison. Accordingly, a police regulation has been enforced, permitting the sale of this fish only after the internal organs have been removed.

Prof. Frick, Zurich, spoke of the treatment of feverish diseases without alcohol, and aroused considerable interest in view of the bearing of this matter upon the anti-alcoholic movement. He said that the popularity of alcohol is entirely due to its quality as a narcotic. Alcohol, however, possesses a number of qualities which make its use seriously contra-indicated in the ward altogether, and more particularly in febrile diseases. Moreover, the power of resistance against infectious matter is abated in the animal organism by the consumption of alcohol, and this is the reason why drinkers show in any kind of infectious disease a lesser power of resistance than people who practise abstinence.

Another question of great interest raised in the proceedings was that of the "circuit of nitrogen." Among the highly instructive communications which were made on the subject, space will permit me here to mention only one. Prof. Meyer, of Göttingen, began his paper with these words: —"Cellulose must become a food stuff." He pointed out the necessity for nitrogen both in vegetable and animal life, and the importance

of preserving it and turning it to practical account in the economy of nature. The population of the German Empire, so he instanced, increases at the rate of one per cent. every year, yet the quantity of nitrogen provided for our sustenance by the ordinary channels remains constantly the same. We shall, therefore, have to take advantage of the free nitrogen present in the air, first to benefit the plants and indirectly to benefit the plant-eating animals. It is known that small organisms, such as the so-called nitrifying bacteria, are able to assimilate directly the free nitrogen occurring in the atmosphere. The immense importance of this economic question is understood upon realising that in the German Empire an area of twelve-and-a-half million acres is covered with lupins and other leguminous plants, cultivated for agricultural purposes, and that these maintain a close touch ("symbiose") with the nitrifying bacteria. The nitrogen of the air which these bacteria attract on such an area may amount to five million quintals, representing at the current market rate something like 300,000,000 marks.

In the Section of Legal Medicine, the director of the Forensic Institute of Graz spoke of the serum diagnostic of blood, and pointed out the difficulties and responsibility involved. Jolles insisted upon the importance of chemical examination of blood, and explained some clinical apparatus which he has devised for such purpose, viz. the ferrometer, the phosphometer and the hæmoprometer.

In the Botanical Section, Prof. Molisch, of Prague, in his paper on the phosphorescence of meat, described the method by which it is possible to obtain such with the certainty of a physical experiment. It is invariably the same micro-organism which causes the phenomenon, namely, the *Micrococcus phosphoreus*, Cohn, a bacterium which has made itself at home all over the continent, though it may be true that it came originally from the sea. Prof. Pribram, Vienna, spoke of the new institute for biological investigation in Vienna, in which it has been made possible to observe an organism during several generations and of studying the principal question of biology, namely, the transmission of acquired characters. Prof. Roehman, Breslau, showed that he had succeeded in keeping mice in the best of health with food consisting of albuminates, carbohydrates and salts mingled in a certain ratio. Prof. Exner, Vienna, with the help of an "acousto-meter," demonstrated that the bad acoustic properties of many public rooms are due in the main to the existence of an echo. Police-Surgeon Dr. Schrank, in the Section for Hygiene, advocated international legal proceedings to prevent the spreading of venereal diseases.

An important demonstration took place in the Section of Mathematics after Prof. Klein, Göttingen, had finished his report on the present condition of the "Encyclopædia of Mathematical Sciences." Prof. Molk, Nancy, added that this great work is now being edited in common by German and French authors, and that this is the first occasion since 1870 that men of science of either side of the Vosges have been brought into active co-operation. In the Section of Astronomy, Prof. Archenholz, of the Treptow Observatory, mentioned that in the determination of the influence which sun spots have on our atmosphere, it is rather the position of these spots and their size on the solar disc than their number which enters into account. Prof. Hasslinger, of Prague, in the Chemical Section, relates the results of his latest experiments by which he has secured diamonds with Goldschmid's thermite method. By adding carbon in various forms, such as that of finely suspended graphite to a fused mass, similar to the South African mother stone Kimberlit, he succeeded in obtaining true diamonds. This is not only an entirely new method, but also corroborates the theory previously maintained of the natural origin of diamonds.

In the Section of Gynæcology, the conservative treatment by bath cures, mud poultices, hot baths, thermophor, &c., was forcibly advocated as yielding complete success and as well qualified to substitute the radical operations, while pus-formation can be stopped by incision only. Prof. Chroback, of Vienna, pointed out that even so pronounced a radical as Prof. Martine expressed himself in favour of the conservative method. Prof. Kehr, of Halberstadt, gave a *résumé* of no less than 730 operations executed for the removal of gall stones. Where gall stones were removed from the gall bladder, mortality was found to be at the rate of 2 per cent., when the gall bladder was removed with the stones it rose to 3 per cent., and when the stones occurred in the hepatic duct to 6·5 per cent.; however, by continual practice he managed in the last 200 operations to restrict mortality to only 1½ per cent.

From these short notes it will be seen that there was abundant material of a very varied character brought under the notice of the Congress, and dealt with in a manner to make the latter a not unworthy successor of its precursors. Science generally has distinctly gained by its transactions. The next Congress is to be held September 21, 1903. F. SCHUMAN-L ECLERCQ.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The 240th meeting of the University Junior Scientific Club was held on October 31. Dr. A. D. Darbishire, Balliol, showed an interesting case of reversion. The offspring of an albino pet mouse and a Japanese "waltzing" mouse bears many resemblances to a common house mouse, and does not "waltz."

Mr. H. M. Hartley, Balliol, read a paper on "Jöns Jakob Berzelius."

Mr. W. K. Spencer (Magdalen) has been elected to the Burdett Coutts' scholarship in geology.

The Chemistry School suffered a heavy loss at the beginning of the present term in Mr. Vernon Harcourt's resignation of the Lee's readership, which he held for forty-three years. Mr. Harcourt was a Balliol undergraduate, and in 1858 was placed in the first class in the Natural Science School. During the next year he was elected to the Lee's readership at Christchurch. In addition to his research work, he took an important part in the teaching of chemistry. He did not merely train his pupils in the ordinary curriculum required for the schools, but imbued them with the ambitions of the researcher, and it is a striking testimony to his efforts that the best experimental work by Oxford men of the present generation has come from those who were his own pupils or worked under his influence. His departure from Oxford will be greatly regretted by very many friends both young and old, and he will leave behind him a place which it will be very hard adequately to fill.

CAMBRIDGE.—In the combination room of Peterhouse on Wednesday of last week, Lord Kelvin unveiled a portrait of the late Prof. P. G. Tait, honorary fellow of the college, who was senior wrangler and first Smith's prizeman in 1852. The portrait, which was subscribed for by the master and fellows of Peterhouse, was painted by Sir George Reid, president of the Royal Scottish Academy, and it will be hung in the hall of the college by the side of the portraits of Lord Kelvin and the late Dr. H. W. Cookson. The *Times* reports Lord Kelvin to have said, in the course of his remarks, that he valued most highly the privilege of being allowed to ask the master and fellows of Peterhouse to accept for their college a portrait of Prof. Tait. He felt specially grateful for this privilege as a forty-years' comrade, friend and working ally of Tait. The master of Pembroke (Sir George Stokes) spoke of Prof. Tait as an intimate friend, and said all who knew him must have been impressed with his great ingenuity and the versatility of his genius.

Mr. F. C. Kempson, Caius, has been appointed a demonstrator of anatomy.

The following are the examiners for the natural sciences tripos:—Physics: Prof. L. R. Wilberforce, F.R.S., and T. C. Fitzpatrick; chemistry: C. T. Heycock, F.R.S., and H. McLeod, F.R.S.; mineralogy: A. Hutchinson and G. F. Herbert Smith; geology: H. Woods and Prof. T. T. Groom; botany: Prof. Ward, F.R.S., and D. H. Scott, F.R.S.; zoology: J. S. Gardiner and Prof. Graham Kerr; physiology: W. B. Hardy, F.R.S., and E. H. Starling, F.R.S.; anatomy: N. B. Harman and Dr. A. Keith.

Dr. W. H. R. Rivers, University lecturer in experimental psychology, has been elected a fellow of St. John's College.

Mr. H. O. Jones, Jacksonian demonstrator of chemistry, has been elected a fellow of Clare College.

DR. R. H. ADERS PLIMMER has been appointed Grocers' Company research student at the Jenner Institute of Preventive Medicine.

SIR GEORGE KEKEWICH, who has been secretary to the Board of Education since 1890, has resigned his appointment and has been succeeded by Mr. R. L. Morant.

DR. H. S. CARSLAW has been appointed professor of pure and applied mathematics in the University of Sydney. He was fourth wrangler (bracketed) in 1894, and is lecturer in mathematics in the University of Glasgow, and Fellow of Emmanuel College, Cambridge.

THE Vienna correspondent of the *Times* states that according to a communication from St. Petersburg, the Russian Ministry of Agriculture has just decided to found an agricultural high school for women. Students at the school will receive a general training as agriculturists, or will be permitted to restrict their attention to special branches of agriculture, such as dairy farming, gardening, bee culture, poultry keeping and cattle and sheep breeding. The course has been fixed for three years and will include practical occupation on a model farm in addition to study and laboratory work. Although the date on which the new institution will be opened has not yet been decided upon, 325 women who have had an intermediate education have announced their intention to follow the course.

A RESEARCH scholarship of the annual value of 200*l.* for the study of the thymus and other ductless glands has recently been founded by Mr. J. Francis Mason, of Freeland Lodge, Woodstock, Oxfordshire. The scholarship is tenable for two years, but the period may be extended to three years. The medical papers announce that on the recommendation of Prof. G. Sims Woodhead, of Cambridge, and Dr. T. F. S. Caverhill, of Edinburgh, Dr. Swale Vincent, lecturer on histology at the University College, Cardiff, has been appointed the first scholar. In addition to the foundation of the scholarship, Mr. Mason has made a donation of 200*l.* to the laboratory of the Edinburgh Royal College of Physicians to enable the medical superintendent, Dr. Noël Paton, to carry out a combined research on ductless glands.

THE chief of the circulating department of the New York Public Library has recently undertaken an inquiry into the kind and amount of the reading of scientific subjects which takes place in connection with the eleven branches of the New York Library. During May, 1901, the total home circulation of books from the eleven branch libraries was 131,700, and that of books of science 8553, or 6·5 per cent. The most popular subjects of science during the month concerned were, in order, zoology, mathematics, physics and botany, the least popular of the ten sciences tabulated being palæontology, on which subject there were only twenty-four books in all the libraries put together, and of these only four were borrowed during the month. But a month is too short a time for the investigation, and little importance can be attached to the results.

THE report of the Somerset County Education Committee for the year ending March 31 last shows that very few changes were made during this period in the system of technical education existing in the county of Somerset. The committee continues to encourage agricultural research. For instance, a grant of 100*l.* a year for three years has been made to the Bath and West and Southern Counties' Society in aid of a research by Mr. F. T. Lloyd into the causes of production of flavour in dairy produce, the Board of Agriculture contributing 200*l.* per annum and the Bath and West Society 150*l.* per annum for the same purpose during the same period. A grant of 25*l.* has also been made in aid of the expenses of experiments on the influence of the manuring of pastures on the growth of sheep fed thereon, to be carried out on Lord Ebrington's estate on Exmoor.

WE have received from Sir Philip Magnus the report, for the session 1901–2, on the work of the department of technology of the City and Guilds of London Institute. Among other matters described are the steps by which arrangements have been made for coordinating the technological work of the Institute with that of the Board of Education for England and Wales and of the Scotch Education Department. These arrangements are to be welcomed as helping to systematise technical instruction and as tending to prevent the overlapping of effort which, in educational matters, has generally led to waste and inefficiency. They mark another step towards the unification of different educational activities under a central board. The work of the department of technology of the Institute continues to grow steadily. During the session, the number of classes registered by the Institute increased from 2222 to 2320, and the number of students in attendance at these classes from 34,246 to 36,189. The total number of candidates for examination in Great Britain and Ireland was 16,580, showing an increase of 1023 on the number presented in 1901.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 15.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—Mr. A. J. Chitty showed an entirely black specimen of *Metoecus paradoxus* as tending to disprove the mimicry suggested by him at the meeting on October 1. Dr. Chapman said that in his experience one out of every six specimens of this species was black. Mr. Donisthorpe stated that out of about one hundred specimens he had never caught or bred a black Metœcus.—Mr. E. P. Pickett exhibited a variety of the female of *Argynnis aglaia*, varieties of *Satyrus janira*, and a long series of *Lycaena corydon* taken near Folkestone and Dover in August last, including four males of the last-named species, with the black band on the edge of the forewings much deeper than usual; also twelve dwarf male specimens of this species, four dwarf females and many other aberrant forms. Mr. Goss said this dwarf form of *L. corydon* occurred constantly in one valley about two miles east from Dover, but he was unaware of its occurrence elsewhere in this country. He remarked that a dwarf form of *L. arion* occurred everywhere where the type was found, both in Gloucestershire and Cornwall. Dr. Chapman and Mr. Sloper also remarked on the dwarf form of *L. corydon*.—Dr. Chapman exhibited specimens of *Notodonta* (*Hybocampa*) *dryinopa* from Queensland. It was remarkably similar in appearance, structure and habits to *Hybocampa milhauseri*. He stated that the pupa with a similar spine to that of *H. milhauseri* does not cut out a regular oval lid from the cocoon like that species, but by a stabbing process pierces it with a number of holes, so that a piece is more easily pushed off. The cocoon being covered with bits of bark, stone, &c., a cutting process would be impossible, whereas the cocoon of *H. milhauseri* was of pure gum-like silk. He pointed out that the larva much resembled that of *H. milhauseri*, but the hinder segments were more like those of *Stauropus fagi*. He also exhibited living eggs, larvæ and imagines of *Orina tristis*, var. *smaragdina*, from Pino, Lago Maggiore. The beetles were taken on May 30, and had laid many eggs. Dr. Chapman said that the embryo, ready to hatch, might be seen within some of the eggs and its hatching spines observed.—Mr. Sloper exhibited a specimen of *Lycaena hylas*, caught at Dover on September 7.—Mr. Martin Jacoby communicated a paper entitled "A Further Contribution to our Knowledge of African Phytophagous Coleoptera."—Mr. Malcolm Burr read a communication from Hofrath Dr. Carl Brunner von Wattenwyl entitled "Observations sur le nom générique Acrida."

MANCHESTER.

Literary and Philosophical Society, October 21.—Mr. Charles Bailey, president, in the chair.—Mr. C. E. Stromeyer exhibited specimens of boiler scale which both internally and externally resembled volcanoes, and he thought might with advantage be studied with the object of gaining a knowledge of volcanic eruptions.—The president read a paper on the adventitious vegetation of the sandhills of St. Anne's-on-the-Sea, in which he remarked on four aliens found in that locality, viz. *Œnothera biennis*, Linn., *Sisymbrium pannonicum*, Jacq., *Ambrosia artemisiaefolia*, Linn., and *Vicia villosa*, Roth. Although the latter plant is distributed throughout Europe, this is probably the first record of its occurrence in Britain. *Ambrosia artemisiaefolia* is also a noteworthy addition, as it is a rare casual in the few places in England where it has previously been found.

PARIS.

Academy of Sciences, October 22.—M. Bouquet de la Grye in the chair.—Demonstration of the absolute irreducibility of the equation $y'' = 6y^2 + x$, by M. Paul Painlevé.—Synthesis of the alkaline hyposulphites and of the hyposulphites of the alkaline earths in an anhydrous condition, by M. Moissan. The hydrides of the alkalis and the alkaline earths when acted upon with sulphur dioxide under reduced pressure give pure hyposulphites, the hydrosulphites of Schutzenberger. From the fact that hydrogen is given off in this reaction, it is shown that the formula given by Bernthsen, $Na_2S_2O_4$, is correct, and that the original formula of Schutzenberger, in which these substances are represented as containing hydrogen, is not in accordance with fact.—The culture of wheat at the experimental field at Grignon in 1902, by MM. Dehérain and C. Dupont. Chiefly owing to the rains in the month of May, the yield of wheat in this experimental station has been exceptionally good. The

conclusion is drawn from this that where irrigation is possible in the spring without too great an expense, the results will be very advantageous to the farmer.—Some cases of integration of the equation to the brachistochrome, by M. Haton de la Goupillière.—On cavitation in screw steamers, by M. J. A. Bormand. The name cavitation is given to the phenomenon met with when a screw is driven in water at speeds above a certain limiting value. A cavity is formed in the water inside which the screw revolves, and a further increase in the power driving the screw then results in no increase in the velocity of the boat. The alterations necessitated in the usual formulæ for screw propulsion by this phenomenon are discussed in detail.—On the velocity of propagation of the X-rays, by M. T. Blondlot. By means of the action of the X-rays upon the discharge of a Hertzian exciter, it is shown that the duration of these rays is less than 5×10^{-10} sec., and that the velocity of the X-rays is of the same order as that of the Hertzian waves.—Remarks by M. le General Bassot on the volume of the *Connaissance des Temps* for 1905.—New observations on the volcanic eruptions at Martinique, by M. A. Lacroix.—Observations on the sun made at the Observatory of Lyons with the Brunner equatorial during the second quarter of 1902, by M. J. Guillaume. The results are summarised in three tables giving the number of spots, their distribution in latitude and the distribution of the faculæ in latitude.—On the theory of algebraic functions, by M. Ludwig Schlesinger.—On Bessel's equation with a second member, by M. A. S. Chessin.—On an example of correlative transformation in mechanics, by M Paul J. Suchar.—The precautions to be taken in the employment of silk fibres as torsion wires, by M. V. Crémieu.—Vision at a distance by electricity, by M. J. H. Coblyn.—The variation of the magnetic resistance of a bar submitted to traction, by M. Fraichet.—The electromotive force of a thermoelectric element, by M. Ponsot.—A method for the volumetric estimation of tannin and the analysis of wood and of tannin extracts, by M. Albert Thompson. The method is based upon the determination of the amount of oxygen absorbed from an alkaline solution of hydrogen peroxide by the tannin.—On a new base derived from galactose, by M. E. Roux. By the reduction of the oxime obtained from galactose, a new base named galactamine is obtained, the preparation and chief properties of which are described.—On a new compound of the hexamethylene-tetramine group, by M. Marcel Descudé.—On a solid acid from the oil of *Elaeococca vernicia*, by M. L. Maquenne.—On musculamine, a base derived from muscles, by MM. A. Étard and A. Vila. The base described is the first example of a triamine base among biological products.—On the origin of the natural coloration of silk in the Lepidoptera, by MM. D. Levrat and A. Conte. These researches show the possibility of passing a substance such as a colouring matter through the digestive tube on to the silk, through the blood.—On the new genus Gyrinocheilus of the family Cyprinidæ, by M. Léon Vaillant.—Contribution to the study of the Anopheles of the Isthmus of Suez, by M. Cambouliu.—The physical conditions of tuberisation in plants, by M. Noel Bernard.—Observations on the germination of the spores of *Saccharomyces Ludwigii*, by M. A. Guillermond.—On the pollen of plants belonging to the genus Asclepias, by M. Paul Dop.—New experiments in maritime aëronautics, by M. H. Hervé.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 6.

LINNEAN SOCIETY, at 8.—Notes on a Natural History Journey to Chile: H. J. Elwes, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—Address by the President, Mr. Herbert Jackson.

CHEMICAL SOCIETY, at 8.—Di-Indigotine: J. Moir.—Note on the Localisation of Phosphates in the Sugar Cane: C. H. G. Sprankling.—The Specific Heats of Gases: H. Crompton.—On the Non-existence of the Gaseous Sulphide of Carbon described by Deninger: E. J. Russell and N. Smith.—The Action of Nitric Acid on Bromophenolic Compounds: W. Robertson.—Hydroxyoxamides. Part II.: R. H. Pickard, C. Allen, W. A. Bowdler and W. Carter.—3:5-Dichlor-*o*-xylene and 3:5-Dichlor-*o*-phthalic Acid: A. W. Crossley and H. R. Le Sueur.—Isometric Anhydrous Sulphates of the Form $M''SO_4,R'_2SO_4$: F. R. Mallet.—The Catalytic Racemisation of Amygdaline: J. W. Walker.—The Combination of Carbon Monoxide with Chlorine under the Influence of Light: G. Dyson and A. Harden.—The Constituents of Commercial Chrysarobin: H. A. D. Jowett and C. E. Potter.

SATURDAY, NOVEMBER 8.

ESSEX FIELD CLUB (Essex Museum of Natural History, Stratford), at 6.30 p.m.—Results of the Fungus Foray on October 17 and 18: Dr. M. C. Cooke.—Report of Delegate at British Association Meeting, Belfast: W. Whitaker, F.R.S.—Lecture, "Insect Life": F. Enock.

TUESDAY, NOVEMBER 11.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Tramways: C. Hopkinson, B. Hopkinson and E. Talbot.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—On the Classification and Arrangement of the Exhibits of an Anthropological Museum: W. H. Holmes.—On the Initiation Ceremonies of the Natives of the Papuan Gulf: Rev. J. H. Holmes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—World-shaking Earthquakes: Prof. J. Milne, F.R.S.

THURSDAY, NOVEMBER 13.

MATHEMATICAL SOCIETY, at 5.30.—Address on the Infinite and the Infinitesimal in Mathematical Analysis: Dr. E. W. Hobson.—Ueber den Satz der Gleichheit der Basiswinkel im gleichschenkligen Dreieck: Dr. D. Hilbert.—The Summation of a Certain Series: Prof. A. C. Dixon.—Expansion by Means of Lamé's Functions: Prof. A. C. Dixon.—Sets of Intervals: W. H. Young.—Note on Unclosed Sets of Points defined as the Limits of a Sequence of Closed Sets of Points: W. H. Young.—Wave Propagation in Two Dimensions: Prof. H. Lamb.—The Continuation of Certain Fundamental Powers Series: Prof. M. J. M. Hill.—A Geodesic on a Spheroid and an Associated Ellipse: L. Crawford.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, NOVEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.

CONTENTS.

SUPPLEMENT.

SUPPLEMENT TO "NATURE."

THE HISTORY OF EGYPT.

A History of Egypt from the End of the Neolithic Period to the Death of Cleopatra VII., B.C. 30. 8 vols., illustrated. Books on Egypt and Chaldæa, vols. ix–xvi. By E. A. Wallis Budge, M.A., Litt.D., D.Lit., Keeper of the Egyptian and Assyrian Antiquities in the British Museum. (London: Kegan Paul and Co., Ltd., 1902.) Price 3*s.* 6*d.* per vol.

IT is now twenty years since Egypt last changed masters, and the completion of these twenty years of British rule has been marked by the completion of a work of public utility, the great dam at Aswân, which will surpass any similar work carried out in the days of the Pharaohs. Simultaneously is published the fullest and most complete English history of Egypt under her ancient native monarchs, from the earliest times to the end of the native kingdom, a period of more than four thousand years. The publication consists of eight small and very handy volumes, all profusely illustrated with photographs and line-drawings of temples, tombs, mummies and other antiquities of the various periods, which are treated in succession. Dr. Budge may be congratulated on the production at a most opportune moment of this work, which should find a place on the shelves of everyone who is interested in the past history of the famous land which we have taken under our protection.

The history is described on the title-page as beginning with the end of the Neolithic period. But in reality Dr. Budge begins earlier than that, for Egypt was inhabited in Palæolithic days, and the fact is chronicled by her historian, who also engraves several flint implements, now in the British Museum, which are undoubtedly of the Older Stone Age (p. 85). All anthropological inquirers will be grateful to Dr. Budge for the large number of illustrations which he gives in his first volume of the weapons, implements, vases, &c., which were used by the earliest Egyptians. The Neolithic Egyptian weapons are beyond doubt the finest ever discovered, the masterpieces of the Neolithic knapper, and those who are familiar only with European or East-Asiatic types will open their eyes when they first become acquainted with those of Egypt. The vases can hardly be believed to have been made without the wheel. Yet they undoubtedly were; neither the wheel nor the lathe were known to the early Egyptians. The Neolithic vase-types, the oldest of which is the well-known red and black ware, gradually progress until they merge insensibly into those of the earliest dynastic period, which was "Chalcolithic" in character, *i.e.* copper had then come into general use.

Dr. Budge describes very fully the probable manner of life of the earliest Egyptians, his authorities being their own relics and the many valuable hints which are given us by the Sicilian historian Diodorus. He also makes clear the whole history of the discovery of these primitive inhabitants of the Nile Valley, showing how their remains were known in many museums years ago, but could not be classified, being often set down as forgeries simply because they were extraordinary; how Prof. Petrie and M. de Morgan made a series of independent but contemporary explorations, which resulted in the discovery of whole cemeteries of the "New Race" (the people to whom these extraordinary objects belonged) and of numbers of these objects, chiefly flints and vases, themselves; how the problem of the chronological position of these remarkable remains arose, and how M. de Morgan dated them rightly and Prof. Petrie wrongly; finally, how the English savant was convinced that the arguments of his French confrère were correct, with the result that all archæologists are now agreed that these remains are veritably those of the Egyptians of the later Neolithic and early Chalcolithic periods. All this, and more, is set forth in most interesting fashion by the Keeper of the National Collection of Egyptian Antiquities.

From the Predynastic period, to which the Neolithic antiquities belong, Dr. Budge proceeds to the discussion of the remains of the Early Dynastic or "Archaic" period, which was "Chalcolithic" in character, as has been already observed above. Here again the historian performs the necessary function of impartially dealing out to each explorer and archæologist the exact meed of due renown to which he is entitled for his particular services to the cause of science in the matter of the discovery and elucidation of the tombs of the earliest dynasties. Prof. Petrie's scheme for the arrangement of the earliest kings is more or less accepted, with the exception of "Dynasty O," of which the author makes no mention, probably because the phrase is a contradiction in terms, since "Dynasty O" is no dynasty. That there were local kings in both Upper and Lower Egypt before Menes is of course probable; indeed, Dr. Budge is, so far as we are aware, the first to point out that a very ancient monument, the Palermo Stele (Fifth Dynasty, about 3500 B.C.), contains the names of a whole series of hitherto unsuspected predynastic monarchs of Lower Egypt, which names, Seka, Tau, Thesh, Mekha, &c., are of a most primitive character (vol. i. p. 169). Since, however, these kings, as well as others (of Upper Egypt) identified at Abydos are mere local monarchs of the ages before Mena, they can hardly be said to belong to any "dynasty" at all, for the dynasties of All Egypt begin with Mena; and the use of the term "dynasty" for these predynastic chiefs is evidently deprecated by Dr. Budge.

In the chapter with which the second volume commences, Dr. Budge describes the advance which the "Archaic" Egyptians had made upon their ancestors of the predynastic time. The civilisation of the Archaic people he does not regard as indigenous, but as an importation from farther east, probably from Southern Arabia. He certainly seems to show that there are undoubted traces of strong Sumerian (Early Babylonian) influence in the archaic civilisation of Egypt which are absent from the older Neolithic barbarism. Further, writing begins with the dynasties. Taking these facts in conjunction with the indications supplied by several Egyptian legends (of great interest to the student of early traditions), he comes to the conclusion that the indigenous stone-using people, who were akin to the Libyans, were overrun at some period previous to the unification of the country under one king by a conquering, more highly civilised people from the east, who used copper weapons. This people invaded the Nile Valley

from the Red Sea coast by way of the Wady Hammamat. This version of a theory which has long been broached and discussed seems more probable than any other, because it does not go too far or ask us to believe too much.

From the Archaic Period, which came to an end with the Third Dynasty, about 3800 B.C., the historian passes on to the period of the great Pyramid-builders of the Fourth Dynasty, the days of the mighty Cheops, Chephren and Mykerinos, so well known to us from the pages of the Father of History. And it is wonderful how well informed Herodotus was about these ancient kings, who seem to have impressed themselves on the memories of their subjects for all time. With the Fourth Dynasty, Egyptian civilisation ceased to develop with the remarkable vigour and quickness which it had shown during the Archaic Period, and became more or less stereotyped. For many centuries, therefore, the task of the historian is the simple one of recording the reign of king after king, war after war, until with the accession of the Eighteenth Dynasty Egypt became a world-power, and subdued mankind from the marshes of the Bahr al-Ghazal to the mountains of Armenia, from the plains of Babylonia to the passes of the Taurus, to her sway. The strange reign of the religious and artistic enthusiast Khu-en-Âten is described, and the story of his shameful abandonment of the Asiatic empire of Egypt and its partial reconquest by Seti I. and his pretentious son Rameses II. (who has, it appears, no particular claim to the title "Great," which is usually bestowed upon him) is retold by Dr. Budge, and the interest of the tale is much enhanced by the contemporary illustrations of these ancient wars and sieges which he reproduces for us. We are speaking now of the fourteenth century B.C., three thousand years after the Archaic Period which we have just been discussing—*i.e.* as much time lies between the days of those monarchs of old, Mena and the rest, and the wars of Rameses and Seti as lies between these and our own day. This may give some idea of the expanse of time which Egyptian history covers. Yet Babylonia was already civilised when Egypt was inhabited by Neolithic savages. At least, so Dr. Budge's conclusions would seem to show.

Many interesting hints are given by Dr. Budge as to the relations between the Egyptians and the peoples of Southern Palestine from the fourteenth century B.C. onwards. He discusses the question of the Exodus very fully, and describes the rise of the Jewish kingdom after the final withdrawal of Egyptian authority during the time of the *rois-fainéants* of the Twentieth Dynasty. Henceforward the Egyptians merely made periodical raids into Palestine, as under Shishak (950 B.C.) and Necho (600 B.C.), with interludes of Assyrian and Ethiopian invasion and conquest of Egypt itself, which now had sunk to the position of the proverbial "broken reed, upon which, if a man lean, it shall pierce his hand," and was ripe for the Persian yoke and the Macedonian deliverance, which was to bring Egypt within the fold of Hellenism.

In the preface to the sixth volume Dr. Budge's tone becomes strongly controversial and, we think, righteously so, for he is tilting at a great error which has had widespread and most unfortunate consequences; we refer to the erroneous conjectures of a German Assyriologist, Dr. Winckler, as to the existence of a country in Arabia called Musri, which have formed the foundation of a series of most amazing theories, enunciated by one of "the ablest of the higher critics," as Dr. Budge courteously describes him, Prof. Cheyne, of Oxford, on the subject of the early history of the peoples of Palestine. The first note of warning against these theories and their source, the baseless conjectures of Dr. Winckler, was sounded in a review which appeared in NATURE for June 26 of the present year (vol. lxvi. No. 1704) of the third volume of the "Encyclopædia Biblica," in which publication Prof. Cheyne's theories about his "Jerahmeelites" are enshrined. Quite lately, on September 25 last, a review signed with the initials R. C. T. also appeared in these columns, which dealt specifically with the theories of Dr. Winckler, and proved them errors step by step and point by point. Dr. Budge's preface covers much the same ground as the reviewer's article, but is fuller, and, as was to be expected in a popular work, not so technical in its phraseology. His final paragraph is worth reading, and should finally dispose of "Musri" and his son "Jerahmeel." It is rarely, we should think, that one eminent man of science has felt compelled to write so severely of the work of another as Dr. Budge has written of the Jerahmeel theory; yet we confess we think that Prof. Cheyne fully deserves the castigation which Dr. Budge has administered to him; he should realise that a mare's nest does not necessarily become a "brilliant and inspired theory" merely because a German discovered it. There is too much of this *Bauchrutschen vor Deutschland* among our archæologists and Biblical critics, and Dr. Budge has made a timely protest against the absurd habit.

Dr. Budge does not leave the Hellenistic period of Egyptian history outside the scope of his work. His last two volumes contain a very complete summary of the events of the Ptolemaic period, which should be useful to classical students. So far as we remember, the older histories of Egypt, such as Brugsch's "Egypt under the Pharaohs," Wiedemann's "Geschichte," Erasmus Wilson's "Egypt of the Past," &c., come to a close with the end of the *native* kingdom, with the flight of King Nekhtnebf before the Persians, about the middle of the fourth century B.C., and not long before the coming of Alexander the Great. Dr. Budge, however, does not regard his task as ended at this point, for, as he points out, although Egypt was ruled by Greek kings during the Ptolemaic period, she still remained an independent kingdom, and these Greek kings were Egyptian Pharaohs and nothing else. So he goes on with his tale until the death of Cleopatra and the Roman conquest finally bring the independent career of Egypt to an end.

Astronomers will be interested to note Dr. Budge's scepticism as to the possibility of any very trustworthy data for Egyptian chronology being obtained from astronomical calculations which involve consideration of the "Sothis period" (on Dr. Mahler's methods, for instance), while at the same time he accepts Sir Norman Lockyer's calculations in "The Dawn of Astronomy" of the probable dates of the foundation of various Egyptian temples, based upon a consideration of their orientation. This, however, is a very different matter from juggling with Sothis periods, Set festivals and the like, and the production of

an exact date for Thothmes III. from under your hat. "Astronomical evidence," says Dr. Budge (i. p. 158), "supports the evidence derived from every other source in assigning a remote antiquity to the period when Egyptian civilisation began; but unfortunately it does not assist us in formulating a complete system of Egyptian chronology with exact dates."

Altogether the work is of great interest, and will no doubt prove of use to the scientific student as well as to the lay inquirer; and it is a monument to the industry of its author.

MOHR ON THE DYNAMICAL THEORY OF HEAT AND THE CONSERVATION OF ENERGY.

Die Entwickelung unserer Naturanschauung in XIX. Jahrhundert und Friedrich Mohr. By Ch. Jezler. Pp. 44 and portrait of Mohr. (Leipzig: Barth, 1902.) Price 1.20 Mark.

MOHR, the apothecary and chemist, is a name that will ever be associated with the foundation of the methods of volumetric analysis. Mohr as a controversialist in the domain of speculative geology is not so generally known, and Mohr as a pioneer in connection with the dynamical theory of heat and the doctrine of the conservation of energy is so little known that his writings have had to be rescued from oblivion by the author of the present pamphlet.

The work under consideration formed the subject of a communication to the Society of Natural Science at Winterthur in December, 1900, and while the paper was being prepared for publication there appeared in the *Berichte* of the German Chemical Society for April, 1900, the "Reminiscences of Friedrich Mohr," by Hasenclever, who knew Mohr personally, and who deals more particularly with his correspondence with Liebig. It appears, however, that one of the two most important works published by Mohr in 1837 escaped the notice of Hasenclever, and it is upon this particular work that Herr Jezler more especially bases Mohr's claim for prominent recognition among the founders of modern science.

The pamphlet which has been submitted for consideration is certainly worthy of very careful attention by all who are interested in tracing the history of one of the greatest generalisations in physical science of the nineteenth century. The first section deals with the development of science as a whole, and is to be regarded as a kind of background in which the figure of Mohr is framed. The second part gives the detailed account of Mohr's work with copious extracts from his published papers, some of the early communications to the first volume of *Poggendorff's Annalen* having given the author no little trouble to obtain on account of their scarcity. The general impression which the reader must form is that Mohr's claim to take high rank among the scientific worthies of the past rests on a very much broader basis than has generally been conceded. Passing over the evidence of his many-sided activity in other departments of science, it is unquestionably in connection with the development of the modern conceptions of heat as a kind of motion and of the "unity of forces" (*Einheit der Naturkräfte*) that the greatest interest will be aroused. In order to fit Mohr into his proper place, the author expands the three scientific achievements of the past century as classified by Haeckel into four:—(1) The doctrines of the indestructibility of matter and energy; (2) the theory of the correlation or unity of natural forces; (3) the establishment of chemistry as an independent science; and (4) the development of physiology and biology and the Darwinian theory. There is, perhaps, scope for criticism in the proposed classification, but it is not essential to the author's main contention whether this scheme be rigidly adhered to or not. It will suffice to mention that under each of the four headings he gives a brief historical *résumé*. The treatment is necessarily very scrappy, owing to the small amount of space which the author has allowed himself considering the enormous field which he has had to cover. It is clear, however from the facts submitted under the heading of "the theory of the indestructibility of force" and elaborated in detail in the second part of the work that Mohr's views were formulated with considerable precision and published some five years before R. Mayer's first paper on this subject in 1842. In chronological order, Herr Jezler therefore names in connection with this generalisation Carnot, Mohr, Mayer, Joule, &c.

A somewhat acrimonious (and unscientific) controversy raged in this country many years ago respecting Mayer's claims to priority. The writer of this notice has not the least desire to stir up the ashes of this dead strife, but admitting Mayer's claims, it is interesting to learn from the pamphlet before us that Mohr himself drew Mayer's attention to his earlier publications and that a correspondence took place in the course of which Mayer wrote:—

"In dem wichtigen und sehr geistvollen Aufsatze, welchen Sie in ihrem neuesten Werke 'Die mechanische Theorie der chemischen Affinität' zitieren, haben Sie unstreitig die mechanische Wärmenlehre ausgesprochen und haben sogar das Wärmäquivalent numerisch zu bestimmen gesucht."

The reference which Mohr makes in this later work quoted by Mayer is to his first paper of 1837, entitled "Ansichten über die Natur der Wärme" (*Annalen der Pharmacie*, vol. xxiv. p. 141). In this same letter it may be mentioned that Mayer claims priority over Joule in the determination of the mechanical equivalent of heat. Mohr's second paper of 1837 is entitled "Ueber die Natur der Wärme," and a quotation from this paper given in the present pamphlet (p. 10) shows that Mohr had fully realised the principle of the "correlation of the physical forces," as it was afterwards called by Grove in his celebrated work bearing this title. The historian of this branch of physical science, Max Planck ("Das Prinzip der Erhaltung der Energie," Leipzig, 1887), in pushing Mohr's claim, appears also to have depended only upon this second paper and to have overlooked the first paper. Reading this contribution now *in extenso* as it is reprinted in the pamphlet, it is remarkable to find how closely Mohr approximated in the year 1837 to the current views held by physicists and chemists. The subject was certainly in the air, but Mohr was apparently too far in advance of the time, for his papers fell into oblivion until he himself reminded his contemporaries of their existence. As is pointed out, however, in the

present lecture, the fundamental importance of the conception of heat as a form of energy was not grasped by the then editor of the *Annalen*. It seems that at first even Mayer's work was more appreciated abroad than in his own country, and the great work of Joule, whose first communication was published in 1843, was not noticed in the *Annalen* until 1848, while his second memoir, published in the *Philosophical Transactions* in 1850, was noticed in *Poggendorff's Annalen* only in 1854. It is not surprising in these circumstances that a writer who failed to enforce his views—although we now know these to have been perfectly sound—by original experiments should not have succeeded in turning the direction of contemporary scientific thought by two philosophical essays which, bearing in mind the date of their publication, were little short of revolutionary. But it certainly is remarkable that his contributions should have been altogether overlooked by later writers who were, and are, fully cognisant of the importance of the doctrines in question. Thus in the list of names given by Father Secchi in 1878, that of Mohr does not appear. In a lecture on the development of the exact sciences during the nineteenth century given by Prof. van 't Hoff before the German Association in 1900, it is pointed out that the law of the conservation of energy, although essentially a physical discovery, was not made by physicists in particular. He mentions Mayer the physician, Joule the brewer, Colding the engineer, and especially Helmholtz, at that time a physiologist. Herr Jezler adds :—

"Warun hier nicht als erster Mohr, ein Apotheker, genannt werden soll, ist mir unbegreiflich. Auf Grund vorliegender Experimentalforschungen (Melloni, 1798 bis 1854) kam Mohr durch Induktion zur dynamischen Wärmelehre im Gegensatz zu der gebräuchlichen materiellen Wärmetheorie, durch Deduktion gelangte er . . . zur Einheit der Naturkräfte, gleichbedeutend mit dem Prinzip der Erhaltung der Kraft."

Cases similar to Mohr's, in which important new conceptions have been started by men who failed to influence contemporary opinions, are well known in the history of science. Sometimes recognition has come during the worker's lifetime, as with Newlands and the periodic law —which example, by the way, is not referred to by the writer of the present pamphlet, although he mentions several other cases. Generally, however, the recognition is posthumous. As an instance of this we have Waterston's anticipation of the kinetic theory of gases, rescued from the archives of the Royal Society by Lord Rayleigh. When by masterly and convincing treatment some great generalisation which has been in the air for some time previously is finally made evident to the scientific world by the stroke of genius, there is always a danger of reading too much into the works of the earlier investigators and of interpreting their results in the light of later knowledge. The writer of this notice ventures to quote by way of illustration the enormously enhanced reputation of Lamarck as an evolutionist since the publication of the "Origin of Species." Is it going too far to say that Charles Darwin has made the reputation of Lamarck? In the case with which we are immediately concerned, however, a candid examination of the evidence will, we believe, show that Herr Jezler has not credited Mohr with more than was due to him.

R. MELDOLA.

SOIL SURVEYS.

Field Operations of the Division of Soils, 1900. By Milton Whitney, Chief (U.S. Department of Agriculture). Pp. 474 + a case containing 24 maps. (Washington, 1901.)

PERHAPS one of the greatest services which the scientific man can render to the agricultural community in any country is the classification of the soils into certain types, defined by their chemical or physical properties, and the allocation of these types to their appropriate areas, so as to obtain a soil map of the district in question.

Despite disturbing factors, certain types of soil persist over wide stretches of country and are characterised by a general physical and chemical resemblance, and also by a corresponding similarity in natural flora, appropriateness to particular crops and responsiveness to certain kinds of manure. The constancy of these soil types is the result of a common origin from the same kind of rock, and the difficulty lies less in recognising the type than in tracing its boundary line.

As a fundamental basis comes the geological survey, particularly the "drift" maps showing the superficial deposits due to running water, ice, &c., which, though of no great geological importance, are the origin of the soil proper. But for the purposes of a soil survey a little more than even a "drift" map is wanted ; further subdivisions must be introduced to show changes in soils on the same formation due to variations in the lithological character of the formation, or those due to the sorting action of water in the case of soils of transport.

These variations, in fact soil classification generally, must be based upon physical structure, must amplify and give exactitude to the practical man's division into clays, loams and sands ; the chemical properties of the soil may vary concurrently, but are too much subject to casual change to serve as prime means of distinction. As an instance, the upper beds of the Lower Greensand in east and mid Kent give rise to rich loams, on which many fine hop and fruit plantations are situated ; further west the formation gradually changes, until in west Surrey and Hampshire it is barren heath land the soil of which is alike wanting in the finer "clay" particles, carbonate of lime and the soluble salts which go to feed the plant. Again, in the book under notice many examples will be found of two or more distinct soils of the same origin, *e.g.* the maricopa soils (p. 302), described as consisting of "colluvial materials . . . largely granite . . . divided into four soils, depending upon the degree of comminution of the rock."

The volume before us represents a year's work of the Division of Soils of the United States Department of Agriculture in this particular direction of constructing a series of soil maps ; twenty-four of the maps are given on a scale of 1 inch to the mile, and show, by a system of colouring similar to that of a geological map, the type to which the soil belongs. The accompanying text gives a mechanical analysis of the type soil, *i.e.* its division into fractions each consisting of particles of a certain size, and in some cases a chemical analysis, also such information collected on the spot as the distance to ground water, climatic features, characteristic crops or natural flora and other local economic conditions.

It was found, according to Mr. Whitney's preliminary review,

'that it was quite possible to map these soil areas independently of the geology of the area, or the exact chemical or physical character of the soil; that the proper course was to construct maps in the field, showing the area and distribution of the soil types; to explain as fully as possible from geological considerations the origin of the soil and to leave the soil chemist and physicist study the differences. The fact is recognised that these chemical and physical properties of soils are so complex and difficult that it may take many years to explain them through laboratory investigation; but, pending this complete investigation, the maps themselves will be of the utmost value to agriculturists in indicating the areas over which certain soil conditions are found to prevail. . . . The recent successful growing of Sumatra tobacco on a certain soil in the Connecticut Valley is a very striking instance of the possibilities growing out of the detailed soil survey in any given locality."

The whole work is an excellent example of the thoroughness with which America carries out her State services; the maps themselves are clear and distinct; some of them, like the Saint Ana (California) sheet, represent a very complex distribution of soils, the survey of which must have involved no light amount of field work, while the accompanying text is most liberally illustrated with analyses, sketch maps and sections, and photographs illustrative of scenery, crops or vegetation, the ease with which photographic illustrations are now produced being perhaps responsible for the trivial nature of one or two of the objects selected.

Several of the sections of the survey deal with that interesting factor in all arid or semi-arid areas, the existence of alkali soils and their extension under irrigation, which is, unfortunately, almost the only method of farming possible. Alkali is used in a generalised sense as indicating any predominance of soluble salts, generally sulphates and chlorides of sodium, magnesium and calcium, in the ground water, so that vegetation is destroyed or restricted to certain "salt" plants, and on occasion the salts effloresce in a white powder on the surface. Sometimes carbonates of the alkalis are also present, which by their injurious action upon the texture of the soil and their solution of the humic acids give rise to "black alkali" spots, more dreaded even than the white. These "alkalis" probably represent nothing more than the normal products of the weathering of the fundamental rock minerals, but owing to the limited rainfall there is no percolation through soil and subsoil, to wash everything soluble into the rivers. Instead the salts remain in the subsoil, and irrigation, by raising the level of the ground water, may easily bring the salts so near the surface that they rise in the capillary water to the surface and there are crystallised out. An instance of the damage due to careless irrigation and the rise of the subsoil water is given in the report before us in the account of the Salt River Valley, Arizona.

The phenomena of alkali soils and their increase through irrigation are neither new nor confined to the United States; any arid climate where the products of weathering are not removed in the "country drainage" shows the same problem. Our irrigation engineers in India and Egypt are regularly confronted with the problem, for which there is only one solution, underdrainage so that the cultivated soil may be washed from time to time, and careful cultivation to minimise all evaporation from the soil except through the leaves of the crop. But though the "alkali" problems are common in the old world, it has not been until the time of Hilgard, Whitney and the present Division of Soils in the U.S. Department of Agriculture that we have had any real knowledge of their composition, or any study of the physical and chemical principles underlying the movement of the injurious material in the soil.

The character of the information provided by a soil survey must largely depend upon the nature of the country; in many parts of the United States agriculture is so recent that there is no accumulation of experience as to suitable crops, hence the survey, by comparison of the texture of the soil, the climatic features, depth to ground water, &c., with the conditions prevailing in known areas, can directly advise the settler with what crops he is most likely to succeed.

But in a country like our own, the land has been under cultivation so long that a great mass of local information, based upon experience, exists as to the character even of individual fields. Hints as to methods of cultivation or cropping based upon analysis are likely to be too general to be of any service; the chief application is rather the information that can be afforded as to the use of manures, for enormous economies could still be effected in the manure bill of nearly every farmer who buys artificial manures, if they were properly adapted to his soils and crops.

In Britain, the great initial want is the publication of drift maps of the Geological Survey on the six-inch-to-the-mile scale; were this in existence, it could be rapidly supplemented by the work of the local agricultural colleges until every farmer could be put in possession of that exact knowledge of his soil which is fundamental for all farming operations. A. D. H.

AN ADVANCED TEXT-BOOK OF BOTANY.

A University Text-book of Botany. By Douglas Houghton Campbell, Ph.D. Pp. xv + 579. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) Price 17*s.* net.

THERE are probably few books that are much harder to write than those which endeavour to deal, within a limited space, and from the point of view of the needs of the advanced student, with the whole range of any extensive branch of science. And indeed it is perhaps doubtful whether the time has not gone by when such works can hope to lay claims to much educational utility. Certainly this is the case as regards botany, which now covers so wide an area of knowledge that a bulky volume would be required merely to indicate in outline the more salient facts and their general connections and bearings.

The impression seems to be gaining ground that, for students of university type at least, a better method of treatment lies in the endeavour to expound on more truly scientific lines the facts embraced in its smaller subdivisions rather than in an attempt to range over the whole science in the course of a few hundred pages. And we think this modern tendency is a good one. The student who is hurried over so large a field of knowledge

can hardly hope even to scratch the surface, much less seriously to cultivate any part of it. He certainly will not receive that kind of training which goes to form a critical judgment on facts and inferences, although the imparting of this ought to be one of the chief objects of all higher education, whether of a scientific character or otherwise. It is this conviction that obliges us to confess that we think Prof. Campbell has set himself a difficult—if not, indeed, an impossible—task, and we cannot avoid a feeling of regret that he should have decided at all "to present in as compact a form as possible an outline of the essentials of modern botany." It is not that the book is not good of its kind—of which many already exist—but we doubt the intrinsic usefulness of its aims, even admitting these to have been realised. At any rate, the results, in so far as taxonomy, morphology and physiology are concerned, are certainly disappointing. The information given is of necessity ofttimes scrappy, and especially is this the case in the chapters dealing with classification. The student would scarcely find any other use for them than as mere statements to be learnt by heart. He would assuredly experience frequent difficulty in ascertaining on what rational basis the systems of classification themselves are erected.

By far the best part of the book is that devoted to a consideration of the geological and geographical distribution of plants. It contains much excellent matter, and may be heartily commended to students. Perhaps one might be inclined to take exception to a statement here and there, as, for example, the assertion that man is a very necessary agent in effecting the wide tropical distribution of the coconut.

But if our judgment on the book regarded as a whole appears to be a somewhat adverse one, this is not due to the way in which Prof. Campbell has executed his self-imposed task; our quarrel lies rather with the nature of the task itself. Nevertheless, the book, considered as a work of reference rather than as a text-book for the average student, may probably prove decidedly useful. It appears to contain very few errors, and the figures are numerous and, on the whole, excellent.

EMBRYOLOGY OF THE LOWER VERTEBRATES.

Lehrbuch der vergleichenden Entwickelungsgeschichte der niederen Wirbeltiere, in systematischer Reihenfolge und mit Berücksichtigung der experimentellen Embryologie bearbeitet. By Prof. Heinrich Ernst Ziegler. Pp. xii + 366; 327 figures and a coloured plate. (Jena: Gustav Fischer, 1902.) Price 10 marks.

THIS volume marks the tendency to increased specialisation in text-books, for it is an embryology of *the lower Vertebrates*. It also fills an obvious gap, for Balfour's classic work is acknowledged to be out of date, the large cooperative treatise now being edited by O. Hertwig is on an altogether bigger scale and different plan, the works of Bonnet, Kollman, Minot and O. Schultze deal with man or with mammals, and even in the well-known text-books of Hertwig and Milnes Marshall the lower Vertebrates are somewhat overshadowed by their successors, the Amniota. Thus there is room for Prof. Ziegler's volume, at which he has laboured, he tells us, for a dozen years. The result seems to us to justify his carefulness.

We would first remark on some of the distinctive features of the book as a whole. (1) Most attention is paid to the earlier stages in development; thus gastrulation and germ-layer-formation have more space than organogenesis. (2) While prominence is given to morphological ideas, the salt of which does not lose its savour, much attention has been paid to the trustworthy results of recent work in experimental embryology. (3) In regard to some of the more important moot points, the author gives a just statement of conflicting interpretations; in regard to others, he frankly states that he has given prominence to the view which his own investigations have led him to confirm or to formulate. (4) Very useful to the student are the numerous foot-notes which define the more difficult technical terms as they occur in the text, and sometimes include little side excursions of pleasant interest. (5) The bibliography at the end of each chapter is very full, but it has been put through a sieve, and, to avoid needless repetition, much of the older literature (given in Balfour's "Embryology," &c.) has been omitted. (6) There is an illustration on almost every page, and while there are many old friends (only eighty-seven from other text-books), seventy-four are Ziegler's own.

The first chapter gives recipes for preservation, and hints as to sectioning, model-reconstruction (of which the author's father was one of the pioneers), photography and the like. In the second chapter, there is a general sketch of the development of Vertebrates, with an exposition of technical terms. Perhaps the most interesting section is that in which the developmental processes in the foundation of organs are summarised:—cell-movements; differentiation; unequal growth; curvature, folding and tube-formation; evagination and invagination, formation of villi and diverticula; proliferation; and splitting. Emphasis is laid on the familiar but difficult distinction between palingenetic and cœnogenetic processes, and it is further noted that complications arise by what may be called temporal and spatial shuntings (Heterochronien und Heterotopien), when an organ of increasing importance appears more and more precociously, *e.g.* the heart in Amniota, and when the seat of formation is altered, as in the shifting of the Blut-Anlagen from mesoderm to endoderm in Amphibians.

The succeeding chapters, forming the body of the book, deal with the lancelets, Cyclostomes, Selachians, Ganoids, Teleosts, Dipnoans, Amphibians and Gymnophiona; and the last chapter, on the Amniota, shows how the development of the lower Vertebrates sheds light upon that of the higher. We find these chapters lucid and interesting; the material is freshened, if not as yet greatly illuminated, by the incorporation of the experimental results; the notes (at the head of important sections) on the most essential memoirs and on demonstration-material will be of service to other teachers; and there is a fresh, stimulating atmosphere about the whole book. In evidence of its up-to-dateness, we may note that it includes the work of Dean on Bdellostoma, Graham Kerr on Lepidosiren, Brauer on Hypogeophis, and so on.

A brief indication may now be given of the author's

attitude to various general problems. It is, on the whole, conservative. His embryological studies leave him more than ever convinced of the unity of the Vertebrate phylum; the different modes of cleavage can be readily unified, but there seems no doubt that the discoidal mode has arisen several times independently; the processes of gastrulation (archi-, amphi- and disco-gastrula) can also be unified as Haeckel maintained; the two ways in which the medullary canal arises are connected by transitions, *e.g.* in Lepidosiren; the neurenteric canal, which had originally a nutritive significance, is another unifying character; and so on. It is more difficult to give a unified account of the mesoderm, which may arise by pouching, by splitting off, or by a proliferating process. "But," as the author says, "one cannot ignore the fact that all the modes of formation which occur in Vertebrates are connected by transitional stages." Against the prevalent view that the mode of origin by pouching, familiar in Amphioxus, is primitive, Ziegler maintains that the Vertebrate mesoderm arose originally as a proliferation on each side of the blastopore-margin, and subsequently spread forwards along the dorsal wall of the archenteron. In spite of some objections, which are not ignored, the author remains a firm adherent to the doctrine of the distinctiveness and "specificity" of the germinal layers—"one of the most important results of embryological research." In his concluding words, the author expresses the mood of the whole book when he says that embryology is luminous only in the light of the evolution-idea. J. A. T.

TWO BOOKS ON AMERICAN SPORT.

The Deer Family. By T. Roosevelt and Others. Pp. ix + 334; illustrated.

Salmon and Trout. By D. Sage and Others. Pp. x + 417; illustrated. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1902.) Each volume 8*s.* 6*d.* net.

BOTH these works belong to the "American Sportsman's Library," of which Mr. C. Whitney is editor, and both fully maintain the high standard of excellence set by their predecessor in the same series, "Upland Game Birds." President Roosevelt, whose name appears first on the title-page of the volume on deer, is an excellent type of the best class of naturalist sportsmen, and of his three coadjutors Dr. D. G. Elliot, who writes on caribou, is a zoologist of high reputation, while Mr. A. J. Stone, who treats of the moose, is a famous Alaskan explorer and field-naturalist. Mr. Roosevelt, who contributes a thoughtful introduction to the volume, describes the deer of the Rocky Mountains and Eastern America as well as the prong-horn antelope; while the deer of the Pacific coast fall to the lot of Mr. T. S. Van Dyke. The only disadvantage we see in this arrangement is that the mule-deer is described twice over.

In his introduction, Mr. Roosevelt refers to the different views entertained as to the number of distinguishable forms of American deer and their nomenclature, but sums up by observing that there are only six wholly distinct kinds, the moose, the caribou, the wapiti, the whitetail, the mule-deer and the blacktail. With this philosophical view we are thoroughly in accord, and if all zoologists would but agree to regard these, and these only, as *species*, the subject would be much simplified. It is satisfactory to note that Dr. Elliot takes practically this view in his chapter on the various local forms of caribou. In consequence, apparently, of the divergent views prevalent in regard to nomenclature, Mr. Roosevelt very wisely avoids scientific names altogether, although such names do appear on the valuable maps showing the range of each species, which have been contributed to the work by Dr. C. H. Merriam.

The great decrease which has taken place of late years in the numbers of American big game is deplored by Mr. Roosevelt, who nevertheless urges that if proper game-laws be enacted and adequately enforced and "sanctuaries" established, most or all of the species may be preserved for many years to come. The professional skin and trophy hunter is the man who does most harm to big game, and next to him the "big-bag" sportsman, who receives a severe "slating" at the hand of the President.

Limitations of space forbid any detailed notice of the text, and it must accordingly suffice to say that in the case of each species attention is very fairly divided between the natural history and the sporting aspects of the subject; in fact, the whole volume is just what a work of this nature ought to be. The authors have been specially fortunate in their artists, among whom the name of Mr. C. Rungius occupies the post of honour. Among the numerous full-page illustrations in the volume, the one that most takes our own fancy is that of the Colorado mule-deer, or blacktail. It may be added that Dr. Elliot (p. 268) authenticates, by reference to an old sporting work, the statement (recently discredited by an American writer) that caribou formerly crossed from Newfoundland to the mainland on the ice.

The second of the two volumes is written on somewhat more technical lines than the first, the writers giving full lists, with the scientific names, not only of the species, but likewise of the subspecies of the salmon group. The first section of the book, by the author whose name is mentioned with the title, is exclusively devoted to the true salmon, which is common to both sides of the Atlantic. Unhappily, from want of due protection, this noble fish has been practically exterminated from the rivers of the United States, and, in the author's opinion, it would take ten years to fully restock them. On the other hand, "the British Possessions in North America undoubtedly afford the greatest field for the salmon angler of the future in any part of the globe." As Mr. Sage is a practical and observant fisherman of many years' standing, his remarks on the vexed question whether salmon feed while in fresh water are deserving of attention. His opinion is that they do, and his explanation of the fact that they are so seldom caught, even in the sea, with food in their stomachs is that they are in the habit of disgorging when threatened by danger. Several instances are cited of salmon seizing objects of considerable size with the apparent intention of swallowing them.

The ugly though valuable Pacific salmon of the genus Ogmorhinus, which often occur in such myriads in Alaskan waters and afford almost the whole of the world's supply of tinned salmon, are described by Messrs. Townsend and Smith, by whom five species are

recognised. Pacific salmon received the attention of fish-breeders at a comparatively early date; and, on account of extensive fishing and the pollution of many of the rivers, it is mainly owing to artificial propagation that the supply of these fish is maintained on the western seaboard of the United States.

The description of the numerous forms of trout and charr met with in the fresh waters of North America falls to the lot of Mr. W. C. Harris, and constitutes (inclusive of the angling notes) more than half the contents of the volume. The author divides these fishes into salmon-trout (commonly called brook-trout in America) and charr-trout. That all the latter are specifically, if not generically, distinct from the true salmon there can be no doubt, although it has yet to be proved that this is the case with the members of the former group. On this point, however, the author is silent, although he admits the extreme difficulty of classifying these fishes in a satisfactory manner.

"The most prominent external marking by which the salmon-trouts and charrs may be distinguished apart," writes the author, "is the presence of red or crimson spots on the body, the only exceptions being the great lake trout, with greyish markings, and the Arctic trout (*Salvelinus arcturus*), upon which no reddish spots have been observed."

It was owing to the absence of these red markings that the great lake trout, which now typifies the genus Cristivomer, was formerly regarded as a true trout instead of a charr.

In addition to being a practical guide which should be in the hands of every angler in American and Canadian waters, this excellent little volume is a valuable manual of North American Salmonidæ. R. L.

GAS ANALYSIS.

Methods of Gas Analysis. By Dr. Walther Hempel. Translated from the third German edition and considerably enlarged by L. M. Dennis. Pp. xix + 490. (London: Macmillan and Co., Ltd., 1902.) Price 10*s.* net.

THE value of this well-known handbook on gas analysis has been increased by additions both by the author and translator, so much so that those who already possess a copy of the first English edition will probably consider it necessary to obtain also the present one. The original work was practically restricted to a description of operations which could be carried out with the apparatus devised by the author, and this character is still retained. The slight incompleteness thus entailed is more than compensated for by the extremely practical nature of the instructions; every process described has been thoroughly tested and will work. The author has found it advisable to abandon the division into technical and exact gas analysis because, as he states in the preface, apparatus originally intended for technical purposes may advantageously be employed for many purely scientific investigations, and, on the other hand, technical analyses must often satisfy the most exacting conditions as to accuracy. The chief additions to the first edition comprise new methods for exact gas analysis and for the determination of combustible gases, the separation of argon from the atmosphere, improved methods for the determination of carbon monoxide in gas mixtures, the analysis of acetylene gas, the examination of gases produced by living bacteria, the simultaneous determination of fluorine and carbon dioxide, the determination of the heating power of gases, the estimation of sulphur in organic bodies and of carbon in steel, and the analysis of the gases evolved in the electrolysis of chlorides and the manufacture of bleaching powder. The method originally adopted by the author for the exact analysis of gases, although accurate, was somewhat cumbersome to work and expensive to set up. By adopting the principle of a compensation tube, slightly modified from the suggestion of Pettersson, the apparatus assumes a very practical form, gaining in convenience and cost without loss of accuracy. The determination of the heating value of gas, a determination which is rapidly increasing in importance on account of the extended use of gas for heating and power purposes and in the Welsbach incandescent burners, has been usually carried out in calorimeters of the Junker type. These are costly, require considerable amounts of gas, and must be carried to the place where the gas is being used. In the ingenious apparatus described by Prof. Hempel, a heating value can be determined on two litres, so that samples of gas can be brought from a distance in metallic receivers and examined in the laboratory.

In the analysis of combustible gases, it is shown by the translator that a modified Coquillion pipette, in which the combustion is carried out by an electrically heated platinum spiral, may in many cases advantageously replace the usual explosion method. The error due to the partial combustion of the nitrogen is avoided, and owing to the use of oxygen instead of air much larger quantities of gases can be burned with a corresponding gain in accuracy, numerous test analyses being given in proof of this point. The only suggestion which can be made as to additions to this chapter is an investigation as to the possible errors introduced into indirect explosion analyses by the deviations of the various gases from Boyle's law. According to Prof. Leduc, the errors from this cause may amount in special cases to as much as 3 per cent. when the gases are measured at constant volume. In the determination of carbon monoxide, a large amount of space, some twelve pages, is devoted to a description of the hæmoglobin method, whilst the method of C. de la Harpe and Reverdin, in which the monoxide is burnt by contact with iodine pentoxide, is dismissed with a short mention, although this method has been shown by Nicloux, Gautier and others to be at least as sensitive as the most refined modification of the blood reaction, and is also applicable to coal gas. As it seems probable that this method will supersede the doubtful cuprous chloride method, it would appear to have been worthy of a more detailed examination. In this case, as in others in which criticism might be offered, the author has preferred to give prominence only to those methods with which he has had personal experience. The work as a whole is a most valuable addition to the very limited number of works dealing with the handling and analysis of gases.

G. N. H.